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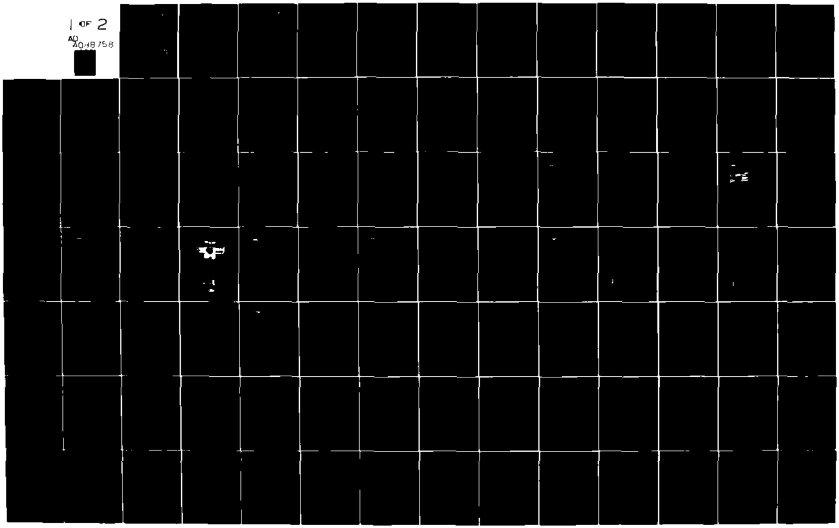

LEVEL II

U.S. Arms Control Objectives and the Implications for Ballistic Missile Defense

Proceedings of a Symposium
held at the
Center for Science and International Affairs
Harvard University

November 1-2, 1979

Sponsored by the
Ballistic Missile Defense Advanced Technology Center
Contract No. DASG-60-79-C-0132

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On November 1-2, 1979, the Center for Science and International Affairs at Harvard University sponsored a symposium on U.S. Arms Control Objectives and the Implications for Ballistic Missile Defense (BMD). The purposes of the symposium were: (1) to discuss arms control objectives and strategies beyond SALT II and their implications for the U.S. BMD program; (2) to identify, analyze and assess the current status and trends in U.S. BMD R&D programs; (3) to assess the significance of constraints imposed by the ABM Treaty on the implementation of current and planned BMD R&D programs; (4) to explore the status of Soviet thinking on work in the field of ballistic missile defense; (5) to examine the application of BMD technologies for missions other than the protection of U.S. land-based ICBMs; and (6) to analyze the strategic significance and arms control implications of alternative modes and levels of BMD development, including deployments which are limited by agreement to defense of American and Soviet strategic offensive forces. Each of these six issues was the subject of a paper commissioned for the symposium. These papers plus a rapporteur's report comprise the set of conference proceedings.

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Introduction

Michael Nacht

On November 1-2, 1979, the Center for Science and International Affairs at Harvard University sponsored a symposium on U.S. Arms Control Objectives and the Implications for Ballistic Missile Defense (BMD). The symposium was supported by a contract from the U.S. Army Ballistic Missile Defense Advanced Technology Center in Huntsville, Alabama.

The purposes of the symposium were:

1. To discuss arms control objectives and strategies beyond SALT II and their implications for the U.S. BMD program.
2. To identify, analyze and assess the current status and trends in U.S. BMD research and development programs.
3. To assess the significance of constraints imposed by the ABM Treaty on the implementation of current and planned BMD R & D programs.
4. To explore the status of Soviet thinking on work in the field of ballistic missile defense.
5. To examine the application of ballistic missile defense technologies for missions other than the protection of U.S. land-based ICBMs.
6. To analyze the strategic significance and arms control implications of alternative modes and levels of BMD development, including deployments which are limited by agreement to defense of American and Soviet strategic offensive forces.

The symposium brought together thirty-five participants from government, academia and industry, some with long experience in the development of ballistic missile defense systems and others with expertise in strategic analysis and arms control negotiations. A wide range of political viewpoints was represented as well.

Each of the six issues cited above was the subject of a paper prepared for the symposium. The first six sessions of the symposium began with an oral presentation by one of the authors followed by a general discussion of the issue among the participants. A seventh

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session provided individuals the opportunity to offer summary remarks and conclusions drawn from the earlier sessions.

What follows are each of the papers prepared for the symposium and a rapporteur's report that summarizes, without attribution, the main lines of argument raised in the various discussion sessions. Together with the list of participants and the agenda these papers constitute the proceedings of the symposium.

Ballistic Missile Defense: *Issues and Prospects*

A Summary of the Symposium on U.S. Arms Control Objectives and the Implications for Ballistic Missile Defense

Steven E. Miller

Introduction

A decade ago, Ballistic Missile Defense (BMD) was at the center of discussion about American strategic policy. Opinion in the United States about the utility and desirability of BMD was deeply divided, and the mid- and late 1960s were marked by a prolonged and often heated debate on this issue. This debate came to a head in 1969-1970, when there emerged substantial opposition to the Safeguard Antiballistic Missile (ABM) system proposed by the Nixon Administration for the primary purpose of defending the Minuteman ICBM force. In 1969, despite this opposition, the Safeguard system won a narrow victory in the Senate, which enabled the program to proceed to deployment. As the 1970s began, therefore, American effort to move toward an operational BMD capability was under way, its future apparently secured by the decision to move from debate to deployment.

Three years later, however, the United States, as a consequence of the Strategic Arms Limitation Talks (SALT I) with the Soviet Union, signed the ABM Treaty. The May 1972 ABM agreement placed severe quantitative and qualitative restrictions on the ABM systems each side was permitted to deploy. Hailed as the most significant arms control agreement of the nuclear era, the ABM Treaty also led directly to the decline of the U.S. BMD program. By 1975, the United States abandoned the deployment of BMD altogether by deciding to dismantle its single operational ABM site. Thus, in the span of three years, the decision to deploy a fairly extensive, multibillion dollar ABM system was overturned by the SALT process while the U.S. BMD program was left in the mid-1970s with no operational equipment, drastically reduced budgetary support, and significant constraints on its future possibilities imposed by a treaty of unlimited duration. The 1970s turned out to be a bad decade for BMD in the United States.

But after nearly eight years in which BMD ceased to be an important item on the agenda of strategic issues confronting the United

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States, there is, as we enter the 1980s, renewed interest in BMD. The resurgence of interest is the result of several different factors. Among them are the growth of Soviet strategic power; changes in military technology that confront the United States with new threats (in particular, the threats to American ICBMs and military satellites) and provide the United States with new options in military technology (as in the area of BMD); a decline in the support for, and reduced expectations from, negotiated arms control; and a rethinking of some of the intellectual underpinnings that contributed to acceptance of the ABM Treaty.

These developments have caused many to look anew at the strategic options that might be provided by BMD. As a result, the fundamental questions about BMD are again being asked: What BMD technologies are, or will become, available for deployment? How long will such technologies take to deploy and what will they be capable of doing when they are deployed? If there are new BMD options available to us, what are the political, arms control, and doctrinal implications of pursuing them? And is the present U.S. program adequate to provide the United States with the ability to pursue new BMD technologies, or does it need to be upgraded? It is these basic questions which underlie reconsideration of BMD and which dominated discussion at the Symposium.

The Technological Dimension

The most basic of these questions had to do with the advances in BMD technology that have been made in the last decade. It was widely agreed that support for Safeguard in the late 1960s was substantially eroded as a result of technical problems (such as vulnerability of radars, susceptibility to nuclear blackout, as well as the high cost of the technologies involved) that led many to believe that Safeguard would not work or was not worth the cost. For BMD to emerge as a serious option in the 1980s, these same concerns must be addressed, particularly since, as was several times pointed out, the Soviet threat against which BMD would be deployed has been and is growing rapidly both in terms of numbers of warheads and sophistication of technologies.

Discussion at the technical level hinged on issues relating to the technologies that are presently within reach and to those that are more promising but longer-term, presently out of reach but within our vision. The general impression was that we have come far toward resolving some of the most pressing problems. Especially important are advances in the ability of target discrimination, which reduces the effectiveness of precision decoys; vast improvements in computer technology, which increase command, control, and communications (C^3) capability; and substantial progress in the hardening of sensors, which reduces the vulnerability of BMD systems. These advances, characterized by some as "tremendous," raise the possibility of placing large demands on an adversary's offensive forces, especially in the context of missions for BMD that are tolerant of leakage. At the same time, it was argued that the costs of BMD technology are declining, to the point where, as several participants suggested, the cost-exchange ratios may favor the defense over the offense; this would be more clearly the case if the marginal cost of adding to a deployed BMD system were compared to the marginal cost to an adversary of adding to his offensive forces. Such ratios could be maximized in certain BMD deployment modes, particularly preferential defense of a Multiple Protective Structure (MPS) system.

So there is progress in BMD technology. But it was also pointed out that many nontrivial problems remain to be solved, including minimizing the effects of a Soviet attack on radars and C^3 (which remains a very stressful attack for BMD to survive), dealing with advances in penetration aid technology, and demonstrating the feasibility of exoatmospheric nonnuclear kill. Also raised was the notion that despite advances in BMD technology, a system deployed within the guidelines of the ABM Treaty would have negligible capability for most purposes. More importantly, several participants expressed concern about countermeasures which could lead to an expensive and possibly not very productive arms race between offensive and defensive capabilities; this concern was thought to be especially important in the context of a non-SALT environment in which the Soviet Union could be expanding its force of strategic nuclear delivery vehicles and further fractionating its ICBM force.

Implications for American Defense Policy

Current Status of the U.S. BMD Program

A matter just as important as the existence of promising BMD technologies is the question of whether the United States is well poised to exploit these technologies. The adequacy and coherence of the U.S. BMD program was one of the most frequently discussed topics at the Symposium.

Much of this discussion centered on the rationales for continuing and increasing the U.S. BMD effort. There was nearly unanimous agreement that it is important to pursue a vigorous BMD R & D program for the purpose of maintaining the viability of the ABM Treaty. The reasoning here was that since the Soviet Union continues to conduct a substantial BMD R & D program (and outspends the United States by 5 to 1 in the process), the Soviets might, in the absence of an American BMD program, find irresistible the temptation to gain a unilateral advantage by exploiting its own advances in BMD technology. Thus, it was argued, the U.S. BMD program reduces, if not eliminates, Soviet incentives to abrogate the ABM Treaty. Several participants felt, however, that the present U.S. program was only minimally sufficient for this purpose.

A related point was that the U.S. BMD program serves as a hedge against actual Soviet abrogation of the treaty. In the event of a Soviet "breakout" in the BMD area (a subject about which there were repeated expressions of concern), the United States would not want to be left with no BMD options of its own; that such options exist is ensured by providing for the adequacy of the U.S. BMD program.

Moreover, it was pointed out that given certain levels of funding (but more than the United States is presently spending) and certain levels of activity (but more than the United States is presently doing), R & D can shorten the lead times between advanced development and deployment; this would have the advantage of providing U.S. policy makers with more immediate BMD options in the future, and, in the opinion of several discussants, constituted an important reason for increasing the present U.S. BMD effort.

In addition to these reasons why the United States should have a vigorous BMD R & D program, several participants advanced arguments why the United States may in the future be interested in actually deploying a BMD system. In the first instance there is, of course, the scenario of Soviet breakout, in which an American BMD deployment is a reaction to Soviet abrogation of the ABM Treaty. There is also considerable interest in the contribution that BMD can make toward ameliorating the ICBM vulnerability problem (discussed more fully below). In a related point, it was noted that the United States might exercise the BMD option to offset further Soviet fractionation. Or the United States might wish to deploy a BMD system as part of an effort to prevent the emergence of new periods of vulnerability. It was also suggested that the United States might be interested in deploying a hard-site BMD system because that might make offensive force reductions possible in SALT III. It was felt by some that moving toward a BMD deployment would increase U.S. bargaining power in SALT III, in particular by reducing the sensitivity of a U.S. MPS system to MIRV limits on Soviet ICBMs. Finally, it was argued that just as the Soviet Moscow ABM system, although never very effective, had a substantial impact on U.S. strategic thinking, planning, and procurement, so might an imperfect U.S. BMD deployment have an important impact on Soviet perceptions; if the Soviets, in their planning and targeting, act as if such a system works, then in large measure it works.

Thus there emerged in the discussion a number of reasons why the United States should have considerable interest in BMD. In fact, several participants expressed the idea that BMD was a concept whose time had finally come. Considerable dissatisfaction was expressed, however, about the limited extent to which this interest has been translated into an appropriate BMD policy and program. Several strands of criticism were articulated on this point. In the days when the United States had strategic superiority, one view held, it was relatively unconcerned about BMD, and the legacy of that negligence is seen today in the lack of coherence in U.S. BMD policy. Indeed, it was suggested, the U.S. BMD program is faced with contradictory missions: on the one hand, to adhere to the ABM Treaty; on the other, to assure U.S. superiority in BMD. Another major criticism was that the U.S. BMD program is caught in a vicious circle in which it is accused of having nothing to offer while never getting enough funding to prove that it can have something to offer. Some put it more strongly by noting that accusations against the BMD program take the form of self-fulfilling prophecy because the program never will have anything to offer if levels of funding are held so low that testing cannot be conducted, contracts cannot be let for hardware, and so on.

Compounding the problem of incoherent policy were a series of self-inflicted wounds. The United States deprived itself of the advantages that would have accrued from deploying Safeguard, even in the limited form permitted by the ABM Treaty. Had we gone ahead with such a deployment, it was argued, our BMD technology contractor base would be better, we would be testing and improving hardware, we would have a BMD infrastructure in which to deploy new BMD technology, and there would be more widespread interest in BMD within both the technical and the defense policy community. Even deploying the one BMD site presently allowed by the ABM Treaty would enable the U.S. BMD program to activate training activities, get new ideas from paper to hardware, and get people thinking abcut defense.

Instead, it was lamented, the United States dismantled its one ABM site, has not fired an interceptor since 1975, and maintains an inadequately funded research and development program. In short, a number of participants were distressed by the present poor state of the U.S. BMD program.

A contrary viewpoint, less often and less forcefully voiced, held that the United States has a perfectly sensible BMD policy which reflects the priorities of the Defense Department, where other urgent concerns tend to overshadow the BMD program. Moreover, the modest levels of funding for BMD reflect the modest gains expected from the BMD program. When there are solid reasons for such expectations to change, more will be spent on BMD; there may already be, it was suggested, gradual movement in this direction.

Another view held that the time for BMD is now, when the ICBM vulnerability problem is pressing, and not in the late 1980s when the problem will have been solved in other ways. It was noted that BMD has nothing to offer now, when there is a need for it, and that by the late 1980s there may well be little need for it and therefore the incentives to move toward BMD could decrease as time passes. It was responded, however, that we might have had a BMD option now if the U.S. BMD program had been better funded in the last five years.

U.S. Defense Posture: Costs and Benefits of BMD

In addition to more general discussion of the U.S. BMD program, considerable attention was paid to the more specific question of what America stands to gain and lose by reopening the issue of BMD. The frame of reference for this conversation was the ICBM vulnerability issue. It was generally conceded that it is this issue more than any other that has aroused interest in BMD and, moreover, for at least a dozen years the primary mission of the U.S. BMD program has been the defense of ICBMs.

The primary benefit to be derived in this context from BMD is, not surprisingly, the enhanced survivability of the U.S. ICBM force. It is a commonplace notion that the way to deal with an adversary's effort to achieve a counterforce capability is to reduce the vulnerability of one's forces. This BMD can do; BMD technologies deployable by the late 1980s could, it was suggested, contribute significantly to the survivability of U.S. ICBMs. A way to make a first strike unattractive to an adversary is to ensure that he must spend a large fraction of his forces if he is to significantly degrade our forces. This, too, BMD can accomplish by requiring the Soviets to aim more warheads at defended targets. And the attractiveness of BMD is all the greater, in the minds of some, because most of the other ways we can reduce the vulnerability of our forces and force the Soviets to spend a large number of warheads are not happy ones; for the most part, they are both expensive and beset with problems, political and technical.

But the more commonly heard line of argument saw the most likely BMD deployment to be as a supplement to the MPS basing mode for ICBMs. This was not to say, it was several times pointed out, that we could not provide some defense of the silo-based Minuteman force; we could, particularly given substantial BMD deployments. But the symbiotic relationship between BMD and MPS is such that BMD strengthens MPS against a greater-than-expected Soviet threat, while MPS maximizes the effectiveness of BMD. The conceptions described would combine a BMD deployment called the Low Altitude Defense System (LoADS) with the multiple shelters of the MPS system; this combination would, it was argued, tremendously increase the advantage of the defense by increasing its leverage vis-à-vis the offense (leverage being defined as the number of additional warheads spent for each intercepter deployed). The idea is that since each interceptor would preferentially defend only one shelter in an MPS squadron of twenty, and the Soviets would not know which one was being defended, they would have to target an additional warhead on each shelter in order to remain confident of destroying the single ICBM. Thus, the numerical advantage in this case is 20-1 in favor of the defense, and even deploying the 100 interceptors allowed by the ABM Treaty would significantly enhance an MPS system. In addition, the marriage of BMD and MPS was said to have two other significant advantages: first, because radars would be deceptively based, they would be much less vulnerable than Safeguard radars would have been; second, the combined system is leakage tolerant—it need not work perfectly, merely well enough to ensure that some fraction of the U.S. ICBM force would survive a Soviet first strike.

Though this kind of deployment holds promise, it was noted that problems remain. Defending the new U.S. ICBM, MX, would be an extremely stressful environment for a BMD system to operate in. There are still concerns about the vulnerability of radars, which themselves would probably need to be preferentially defended. A Soviet maneuverable reentry vehicle (MaRV) capability would pose a taxing challenge. And should the Soviet Union develop a real-time intelligence capability, the leverage of the MPS/BMD system could be significantly reduced.

It was also pointed out in the discussion that deployment of such a combined system is not presently contemplated. LoADS is being developed as a safety option should SALT collapse or the Soviets break out of SALT limits. Should either of these developments occur, say in the late 1980s, it would be possible for the United States to phase in BMD fairly quickly and easily, and combine it with an already deployed MPS system.

Protecting the ICBM force is the primary benefit to be gained from an American BMD deployment in the next decade. But other advantages were described as well. BMD, it was said, could possibly substitute for some offensive force modernization by increasing survivability and thus reducing the need for new systems or large numbers. It could also compensate for the Soviet advantage in throwweight by reducing our need to worry about increased numbers of Soviet warheads, especially in an environment in which both SALT constraints on offensive forces and a U.S. MPS system existed. It was also pointed out that numbers of ICBMs could possibly be reduced by a SALT III agreement if a BMD system were deployed. And, it was suggested, an American BMD deployment could force the Soviets to spend billions developing advanced ballistic reentry vehicles.

There are, in short, a number of gains that could result from deploying a hard-site BMD program in the next decade; this point was often made in the course of discussion. But others were equally concerned about the costs of reopening the issue of BMD deployment. These costs, it was several times stressed, have to be balanced against the benefits of BMD before any reasonable decision can be made on this matter.

In a general sense, of course, the cost of a U.S. BMD program is a Soviet BMD program; several participants emphasized that a world in which only one side has substantial BMD deployments is inconceivable, and that we must assume any American move toward BMD would be accompanied by a Soviet move in the same direction. Therefore, some of the discussion focused on how great a cost a Soviet BMD program is to the United States.

The obvious cost, a point repeatedly raised, was that a Soviet BMD system would degrade the penetrability of U.S. strategic forces. This would apply to bombers and SLBMs as well as to ICBMs. How high this cost would be, it was suggested, depends on two key factors. It would depend first on how effective the Soviet system was. Obviously the better the Soviet system, the more U.S. forces would be degraded. Several participants expressed the opinion that a not implausible Soviet BMD deployment in the late 1980s or early 1990s could be a serious challenge indeed. Second, the extent of the cost to the United States would depend on the nature of our targeting doctrine. If the United States desires to have some form of counterforce doctrine, permitting a Soviet BMD deployment could be a very high cost because it would negate an important dimension of American strategy. On the other hand, if American doctrine emphasizes the assured destruction mission against countervalue targets, then the cost becomes marginal.

The central trade-off, then, is between survivability and penetrability, and this is not a trade-off that is easy to assess. Some felt that since with BMD we would have significantly more surviving forces, our concerns about penetrability would be reduced to an acceptable level. Others argued that it makes little sense to degrade the penetrability of our entire strategic arsenal simply to protect one portion of the force, especially since there exist other ways of reducing the vulnerability of ICBMs.

There were several other costs that were advanced in the discussion as well. One concern was that since the Soviets are outspending the United States in BMD R & D, have been testing some hardware, and already maintain an operational ABM site, reopening the BMD issue might, at least in the near term, be advantageous to the Soviet Union and thus augment rather than counter some of the adverse trends in the strategic balance. This was seen as particularly troublesome because the near-term strategic future already looks quite worrisome from an American perspective. A second concern was that BMD deployments in the Soviet Union could increase the possibility of a Soviet breakout in BMD which, especially if it took the form of area defense, could be dangerous when combined with the Soviet damage-limiting strategy (although others pointed out that a U.S. BMD system would make us less sensitive to such a Soviet breakout). A third point was that a significant U.S. BMD program could drain large sums of money away from U.S. offensive forces.

While this is not, in net, necessarily a negative development, it does raise the point that there could be sizable opportunity costs associated with moving back into the BMD deployment business.

An additional concern voiced was whether it makes sense for the United States to absorb any cost in order to have BMD in the time-frame and environment in which a U.S. BMD deployment is contemplated. In particular, if there is no SALT in the late 1980s there will be many force posture options available to the United States which it can pursue to rectify perceived strategic problems. Given the existence of many unconstrained options, the question was posed, why pursue the BMD path, which has a number of potentially significant costs associated with it?

Arms Control Implications

An additional subject of considerable concern was that the promising BMD concepts under consideration are generally prohibited by the ABM Treaty, and thus to gain the benefit of BMD it would be necessary to "undo," "abrogate," "revise," "modify," "amend," or "relax" the ABM Treaty. There was, as a result, much discussion whether we should seek to tamper with the ABM Treaty, and, if so, when and how we should go about it.

Two distinct views of the ABM Treaty were in evidence in the conversation at the Symposium. One view emphasized arms control as threat control, and suggested that sacrificing U.S. BMD was the price that was paid to reduce the threat of Soviet BMD and thereby guarantee the penetrability of U.S. strategic forces. Depending on one's opinion of the U.S. BMD program, the price was either modest or substantial, but in either case the benefits were commensurate with the cost. The other view perceived the ABM Treaty primarily as a constraint on U.S. BMD options, one which limited testing and prevented deployment of interesting BMD technologies. Of course, those in the former group contemplated changes in the ABM Treaty with considerable reluctance, while the latter group was more concerned with how the treaty might be modified in such a way as to salvage some of the benefits of arms control while permitting attractive BMD systems to go forward.

There was complete agreement that any U.S. BMD deployment in the late 1980s would require either abrogation or modification of the treaty. For one thing, current deployment restrictions would prevent the placement of interceptors at sites where they could defend ICBMs. In addition, it was pointed out, restrictions on mobile ABM components, on multiple ABM interceptor launchers, and on multiple warheads for interceptors represent significant obstacles to deployment of a reasonably effective BMD system, while limits on testing inhibit the pursuit of these promising technologies. Even the LoADS contemplated for possible deployment with MPS in the late 1980s would not be permitted by the treaty as it presently is written.

Therefore, a frequently voiced opinion was that we should begin to think *now* about how the United States would like to see the treaty changed. Several participants advanced the proposition that for the near term we need to consider relaxing the treaty while in the longer term we will have to anticipate major revision. By the late 1980s, it was suggested, we will face an entirely different strategic environment, one in which the usefulness of the ABM Treaty could be much reduced.

Some were concerned, however, that our envisioned BMD deployments have characteristics compatible with continued arms control (and compatible with continued strategic stability). These characteristics were four in number: such BMD systems should be (1) unambiguously hard-site, (2) nonmobile, (3) verifiable, and (4) breakout resistant. Others were more optimistic about what might be compatible with arms control, and it was suggested that even a heavy area defense could possible be deployed in the context of a much modified ABM Treaty. Moreover, it was noted that the underlying purpose of the ABM Treaty was to prevent the deployment of heavy nationwide area defenses, and that systems for hard-site defense, like LoADS, are not inconsistent with the *principles* of the treaty though they would, if deployed, violate the *provisions* of the treaty. Therefore, it was argued, it might be possible to modify the ABM Treaty without undermining its broad purpose.

There was discussion not only about the extent to which we might want to change the treaty, but also how we might go about it. In this context it was noted that the treaty can be amended at any time, though the ABM Treaty review conferences held every five years (next in 1982) are useful benchmarks for thinking about this problem. A more difficult problem is when to begin discussions with the Soviets on this issue. Some felt that since it is obvious that we are not going to treat (and should not treat) the ABM Treaty as sacrosanct and since it seems likely that there is going to be more emphasis on defense in the strategic environment of the future, we ought to think about talking with the Soviets soon, perhaps in the framework of SALT III. This, it was suggested, could have a salutary educational effect on the Soviets, would force us to define our own interests carefully, and would ensure that the process was begun early enough that negotiations would not be conducted in haste and would not delay preferred deployment schedules. The contrary feeling was expressed, however, by participants who felt it was dangerous to begin talking with the Russians before we have the necessary BMD technologies firmly and confidently in grasp, and before we are absolutely certain that we are better off with a BMD system even if the Soviets have something similar.

There was also concern expressed about Soviet incentives to negotiate. If modification of the ABM Treaty is advantageous to the United States, what interest would the Soviet Union have in being cooperative (and vice versa)? It was felt that this might be especially true if the United States wanted to revise the treaty to permit a BMD deployment whose purpose was to augment an MPS system. Some also believed it unlikely that the Soviet Union would be interested in revising the treaty in the same way as the United States. In particular, it was argued that the Soviets would be unwilling to revise the treaty to permit only hard-site defense because they have shown a persistent interest in area defense. And there was some contemplation of what motives the Soviets themselves might have to seek modification of the treaty. Many felt that there were two worries that might drive the Soviets toward BMD: (1) that the countersilo capability of the MX will render their ICBM force unacceptably vulnerable, and (2) that the Chinese nuclear threat might grow more menacing. The idea was raised that because of these Soviet worries, by the late 1980s both the United States and the Soviet Union might be interested in modifying the ABM Treaty.

Another element of the discussion on arms control was introduced by those who pointed out that while our concern about U.S. BMD options led us to think in terms of relaxing the provisions of the treaty, our concern about Soviet breakout should lead us to consider tightening the treaty and introducing more stringent restrictions. There is an obvious tension between these two ideas, one which BMD advocates resolved by arguing that our BMD program is itself a hedge against Soviet breakout. The counterargument was that more arms control rather than more forces could be a solution to the problem of Soviet breakout.

There was brief consideration of the implications of SALT II for BMD. It was noted that SALT limits on launchers and fractionation could keep the challenge to U.S. BMD within manageable proportions, while contributing to an environment in which BMD is less likely to emerge as a major factor. On the other hand, were SALT II to fail, the environment might be more conducive to the reemergence of a major U.S. BMD program, but the Soviet threat to BMD would probably be much greater, and BMD would have to compete with unconstrained U.S. offensive force options.

Finally, there was some discussion of the general relationship between defense and arms control. It was argued that defense is completely consistent with the objectives of arms control, and that a more sensible approach to strategic arms control would be to control offensive rather than defensive forces. If this were done, the United States and the Soviet Union could move in the direction of a defense-dominated world, one in which defense dominance was cultivated as assiduously as offense dominance is now. Rather, SALT has tended to reinforce the offense-dominated world dictated by the tenets of the assured destruction doctrine.

There was a great deal of interest in this notion of a defense-dominated strategic world. A number of participants indicated that such a world would be preferable to the present world of high vulnerability, although several expressed skepticism that BMD technology is sufficiently advanced to bring a defense-dominated world within reach.

But the aspect of this idea that elicited the most response was the problem of transition from here to there. This transitional stage, it was several times stated, is bound to be dangerous and unstable, with difficult problems of phasing. In moving towards area defense, it matters who acquires the capability first. Whoever did could have for some period of time a sizable advantage and, perhaps, the incentive to strike while their advantage existed.

And there was a brief exchange in which it was said to be important to remember that there are problems with a defense-dominated world too—problems in maintaining deterrence at the low end of the spectrum, in extending deterrence commitments to allies in a credible way, or in achieving confidence in a world in which we constantly fear that while their system will work, ours can be beaten. It was responded that these problems exist already, and are no worse in a defense-dominated world than in a world in which parity has largely neutralized strategic forces. Indeed, it was argued, in some ways these problems are easier to deal with in a defense-dominated world; for example, America's credibility in NATO might be increased in such a world. If we can defend ourselves, we are more likely to use strategic nuclear forces in response to Soviet provocation in Europe.

Doctrinal Implications

Finally, undergirding much of the discussion at the Symposium was concern with the concept of stability. This was a recurrent theme in the conference, raised in a number of different contexts as participants attempted to assess the impact of BMD on strategic stability. There are two dimensions of strategic stability that played a role in these discussions: arms race stability and crisis stability. The former was less scrutinized, raised primarily by those concerned that the interaction of defensive deployments and offensive countermeasures could give impetus to the arms race at great cost but with no net improvement in our strategic position; others pointed out, however, that this problem could be mitigated if offensive forces were constrained by arms control.

Of greater interest to the conference participants was crisis stability. The question posed was the impact various BMD deployments would have on incentives to strike first. Many felt that BMD's effect on stability depends on what one defends. In particular, it was repeatedly argued that defending ICBMs is not destabilizing. Rather, hard-site defense disrupts the dangerous reciprocal fear of surprise attack mechanism in which both sides have incentive to strike first rather than lose forces in a surprise attack. Even a one-sided deployment of ICBM defense disrupts this mechanism and thus contributes to stability, although it was noted that the side that did not have defenses deployed might feel itself at a substantial disadvantage. (Concern about the dangers of the reciprocal fear of surprise attack mechanism also led to a brief discussion of what kind of counterforce worlds are most troubling. The idea was expressed that a *mutual* counterforce world would be the most worrisome because the reciprocal fear of surprise attack would exist).

Not only would a BMD deployment diminish the reciprocal fear of surprise attack problem, it was argued, but it could have other stabilizing effects as well. For instance, the existence of BMD would vastly complicate planning for limited nuclear options. As a result, BMD could serve as a substantial escalation barrier by making limited strikes much less likely.

Not everyone was persuaded by this argument, and a counterview held that the logic of defense-based stability breaks down at some point under the pressure of offensive countermeasures. But several participants asserted that in the context of arms control, BMD (whether point or area) need not be destabilizing.

Ballistic Missile Defense: *Updating the Debate*

Albert Carnesale

Introduction

With the entry into force in 1972 of the Treaty on the Limitation of Anti-Ballistic Missile Systems, it appeared that America's decade-long domestic debate over the deployment of ABM systems had at long last come to an end.* We should have known better. A matter so fundamental as that of whether or not literally "to provide for the common defense" cannot—and should not—for long be considered as closed.

The world has not remained as it was on October 3, 1972, when the United States and the Soviet Union each undertook formally the obligation "not to deploy ABM systems for a defense of the territory of its country." In this paper I attempt to identify the ways in which segments of the context for BMD decisions have changed or remained unchanged in the intervening years, and to explore the implications of the contemporary context for U.S. programs in ballistic missile defense.

Entering the 1970s

Consider first the setting and substance of the ABM debate which was taking place as America prepared to enter the 1970s.

The Military and Political Setting

Dominating the landscape of Soviet-American relations was the military balance, especially the balance of strategic nuclear weapons. The essential numerical features of the nuclear balance extant in 1969 are tabulated below.

Strategic Balance in 1969

	U.S.	U.S.S.R.
ICBM Launchers	1054	~1100
SLBM Launchers	656	~160
Heavy Bombers	450	~150
Nuclear Weapons	~4000	~2000
ABM Launchers	0	64
SAM Launchers	<500	10,000

*The terms anti-ballistic missile (ABM) system and ballistic missile defense (BMD) system are used interchangeably to describe systems for countering offensive ballistic missiles in flight. Whereas ABM was the more fashionable acronym through the early 1970s, BMD has come to replace it in the contemporary jargon of the professionals.

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It is seen that, with regard to offensive strategic weapons, the Soviets had a small advantage in numbers of launchers for ICBMs (inter-continental ballistic missiles), while the United States had advantages of three-fold in launchers for SLBMs (submarine-launched ballistic missiles), of two-fold in heavy bombers, and of 100 percent in the total number of nuclear weapons carried by these long-range missiles and bombers. But the trends were far less satisfying. The Soviets were adding to their central strategic forces at a rapid rate, with about 200 new ICBMs and 130 new SLBMs coming on line each year—and about half of the new ICBMs were extremely large missiles of the SS-9 type. In contrast, the U.S. missile force had not grown for several years, and there were no plans for increasing the numbers of U.S. missiles. However, the United States had recently tested ICBMs and SLBMs equipped with MIRVs (multiple independently-targetable reentry vehicles), and was preparing to replace some of its older systems with these newer, more capable, systems. The Soviets had not yet flight-tested a MIRVed missile.

With regard to defensive strategic weapons—ballistic missile defenses and air defenses—the Soviet Union had a clear lead. The Galosh ABM system, then incorporating 64 launchers for ABM interceptor missiles, had been deployed around Moscow, while the United States continued its internal debate over ABM deployment. A decision to deploy at least some part of the Safeguard system had been made, but the extent of any deployment ultimately to be made was unclear at best. In the area of air defense, there was no contest. The United States was phasing out its remaining surface-to-air missile (SAM) sites, while the Soviet Union continued to modernize its massive air defense network.

The central characteristic of the American political scene in 1969 was disenchantment with the war in Vietnam, and the attendant widespread hostility toward virtually all things military strengthened the hand of those opposed to ABM deployment. The new President and his Assistant for National Security Affairs sought not only to bring the war rapidly to an end, but also to establish an opening to China and to achieve detente in relations with the Soviet Union. The primary vehicle for bringing about improved Soviet-American relations was to be the Strategic Arms Limitation Talks (SALT).

Missions and Threats

Two distinct kinds of missions for ballistic missile defense systems were under discussion; viz., defense of people and defense of land-based strategic forces. A "thick" area defense was required if the American population was to be protected against the kind of massive attack which could be launched by the Soviet Union, while a "thin" area defense might be adequate to protect the population against an emerging Chinese threat or against an accidental or unauthorized launch from any source. Some degree of area defense also would be required if the strategic bombers were to be protected, whereas "hard-site" or "point" defense would be appropriate for protection of ICBMs in their hardened silos.

Estimates of the threats to be faced by a U.S. BMD system varied widely. In 1969, the Soviets could deliver to targets in the United States more than 1000 reentry vehicles, and the number was growing by about 300 each year. China had not yet tested a missile of range sufficient to reach the United States, but some estimates called for tens of Chinese ICBMs deployed by the mid-1970s. Defense of the population against a missile attack of the magnitude which the Soviets could mount simply could not be accomplished with any plausible level of BMD deployment based upon Safeguard system technology. Defending U.S. cities against a Chinese missile threat which had yet to emerge was a far less ambitious objective, but also was far less likely to win overwhelming public support.

The survivability of the U.S. ICBM force in 1969 was unquestionable, but views differed on the length of time over which this salutary condition could be expected to persist. Some calculated that by 1977 or so the Soviets could in a first strike destroy as many as 950 of the 1000 Minuteman ICBMs in the U.S. arsenal. Others, performing comparable calculations, concluded that even under the worst conditions, at least 250 Minuteman missiles would survive. Still others considered estimates in this range to be wildly pessimistic. As to protection of the bombers against missile attack, the consensus was that a relatively high survival rate was likely unless and until the Soviets could deploy in substantial numbers MIRVed SLBMs designed to fly along depressed trajectories.

The threat to U.S. security posed by Soviet BMD capability also was considered. Although in 1969 the Galosh system included only 64 interceptor missiles, some estimates projected that by 1980 the number would grow to 10,000. In addition, some defense analysts believed that the Soviets' widely deployed air defense systems—especially the SA-2 and SA-5 systems—had (or could readily be upgraded to have) significant BMD capabilities.

Effectiveness

The effectiveness, or lack thereof, of a ballistic missile defense employing Safeguard system components was a central feature of the American debate. Critics argued that the system would not be sufficiently reliable, that it would be vulnerable to countermeasures, and that it was not cost-effective.

In questioning whether the system could be adequately relied upon, critics cited several factors: the inherent sophistication of BMD technology and complexity of the overall system; the extraordinarily high availability required; the inability (because of the

Limited Test Ban Treaty) to test either the nuclear kill mechanism relied upon to neutralize incoming reentry vehicles or the effects of nuclear detonations upon radar performance; and the infeasibility of a full-scale test of the system under operational conditions. Among the countermeasures that might be employed to defeat a BMD system, critics identified exoatmospheric and endoatmospheric decoys, chaff, electronic jamming, maneuvering reentry vehicles, radar blackout, and attacks designed to exploit the vulnerability of the small number of radars in the Safeguard system. It was argued that BMD in general, and the Safeguard system in particular, simply was not cost-effective; i.e., that the cost of the defensive forces was greater than the cost of the offensive forces required to offset them. Finally, it was argued that, because any BMD system would be more effective in defense against a retaliatory attack (from an adversary whose forces had previously been subjected to a counterforce first-strike attack) than it would be in defense against a more massive and better coordinated first-strike attack from the same adversary, the deployment of BMD by either or both sides would strengthen both sides' incentives to strike first in a time of crisis.

The BMD proponents countered that deployment of the Safeguard system, despite its (in their view, exaggerated) imperfections, would achieve at least two important strategic objectives: it would increase the cost (in deliverable offensive warheads and, therefore, in rubles) to the Soviets of a first strike against American land-based strategic offensive forces, and it would vastly complicate Soviet calculations of the effectiveness of such an attack. By thus raising the threshold of nuclear war, the proponents argued, an American BMD would contribute to strategic stability.

Effects of BMD Deployments

It was argued that substantial deployment of ballistic missile defense would have a broad range of effects. Among the factors believed to be subject to such influence were the operational utility of strategic offensive forces, relations between the United States and the Soviet Union and between the United States and its allies, the proliferation of nuclear weapons, and the prospects for strategic arms control.

To be effective in a retaliatory role, strategic offensive forces must be able to survive an attack and subsequently to penetrate to designated targets in the homeland of the adversary. The nature of BMD deployments preferred for maximum pre-launch survivability and for maximum penetrability of the surviving offensive forces available in 1969 are indicated below. (It is assumed here that there would be no substantial difference between the BMD deployments of the two sides.)

Preferred (Symmetric) BMD Deployments

	For Survivability	*For Penetrability*
Fixed ICBMs	*maximum* BMD of launchers	*minimum* BMD of targets
SLBMs	(not applicable)	*minimum* BMD of targets
Heavy Bombers	*maximum* BMD of air bases	*minimum* BMD of air defenses

The conflict is clear. Higher levels of BMD are associated with higher levels of pre-launch survivability but with lower levels of penetrability. The potential contribution of increased BMD to pre-launch survivability is greatest for the ICBM segment of the offensive force, far less for the bomber segment, and nonexistent for the SLBM segment. However, increased BMD degrades the penetrability of all of the offensive weapons: ICBMs and SLBMs directly, and bombers indirectly (i.e., by way of affecting adversely the execution of precursor missile attacks upon the air defenses to clear corridors for the bombers). This tension between survivability and penetrability is at its worst in counterforce (i.e., warfighting) scenarios, for in such cases the targets to which penetration is to be accomplished include ICBM launchers and bomber bases. The tension is lowest in countervalue (i.e., assured destruction) scenarios, for then the targets need not include the ICBMs and bombers.

The discussion a decade ago of the potential effect of U.S. BMD deployments on U.S.-Soviet relations was unfocused and inconclusive. Some argued that such deployments would stimulate the arms race and reduce to essentially zero the chances for establishing detente between the superpowers. Others claimed that detente could be achieved only in an environment of mutual respect, and that Soviet respect of the United States would be forthcoming only in the face of a strong America; that is, an America defended against ballistic missile attack.

How an American BMD would affect relations between the United States and its allies was comparably unclear. The anti-BMD argument was that an American defense would be viewed by our allies as an attempt to make their homelands, rather than our own, the targets of choice. The pro-BMD line was that reduced American vulnerability would be attractive to our allies because it would increase our willingness to risk escalation of a war that might start in Europe.

As to the connection, if any, between BMD deployment and the acquisition of nuclear weapons by additional countries (i.e., horizontal proliferation), it was maintained by the BMD opponents that American and/or Soviet BMD deployments would be viewed as further steps in the arms race and, therefore, would undermine the

Treaty on the Non-Proliferation of Nuclear Weapons. They noted that, in Article VI of the Treaty, each of the parties—including the United States and the Soviet Union—"undertakes to pursue negotiations in good faith on effective measures relating to cessation of the nuclear arms race at an early date and to nuclear disarmament. . . ." Furthermore, the BMD opponents maintained, *BMD deployments would stimulate* the growth of existing arsenals of offensive weapons (i.e., vertical proliferation) and thereby heighten incentives for horizontal proliferation. The proponents of BMD, on the other hand, believed that BMD deployments by one or both superpowers actually would reduce the incentives for horizontal proliferation by rendering small offensive arsenals useless against the defended nations.

That an American BMD deployment would affect prospects for negotiating with the Soviets mutually acceptable limitations on strategic arms was an uncontested proposition; the matter in dispute was whether the effect would be adverse or favorable. The BMD critics argued that prospects for strategic arms control would be dimmed by deployment of an American BMD because it would stimulate an offsetting growth of the Soviet offensive arsenal and because the chance for agreement on a complete ban on BMD deployment would be lost forever. The BMD advocates argued that, because the Soviets already had deployed and were continuing to work on their Galosh system, an active BMD program on the American side was needed if we were to enter into negotiations as strategic equals and if we were to have something to trade (i.e., a "bargaining chip") for constraints on Soviet programs.

Key Questions

This all-too-brief summary of the American BMD debate of a decade ago concludes with a reiteration of the principal issues addressed at that time. The key questions were these:

- Is a BMD deployment needed to preserve the survivability of land-based strategic offensive forces? If so, when?
- Is a BMD deployment needed to protect the population against small-scale attacks? If so, when?
- Would a BMD deployment based upon technologies currently available provide adequate protection against the projected threat(s)?
- Would a BMD deployment serve to provide meaningful operational experience?
- Would a BMD deployment undermine strategic stability by threatening the penetrability of strategic retaliatory forces?
- Would a BMD deployment improve (or degrade) America's relations with its allies? With its potential adversaries?

• Would a BMD deployment discourage (or encourage) the proliferation of nuclear weapons?

• Would a BMD deployment enhance (or diminish) the prospects for meaningful arms control agreements?

Entering the 1980s

As we enter the 1980s, the context in which BMD decisions must be made differs substantially from that of a decade ago. It is useful to identify those important aspects which have undergone significant changes, and those which have not.

The SALT Agreements

The "great debate" over whether to deploy an extensive ABM network based upon the technology of the Safeguard system ended (or so it appeared) on October 3, 1972. On that date, there entered into force the ABM Treaty, which had been negotiated in the first phase of the Soviet-American Strategic Arms Limitations Talks (SALT I). It is not necessary to repeat here all of the measures in the treaty; however, it is worthwhile to recall some of the more important provisions.

The treaty, which is of unlimited duration, embodies as its basic principle the undertaking by each side "not to deploy ABM systems for a defense of the territory of its country and not to provide a base for such a defense." As defined in the treaty, ". . . an ABM system is a system to counter strategic ballistic missiles or their elements in flight trajectory, currently consisting of . . . ABM interceptor missiles, . . . ABM launchers, . . . and . . . ABM radars . . ."

Under the treaty, each side is permitted two geographically, quantitatively, and qualitatively constrained ABM deployments: one at its national capital and another at an ICBM silo deployment area. A 1974 protocol to the treaty further constrains ABM deployment to one site for each side.

Moreover, the treaty provides that if exotic new "ABM systems based on other physical principles and including components capable of substituting for ABM interceptor missiles, ABM launchers, or ABM radars are created in the future," their deployment would be prohibited unless specific limitations were agreed upon through consultation and amendment of the treaty. Technological innovation is inhibited also by provisions banning development, testing, and deployment of "ABM systems or components which are sea-based, air-based, space-based, or mobile land-based" and of "ABM interceptor missiles for the delivery by each ABM interceptor missile of more than one independently guided warhead."

Along with the ABM Treaty, SALT I yielded the Interim Agreement on Certain Measures with Respect to the Limitation of Strategic Offensive Arms. An agreed objective of SALT II was to replace this Interim Agreement "by an agreement on more complete measures limiting strategic offensive arms." Of particular relevance to the subject matter of this paper is a statement made at SALT I by the U.S. delegation relating the follow-on negotiations to the future of the ABM Treaty; viz.,

> The U.S. Delegation believes that an objective of the follow-on negotiations should be to constrain and reduce on a long-term basis threats to the survivability of our respective strategic retaliatory forces. . . . If an agreement providing for more complete strategic offensive arms limitations were not achieved within five years, U.S. supreme interests could be jeopardized. Should that occur, it would constitute a basis for withdrawal from the ABM Treaty.

Remaining as an open question is whether the objectives and conditions set forth in this American statement should be considered as met by the Treaty on the Limitations of Strategic Offensive Arms negotiated in SALT II.*

The Military and Political Setting

The balance of strategic forces, which a decade ago tipped lopsidedly in favor of the United States, now is nearly level; indeed, in the minds of some the balance now tips somewhat in favor of the Soviet Union. Tabulated below are the essential numerical features of the operational strategic forces of the two sides in late 1979.

Strategic Balance in 1979

	U.S.	*U.S.S.R.*
ICBM Launchers	1054	1398
SLBM Launchers	656	950
Heavy Bombers	352	156
Nuclear Weapons	>9000	~5000
ABM Launchers	0	64
SAM Launchers	~0	~10,000

It is seen that, in the course of the 1970s, some important shifts had taken place. In ICBM launchers, the Soviet lead had grown from 5 percent to 33 percent, and 308 of these launchers were for "heavy" ICBMs; in SLBM launchers, an American lead of 300 percent was transformed into a Soviet lead of 45 percent; in heavy bombers, the U.S. advantage decreased from 200 percent to 125 percent as a result of transfers of American aircraft from operational to reserve status (the current U.S. figures are 352 heavy bombers in

*At this writing, the U.S. Senate has yet to complete its debate over SALT II. If the Senate should choose not to offer its consent to ratification of the Treaty on the Limitations of Offensive Strategic Arms, the future of the ABM Treaty would be all the more open to question. I shall not speculate here upon the effects of such Senate rejection upon American or Soviet decisions regarding BMD.

operation and 221 in reserve); and, in nuclear warheads, the U.S. advantage remained at nearly two-to-one, though the total number of warheads on each side had more than doubled. In contrast to the situation a decade ago, many of the missiles on both sides are now equipped with MIRVs. The American force of MIRVed missiles includes 550 MIRVed ICBMs and 496 MIRVed SLBMs. The corresponding figures for the Soviet side are 608 MIRVed ICBMs and 144 MIRVed SLBMs.

The balance of defensive strategic forces is much as it was at the start of the decade. The Soviet Galosh system, though improved slightly, has not been expanded, and an American ABM system at Grand Forks, North Dakota, has gone through the full cycle of being constructed, brought into operation, and "mothballed." The Soviets have continued to modernize their SAM systems, but the level of deployment remains essentially unchanged. At the same time, the United States has for all practical purposes completed the phasing out of its SAM deployments.

The marked change in the balance of strategic offensive forces is matched by the change in the political environment. Many Americans with good cause now view the Soviets as adventurous rather than conservative. They are convinced that the U.S.S.R. will continue to expand its nuclear and general purpose forces and that parity, to the Russians, is just a step on the way to superiority. With the United States emerging from its post-Vietnam era, detente is on the defensive. Now is a time in which American political leaders feel the need to act tough, especially with regard to the Soviet Union.

Missions and Threats

Only one BMD mission receives serious attention in the United States these days; namely, the defense of land-based ICBMs. The continuing growth in the number of Soviet warheads and improvements in their accuracy have brought most analysts to accept the notion that by 1985 or so the Soviets could have the capability to destroy in a first strike more than 90 percent of the U.S. ICBMs. Opinions differ sharply on the credibility and significance of scenarios in which such an attack is assumed to take place, but not on whether it must be considered as technically possible.

Effectiveness

The technology available for defense of ICBM silos has improved substantially, yet the effectiveness questions raised by critics more than a decade ago appear still to be relevant. Today's skeptics, like their predecessors, are not at all convinced that a silo defense based upon contemporary BMD technology would be sufficiently reliable, adequately invulnerable to countermeasures, and cost-effective. To an extent far greater than their predecessors, these skeptics focus on the question of whether the United States would be more secure if both it and the Soviet Union were to deploy BMD systems than if neither nation were to do so.

Effects of BMD Deployments

Consider now, in the context of the 1980s, the potential effects of BMD deployments on the performance of strategic offensive weapons, on relations between the United States and the Soviet Union and between the United States and its allies, and on nuclear proliferation. With regard to the effect of BMD on the utility of offensive forces, the situation is much as it was a decade ago. The survivability of one's ICBMs and to a small extent one's heavy bombers could be enhanced by one's deployment of a defense against ballistic missile attack, but deployment of BMD by the adversary would degrade the penetrability of all three legs of one's triad of retaliatory forces; viz., the ICBMs, the SLBMs, and the bombers. This tension between survivability and penetrability of offensive forces applies also to all of the new weapons systems which might be added to our arsenal within the 1980s: mobile land-based ICBMs, air-launched long-range ballistic missiles, and long-range cruise missiles launched from aircraft, from submarines, or from the ground.

The passage of time has not been accompanied by any perceptible improvement in our ability to predict the effects of BMD deployments upon our relations with either the Soviet Union or our allies. One clearly important change that has occurred is the adoption of the ABM Treaty. Any BMD deployment which would require withdrawal from (or abrogation of) the treaty would have an adverse effect on U.S.-Soviet relations, and the possibility of irreparable damage cannot be ruled out.

Any direct connection between perturbations in the massive nuclear arsenals of the superpowers and the prospects for (horizontal) nuclear proliferation remains elusive. It is evident, however, that the nonproliferation cause would be more likely to suffer than to benefit if the ABM Treaty—the principal accomplishment (for better or worse) of ten years of SALT—were to be scrapped.

Key Questions

While the context in which BMD decisions are made has changed substantially over the past ten years, the questions that characterize the underlying issues have changed hardly at all. To demonstrate to the reader that these questions have remained essentially invariant, it is sufficient to repeat here, verbatim, the "key questions" posed earlier in this paper to characterize the central issues of the debate of a decade ago:

- Is a BMD deployment needed to preserve the survivability of land-based strategic offensive forces? If so, when?
- Is a BMD deployment needed to protect the population against small-scale attacks? If so, when?
- Would a BMD deployment based upon technologies currently available provide adequate protection against the projected threat(s)?
- Would a BMD deployment serve to provide meaningful operational experience?
- Would a BMD deployment undermine strategic stability by threatening the penetrability of strategic retaliatory forces?
- Would a BMD deployment improve (or degrade) America's relations with its allies? With its potential adversaries?
- Would a BMD deployment discourage (or encourage) the proliferation of nuclear weapons?
- Would a BMD deployment enhance (or diminish) the prospects for meaningful arms control agreements?

Arms Control and BMD

Arms Control as Threat Control

A fundamental objective of the United States in strategic arms control negotiations is to achieve meaningful constraints on Soviet strategic arms. Such constraints, which clearly would be to the advantage of the United States, are not available gratis. The price to be paid by the United States for constraints upon the Soviet threat is the acceptance by the United States of constraints upon its own forces. In the end, our overall assessment of any proposed arms control agreement should be based primarily on a weighing in the balance of these benefits and costs.

In this light it is interesting, if not remarkable, that absent from America's extensive public debates over arms control and BMD has been any sustained consideration of the implications for U.S. security of Soviet BMD deployments and programs. Rather, the debates have focused almost exclusively on the pros and cons of American BMD.

The benefits to the United States derived from the ABM Treaty are the constraints upon Soviet BMD. These constraints benefit the United States in that they help to ensure the penetrability of our strategic retaliatory forces. The cost to the United States is the imposition of corresponding constraints upon our own BMD activities. To those who believe that an American BMD deployment would be inadequately reliable, excessively vulnerable, and/or cost-ineffective, the cost to America of accepting the ABM Treaty constraints on our own programs is low, and might well be so low as to be a benefit. Members of this group can conclude easily that the benefit of limiting Soviet BMD outweighs the cost—if any—of limiting American BMD. For those who believe that U.S. BMD would be sufficiently reliable, adequately invulnerable, and cost-effective, the task of weighing benefits and costs is a far more difficult one.

It appears that, for the near term, U.S. interest in BMD deployment is confined to systems for defense of ICBMs. To deploy such defenses at a meaningful level would require either modification of, withdrawal from, or abrogation of the ABM Treaty. In any of these events, the Soviets too would be free to deploy BMD. Only in the case of modification of the treaty would Soviet BMD be subject to mutually agreed constraints, and the revised constraints would be less stringent than those currently in effect.

The benefit to the United States potentially to be derived by relaxing or eliminating the current constraints on BMD is the deployment of defenses that would enhance the survivability of our ICBMs. The potential cost to the United States is the deployment by the Soviet Union of BMD systems that could threaten the ability of our strategic offensive forces to penetrate to (at least some of) their targets. The benefit-cost analysis, in its simplest form, consists of weighing the improvement in the survivability of our ICBMs against the degradation in the penetrability of our ICBMs, SLBMs, heavy bombers, and possible future air-launched, sea-launched, and ground-launched cruise missiles. In view of the fact that the ICBMs represent (according to most of the generally accepted static indices of strategic utility) only about one-fourth of the U.S. strategic offensive arsenal, intuition might lead one (as it does this writer) to expect that the balance of costs and benefits would tip against relaxation or elimination of the constraints now embodied in the ABM Treaty. A conclusion based upon analysis might differ from an expectation based upon intuition; but, then again, it might not.

Implications for U.S. BMD Programs

If the United States is prepared to forego acquisition of a capability to destroy Soviet ICBM silos, then deployments of silo defenses by the U.S. and the U.S.S.R. might be in our interest (and might also be in the Soviets' interest). To the extent possible, such silo defenses should be unambiguous, verifiable, and resistant to breakout. These desired characteristics are approached most nearly if the area defended by the BMD deployment is small (i.e., point defense rather than area defense); if the components are immobile, large, and easily identifiable by reconnaissance satellites; and if the system clearly is devoid of capabilities for rapid reload of interceptor missiles or for launching interceptor missiles capable of countering more than one attacking warhead.

American research and development in BMD should focus on systems exhibiting these desirable characteristics. Such R & D is entirely consistent with the ABM Treaty. In addition, in order to deny to the Soviets any advantage in the event of termination of the treaty, the United States should conduct (within the treaty bounds) R & D across the full spectrum of BMD possibilities. For each BMD concept explored, the United States should invent and examine possible Soviet "not-quite-mirror-image" systems to see how they would stand up under the tests for unambiguousness, verifiability, and breakout resistance. An objective assessment of the attractiveness of any perspective U.S. BMD deployment must give full consideration not only to plausible Soviet countermeasures, but also to the implications for U.S. security of Soviet "not-quite-mirror-image" deployments.

Choices must be made among realistic alternatives. A world in which the United States has strategically important BMD deployments, while the Soviet Union does not, is attractive to Americans, but in all likelihood is unattainable. Conversely, a world in which the Soviet Union has important BMD deployments, while the United States does not, is unacceptable to Americans. In real life, either both nations will have significant BMD deployments or neither nation will have them.

The ABM Treaty, with its severe restraints on BMD deployment, embodies implicitly a joint Soviet-American selection of the world in which neither side has a meaningful defense. To move from this non-BMD world to one in which both sides have extensive BMD deployments would at best be expensive and could at worst be disastrously destabilizing. The burden of proof rests on those who would have us make the move.

Current Technical Status of U.S. BMD Programs

William A. Davis, Jr.

Introduction

During the past decade, the U.S. Army's Ballistic Missile Defense (BMD) Program has made significant progress toward technical and economic parity with strategic ballistic missile systems. Following the 1960s, when it was demonstrated that the challenge of intercepting strategic ballistic missiles could be accomplished, the focus of the BMD R & D program shifted to the economics of BMD in relation to strategic offense. The task was to apply emerging technologies and system design features that would lead to an economically feasible solution to defense against large numbers of reentry vehicles (RVs). In the parlance of strategic analysis, the goal became one of gaining a favorable cost-exchange ratio (lower cost for the defense than the offensive threat being defended against).

BMD system concepts that are now entering the experimental hardware phase of R & D show promise of achieving a cost-effectiveness equilibrium with strategic ballistic missiles, or even an advantageous cost-exchange ratio. These systems capitalize on technologies that are coming into maturity in the 1980s, and they exploit leverages associated with preferential defense, multiple kill vehicles, low system leakage and deceptive basing.

These technologies and techniques can be given only cursory treatment in this paper; it is not feasible to describe here the multiplicity of BMD trade-offs involved in various potential BMD missions. What is common to all defense roles, however, is the fact that BMD systems cannot economically duel with the large MIRVed strategic inventories now existent in a one-on-one engagement mode; they must invoke high technology solutions and/or apply finesse to the methods of engagement.

BMD History

Figure 1 is a simplified diagram of the last two decades of BMD history and a projection into the 1980s. The centerpiece of the U.S. BMD program in the 1960s was deployment of the Safeguard system. An outgrowth of the earlier Nike-X and Sentinel programs, Safeguard reached full operational capability at one site at Grand Forks, North Dakota, in October 1975 and was closed by congressional direction four months later. Despite its short operational life, it was a highly successful enterprise, meeting all operational re-

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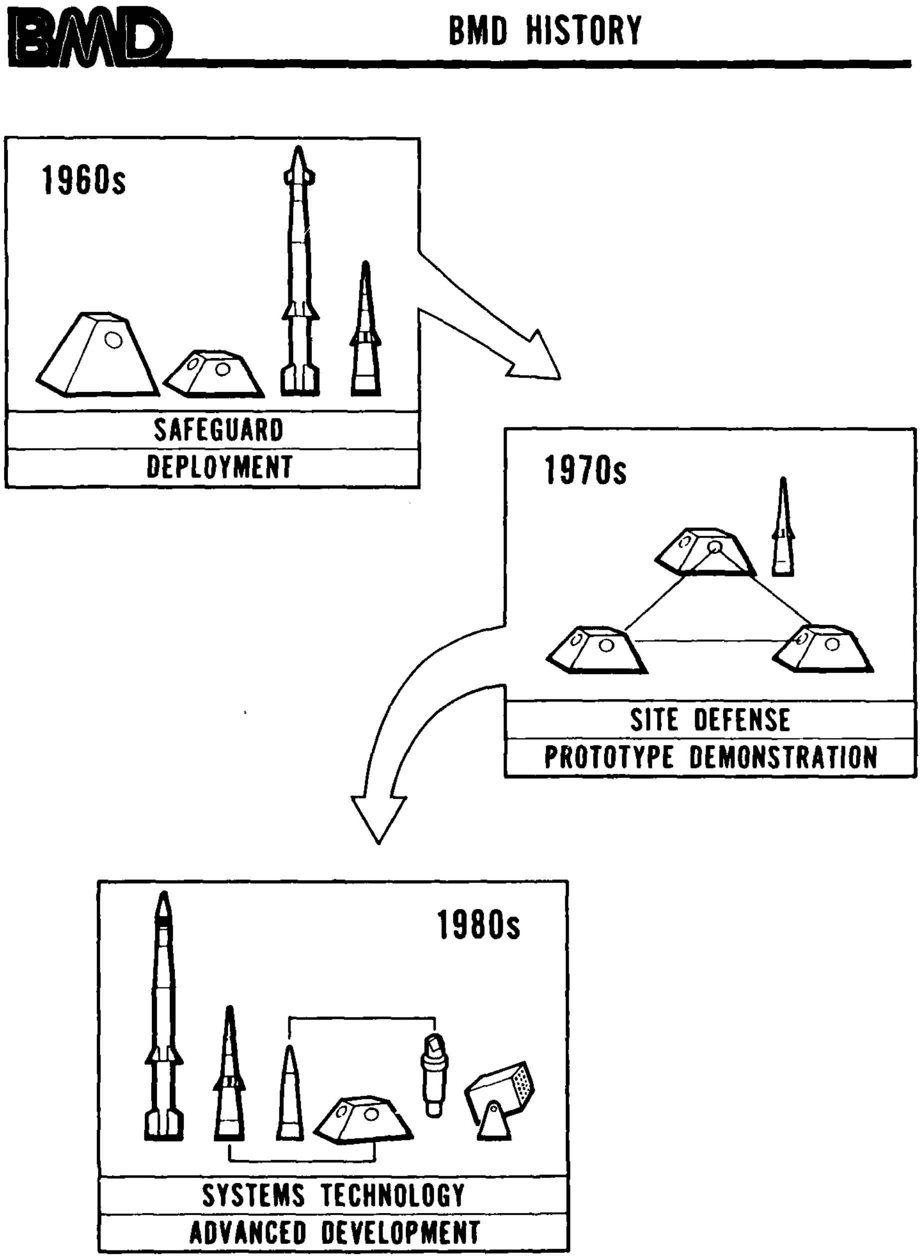

BMD
BMD HISTORY
1960s
SAFEGUARD
DEPLOYMENT
1970s
SITE DEFENSE
PROTOTYPE DEMONSTRATION
1980s
SYSTEMS TECHNOLOGY
ADVANCED DEVELOPMENT

Figure 1

quirements and availability dates. It has often been said that the success of the Safeguard program was largely responsible for the Soviet Union's agreement to the ABM Treaty of 1972.

The main components of the Safeguard system were the Spartan nuclear-armed, exoatmospheric interceptor; the high acceleration, nuclear-armed Sprint interceptor for endoatmospheric operation; the Perimeter Acquisition Radar (PAR) and the Missile Site Radar (MSR). The PAR is the only element of the original Safeguard system that is still operational; it was transferred from the Army to the Air Force to become an attack characterization sensor (now called PARCS).

Safeguard demonstrated in live firings at White Sands Missile Range and Kwajalein Missile Range (KMR) that a "bullet could, indeed, hit a bullet." The main problems that faced the BMD designers of the 1970s were how to reduce the cost of the system, how to remedy the "Achilles heel" of the vulnerability of large radars to direct attack, and how to develop adequate discrimination capability (the ability to differentiate between real RVs and decoys).

The next generation of BMD was Site Defense, a system designed primarily for Minuteman defense. It was strictly an R & D program, since it was carried out mostly after the signing of the ABM Treaty, a protocol which limits deployment to one site. Site Defense was oriented toward prototype demonstration at KMR until the Congress directed cessation of prototyping in 1975. It embodied many improvements over Safeguard, including modular netting of smaller radars to reduce vulnerability to direct attack and precursor nuclear blackout; the use of high capacity commercial computers; a low cost version of the Sprint interceptor; preferential defense firing doctrine; and sophisticated discrimination capability. The Site Defense system, which evolved into a Systems Technology Program, is now drawing to a successful completion of field testing at KMR. All of the improved features of Site Defense have been proved-out or will be demonstrated by the end of FY 1980. Featuring the first-time use of a palletized construction technique to reduce deployment time, the Systems Technology radar at KMR has met or exceeded all significant specifications.

Looking to the 1980s, the BMD Program will be a more open-ended, broadly based technology program than in the previous two decades. As symbolized at the bottom of Figure 1, it will encompass a wide variety of BMD systems and technical approaches. The interceptor sketch on the left of the 1980s box represents an exoatmospheric, non-nuclear kill vehicle. Site Defense is represented as an "on the shelf" system that is available for application should the need arise. The smaller radar-interceptor pairing indicates a low altitude system that is planned for prototyping in the early 1980s. The multiple launcher sketch on the right symbolizes a class of BMD systems generally referred to as simple or novel systems.

Baseline Terminal Defense System (Site Defense)

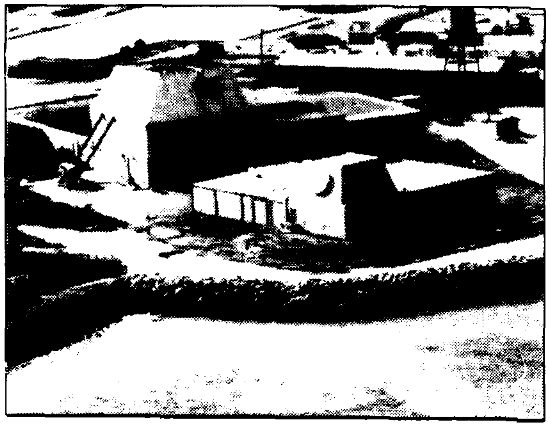
Figure 2 depicts the Systems Technology Test Facility (STTF) at KMR on the left (with the deactivated Safeguard MSR prototype in the background) and a diagram of its operating regime on the right. Like most of its forebears in the genealogy of U.S. BMD, it is essentially a "terminal" defense system; that is, it operates at the "terminal," or reentry leg of a ballistic missile trajectory. Historically, the concentration of U.S. BMD effort on the terminal regime is associated largely with the filtering effect of the atmosphere on ballistic missile reentry complexes. The atmosphere slows down RVs, produces observable wakes behind RVs and filters out many lightweight objects.

As indicated in Figure 2, the Baseline Terminal Defense System outgrowth of Site Defense employs a phased array radar (about one-fifth the power-aperture product of the MSR), a commercial computer and an upgraded version of the Sprint interceptor. It was designed for multi-radar modular deployment and it employs radar command guidance. The right side of Figure 2 shows the approximate altitude regime, with the reference altitude of less than 200 kilofeet indicating a barrier above which radar-opaque chaff may deny system vision. In a span of about 15 seconds, the time from initial detection until impact, the threat complex must be tracked, discriminated and intercepted. These functions must be performed automatically and error-free by real-time data processing, implying a data processing throughput of tens of millions of instructions per second. The system leakage, defined as the percent of targeted RVs that penetrate the defense, is classified as "moderate." Leakage is tolerable in any defense mission where a 100 percent survival level is not required, such as the defense of hardened targets like missile silos.

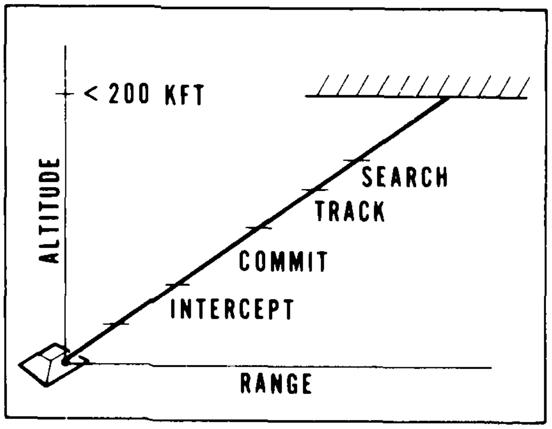
The three items shown under "Technology Status" on Figure 2 are the main R & D goals which will have been met by the end of the next fiscal year. "Bulk filtering" refers to the process of eliminating lightweight objects such as tank debris or traffic decoys from further consideration in the engagement logic, with the expenditure of little radar and data processing resources (radar pulses and data processing instructions). Such objects must be kicked out quickly and efficiently to avoid saturation of the system. Techniques for doing this have already been demonstrated. "Discrimination" refers to more-resource-consuming techniques required to differentiate between precision decoys and RVs. Precision decoys typically weigh about 10 percent of the weight of an RV and they can be designed to simulate RV radar cross-section, ballistic coefficient and wake characteristics. Discrimination techniques have been partially demonstrated with the STTF (the discrimination algorithms were previously proved out, singly, with dish radars, at KMR) and will be

BMD BASELINE TERMINAL DEFENSE

(SITE DEFENSE)



- MODULAR FIXED BASING
- RADAR COMMAND GUIDANCE



- 15 SEC. TIMELINE
- MODERATE LEAKAGE

DEMONSTRATED TECHNOLOGY

- BULK FILTERING
- DISCRIMINATION
- REAL-TIME SOFTWARE

Figure 2

finally wrung-out with dedicated targets next year. Next, the real-time software bullet refers to the rather sizable package of application software which operates with the CDC 7700 computer. This software embodies complex logic to execute the acquisition, tracking, bulk filtering and discrimination functions and it has been operating effectively.

The small diagrams at the bottom of Figure 2 illustrate two areas of technical progress since Safeguard that merit emphasis. On the left is a hypothetical plot of the probability distribution of a discrimination parameter (such as radar cross-section, ballistic coefficient, weight or length) for a decoy and an RV. This plot is illustrative of our current methodology for describing discrimination effectiveness. The factor "K" is a measure of discrimination effectiveness; the larger the "K" value, the better the discrimination capability. As indicated, "K" is a multiple of the standard deviation of the distributions and, therefore, represents the amount of separation between decoy and RV. The tails of the distributions show shaded areas representing probability of leakage (P_L) and probability of false alarm (P_{FA}).

The point to be made about discrimination is that we have learned since Safeguard to discriminate against precision decoys, and we will demonstrate this with the System Technology Test Facility at KMR next year against dedicated targets. Our discrimination results with a number of algorithms reveal "K" factors large enough to reject decoys with high probability. Our analysis indicates that, because of this discrimination effectiveness, it does not pay for the offense to use precision decoys; he is better off fractionating his payload.

The lower right diagram of Figure 2 illustrates the progress we have made in reducing the cost of software. It is a plot of the number of man-months per 1000 instructions versus the total number of instructions in the software package. The slope of the lines is a measure of software cost. As shown, the value for Safeguard was 7.6 man-months per 1000 instructions. In our software R & D program, we reduced the cost for Site Defense to 5.3 man-months per 1000 instructions. This has been further reduced in our continued research to 1.7 man-months per 1000 instructions. Hence, we have reduced the cost of BMD software since Safeguard by over 400 percent. Of equal importance is the fact that the software engineering applied to this cost reduction also results in more reliable software.

Discrimination and software development are but two examples of significant technical progress in Terminal BMD over the past several years. Substantial progress has also been made in digital signal processing, terminal optics and a host of other technologies. It is not practical to fully describe this technical progress in this paper. However, it is reasonable to generalize that Terminal BMD has reached a level of maturity that leaves little uncertainty about its functional capability against ballistic missile threats.

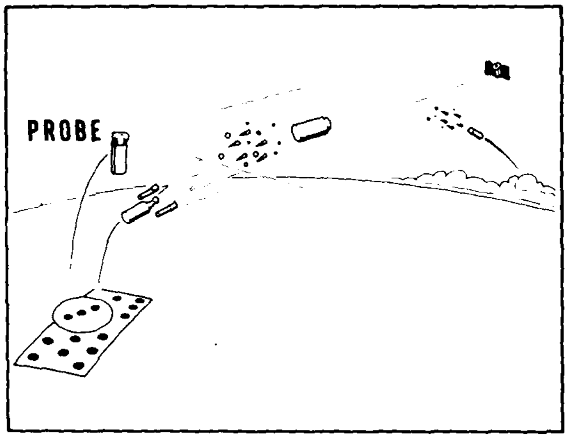
Exoatmospheric Defense

Figure 3 depicts an artist's concept of the exoatmospheric system and its contrasting operating regime. This system is based on less-mature technology than Site Defense and it will not be validated until the mid-'80s. With reference to the "cartoon" on the left side of Figure 3, the concept is to employ optical probes which are fired upon early warning. These probes are lofted above the atmosphere, where they survey the threat complex and obtain information on the numbers, composition and direction of the threat. This information is used as a basis for firing interceptors, which are also equipped with sensitive optical sensors. The interceptors autonomously perform the same functions as a conventional terminal defense system, culminating in non-nuclear kill of RVs using multiple kill vehicles. The multiple kill vehicles are stacked on the upper stage of the interceptor and are bus-deployed in much the same way as MIRVed ballistic missiles. Although full development of such a system is constrained by the ABM Treaty, the technology required for future development can be validated within the limits of the treaty.

As indicated on the right side of Figure 3, exoatmospheric engagements take place above about 300 kilofeet, and the time available for engagements is on the order of hundreds of seconds. Because there is more time to perform all the BMD functions and the reach of the system is so much greater, exoatmospheric BMD has certain inherent advantages over conventional terminal defense. The threat cloud can be observed and dissected for a relatively long period before final commitment of kill vehicles. The long reach of the system, into the midcourse regime, provides greater coverage per site and, thus, lower system cost. Greater system leverage can be realized through the use of adaptive preferential defense and multiple kill vehicles. Adaptive preferential defense, as contrasted with tapered preferential defense, is a firing doctrine that allows real-time allocation of interceptors, depending on how the attack is structured.

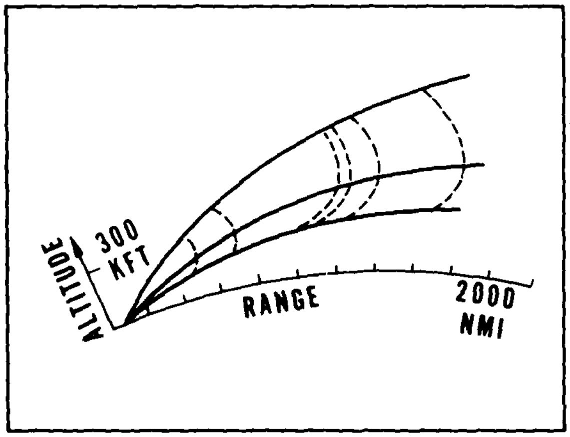
Although non-nuclear exoatmospheric BMD is relatively immature in a "systems" sense, the critical optical technology on which it depends has been under investigation for about 10 years. The optical sensors for this application operate in the Long Wave Infrared (LWIR) part of the electromagnetic spectrum. Because they operate at frequencies about four orders of magnitude greater than BMD radars, they are much smaller than radars for a given sensitivity and resolution. Experimental flight tests and laboratory tests have been conducted with these sensors, verifying their extreme sensitivity, angular resolution and overall operability in a BMD en-

BMD EXOATMOSPHERIC DEFENSE



- FIXED BASING
- OPTICAL HOMING GUIDANCE – NNK

Figure 3



- 100'S SEC TIMELINE
- MODERATE LEAKAGE

ADVANCED DEVELOPMENT

- FUNCTIONAL DEMONSTRATION
- DATA BASE ACQUISITION

- DESIGNATING OPTICAL TRACKING EXPERIMENT (DOT)
- HOMING OVERLAY EXPERIMENT (HOE)
- ARMY OPTICAL STATION
- OPTICAL ADJUNCT

vironment (a photograph of a BMD optical sensor, about one foot in diameter, and an experimental flight vehicle are shown as Figures 3a and 3b respectively). What remains to be done, as itemized at the bottom of Figure 3, is to acquire an adequate signature data base and to conduct functional demonstrations of these sensors in the BMD role. The indicated programs to achieve this are either under way now, or under consideration for the future.

With the advent of exoatmospheric, optical homing guidance technology, BMD will, for the first time, achieve the ability to perform non-nuclear kill (NNK). The advantages of NNK include lower cost for warheads, elimination of the requirement for critical nuclear materials, avoidance of self-induced nuclear effects, elimination of the need for nuclear release authority (NRA), and the ability to test. While the first live test of exoatmospheric NNK is several years away, available evidence from simulations and laboratory tests indicates that it is feasible.

NNK can be accomplished in two different ways: by direct impact or by use of a non-nuclear warhead to deploy fragments at a small miss distance. The feasibility of the former approach was demonstrated in the Army's HIT program several years ago, an experimental program involving laboratory models of the small (15-pound) kill vehicles. The latter approach will be demonstrated in the Homing Overlay Experiment (HOE), a live flight test program currently under way.

Perhaps more technically challenging than exoatmospheric NNK are the on-board data processing; optical discrimination; communication, command and control (C^3); and battle management problems associated with exoatmospheric BMD. All of these problems are under investigation in the BMD R & D program and there are candidate solutions which appear feasible. For example, the on-board data processing problem, which would have been considered impossible a few years earlier, is estimated to be within reach in the 1980s with microprocessors, LSI circuitry and distributed data processing architectures. Passive optical discrimination, based on computer simulations using signature data on exoatmospheric pen aids, appears to be attainable with multicolor sensors of the type that have been flight tested. The C^3 and battle management problems, while complex, are not problems in physics so much as in engineering; approaches have been designed which are within today's state of the art.

Layered Defense

Figure 4 illustrates the combination of a terminal defense system, such as Site Defense, and an exoatmospheric system. This system is labeled Layered Defense because of the two tiers of defense. Layered Defense is the preferred approach to any BMD mission requiring low system leakage. The low leakage is achievable because

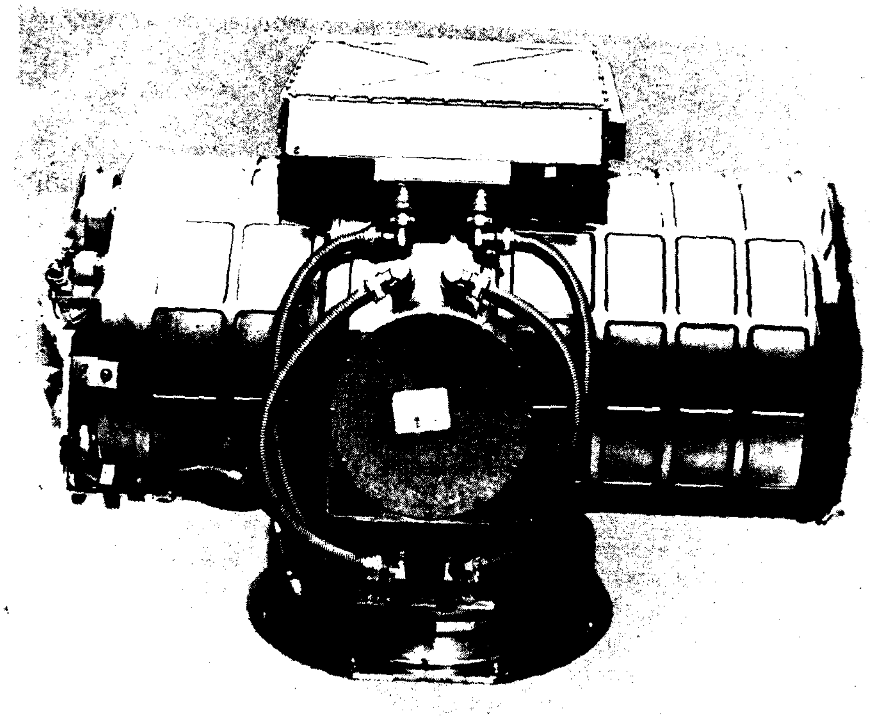


Figure 3A

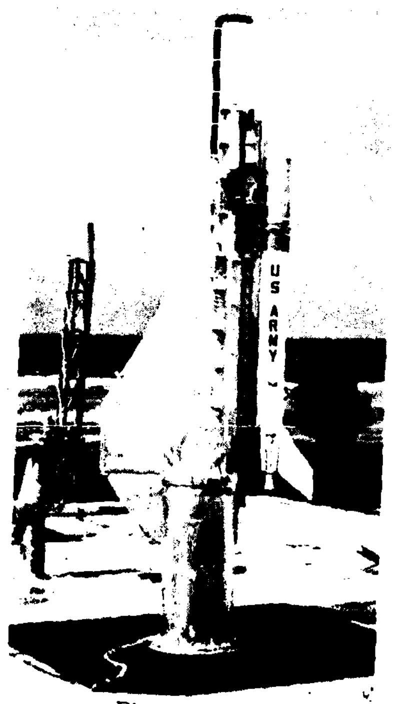
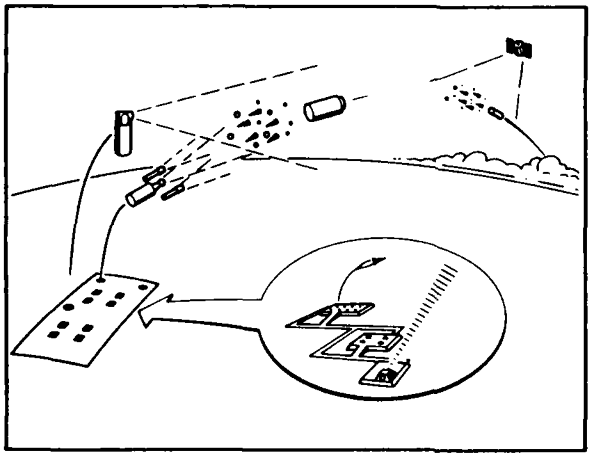
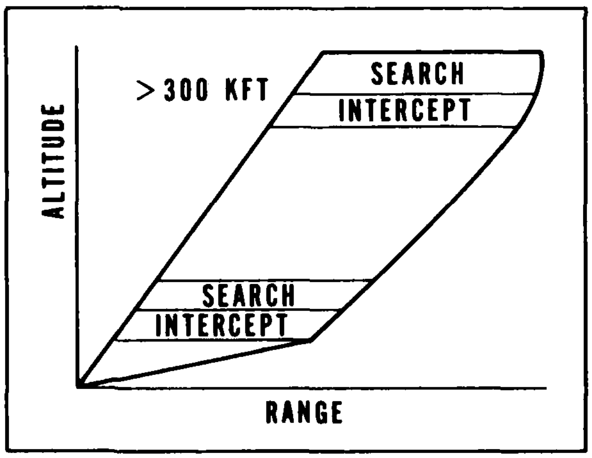


Figure 3B

BMD LAYERED DEFENSE



- EXO OVERLAY - ENDO UNDERLAY
- OPTICAL HOMING - RADAR COMMAND GUID.



- 100'S SEC TIMELINE
- LOW LEAKAGE

- **EXOATMOSPHERIC OVERLAY PACING**
- **MAXIMUM LEVERAGE FOR FIXED BASING**
- **RELATIVELY INSENSITIVE TO PEN AIDS**

Figure 4

the overlay and underlay leakage values are multiplicative to obtain total system leakage. For example, an overlay and underlay leakage of 20 percent each would yield a system leakage of 4 percent.

Conceptually, layered defense would depend on the exoatmospheric overlay to thin the attack with multiple NNK intercepts. The underlay, operating autonomously, would catch the leakers from the overlay engagement. The combination of exoatmospheric and terminal defense not only drives leakage down, but it is relatively insensitive to penetration aids because of the use of two different kinds of sensors. With both radars and optical sensors in the system, penetration aids are difficult to design which can function effectively against the integrated system. Typically, penetration aids that are effective against radar are not effective against optics, and vice versa.

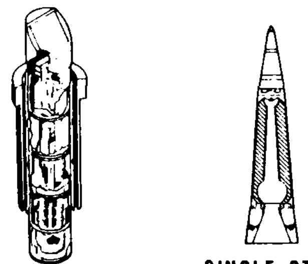
The exoatmospheric overlay part of layered defense is technically pacing since it involves higher risk technology than the underlay. The underlay may be either the Baseline Terminal Defense or the Low Altitude Defense System, to be described later. Both of these underlay system candidates are technically straightforward. In their use as an underlay, as compared with a stand-alone role, they would be thinly deployed (approximately one-half the number of radars and one-tenth the number of interceptors).

The economics of BMD is substantially shifted by layered defense. This concept exploits three interrelated leverage factors to gain cost advantages over conventional BMD systems: adaptive preferential defense, multiple NNK interceptors and low leakage. The combination of these factors results in a reduction in cost, for equal effectiveness, by a factor of two to three over the Baseline Terminal Defense System. This reduction stems not from a reduction in unit cost of equipment, but from the lesser amounts of equipment required. For example, interceptor stockpiling requirements, a major cost driver, are substantially reduced by the lower leakage factor alone.

Low Altitude Defense System (LoADS)

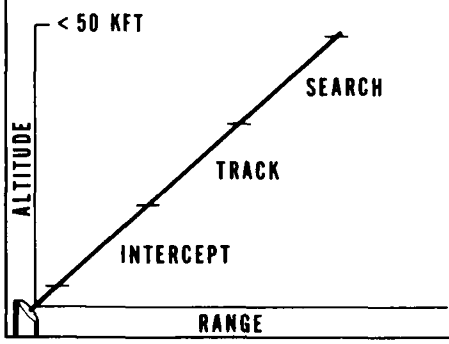
The Low Altitude Defense System, depicted in Figure 5, is essentially a "down-sized" derivative of the Baseline Terminal Defense System. It was designed primarily for compatibility with MX defense. Because of its small size, it can be deceptively based in any of the basing modes being considered for MX. In this role, LoADS provides extremely high leverage. The leverage is attainable because of the intrinsic characteristics of the ICBM basing scheme. For example, a multiple protective structure (MPS) deployment of 20 aimpoints per MX would draw 20 RVs per MX in the undefended case and 40 RVs per MX if defended by one interceptor. In other words, one BMD intercept per MX doubles the attack price and is in effect a multiplier of the leverage attained by using multiple aimpoints.

BMD LOW ALTITUDE DEFENSE SYSTEM (LoADS)



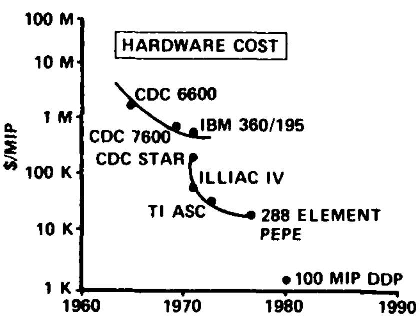
- SMALL PHASED ARRAY (1/40 SITE DEFENSE)
- DISTRIBUTED DP
- SINGLE STAGE (1/2 SPRINT SIZE)

- RAPIDLY DEPLOYABLE
- INERTIAL GUIDANCE



- < 10 SEC TIMELINE
- MODERATE LEAKAGE

PROTOTYPE DEVELOPMENT
- LOW TECHNICAL RISK
- NUCLEAR HARDNESS
- NNK GROWTH POTENTIAL



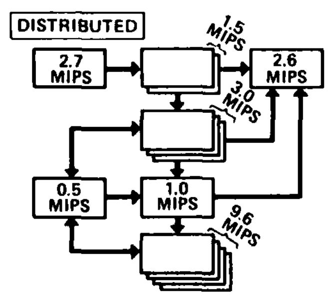


Figure 5

As shown on the Altitude-Range plot of Figure 5, LoADS operates in a much lower altitude regime than Baseline Defense. This mode of operation provides a fundamental advantage with respect to penetration aids, in that it is difficult to design lightweight decoys that will survive to low altitude. However, the timeline is compressed to the point that quick reaction must be built into the system and multiple sequential intercepts are limited.

Because it is based on extensive experience with terminal defense systems, LoADS is of low technical risk. The only exception to this general assessment is the need to harden the components to nuclear effects to a greater degree than previously experienced. The estimated MX nuclear environment requires radar and interceptor hardness values that exceed those of the Baseline Terminal Defense System. However, available experimental results at the component level indicate that the required hardness values can be met.

Another feature of LoADS is the potential growth to an endoatmospheric non-nuclear capability. It is more technically challenging to achieve endoatmospheric NNK than exoatmospheric NNK because of the perturbing influence of the atmosphere. A long-term effort is under way in the BMD program to reach the goal of endo-NNK, but this capability is expected to lag exo-NNK by several years.

The two diagrams at the bottom of Figure 5 illustrate Distributed Data Processing, planned for use in the LoADS system. This is one of the more advanced concepts that will be applied to LoADS. The use of Distributed Data Processing promises great benefits, but challenging technical issues must be resolved to apply this technology effectively.

At the lower left of Figure 5 is a computer hardware cost trend graph which shows the potential payoff of Distributed Data Processing. Going back to third generation computers, such as the CDC 6600, it can be seen that the dollars per MIP (millions of instructions per second) was on the order of one million. With the advent of fourth generation computers, this cost was reduced to under $100,000. Projecting ahead to Distributed Data Processing, we can see costs of a few thousand dollars per MIP. Hence, there is a strong economic incentive to harness Distributed Data Processing for BMD.

On the bottom right portion of Figure 5 is the hypothetical layout of a Distributed Data Processing system for BMD. It consists of a partitioning of BMD functions, and the required allocation of computational elements to perform the functions, in an interlocking network. This contrasts sharply with the historical BMD practice of centralizing all of the functions in a common computer. To distribute BMD data processing properly requires not only an innovative use of small computational elements, but a rigorous system-level analysis to determine how best to distribute the functions.

With a LoADS distributed data processing system as illustrated by the lower right diagram of Figure 5, substantial benefits can be realized, in addition to lower cost. First, the capacity of the system can grow gracefully by the addition of modular units. Second, the system can be reconfigured to adapt to changed requirements without as much breakage as required for centralized data processing systems. Finally, a high degree of fault tolerance can be built into the system through the use of redundancy and other design techniques.

Simple BMD Systems

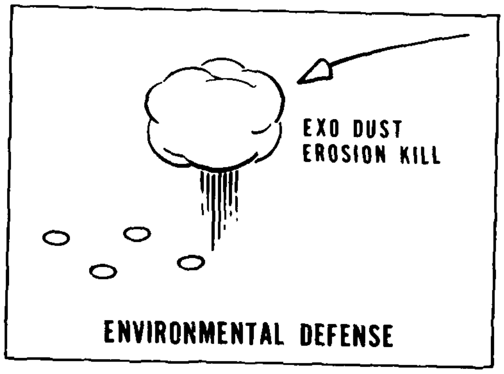
Figure 6 illustrates a sample of simple BMD systems that are under evaluation. This class of systems is of interest for the possibility of low cost, rapidly deployable options for Minuteman defense. The Environmental Defense approach suggested by some theorists outside the defense establishment envisions burying nuclear devices in the Minuteman fields and then detonating them at the proper time to create erosive dust in the path of RVs. RV kill is produced by dust erosion of the RVs. In the case of Multiple Unguided Projectiles, the idea is to send clusters of projectiles up the threat tube to produce direct impact NNK. A derivative of this approach is to add simple guidance mechanization to the projectiles such as semiactive homing (illustrated in the lower left quadrant of Figure 6). The final concept illustrated, "Massive Hit", employs the demonstrated HIT vehicles in a relatively primitive, exoatmospheric deployment to effect direct impact kill of RVs.

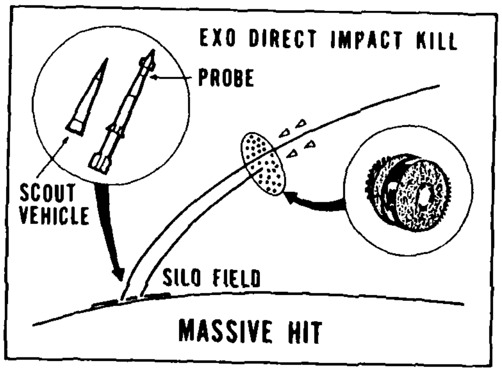
In general, Simple BMD Systems which meet the criteria of low cost, rapid deployability and adequate effectiveness are difficult to synthesize. The BMD program will remain open to ideas in this category, but most of the current candidates suffer from one or more deficiencies. It is a goal to narrow the spectrum of candidate solutions and to test-out one or two surviving concepts.

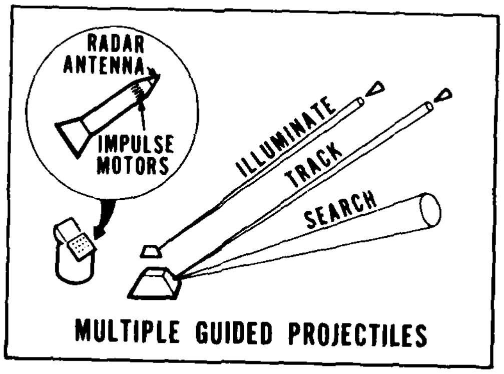
BMD System Relevance to Potential Missions

The matrix of Figure 7 relates the BMD systems which have been described to several potential missions which have been analyzed. A couple of trends in the matrix are worthy of note: (1) all of the systems described have relevance to Minuteman defense and (2) the Exoatmospheric Defense and Layered Defense rows portray a great deal of mission versatility. The first trend is primarily a product of the emphasis of the BMD program over the past 10 years; Minuteman defense has been a strong mission objective of the program. The second trend derives from the inherent attributes of these systems in terms of large battlespace, relaxed timeline, and high system leverage.

SIMPLE BMD SYSTEMS







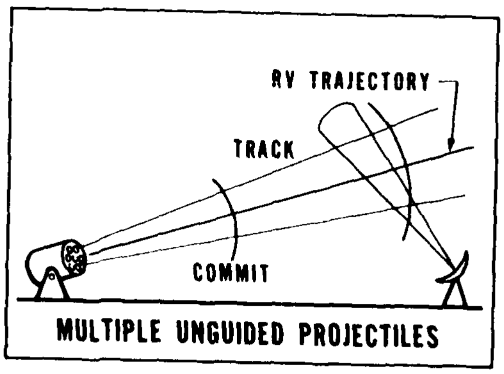


Figure 6

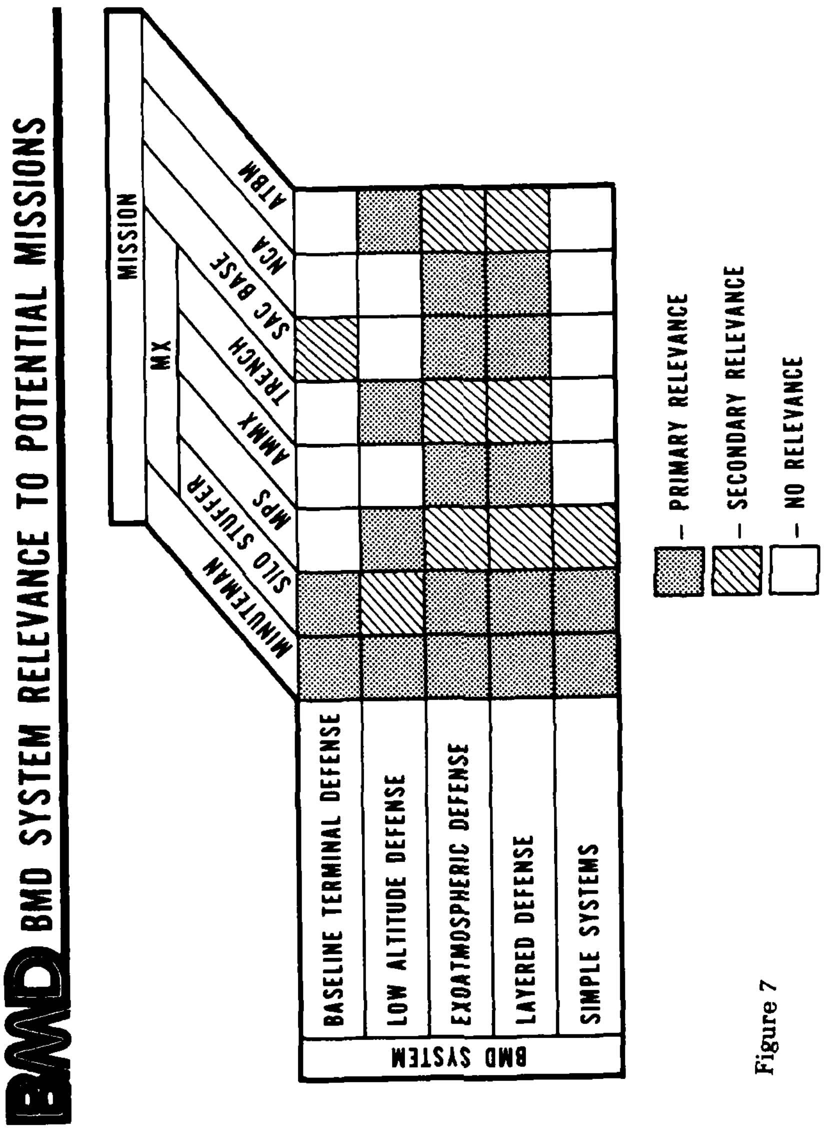

BMD BMD SYSTEM RELEVANCE TO POTENTIAL MISSIONS
MISSION
MX
ATBM
NCA
SAC BASE
TRENCH
AMMX
MPS
SILO STUFFER
MINUTEMAN
BMD SYSTEM
BASELINE TERMINAL DEFENSE
LOW ALTITUDE DEFENSE
EXOATMOSPHERIC DEFENSE
LAYERED DEFENSE
SIMPLE SYSTEMS
— PRIMARY RELEVANCE
— SECONDARY RELEVANCE
— NO RELEVANCE

Figure 7

In the case of defense of time-dependent and soft targets, such as Strategic Air Command (SAC) bases and the National Command Authority (NCA), the only cost-effective way to defend is with long reach systems (Exo and Layered). In the unique case of Anti-Tactical Ballistic Missile Defense (ATBM), the only system with primary relevance is LoADS. This LoADS role is an inherent, spin-off capability; the BMD R & D program does not have an official ATBM mission assignment.

BMD Effectiveness

The effectiveness and the cost of BMD for the potential missions portrayed in Figure 7 vary over a wide range. Generally, BMD is more cost-effective in defense of hardened ICBM sites than for relatively soft, time-dependent targets such as SAC bases. This is because defense of ICBM sites can be accomplished with preferential firing doctrine, as well as the fact that hard targets allow smaller "keepout zones." Preferential defense is explained in the following paragraphs; "keepout zones" simply refers to the region surrounding the target where penetration of the reentry vehicle must be denied to prevent target kill.

In considering the utility of preferential defense, it should be noted that the only place it can be used is where 100 percent survival of the target complex is not the defense objective. This objective, sometimes referred to as a damage denial policy, greatly stresses the technology and cost of BMD systems. It implies a zero leakage system which is, strictly speaking, not achievable and can only be approached for a very light attack and/or a costly stockpile of interceptors. Preferential defense can be invoked for assuring the survival of a fraction of the target complex being defended, and it results in relaxation of technical requirements and reduction of the cost of the BMD system.

Figure 8 shows a simple example of preferential defense of fixed sites, such as Minuteman silos. For the numbers shown, the advantage of preferential defense over subtractive defense is tabulated. In the subtractive defense case, the first eight arriving RVs are intercepted on a "first come, first serve" basis. Then, the second wave of eight arriving RVs kill all eight silos; hence, the outcome for substractive defense is zero survivors. (For simplicity, it is assumed in this example that all interceptors and RVs have unity kill probability and that the silos are uniformly targeted.)

In the preferential defense case of Figure 8, it is decided *a priori* by the BMD planner to defend only one-half, or fewer, of the silos. In this case, all eight of the interceptors are allocated to defense of the four designated silos; and the outcome is four survivors. The corresponding leverage achieved by preferential defense, defined as the ratio of RVs in the attack to the number of interceptors required to satisfy the defense objective, is two.

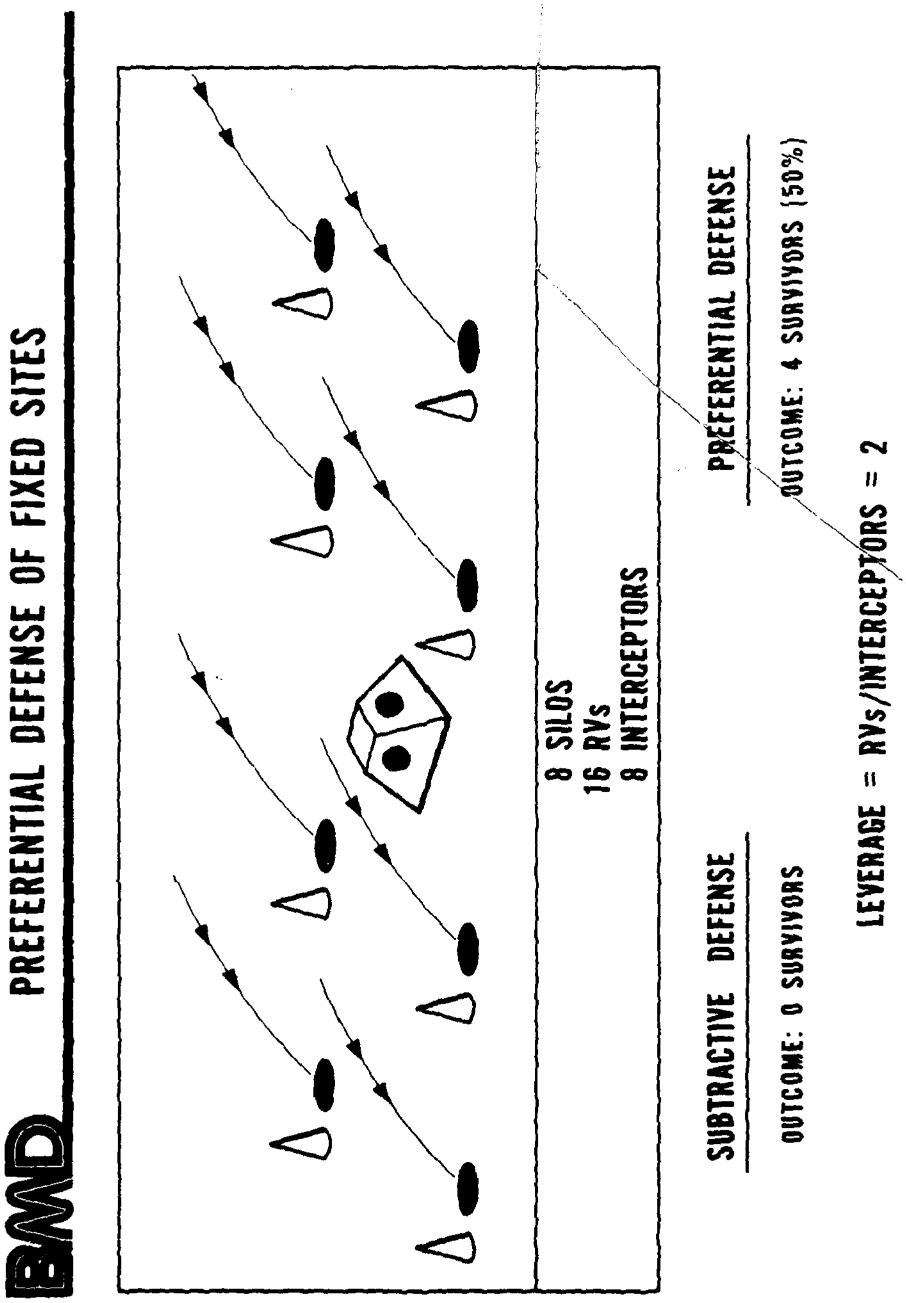

BMD
PREFERENTIAL DEFENSE OF FIXED SITES
8 SILOS
16 RVs
8 INTERCEPTORS
SUBTRACTIVE DEFENSE
OUTCOME: 0 SURVIVORS
PREFERENTIAL DEFENSE
OUTCOME: 4 SURVIVORS (50%)
LEVERAGE = RVs/INTERCEPTORS = 2

Figure 8

Figure 9 depicts a more highly leveraged BMD role, that of defense of multiple protective structures (MPS). This kind of ICBM basing is planned for the MX missile. Insofar as the leverage example is concerned, it makes no difference whether the multiple aimpoints are vertical or horizontal shelters or trenches. The indicated leverage is achievable in any case where the number of aimpoints exceeds the number of ICBMs by the ratio shown.

In Figure 9, the darkened circles indicate the "filled locations" of the MX, the BMD radar and the BMD interceptor. All of the open circles are dummy aimpoints which are assumed to be also targeted by the attacker. The leverage then becomes, when only the aimpoint containing the missile is defended, the same as the deployment ratio, or 20 in the example. Another way of stating the leverage is that the presence of a single intercept BMD system doubles the attack price from 20 to 40 RVs in the example.

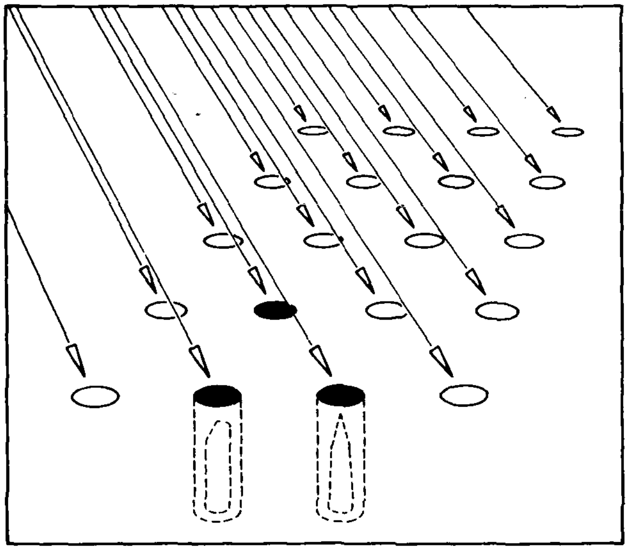
Figure 10 summarizes the utility of BMD in the two ICBM defense roles described and shows typical formats for representing BMD effectiveness. The left graph plots survivors versus attack size (number of RVs) and shows a typical drawdown curve for undefended silos by the solid line. The dotted line represents the restoration of survivability achievable with a BMD deployment. If the drawdown curve results in an unacceptably low survivor level before a BMD system can be deployed, the "bucket" in the diagram occurs. The most popular remedy to "the bucket problem," advocated by a number of defense specialists, is the deployment of one or more of the "simple systems," previously described.

The graph on the right side of Figure 10 is a representation of BMD effectiveness in an MPS defense role. The upper curve, for MPS proliferation, shows a steeper increase in cost, as a function of attack size, than the lower curve for MPS plus BMD. The dotted lines reflect the effect of phasing-in BMD at various points as the attack size increases. The vertical portion of the dotted curves represents the buy-in price of BMD and the horizontal dotted lines reflect the relative cost insensitivity of the integrated MPS–BMD System to increase in attack size.

Leadtime and Budgetary Considerations

Figure 11 illustrates three different kinds of advanced development programs, on the top two diagrams, and a compressible period from the end of advanced development to Initial Operational Capability (IOC) on the bottom. The diagram at upper left shows three rates of leadtime reduction, curves A, B, and C, which are correlated with budget profiles on the right. Curve A, for complete system prototype demonstration, reduces leadtime about 1:1—that is, one year reduction in years to IOC for every year in advanced development. Curve B, for subsystem level advanced development, stretches the years of advanced development for equivalent leadtime reduction. Curve C is

PREFERENTIAL DEFENSE OF MULTIPLE PROTECTIVE STRUCTURES (MPS)



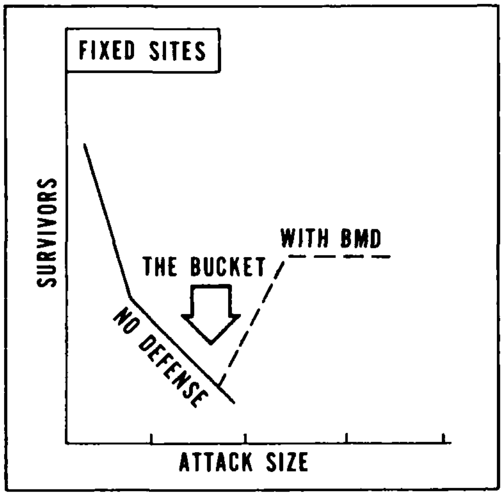
20 SILOS
20 RVS
1 INTERCEPTOR

PREFERENTIAL DEFENSE OUTCOME: 1 SURVIVOR (100%)

- **ONE INTERCEPT EQUIVALENT TO TWENTY AIMPOINTS**
- **LEVERAGE = RVS/INTERCEPTORS = 20**

Figure 9

BMD ICBM DEFENSE EFFECTIVENESS



- REQUIRED SURVIVOR LEVEL CAN BE RESTORED WITH BMD
- COST RELATIVELY HIGH
- THE BUCKET DURATION DEPENDENT ON BMD LEADTIME

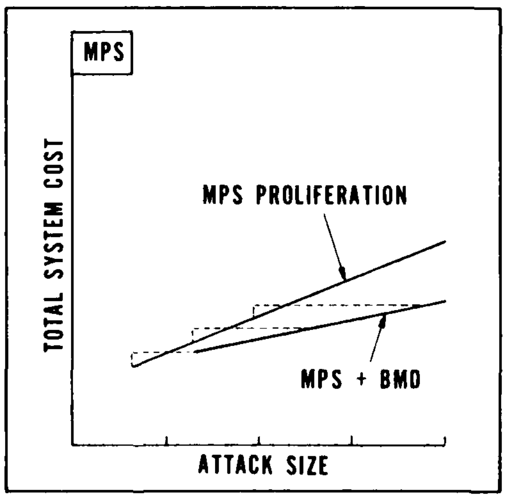


Figure 10

- BMD OPTION CAN BE INVOKED WITH RELATIVELY SMALL INVESTMENT
- BMD ADDITION DOUBLES ATTACK SIZE REQD FOR CONSTANT SURVIVORS
- BMD LEADTIME SHORT

BMD LEADTIME & BUDGETARY CONSIDERATIONS

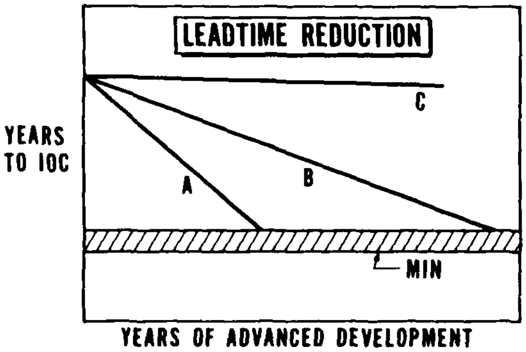
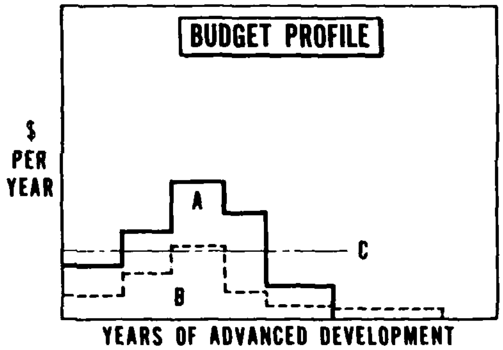
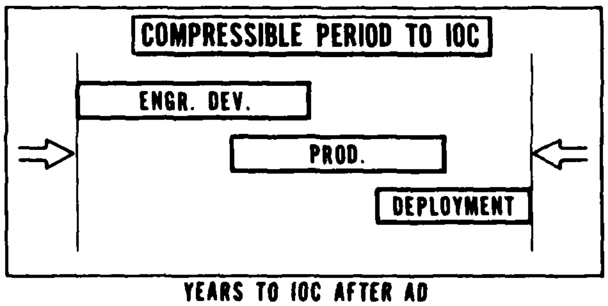


Figure 11



A - SYSTEM PROTOTYPE DEMONSTRATION / OPTIMUM BUDGET
B - SUBSYSTEM ADVANCED DEVELOPMENT / BUDGET CONSTRAINED
C - ADVANCED TECHNOLOGY / LEVEL OF EFFORT



for advanced technology at the component or technique level, at a constant level-of-effort budget, and it does not contribute appreciably to leadtime reduction. Curve A is representative of the program we plan for LoADS, Curve B is the kind of program we wound up with on Site Defense, and Curve C is representative of the program we have conducted for the past several years.

The bottom diagram of Figure 11 indicates that the period after advanced development, including the three conventional phases shown, is compressible. For a BMD system, the minimum interval is estimated to be two to four years. In order to reach the minimum interval, three options are available: (a) streamlining—reducing bureaucratic encumbrances, (b) more money—to provide acceleration and parallelism, and (c) concurrency between phases.

Major Thrusts

The major thrusts of the BMD R & D program are summarized in Figure 12. The exoatmospheric thrust will provide an extension of BMD into the midcourse regime and the LoAD system will provide a new capability in the deep reentry phase. Both of these are supported by a broad technology base covering the spectrum of indicated technologies. Looking further into the future, an extension of BMD into the boost-phase is conceivable using Directed Energy Weapons (DEW). This latter subject was not previously treated for security reasons, but a modest investment in the DEW technologies is being made in the program. Ideally, BMD that is performed against soft ballistic missile boosters, before deployment of RVs and pen aids, provides maximum leverage and dominant strategic defense.

These major thrusts in R & D are expected to yield ballistic missile defense solutions that significantly change the economics of BMD. If they are successful, they will usher in an era in strategic sciences when it is no longer axiomatic that offense always holds a cost advantage over defense. Defensive response options will emerge that provide large cost-effectiveness leverage, particularly in those cases where the defense can capitalize on deceptive basing.

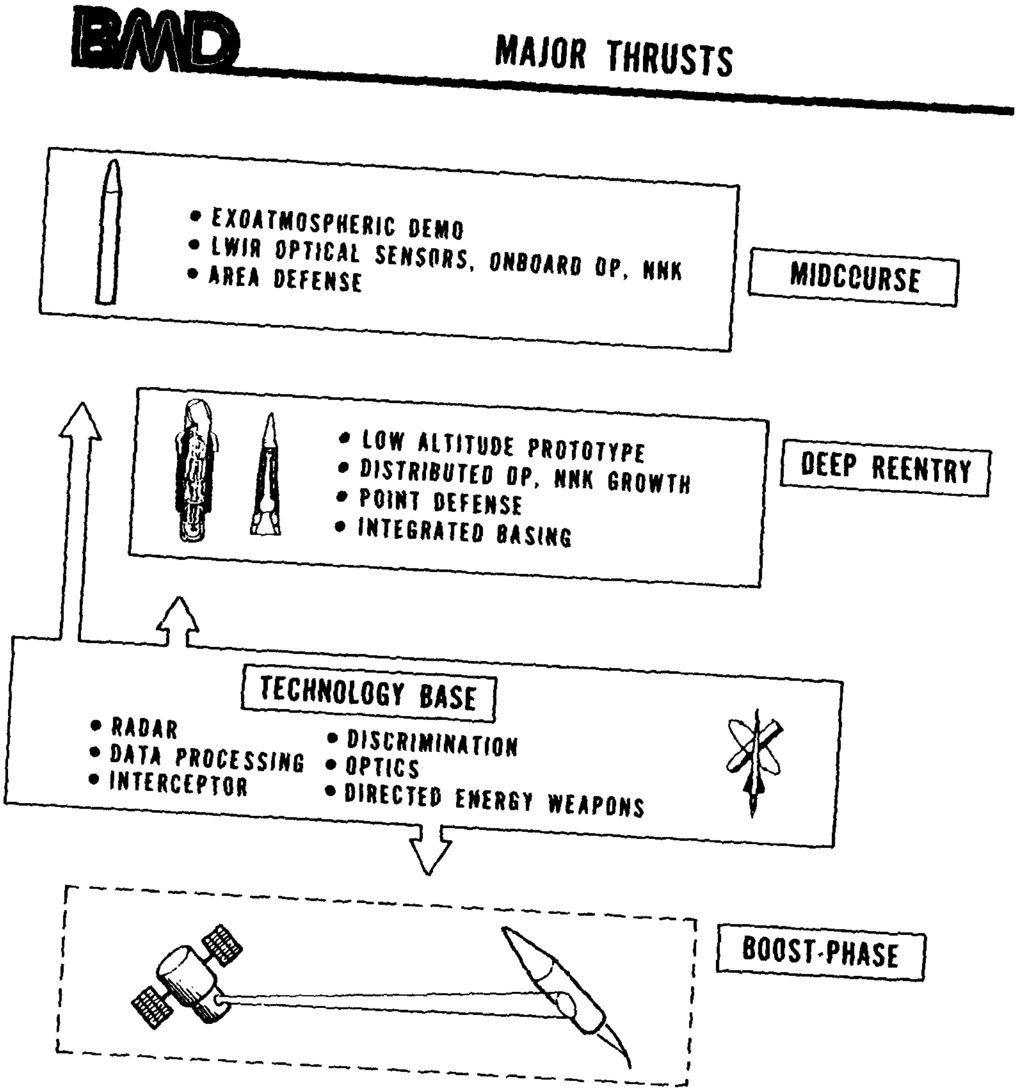

BMD
MAJOR THRUSTS
• EXOATMOSPHERIC DEMO
• LWIR OPTICAL SENSORS, ONBOARD DP, NNK
• AREA DEFENSE
MIDCOURSE
• LOW ALTITUDE PROTOTYPE
• DISTRIBUTED DP, NNK GROWTH
• POINT DEFENSE
• INTEGRATED BASING
DEEP REENTRY
TECHNOLOGY BASE
• RADAR
• DATA PROCESSING
• INTERCEPTOR
• DISCRIMINATION
• OPTICS
• DIRECTED ENERGY WEAPONS
BOOST-PHASE

Figure 12

SALT Implications of BMD Options

E.C. Aldridge, Jr. and
Robert L. Maust, Jr.

SALT I and the ABM Treaty were attempts to bring under control the strategic nuclear arms race between the United States and the Soviet Union. The stated intent of the ABM Treaty is to constrain the quantity and quality of U.S. and Soviet BMD forces and, by so doing, contribute to curbing the strategic offensive arms race and reduce the risk of nuclear war. This paper will address each of these tenets in terms of the following questions:

- What is the ABM Treaty?
- What has been the impact of the ABM Treaty?
- What are the current U.S. BMD systems and constructs?
- What are the current Soviet BMD systems and constructs?
- What are the ABM Treaty implications associated with U.S. and Soviet near-term, intermediate-term, and long-term BMD systems?
- What are the implications of the ABM Treaty and ABM systems on U.S. policy?

The following discussion will briefly describe the principal elements of the current ABM agreements, i.e., the ABM Treaty, Agreed Interpretations, and Unilateral Statements.

The ABM Treaty

To understand the implications of the ABM Agreements on BMD systems and the potential implications of future BMD systems on ABM Treaty reviews first requires a brief understanding of the basic components of the Agreements. In general, the Agreements, by limiting the quantity and quality of each party's ABM forces, attempt to ensure that each country leaves unchallenged the penetration capability of the other party's retaliatory missile forces. More specifically, the existing ABM Agreements prescribe that no more than 100 missiles and launchers can be deployed at one designated site (the United States chose Grand Forks, North Dakota, and the Soviet Union chose Moscow). The Treaty specifies numbers and types of ABM radars and defines the maximum size of the deployment area. Additionally, several qualitative limitations deserve mention. Deployment, testing, and development of rapid reload launchers, multiple kill vehicles on interceptors, and sea-based, air-based,

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space-based or land-mobile ABM systems are prohibited. The development of exotic systems utilizing other physical means (e.g., high energy lasers or particle beams) is subject to discussion in the Standing Consultative Commission. ABM capabilities and force levels not specifically permitted by the Treaty are denied to both signatories.

Impact of the ABM Treaty

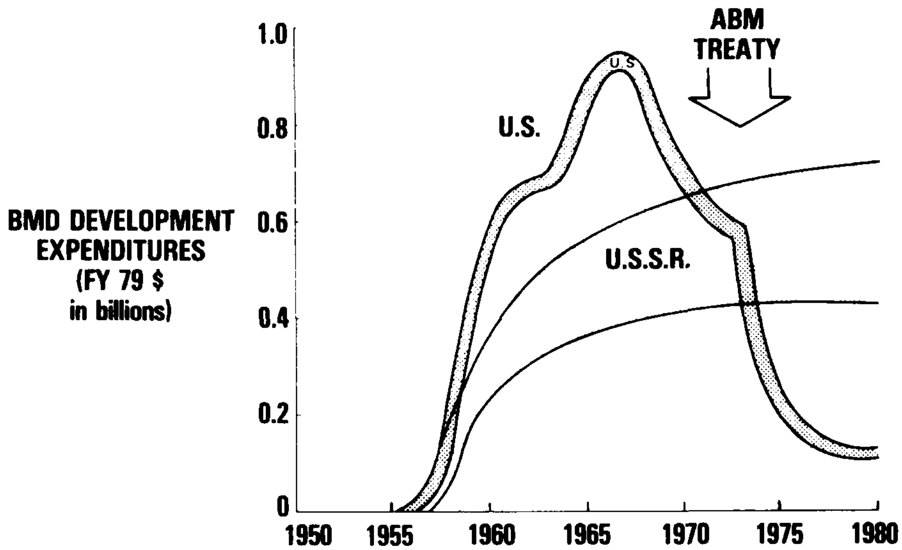
As a result of the SALT process and the ABM Treaty, the U.S. and Soviet BMD programs have changed relative to each other. Both countries initiated BMD programs in the mid-1950s, but the initial U.S. technology and level of effort far exceeded that of the U.S.S.R. In the following paragraphs, the relative changes in the U.S. and Soviet programs are discussed in terms of the observed changes in the relative levels of effort applied to BMD system technology and systems development.

In the late 1960s, prior to the ABM Treaty, the United States was expending approximately $400 million annually on BMD system technology and system development, plus $100 million annually on supporting advanced technology, or in FY 80 dollars, approximately $800 million and $200 million, respectively. The current level of effort stipulated in the FY 80 budget is slightly over $100 million in each area; i.e., one-eighth the late 1960s level of effort in system technology and system development and one-half the late 1960s level of effort in supporting advanced technology.

No one knows precisely what resources have been or will be dedicated to Soviet BMD programs. However, the cost of the Soviet systems can be estimated by determining what it would have cost the United States to pursue the various Soviet development and R & D programs. The results of this exercise, as illustrated in Figure 1, indicate that, by comparison, the Soviet BMD system development programs in the late 1960s would have required roughly one-half the level of effort expended on the U.S. BMD system development programs of that period. Furthermore, since 1970, Soviet BMD programs have appeared to maintain a steady, gradual rate of growth. (Estimates of Soviet expenditures for supporting advanced technology programs are not available.) There are significant uncertainties and limitations to this type of U.S./Soviet BMD program comparison, but the basic relative trends appear credible, and the implications of these trends may provide insight into future U.S. and Soviet BMD options.

The relative U.S./Soviet allocation of resources to BMD system technology and development programs changed from an approximate U.S. advantage of 2 to 1 in the late 1960s to a possible Soviet advantage of 5 to 1 in 1980. What has been the impact of the ABM Treaty? Two summary responses seem in order: (1) While the SALT process has seriously eroded funding support for the U.S. BMD pro-

Figure 1 Comparison of U.S. and Soviet BMD Development Program Effort



grams, Soviet BMD programs appear to have remained reasonably stable, and (2) the 5- to 10-year BMD technological lead-time advantage that the United States enjoyed in the late 1960s has eroded substantially. It is conceivable that the Soviet Union today has the advantage in some aspects of BMD system technology.

Current U.S. BMD Systems and Constructs

The United States has had no operational BMD system since the 1974 decision to dismantle the Safeguard site at Grand Forks, North Dakota. However, there are several system technology programs and constructs that could provide the basis for future BMD options. This section will briefly describe each of these programs and constructs. Components of the Baseline Terminal Defense System have been under evaluation at Kwajalein Missile Range for several years. This system has evolved from Site Defense, which in turn evolved from the endoatmospheric portion of the Safeguard system and consists of an upgraded Sprint interceptor, a small (relative to the Safeguard Missile Site Radar, or MSR) phased array radar, and a commercial computer.

The Low Altitude Defense System (LoADS) and the Layered Defense System (LDS) are the principal candidates to become future BMD systems, but at this point in time both LoADS and LDS are only constructs. LoADS, in the early stages of system definition, is envisioned to become a compact, relatively inexpensive, rapidly deployable terminal defense system that could be deployed with an MX missile in a mobile or transportable basing mode. A baseline system has not yet been defined, but such a system might be comprised of small, single-stage interceptors and very small phased array radars that could, like the MX, be moved from launch point to launch point in a multiple aimpoint system.

The current LDS baseline consists of an exoatmospheric, or overlay, defense, as well as an endoatmospheric, or underlay, defense. Either the Baseline Terminal Defense System or LoADS could be used as an underlay. The overlay is a totally different independent system comprised of an exoatmospheric sensor in the form of a short-duration probe or a satellite system and an exoatmospheric interceptor of the Spartan type, which has its own sensor system that delivers multiple non-nuclear kill vehicles equipped with homing sensors. Each of these sensors on the probe, interceptor, and kill vehicle employs long-wavelength IR optical systems designed to cope with the severe threat environment (i.e., a large number of incoming reentry vehicles and penetration aids) to which the Safeguard system was vulnerable. Later in this paper, the SALT implications of each of the systems will be discussed, but before addressing these issues it is necessary to describe current Soviet ABM capabilities.

Current Soviet BMD Systems* and Constructs

There is not a significant amount of information in the unclassified literature concerning the Soviet ABM program. However, because the Soviet systems have been around a long time, the basic characteristics of the systems and the program are available. The only operational Soviet system, the ABM-1 system at Moscow, was deployed in the mid 1960s, and many of the systems in the current R & D program apparently have been in various stages of testing since the late 1960s and early 1970s. These systems are the product of an evolutionary program that has not produced a multitude of surprises. The Moscow system contains 64 Galosh BMD interceptors that were already deployed when the ABM Treaty was signed. There was no attempt by the Soviets to expand this system to the 100 launchers permitted by the Treaty. The Try Add engagement radars and Dog House battle management radars are deployed at the Moscow complexes, and presumably the remotely deployed, out-

*All information concerning Soviet BMD systems was derived from two publications, *The Soviet War Machine* and *Jane's Weapons Systems*, 1979-80 (see Selected References).

ward looking, long-range Hen House radars provide early warning and battle management information. (Try Add, Dog House, and Hen House are NATO designated names for these systems.) It has been hypothesized that the SA-5 air defense interceptor, several modern ground-based radars, and space-based sensors may also have BMD roles.

In addition to the Moscow ABM-1 system, there are believed to be at least two new Soviet BMD development programs. A test program designated the ABM-X-3 is near, or at, operational capability. This program is reported to be developing a rapidly deployable system comprised of a Galosh follow-on interceptor designated the SH-4, a phased array radar, a tracking radar, and possibly a high-performance endoatmospheric interceptor. Another BMD program is said to be in the early stages of development and may be ready for testing in the near future.

ABM Treaty Implications for U.S. and Soviet BMD Systems

Any analysis of the implications of possible BMD deployments on the ABM Treaty must address the following issues:

- When could the system achieve initial operational capability (IOC)?
- What revisions to the existing ABM Agreements would have to be made in order to legally permit deployment of the system?
- How might these revisions be accomplished?
- What is the net effect to the strategic balance of both sides implementing the revisions?
- Would the strategic balance be more or less stable in light of a potential Soviet breakout after implementing the revisions?

Since the revisions to the ABM Treaty would most likely follow the 1982 and subsequent five-year ABM Treaty reviews, it is appropriate to discuss the implications of the Treaty to BMD systems, and vice versa, in terms of these time periods. This approach is summarized by Figure 2.

Present to 1982

The components of the U.S. Baseline Terminal Defense System could be deployed in the early 1980s and be in compliance with the restrictions contained in the existing ABM Agreements. However, the provisions of the existing Treaty would limit the United States to deploying no more than 100 missiles and launchers at Grand Forks, North Dakota, with all components being fixed and land based. This option would provide only a limited deterrent to the Soviet Union and be of virtually no military value to the United States. To increase the military potential of this system would require relaxing the provi-

Figure 2

THE BMD PROGRAM IMPLICATIONS

	1977 1ST TREATY REVIEW	NOW: EXISTING ABM TREATY	1982 2ND TREATY REVIEW	RELAXED TESTING LIMITS?	1987 3RD TREATY REVIEW	RELAXED DEPLOYMENT LIMITS?	1992 4TH TREATY REVIEW	NEW TREATY?
U.S. BMD CONCEPT		SDS		LoADS SDS		LDS LoADS		
SOVIET BMD CONCEPT		ABM-X-3		ABM-X-3 VARIANT		ADVANCED LAYERED SOVIET BMD		
U.S. DEPLOYMENT OBJECTIVE		DEPLOYABLE MM DEFENSE		DEPLOYABLE MM DEFENSE		MX AND MM DEFENSE TERRITORIAL DEFENSE		
SOVIET DEPLOYMENT OBJECTIVE		"THIN" MOSCOW DEFENSE		TERRITORIAL AND SITE DEFENSE		TERRITORIAL AND SITE DEFENSE		
NET STRATEGIC ADVANCE TO U.S.		UNCERTAIN, POSSIBLY NEGATIVE		UNCERTAIN		POSITIVE		
STABILITY ISSUES U.S. PERSPECTIVE		SOVIET BREAKOUT POTENTIAL IS DESTABILIZING		UNCERTAIN		RETALIATORY FORCES ARE SURVIVABLE – BMD IS STABILIZING		

sions of the ABM Treaty to (1) increase the number of permitted launchers, missiles, and radars to allow at least one interceptor for each missile to be defended, (2) permit deployment at all launch areas or some desirable subset of the ICBM launch areas, (3) permit defense of other critical strategic assets, and (4) permit a mobile or transportable basing mode to increase the survivability and, as a result, the effectiveness of the BMD.

Between now and the 1982 ABM Treaty review, the Soviet Union has only three legal unilateral BMD deployment options: (1) expand the ABM-1 system to the permitted 100 launchers, (2) partially upgrade the current ABM-1 system with new system components, or (3) replace the ABM-1 system with the ABM-X-3 system. Each of these options could only be exercised for the Moscow deployment area, because in the 1974 protocol to the ABM Treaty, the Soviet Union designated Moscow as the only allowable Soviet ABM deployment area. None of these options, if exercised by the Soviets, would significantly impact on the strategic balance. Both the ABM-X-3 and an upgraded ABM-1 would be vulnerable to a precursor attack against the BMD assets, and the 100-missile limit could provide virtually no deterrence or protection against the U.S. strategic force. To increase the military potential of these systems would require the same type of Treaty revisions suggested for the U.S. system.

1982–1987

In 1982, the United States could legally, unilaterally decide to deploy a BMD system at either Grand Forks, North Dakota, or Washington, D.C. Both options require only that the United States notify the Standing Consultative Commission between October 1982 and October 1983. The Soviet Union, in addition to modernizing or replacing the Moscow system, could also exercise the option to dismantle or destroy the Moscow system and to deploy a BMD system in an area containing ICBM silo launchers—provided that the area is at least 1300 km from Moscow and that prior to initiation of construction, notification is given to the Standing Consultative Commission.

In addition to the Baseline Terminal Defense System, the U.S. LoADS could achieve IOC towards the end of the 1982–1987 frame. However, it is difficult to rationalize either a Baseline Terminal Defense System or a LoADS treaty-constrained deployment at either Grand Forks or Washington, D.C., as anything other than a full-scale system evaluation. The existing limitations concerning the number of launchers, type of launchers, and type of basing mode preclude a cost effective deployment of these systems for defense of fixed silos or population. LoADS is being designed as a BMD option for a mobile MX system that will not be totally operational in this time period. If the ABM Treaty were revised to permit more than 100 missiles and launchers to be located at more than one site, a LoADS in defense of Minuteman might be cost effective.

The status of the Soviet BMD program in the 1982–1987 time frame is, at best, conjecture. However, it is reasonable to assume that a variant of the ABM-X-3 would be a likely deployment candidate. As in the case of the U.S. LoADS, there is no compelling rationale for the Soviet Union to deploy this system. As a replacement for the ABM-1 system at Moscow, it would be more effective and would provide system evaluation information, but it would not provide any significant level of defense deployed within the constraints of the existing ABM Agreements. However, if the force level and deployment area limitations in the existing Agreements are relaxed, a Soviet BMD could provide an effective defense of military assets and a deterrent to an attack on economic and industrial assets.

It is not within the scope or security limitations of this paper to determine, quantitatively, the net advantage to the United States or the Soviet Union of revising the ABM Treaty. However, a cursory analysis of Baseline Site Defense System, LoADS, and ABM-X-3 deployment options in the 1982–1987 time frame reveals one potential disadvantage. The Soviet system is a layered system that defends a relatively large area, whereas the U.S. systems provide strictly a point defense. Consequently, a revision to the treaty that greatly increased the number of interceptors and deployment areas might permit the Soviet Union to defend legally a significant portion of its land mass while permitting the United States to defend only a large number of ICBM silos. It is not clear that a revision permitting an unambiguous U.S. system and an ambiguous Soviet system would necessarily produce an unstable strategic environment, but it would most likely produce a net military advantage to the Soviet Union. This problem could be minimized by permitting deployment areas that are not collocated with other military or industrial assets (e.g., enforcing the provision prohibiting deployment closer than 1300 km from Moscow).

1987–1992

There are many more uncertainties with the post-1987 period. U.S. offensive systems (e.g., MX, cruise missile, Trident) projected to reach IOC in this period will affect U.S. BMD requirements and may have a significant impact on Soviet perceptions and requirements for BMD. Conversely, new Soviet offensive systems could have a greater than projected impact on U.S. requirements for BMD. Other uncertainties affecting BMD systems in this time frame include: the status of arms controls for offensive systems (i.e., no SALT, SALT I, SALT II or SALT III could be in force); the results of the 1982 and 1987 ABM Treaty reviews; and limitations resulting from other arms control agreements such as the proposed ASAT Treaty. However, for purposes of this discussion, the preferred U.S. BMD option in the

1987–1992 period is assumed to be the Layered Defense System, or LDS, as described earlier; the LoADS should be available as either a rapidly deployable response option or as part of the LDS. A follow-on to the Soviet ABM-X-3 could be available by 1987. The characteristics of this system are unknown, but based on the evolutionary nature of the Soviet BMD program, it is not unreasonable to assume that the ABM-X-3 follow-on could be an advanced layered BMD comparable to the U.S. LDS.

As stated previously, several critical components of the U.S. LDS are clearly not consistent with the existing ABM Agreements. For example, the LDS is not an effective system if the overlay interceptor cannot utilize multiple kill vehicles, but according to the Agreed Interpretations of the ABM Treaty, Article V of the Treaty includes obligations not to develop, test, or deploy BMD interceptors that can deliver more than one independently guided warhead. It is also not clear whether or not components such as the early warning satellites, exoatmospheric probes, and airborne optical platform are precluded by the Article V restriction on air-based and space-based systems. Furthermore, a large-scale deployment of LDS to defend ICBM and possibly other strategic assets would require more than 100 launchers and more than the one launch area permitted by Article III. Such a deployment is also inconsistent with the intent of Article I, in which both parties agree to limit ABM systems and not to deploy a territorial or regional defense.

A Soviet advanced LDS would probably require similar changes to the existing ABM Treaty. The system would likely have a regional or territorial capability and could utilize sea-based, air-based or space-based systems. Such a system centered at Moscow would defend a large portion of the Soviet population and economic assets and, centered at ICBM launch areas, would provide a deterrent to a counterforce attack.

Soviet warfighting strategy may dictate that the Soviet Union anticipate a U.S. attack and attempt to launch a preemptive counterforce attack as a means of limiting damage to Soviet strategic forces and assets. Such a Soviet policy would require launching ICBMs "on indication" of a threat or on warning. It is likely that, if the Soviet Union had an effective LDS, their negotiating priorities would be (1) a national defense or a set of region defenses, (2) an ICBM defense to minimize the threat of a failure in the early warning system that precludes preemption or launching under attack, and (3) an ICBM defense to maximize the survivability of a strategic secure reserve.

In general, if the United States and/or the Soviet Union wanted to revise the ABM Treaty (as it exists in 1979) to be compatible with the current U.S. LDS concept, extensive revision of the Treaty would be required and a complete renegotiation of the Treaty would appear to make sense, particularly if linked to further reductions in offensive weapon systems in a future SALT agreement.

Long-Range Weapon Concepts

Both the United States and the Soviet Union have pursued active directed-energy research programs to investigate the potential of high energy laser (HEL) and particle beam weapon systems suitable for BMD applications. Due to the limited availability of information concerning Soviet military-directed energy programs, only U.S. programs are discussed in this paper.

One HEL system being considered by the United States utilizes an orbiting laser or particle beam system that would attack ICBMs during the boost phase of flight. U.S. HEL technology is more advanced than the U.S. particle beam technology, but existing HEL concepts suffer from lack of miniaturization (one concept would require 10 to 20 shuttle payloads per system), system flexibility, and threat vulnerability information. These systems also present unique problems for the ABM Treaty. As stipulated in the Agreed Interpretations, any ABM system or its components "based on other physical principles" would be subject to review by the Standing Consultative Commission and possible limitations imposed by the amendment process. However, because of the technology, arms control, and operations limitations, it is unlikely that either the United States or the Soviet Union will deploy a directed-energy BMD weapon system in this century.

Implications of the ABM Treaty and BMD options on U.S. Policy

As stated in Article I of the existing ABM Treaty, both the United States and the Soviet Union undertook to limit BMD missile systems and, in particular, sought to preclude the capability to deploy a territorial or regional defense. This was accomplished by establishing a very effective set of quantitative and qualitative limitations that has made BMD an unattractive deployment option for both the United States and the Soviet Union. The result was an offense-dominated world. Both parties recognized the value, in terms of crisis stability, of maintaining the survivability of their ICBM forces, but advances in guidance and sensor technology have tended to negate attempts to harden silos or devise alternative ICBM basing modes. Consequently, other methods of making ICBMs survivable are being examined, and the implications of a defense-dominated world are being considered.

Defense of MX

With the introduction of the new generation of Soviet ICBMs, the U.S. Minuteman silo-based ICBMs will no longer be able to withstand a first strike. United States options include abandoning the ICBM concept and switching from the Triad to a strategic dyad policy, revising U.S. policy to one of launch on warning of attack, devising alternate basing options for the ICBMs, or defending the

ICBMs. Initially the United States has decided to deploy the new MX missiles in a mobile basing mode that contains multiple launch points for each missile. If the United States can generate enough aimpoints and maintain deception, the Soviet Union cannot target more than one weapon per aimpoint, and with current forces might not have enough reentry vehicles (RVs) to target even one RV to each MX and Minuteman aimpoint. This would preclude a Soviet first strike. However, both U.S. military and congressional studies have indicated that American proliferation of aimpoints could result in Soviet fractionation (putting more RVs on each missile) for their ICBMs and SLBMs. The proliferation and fractionation could expand to ridiculous limits if not curtailed by SALT, other political actions, or simple economic considerations.

BMD provides an alternative to proliferating aimpoints. Because the vulnerabilities of the BMD and multiple aimpoint (MAP) basing mode are totally different, developing a high-confidence counterforce attack would be more difficult for the Soviet planner. U.S. military and congressional studies have also indicated that for each combination of threat, MX basing mode, and BMD examined there is some optimum number (typically 20 to 30) of launch points such that if additional MX survivability is required it would be more cost-effective to deploy a BMD of the existing MAP than to construct additional launch points. Consequently, there could be strong political arguments to support BMD, particularly if the BMD system deployed utilizes only non-nuclear kill vehicles. Any system that provides crisis stability, is cost-effective, requires less disruption of the environment, and minimizes proliferation of nuclear weapons would be politically attractive, and a BMD deployed with MX can potentially achieve each of these objectives.

Other Defense Considerations

A defense of the existing Minuteman silos could also prove an attractive option under two sets of circumstances: (1) the MX/MAP program is cancelled and (2) a new missile is deployed in the Minuteman silos. In the first case, a BMD would be required to maintain the credibility of the Triad; studies have shown that with a layered defense revising the ABM Treaty to permit such a deployment can be in the best interests of the United States. The second case can exist whether or not the MX/MAP program achieves its milestones. If MX is deployed in a MAP basing mode, the United States may be faced with a requirement to modernize its non-MIRVed forces. One solution to such a requirement would be to deploy a new ICBM in the existing Minuteman silos. Deploying a new ICBM in the existing silos may also make sense if the MX/MAP program fails. In either case, a new ICBM deployed in a silo makes sense only if the silos are defended.

Another consideration that involves BMD options is the concept of changing U.S. strategic policy from one of mutual assured destruction to one of mutual assured survival; i.e., from offense domination to defense domination. To achieve a defense-dominated world, offensive forces should be significantly reduced and all aspects of strategic defense, including a territorial BMD, should be employed. The feasibility of achieving a defense-dominated world and the stability issues associated with such a transition require further study.

Future Treaty Reviews

For a BMD system to be survivable, it should be deceptively based; to be cost effective and minimize the requirement for nuclear weapons, it should be a layered defense system with an exoatmospheric non-nuclear multiple kill vehicle capability. (Eventually, a non-nuclear endoatmospheric system would also be available.) However, to permit deployment of this type of system requires the following changes in the ABM Treaty:

- Articles I and III should be revised to change the implications and the limitations that restrict BMD deployment areas and force levels. A territorial defense system or several regional defense systems composed of considerably more than 100 launchers and missiles and more than 18 radars would have to be permitted.
- Article V would have to permit air-based, space-based, or mobile land-based BMD systems.
- Article V and the Agreed Interpretations would have to be revised to permit multiple kill vehicles.
- Article VI might be rephrased to permit space-based, air-based, and sea-based early warning radars.
- Article XII should be interpreted to state that a deceptive MX-type basing mode does not constitute deliberate concealment measures which impede verification by national technical means.

The changes required are extensive, but if they promote an environment in which the strategic offensive forces of both countries are survivable, then crisis stability is more achievable. Also, if stability can be achieved by way of a defensive deployment to ensure survivability rather than an expansion of offensive forces to ensure mutual assured destruction, the two parties will have promoted the fundamental objectives of the ABM Treaty—reductions in strategic offensive arms and nonproliferation of nuclear weapons.

Within the general framework of the limitations specified above, the United States and the Soviet Union could investigate the desirability of defending assets other than ICBM launch areas and the national capitals. Assets such as strategic bomber bases, communication nodes, specific port facilities, and critical economic assets could also be considered. In short, these revisions would be part of the transition required for the United States to change from a policy of "mutual assured destruction" to a policy of "mutual assured survival."

The Bottom Line

The SALT implications of the U.S. and Soviet BMD options discussed in this paper should change significantly over the next ten years. From a U.S. perspective, two factors will have the greatest impact on American motivations to pursue BMD options. First, the deployment of the MX missile in a multiple aimpoint basing mode could prompt the Soviet Union to pursue offensive reactions such as fractionation and possibly to consider defensive options such as an expanded BMD. The second factor affecting U.S. BMD options will be the perceived effectiveness of the U.S. BMD systems. If the technology programs to develop an exoatmospheric interceptor with multiple kill vehicles, optical sensors, and non-nuclear warheads prove successful, many of the political problems (e.g., cost and nuclear proliferation) confronting a BMD deployment option could be diminished. Development of an effective non-nuclear endoatmospheric interceptor capability would make BMD an even more attractive option. However, neither the MX in a multiple aimpoint basing mode nor an operational layered BMD will be available until the late 1980s or early 1990s.

Between now and the 1982 Treaty review, the only two U.S. BMD options are to abrogate the Treaty or to deploy BMD within the limits of the existing agreements. There is currently no rationale to justify abrogation of the Treaty, and there does not appear to be sufficient military advantage to warrant deploying a Site Defense System limited to 100 interceptors.

The 1982 ABM Treaty review provides additional options; i.e., revising the Treaty to permit additional forces and relaxing the qualitative restrictions to permit more capable systems. However, since the U.S. layered BMD will not be available until after the 1987 Treaty review, these options have to be considered in terms of the U.S. Baseline Site Defense System or possibly a variant of LoADS that should achieve IOC in this period and a Soviet variant of the ABM-X-3 system. The ability of any of these systems to counter a large-scale attack is unknown. However, it is reasonable to assume that the net change to strategic stability resulting from a deployment of those systems would be minimal. (If either side perceived a net disadvantage, the revisions would not be negotiated.) The more critical issue might be the potential instability resulting from the revisions (i.e., would a breakout become more attractive?). In this context, the broad area potential and rapid deployment potential of the Soviet ABM-X-3 follow-on is more destabilizing. Consequently, the U.S. negotiating position for the 1982 Treaty review might be to seek only those clarifications and revisions required to optimize the research, development, testing and engineering (RDT&E) program for the layered BMD system, and possibly the option to deploy in the new MX basing area.

The critical Treaty review will probably be in 1987. By this time, Soviet responses to perceived U.S. MX deployments and U.S. advances in layered BMD technology should be evident. Should the United States and the Soviet Union decide that layered BMD provides an attractive, stabilizing option, the 1987 and possibly the 1992 Treaty reviews would provide the mechanism for making the required radical revisions to the Treaty discussed earlier in this paper.

What can be done now and in the future to optimize the U.S. options entering the 1982, 1987, and 1992 ABM Treaty reviews? Based on this analysis, the following observations can be made:

- In the near term, the viability of the ABM Treaty must be maintained.
- The LoADS and LDS RDT&E programs must produce effective, deployable BMD systems by 1987. If these programs are successful and timely, U.S. decision makers will have the deployment, negotiating, and response options necessary to negotiate future ABM and other SALT treaties.
- A greater understanding of the potential impact on the strategic balance of both U.S. and Soviet BMD systems is required. Any future debates on treaty revisions or system acquisitions are going to hinge on the perceived effectiveness of these systems, which to a large extent will depend on the perceived credibility of the supporting arguments.
- A coherent U.S. BMD strategy is required to take advantage of the relationships existing between U.S. and Soviet BMD objectives, the perceptions each has of the other's objectives, and the interaction of both the U.S. and Soviet BMD programs with the other components of their respective strategic programs.
- In the long term, there may be a net strategic advantage to the United States in permitting significant revisions to the ABM Treaty. This could mark a major shift in the U.S. policy away from the concept of mutual assured destruction.

Selected References

1. *Department of Defense Annual Report,* Fiscal Year 1980, Washington, D.C., U.S. Government Printing Office, 1979.
2. *Military Balance, 1978-1979,* International Institute for Strategic Studies, London, 1978.
3. *Statement of Paul H. Nitze Before the Committee on Armed Services of the House of Representatives,* February, 1979.
4. *Retaliatory Issues for the U.S. Strategic Nuclear Forces,* Congressional Budget Office, Washington, D.C., U.S. Government Printing Office, June 1978.
5. *SALT II and the Costs of Modernizing U.S. Strategic Forces,* Congressional Budget Office, Washington, D.C., U.S. Government Printing Office, September 1979.
6. *The MX Missile and Multiple Protective Structure Basing: Long Term Budgetary Implications,* Congressional Budget Office, Washington, D.C., U.S. Government Printing Office, June 1979.
7. *The Soviet War Machine,* Salamander Books, Ltd., London, 1978.
8. *Jane's Weapon Systems, 1979-80,* MacDonald and Jane's Publishers, Ltd., London, 1979.

Soviet Ballistic Missile Defense (BMD) Objectives: Past, Present, and Future

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The 1972 Treaty on the Limitation of Anti-Ballistic Missile (ABM) Systems between the United States and the Soviet Union is the showpiece of U.S.-Soviet arms control. Unlike the agreements on limitations on offensive systems reached in Moscow and at Vladivostok, which provided only limited and interim arms control, the ABM Treaty marked a watershed in the strategic arms control process both in its scope and duration. At the time of its signing, if not today, the Treaty was also viewed as the single most positive step towards achieving stability by preserving mutual assured destruction through mutual vulnerability. The relative satisfaction of both parties with the Treaty is reflected in the 1977 quinquennial review, which passed almost unnoticed despite a series of allegations regarding Soviet "cheating" on the SALT I agreements.

Unhappily, the future of the ABM Treaty may not be as bright. The evolution of offensive systems, notably the acquisition by the Soviet Union of a significant hard-target counterforce capability and the resulting increase in U.S. ICBM vulnerability, has served to raise questions as to the value of the stringent limitations on ballistic missile defenses embodied in the ABM Treaty. Although the issue of relaxation on ABM deployments, particularly for hard-site defenses, would exist regardless of the fate of the SALT II Treaty, it is, in some sense, the unfortunate burden of SALT II that in the event the Treaty is ratified it may serve as an additional impetus to those seeking to deploy some form of U.S. ABM defense. If SALT II is not ratified the continued viability of the ABM Treaty could be in doubt, especially in view of the strong linkage between offensive and defensive arms limitations set forth by the United States on May 9, 1972. In sum, it may well be that the era that Henry Kissinger termed "the free ride" of offensive missiles may be ending.

In light of the uncertainties that cloud the future of the ABM Treaty, it is important not only to reassess U.S. interest in an option for ballistic missile defense, but that of the Soviet Union as well. This paper seeks to address Soviet perceptions, motivations, and policies pursuant to ballistic missile defenses, and in particular likely Soviet interests and objectives relative to possible alternatives in the existing ban on ABM deployment.

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Historical Background

Ballistic missile defense was a natural outgrowth of the Soviet Union's long-standing preoccupation with homeland defense. In the late 1940s and early 1950s, when the Soviet Union lacked an appreciable counterforce capability even against U.S. forward-based systems, the Soviet Union sought security by way of a strategy combining deterrence with defense: deterrence through the conventional threat to Western Europe, and defense by the creation of a massive air defense network designed to limit the penetration of U.S. and European medium bombers. Soviet interests in achieving a BMD capability appear to correspond with the first efforts to develop long-range ballistic missiles.[1] Moreover, BMD was viewed as the natural outgrowth of the air defense effort and a response to the prospective ballistic missile threat posed by the United States. The Soviet Union began research into BMD, specifically an antiballistic missile, by the early 1950s.[2]

The importance of BMD as a damage limiting measure was affirmed in the policy debates which occurred in the late 1950s leading to the codification by the early 1960s of the current Soviet military strategy. Soviet military doctrine, driven by the ideologically rooted maxim that the possibility of a nuclear war was indeed real and that the "balance of terror" was inherently unstable, required a military strategy that would promise some success in both defeating the military forces of the aggressor and at the same time limiting the damage to the Soviet homeland to tolerable levels. The ICBM was viewed as offering the best hope for accomplishing the first mission. However, this period witnessed not only the development of the first Soviet ballistic missiles, but more importantly for the purposes of this paper, the first concerted efforts toward an interlocking defense capability composed of ballistic missile, air, and civil defenses.

In the late 1950s, the Soviet Union devoted an increasing amount of resources to an active air defense capability including tube-fired antiaircraft weapons, the first interceptor aircraft, and the SA-2 surface-to-air missiles.[3] In addition, development work was seriously begun on the first ABM system, the Gaffer/Griffon, a two-stage missile with a slant range of approximately 100 miles and possibly a nuclear warhead.[4] This first Soviet BMD system was designed to be a dual-purpose high altitude air defense system with some limited ABM capability, hence its planned deployment around Leningrad. Its placement, at Leningrad rather than Moscow, appeared to reflect Soviet concerns for the real U.S. bomber threat and the emerging ballistic missile capabilities.

Current Soviet military strategy, which has remained virtually unchanged since the debates of the late 1950s, maintains a requirement for BMD. The central tenet of this strategy is that a warfighting/warwinning posture constitutes the best means for achieving both prewar deterrence and victory should deterrence fail.[5] Warfighting necessitates the ability to both defeat the opponent's means of waging war and to defend the Soviet Union against attack. The foremost element in a successful warfighting strategy is preemption, and particularly preemptive counterforce. The concept of preemption in Soviet strategy is not synonymous with either preventive war or a "bolt-out-of-the-blue"; rather, it signifies a response to an imminent threat of attack based on the objective of destroying the enemy's means of attack before they can be launched.

The requirement for preemption is derived from three doctrinal precepts: (1) that success in the initial period of conflict is crucial to the outcome of the war, (2) that surprise is critical to success in the initial period, and (3) that the imperialists by their very nature will attempt a first strike. Logically, if the Soviet Union is to win the next war it must be prepared to win in the initial period of the war which, in full, means seizing the initiative from the enemy. The best way to do this is by means of preemption, especially of the enemy's means of waging war. In order to achieve successful preemption, Soviet strategy places increased importance on correctly anticipating the enemy's attempts to undertake a first strike. The key Soviet programmable concern during this period was the development of reliable and invulnerable strategic systems with which to carry out the preemptive counterforce mission.

Soviet military writings admit that even with a successful preemptive attack the Soviet Union cannot expect to escape all damage, although the level of destruction could be significantly reduced. The degree of damage sustained will be much greater, however, if the Soviet Union is unable to achieve preemption and is required to absorb a U.S. first-strike before retaliating. The strategic defense requirements concomitant to a warfighting strategy were reflected as early as 1962 in the first edition of *Military Strategy:* (1) the acquisition of a preemptive counterforce capability, (2) active air and ballistic missile defenses, and (3) passive defenses, particularly civil defense.[6] Certainly, the prospects for successful preemption could not have seemed very bright to Soviet leaders in the 1960s when they observed the marked disparity in U.S. and Soviet offensive forces. Nonetheless, as has become clear in recent years, Soviet inferiority acted as a spur for R & D and acquisition policies which became apparent only in the late 1960s and early 1970s.

The offensive and defensive programs initiated by the Soviet Union during the late 1950s reflected the key features of the new strategy. Deployment of the SS-7 and SS-8 were initiated. Although these were less than adequate for the counterforce mission, they did serve as a deterrent of sorts, supplementing the large force of medium bombers and MR/IRBMs targeted on Europe and U.S.

forward-based systems.[7] More important, it is in this period that work began on the third generation ICBMs, the SS-9 and SS-11, and on the first modern Soviet nuclear ballistic missile submarines.[8] However, until the third generation of ICBMs was deployed and measures were taken in the mid-1960s to harden existing missile launch sites, the Soviet Union remained extremely vulnerable to a U.S. preemptive strike. Nonetheless, the Soviet Union could look forward to the time when it could retaliate against the U.S. intercontinental threat with an equal one while maintaining some hope of damage limitation.

Progress, such as there was, in BMD was slow. The Griffon system around Leningrad was cancelled in the early 1960s, probably as a result of both technological and cost problems.[9] At the same time, however, work was begun on both the Moscow ABM (Galosh) and the SA-5, an air defense system with a possible limited ABM capability.[10] During this period, the Soviet press brought forth a series of statements that appeared to indicate Moscow's belief that it had solved the ABM problem. First, Minister of Defense Malinovskiy stated at the 22nd Party Congress that "The problem of destroying missiles in flight had also been successfully resolved."[11] Soon thereafter, Khrushchev claimed that the Soviet missile defense forces could "hit a fly in space."[12] Minister of Defense Marshal V. D. Sokolovsky made a similar claim in the first edition of *Military Strategy*.[13] This contention was reinforced and the Soviet goal for ABM clearly stated by then Major-General Talensky. According to Talensky, ABM was a logical response to the growing stockpiles of strategic offensive weapons, and Soviet security could not be made dependent on the good-will of other states but must instead derive from the ability of the Soviet armed forces to defeat any opponent.[14]

Construction of the Galosh system around Moscow began in the early 1960s. It was natural for the Galosh, a pure BMD system, to be deployed around Moscow, since Moscow is the administrative, political, and economic heart of the Soviet state. The Galosh system was apparently intended for deployment at several Soviet cities, perhaps as the forerunner of a nationwide ABM system, but these plans were dropped. It is unlikely that Soviet planners viewed the relatively simple Galosh as a means for preclusive nationwide defense. It served instead to increase U.S. uncertainty, thereby buttressing Soviet deterrence of a U.S. nuclear attack. Faced with even a moderately capable ABM system, U.S. planners would have to choose between attacking defended soft countervalue targets or hardened point targets that remained undefended. It is likely that Soviet planners viewed the initial ABM deployments as enhancing their deterrent by promising to weaken a U.S. countervalue attack.

The halt in Soviet ABM deployments, marked by the truncation of the Moscow Galosh system in 1968 when only two-thirds completed, probably reflected a combination of technological difficulties with the system and a recognition that it would not be effective against U.S. MIRVed ICBMs. These problems were reflected in the altered tone of Soviet writings on BMD. Unlike earlier statements, which bespoke a certain confidence in the Soviet programs, the new "line" emphasized the difficulties inherent in deploying an ABM system capable of dealing with the growing ICBM-MIRV threat. In the 1968 addition of *Military Strategy*, Marshal Sokolovsky's previously confident tone regarding a solution to the ABM problem was moderated in favor of a more tentative declaration that a solution to "some" of the problems associated with ABM had been achieved.[15] A similar declaration was made by Defense Minister Malinovskiy at the Twenty-Third Party Congress, where he stated that Soviet defenses could cope with some but not all enemy missiles.[16] The emergence of a debate in the Soviet press on the effectiveness of ABM technology serves as an instant indicator of the growing dissatisfaction within the Soviet military at the time over the state of ABM technology.

The basic problem facing the Soviet Union was that while Soviet ABM technology, as represented by the Galosh, might have been at least marginally effective against the U.S. ballistic missile force of the 1960s, it was virtually useless against MIRVed ICBMs and SLBMs. Reflecting this point and echoing a view that was gaining widespread credence in U.S. defense circles was an article by G. Gerasimov which argued that only a 100 percent effective ABM could be considered effective, but even were such a system to be developed, "investments in ABM could be neutralized by much smaller investments in additional offensive means."[17] This argument, it would appear, reflected a growing Soviet realization that U.S. MIRV technology posed a virtually insuperable threat to the then primitive Soviet BMD capability. Soviet concerns were heightened by the U.S. decision to initiate deployment of the Safeguard system, which had the potential for use against a Soviet missile force that at that time lacked a significant MIRV capability. If upgraded and expanded, Safeguard might have served adequately as a nationwide BMD against the then limited Soviet offensive threat, or so it might have seemed to Moscow. A U.S. ABM capability in addition to MIRVed ballistic missiles was viewed by the Soviets as a serious destablization of the strategic balance. According to the editor of *Military Thought:*

> It [the disruption of the nuclear balance] is possible, for example, in case of further sharp increases of nuclear potential or the creation by one of the sides of *highly effective means of anti-ballistic missile defense, while the other side lags considerably in the solution of these tasks.*[18]

It is at this point of growing dissatisfaction with the state of Soviet ABM development and the looming threat of U.S. offensive and defensive superiority that SALT emerged to take a significant place in Soviet strategy and arms acquisition policy. Soviet strategic offensive nuclear programs were viewed by Moscow as holding great promise for the 1970s, if the U.S. technological lead could be diminished. The fourth-generation ICBMs, then only in the development stage, offered hope for the first time of a significant hard-target counterforce capability.[19] In addition, Soviet efforts in other areas of defensive technology, notably air defense, antisubmarine warfare, and civil defense, presented the possibility for successful amelioration of an increasing portion of the strategic threat. It was with this perspective that the Soviet Union entered into the SALT negotiations.

SALT I: Soviet Motivations for the ABM Treaty

The history of the SALT I negotiations has been well documented and thoroughly discussed in the United States since 1972. It is apparent that a dominant Soviet interest in SALT I was the attainment of limitations on the U.S. ABM program.[20] Perhaps it is indicative of subsequent U.S. difficulties in strategic arms control that the United States initially misread the deep Soviet concern over the U.S. lead in ABM in the rush to gain constraints on offensive systems.[21] An effective U.S. ABM capability struck at the heart of Soviet nuclear strategy. In the Safeguard configuration, ABM threatened to degrade Soviet retaliatory capabilities. More importantly, if steps were taken to deploy a hard-site defense of Minuteman, the Soviet preemptive counterforce program, the keystone of Soviet strategy, would be of questionable value. It is in this light that Soviet acquiescence on U.S. demands for various limitations on offensive forces should be viewed.

There is now general, although not complete, agreement in the United States on Soviet intent in signing the ABM Treaty. Rather than signalling the acceptance by Moscow of the U.S. concept of mutual assured destruction, SALT I merely denoted the Soviet concern for an ABM "gap." In support of this view it is possible to point to both Soviet statements and actions and, in the latter case, to Soviet efforts in both defensive and offensive programs. During the Supreme Soviet session that ratified the ABM Treaty, Defense Minister Grechko defended the decision to sign the Treaty with the statement that "it does not place any limitations on carrying out research and experimental work directed towards solving the problems of defense of the country against nuclear missile attack."[22]

More generally, the ABM Treaty failed to engender any visible change in the Soviet position on damage limitation; Soviet statements since 1972 consistently called for the development of impenetrable defenses against both airborne and space attacks.[23] According to the Chief of the National Air Defense Academy, Marshal Zimin, The enormous destructive power of nuclear warheads raises the necessity of destroying all targets without exception, which accomplished a breakthrough into the territory of the country from air or *space*.

All of these conditions put before the air defense complex and responsible tasks, the resolution of which will be determined by the ability to repulse strikes not only of aerodynamic, but also of *ballistic means of* attack.[24]

Equally significant is the lack of Soviet acceptance of the principle of survivable offensive forces. The abiding Soviet interest in counterforce remains as firmly entrenched in Soviet doctrinal writings today as it was prior to the signing of the strategic arms limitation agreements. Although the more bellicose Soviet expressions of interest in counterforce and particularly preemptive counterforce have been muted of late, a careful examination of Soviet literature and statements provides strong evidence of Moscow's unswerving adherence to this strategy. Soviet sources continue to insist that the primary function of strategic offensive forces is the destruction of the offensive forces of the enemy.[25] The value of offensive forces rests with their ability to defeat the strategic weapons of an opponent, to the extent that, in synergism with existing Soviet defenses, they improve the prospects for damage limitation.[26] The Soviet decision to proceed with deployment of the fourth-generation ICBM systems may have been motivated, in part, by the *recognition* of the inadequacy of extant ABM technology and by a perception of the potential impact on the operation of even imperfect defenses of a preemptive counterforce capability.[27]

The continual preoccupation in Soviet literature with damage limitation and counterforce is matched by actual programs, both defensive and offensive. Despite the limitations on ABM, the Soviet Union maintained and even increased its effort in other areas of defense. In SALT I the Soviets categorically refused to consider any measures to limit defenses other than ballistic missile defenses.[28] Soviet air defenses have been modernized and increased, civil defense—both in-place sheltering and crisis evacuation—has been given considerable additional attention, and submarine warfare capability has expanded.* Much of this expansion appears to date from the early 1970s, a time when the Soviet leadership was seriously coming to grips with the prospects for limitations on ABM and the implications this would have for other Soviet defenses.[29] These programs are clearly in keeping with the Soviet doctrinal requirement for layered and multifaceted defenses, which dates back to the early 1960s.[30] These continuing efforts would appear to belie any claim that the Soviet Union has abandoned the concept of damage limitation in favor of the principle of mutual assured vulnerability.

Perhaps the most significant Soviet weapons program for the purposes of this discussion is the fourth generation of Soviet ICBMs. In deploying these systems, the Soviet Union appears to have satisfied

*See the next section for a more detailed discussion of Soviet strategic defense efforts.

the combination of throwweight, accuracy, and numbers requirements for achieving a significant hard-target counterforce capability. Moreover, since 1972, and perhaps as a result of the lack of an adequate active BMD, Soviet doctrinal pronouncements have increasingly spoken of the role of offensive forces as in themselves an instrument of damage limitation. According to one such statement, "The most effective means of defending the country's population are effective actions aimed at destroying the enemy's offensive weapons both in the air and on the ground at their bases."[31] Thomas Wolfe has noted that in light of the continuing Soviet interest in counterforce, the ABM Treaty might have been viewed in the Soviet Union as a device for increasing the potential of Soviet strategic systems by preventing the United States from actively defending its ICBMs.[32]

In light of the programs undertaken during the SALT I negotiations or that have emerged since, it is clear that the Soviet Union did not perceive the ABM Treaty as nullifying efforts to achieve a damage-limiting capability. The well-documented Soviet opposition to SALT proposals that might adversely affect or limit Soviet acquisition and deployment practices and the level of Soviet R & D bears out the view that the ABM Treaty was considered an expedient measure intended to limit a U.S. technological advantage. In making concessions on its ABM program, the Soviet Union was underscoring its nascent interest in alternative forms of damage limitation. As post-SALT I developments have indicated, the Soviet Union maintains an active R & D program not only in BMD, but in all forms of strategic forces, including those contributing to a preemptive counterforce option.

Current Soviet Defense Activities

Unlike the United States, which has seen fit to disparage the value of strategic defenses in the absence of any BMD, the Soviet Union has continued to devote considerable resources and interest to the development and improvement of such capabilities. Perhaps because the Soviets long ago recognized and perhaps even planned for the synergistic effects of multi-faceted, mutli-layered defenses, they continue to differ with the Western notion that such capabilities are insignificant in the absence of a national BMD. In part, Moscow's view can be attributed to the nature of the strategic threat facing the Soviet Union; the large and capable U.S. strategic bomber fleet is certainly a major rationale for the continuation of the Soviet defense network. According to the Soviet view, air defenses continue to play an important role in national defense by preventing enemy aircraft from inflicting damage on the Soviet Union, thereby ensuring the continuation of the national economy and, hence, the war effort. However, even here it is important to note that the ABM Treaty has had no discernible impact on the role and missions of the National Air Defense (PVO); these roles continue to include defense against ballistic missile attacks. Although little is said regarding the precise means by which defense against ballistic missiles will be accomplished, antimissile and even antisatellite responsibilities are still listed as missions for the National Air Defense. This should not be unexpected since the Soviets are maintaining the Moscow ABM system and have an active BMD/ASAT R & D program.

The Soviet Union maintains the largest aerospace defense capability in the world. Particularly in the area of air defenses, the sheer magnitude of the Soviet defense program is beyond any defensive capability ever deployed by a modern state. Currently, the Soviet Union maintains between 9,500 and 10,000 surface-to-air missile (SAM) launchers at over 1,000 sites, and some 2,300 interceptor aircraft.[33] The quality of both Soviet SAMs and interceptors varies; older SA-2s and MIG-19s coexist with the most modern SA-3s and MIG-25s. In addition, the Soviet Union deploys more than 7,000 air defense and surveillance radars. By comparison, current U.S. air defenses consist of some 330 obsolete aircraft of which some 190 are manned not by the Air Force itself but by the Air National Guard. The United States also maintains essentially no SAM capability and only a handful of surveillance radars. Although existing Soviet air defenses are of questionable adequacy against the modernizing U.S. strategic bomber force, there can be no question that the Soviet Union continues a major program to modernize its air defenses. Efforts have been made to improve both interceptor and SAM capabilities. The former have centered on both the acquisition of more modern interceptors and the development of a Soviet AWACS and a look-down/shoot-down capability.[34] The latter efforts have concentrated first on upgrading existing fixed defenses through the replacement of aging SA-2s with more capable SA-2s, SA-3s, and SA-5s; and second with the introduction of the mobile SA-10.[35] This latter system is of additional concern to U.S. defense planners since it has an apparent capability to defend against low-flying U.S. cruise missiles.[36] The use of the SA-10 in a point defense mode—probably against cruise missiles and possibly against SRAM—would further degrade the effectiveness of the U.S. bomber-cruise missile force, which would first have to penetrate against longer-range Soviet air defenses in order to reach their targets.

Civil defense is treated in a similar manner to air defenses. Since 1972, Soviet investment in civil defense appears to have increased significantly to a level of approximately 2 billion dollars annually.[37] In the fall of that same year the role of civil defense was also given a major boost within the Soviet military hierarchy with the appointment as chief of U.S.S.R. Civil Defense of Colonel-General A. Altunin, who was also a Deputy Minister of Defense of the Soviet Union, and with the raising of Civil Defense to the level of a military service on a par with the Strategic Rocket Forces, Long-Range Aviation, and so on. At least one U.S. observer has suggested that the intensification of activities in Soviet civil defense may have been in response to the ABM Treaty; the sheltering or dispersal of the Soviet urban population serving much the same function as a nationwide BMD.[38] Without presenting the entire range of debate on the potential effectiveness of Soviet civil defense, it is still worth noting that some experts believe that the present Soviet system has the capability of reducing Soviet casualties to between 5 and 8 percent of urban population.[39]

Soviet ballistic missile defenses presently deployed are quite limited. The Soviet Union maintains the Galosh system around Moscow with 64 launchers. It is believed that the Galosh has a range of some 200 miles and carries a warhead of 1-2 megatons. At the present time there are no firm indications that the Soviet Union intends to expand this sytem to the full 100 launchers permitted under the ABM Treaty.

Although the current Soviet ABM deployment does not pose a serious problem for U.S. penetration, considerable attention and concern has been devoted to the Soviet ballistic missile defense R & D program. While it is unclear what effect the ABM Treaty had on Soviet ABM deployments (in light of Soviet dissatisfaction with the Galosh system), it is quite clear that the ABM Treaty has had no effect on the level of Soviet ABM R & D. Indeed, Soviet arms development and acquisition appear to have undergone little or no alteration as a result of the ABM and SALT Agreements. This in itself, due to limitations on the U.S. ABM program, has resulted in a change in the relative state of ABM R & D in the United States and the Soviet Union. According to Malcolm R. Currie, the Director of Defense Research and Engineering:

> When the ABM Treaty was signed . . . our test activity of ABM interceptors goes practically to zero, just catastrophically within a couple of years, you know, as we deployed that one Safeguard system. Their activity continues monotonically steadily to go up. So they have an intensive activity in ABM research and development from which they could react at some time in the future.[40]

The Soviet BMD activity reflects a continuity or regularity that results from a combination of steady funding and decision-making routine. The funding for weapons acquisition and R & D is apparently tied to the Soviet Five-Year Planning cycle; this allows major decisions to be taken at the start of the five-year cycle which, it should be noted, tends to coincide with Party Congresses.[41] Soviet weapons R & D and acquisition decision making has developed an almost cyclic escalation. As is the case with ICBM and SLBM deployment, the Soviet approach to BMD development reflects this cyclical nature with new systems or a modified version of an existing system following close on previous systems in a pattern almost machine-like in its regularity. Although a similar regularity or rigidity is often not reflected in deployments—which are naturally subject to a variety of mitigating conditions—the Soviet military R & D process in general, and Soviet ABM R & D in particular, have operated since the early 1970s at a methodical pace. The level of ABM research provides an indicator of the seriousness with which the Soviets are pursuing the possibilities for a workable BMD system.

The ongoing Soviet ABM program, while not unexpected, is nonetheless disturbing in its implications, especially in light of the reduced U.S. activity in BMD development. In contrast to the U.S. program, which is limited to systems technology programs and advanced technology concepts—neither of which would provide a near-term ABM capability—the Soviet Union appears to be pursuing three goals simultaneously: (1) the improvement of existing ABM capabilities with new radars and possibly new interceptors; (2) the expansion of ABM-capable radar systems, including new early warning and possible battle-management radars along the Soviet periphery; and (3) research and development of new BMD concepts, including possibly exotic technologies such as laser and particle beam weapons. Although the specific character of Soviet R & D in new BMD systems is not known with any precision, some have suggested that Soviet emphasis has been placed on the development of a rapidly deployable, possibly mobile ABM.[42] Others have speculated that the Soviet Union is looking towards a layered defense involving an exoatmospheric interceptor (an improved ABM-X-3); an upgraded SA-5; and a low-altitude, high velocity system, perhaps similar to the U.S. Sprint.[43] A report by the Library of Congress raised the possibility that the Soviet program might include development of an interceptor with a loiter capability as well as a discrimination system based on infrared detection in addition to radar.[44] Such reports, if true, would indicate that the U.S. ABM technology lead-time advantage had been seriously eroded over the past seven years.

The more exotic technologies, those involving lasers or directed energy weaponry, have also apparently captured Soviet interest. Current Soviet ASAT capabilities threaten only lower altitude satellites; no evidence exists to suggest a Soviet capability to intercept satellites operating in geosynchronous orbit.[45] Although Soviet ASAT tests have proven only moderately successful, it would appear that Moscow intends to continue its programs in an effort to maintain and even widen its edge in this area. In laser and other directed-energy research, there is little agreement as to the scope of Soviet activities or the potential for the development of a usable ABM or ASAT weapon.[46] Some observers have raised the possibility of a Soviet space-based laser weapon; such a system would appear to have significant advantages over a ground-based energy weapon.[47] To date, there is little firm indication of the manner in which the Soviet Union might deploy such nonnuclear technologies.

Soviet attention to strategic defenses would seem to imply that the absence of a nationwide Soviet ABM capability should not reassure U.S. decision makers but merely increase our own concern about Soviet breakout potential. If, as some have argued, ABM is a necessary element of any strategic defense, the absence of this last component in the panoply of deployed Soviet capabilities appears to have proven less a nullifier of Soviet strategy or a deterrent to Soviet arms acquisitions than a lure for Soviet R & D. For the Soviet Union, which possesses other defensive measures in detail, an ABM capability might be viewed as providing a significant defensive edge in a strategic exchange.

Future Soviet BMD Activities, Objectives, and Arms Control

BMD appears to have several uses according to current Soviet thinking. First, in conjunction with offensive systems for damage limitation (i.e., preemptive counterforce) and other defenses, BMD provides, in theory, an additional measure of damage limitation in the event of a strategic engagement. Second, it provides a means of protecting certain critical assets against the forces remaining after a Soviet preemptive strike. Third, it has relevance to warfighting under conditions of limited nuclear exchanges. To preclude the use of limited nuclear options, thereby preventing the United States from threatening the use of nuclear weapons except at the risk of escalation to all-out war, the Soviets have discussed the use of defensive forces, including BMD. Last, it should be noted that BMD has political utility, as is true of all military capabilities according to Soviet doctrine. Insofar as Soviet military strength, both offensive and defensive, prevents the United States from "operating from a position of strength," the United States must seek accommodation with the Soviet Union. Furthermore, in the face of the Soviet potential to defeat a U.S. strategic attack perhaps through a defensive edge, the United States might back down in a crisis. Certainly the ability to threaten an opponent under conditions of relative or increasing immunity from retaliation would, in Soviet estimation, provide important benefits during a crisis.

It must be remembered that future Soviet decisions on BMD will take place against a strategic backdrop far different from that which existed at the time the ABM Treaty was negotiated. No longer is the Soviet Union in a position of either quantitative or qualitative inferiority to the United States according to most measures of the strategic balance. Even the intense technological competition that marked U.S.-Soviet relations in the 1950s and 1960s has been reduced. In many respects the "arms race" of the past has been replaced by considerable unilateral restraint on the part of the

United States. In looking ahead to the decade of the 1980s, and perhaps even beyond, it is necessary to remind ourselves that the Soviet Union is no longer a strategic inferior to the United States and may in fact be capable of gaining significant advantages in strategic offensive and defensive capabilities.

In discussing the future course of Soviet BMD activities, and particularly the issue of Soviet interest in or responses to alterations in the limitations on ABMs, it is important to distinguish the key perceptions of the Soviet decision makers. Soviet interest in a revision of the Treaty or in its abrogation would be a function of three perceptions: (1) that of threats posed to Soviet strategy; (2) that of threats posed to Soviet national survival, and (3) that of the political benefits or opportunities arising out of a change in the Treaty, perhaps through a unilateral deployment outside of Treaty limitations (i.e., a breakout). Each of these categories is worth considering before turning to the issue of Soviet objectives and changes in the ABM Treaty.

Threats to Soviet Strategy

As has been discussed above, the primary tenet of Soviet military strategy is the requirement for a preemptive counterforce capability. While deterrence is currently maintained by a combination of Soviet preemptive counterforce and secure retaliatory capabilities, in the event of an imminent nuclear conflict Soviet forces must try to achieve a knockout first strike. Hence, for the Soviet Union the first problem in relation to BMD is how to defeat one. A Soviet BMD would be relegated to the role of absorbing a U.S. second strike; as a defense against U.S. ballistic missiles BMD makes less sense from a doctrinal perspective than a high confidence preemptive counterforce capability.

A threat to Soviet strategy would emerge if the United States took measures to defend existing strategic forces or if it were to change its targeting strategy, perhaps emphasizing counterforce strikes against selected targets. In either event, the Soviet Union would logically perceive the result to be a degradation of its warfighting capabilities. In this regard, the Soviets would be more likely to respond to the efforts to defend U.S. ICBMs than to efforts to improve their hard target capability if, in the latter case, no effort were made to improve survivability. A vulnerable counterforce capability—for example, MX deployed in Minuteman silos—would not serious affect Soviet strategy. However, Minuteman or MX deployed in a multiple aimpoint arrangement would pose a significant threat to Soviet strategy. It has already been suggested that the Soviet Union is preparing to respond to a multiple aimpoint deployment with offensive programs intended to reestablish its counterforce superiority (i.e., fractionation).[48] However, SALT II will provide some limits on such fractionation. The extent to which SALT

III will be able to maintain or improve upon these fracticnation limits must be an important planning factor for both the Soviets and the United States.

The United States should not make the error of assuming that in the event the ABM Treaty were revised the Soviet Union would naturally seek a mirror-image BMD deployment to that adopted by the United States. In recent years the United States has appeared to be concerned with devising strategic programs whose character is determined by survivability and verifiability. Regardless of our intent—whether for purposes of adequate verification or survivability of strategic offensive systems—it is important to note that the Soviet Union may not share our concerns, and most likely will not copy our deployment patterns. Should the Soviet Union choose to exercise its option under a revised ABM Treaty to deploy a BMD system, it will be based on Soviet requirements and perceptions and therefore will probably not mirror the preferred U.S. deployment (i.e., hard-site defense). Unhappily, such asymmetrical deployments (Soviet area defense, U.S. ICBM defense) could present the U.S. with a new problem, one of penetrability, which could call into question the effectiveness of survivable strategic forces.

Threats to Soviet National Survival

Damage limitation is the second key tenet of Soviet strategy. The Soviet Union must survive the nuclear exchange(s) as a functioning political, economic, and military power. Although damage cannot be avoided, its attenuation by active and passive defenses is imperative. It is in this context that the most likely role for BMD emerges.

Soviet doctrine assumes that in the event of war the United States would, perforce, adopt a targeting strategy similar to that of the Soviet Union. Soviet planners appear hard pressed to believe that when faced with the reality of nuclear conflict the United States would hold to its stated policy of mutual assured destruction.[49] Thus, according to the Soviet perception, a U.S. attack would, if possible, attempt to achieve a preemptive counterforce strike on Soviet strategic forces in order to disarm the Soviet Union or at least limit the severity of the retaliatory blow. Although it is generally assumed by the Soviets that they would be the ones to achieve preemption, they acknowledge that they must expect to sustain some level of damage from surviving U.S. weapons (essentially a few ICBM and bomber-delivered warheads, plus a number of SLBM warheads). The primary objective of BMD for the Soviets is the protection of countervlaue targets subject to a U.S. second strike.

A second use for BMD in Soviet strategy would be to protect command and control, especially political and military leadership and key cadres. The Soviets place great emphasis on the destruction of command, control and communication (C^3).[50] They are likely to be equally sensitive to U.S. targeting of Soviet C^3. National survival in the Soviet system is to a great extent synonymous with maintenance of the leading role of the Communist Party of the Soviet Union. Targeting of the Soviet control apparatus (e.g., Party, KGB, internal security forces), in addition to the National Command authority, with the intention of fracturing the Soviet state or exacerbating internal political-civil discontents would likely be perceived by Moscow as a serious threat to national survival. One measure of the potential for preferential deployments of ballistic missile defenses in support of leadership cadres can be derived from the extent of civil defense protection offered for those same groups in particular regions or cities.

At the same time it must be noted that Soviet doctrine and strategy appears to place no particular emphasis on defense of cities, perhaps reflecting the recognition that the requirement for such a defense is beyond current or anticipated capabilities. The Soviets believe that city-busting or population kill would not be vital to the outcome of a nuclear war. In fact, the Soviets stress the lack of strategic purpose associated with wholesale—and especially retaliatory—strikes on cities. More important to the Soviet planner is the protection of key industrial sites and the associated work force since these resources are expected to continue in operation during and after the war. Although the distinction between attacks on industrial targets colocated with urban centers and attacks on cities themselves might appear ephemeral at best—especially in view of the potential for collateral damage against soft urban centers—from the Soviets' perspective it reflects a very clear understanding of what is necessary for war-survival and what the defense can reasonably accomplish.

The importance of Moscow and Leningrad as administrative and military C^3 centers may make them exceptions to the above statement. In the past, these two great Soviet cities have been the centers for deployment of the most advanced defensive systems in the Soviet arsenal—most notably, the Griffon system at Leningrad and the Galosh system around Moscow. At one time early in the SALT I negotiations, the Soviets appeared willing to accept a total ban on ABM.[51] Currently, however, Moscow shows every intention of maintaining its existing ABM deployment. A U.S. proposal to permit ABM deployments for hard-site defense would likely provide unacceptable to the Soviet Union if it required the deactivation of the Moscow system. Therefore, it is unlikely that the Soviet Union would accept such a change unless allowance were made for the special circumstances of the Moscow ABM.

Political Motivations

Military science and technology has long been viewed by Moscow as one of the cardinal factors in the attainment of victory in war.[52] The side with the best equipment, it is contended, will prevail. In addition, it is argued that military-technical superiority provides political benefit. At the same time, however, the potential always exists for technological breakthroughs that can fundamentally alter the nature of warfare, and hence, the existing balance of military power. Such a fundamental revolution in military affairs occurred in the late 1940s and early 1950s, according to the Soviets, with the development of the thermonuclear bomb and the first ballistic missiles.[53] In recent years the Soviet view of the U.S.-U.S.S.R arms race has emphasized that the competition has been transformed from one of quantity to one of quality. In light of this, the Soviet Union must constantly strive to acquire and maintain the lead in military science and technology in order to prevent an aggressor from establishing a technologically dominant position and in order to acquire, if possible, a technological edge in military hardware that would guarantee victory in a war.

Soviet sensitivity to new technologies has been particularly apparent in the area of BMD. Despite some of Moscow's statements to the contrary, it is readily apparent that during the SALT I negotiations the Soviet Union had little confidence in the viability of its ABM technology and had granted to the United States a definite lead in this field. The deployment of a workable U.S. ABM coupled with the American advantage in MIRV technology presented the Soviet Union with a rather bleak picture of the near future. The Soviets could not but expect the United States to use this military-technological advantage to reverse Soviet political gains. To forestall such a disadvantageous situation and to close the technological gap between the two countries, the Soviet Union sought in its arms control strategy to limit U.S. ABM programs, perhaps with the additional hope that deployment limitations might adversely effect the U.S. R & D program.

However, the Soviets have maintained their interest in competing with the United States in military technology and it is in this regard that the possibilities of deploying an ABM system must be considered. BMD in the 1980s may play much the same role in Soviet political strategy that the ICBM played in the late 1950s. A demonstrated capability for rapid deployment, intended to show the ability of the Soviet Union to field a system of greater sophistication than that possessed by the United States, might be undertaken for political effect or as a bargaining chip in arms control negotiations. The Soviet Union might also attempt to threaten an ABM deployment to preempt either a U.S. move towards a BMD system or a U.S. effort to upgrade its offensive forces. Should the Soviet Union in fact possess an advantage in such technology, then an actual ABM deployment, rather than the mere threat, could be undertaken in order to shift the strategic balance in favor of the Soviet Union. The rapid deployment of a Soviet BMD for coercive effect could be postulated in a superpower crisis.

A coercive deployment would likely involve an attempt at strategic breakout based on either a rapidly deployable BMD system or a covert deployment, perhaps through the upgrading of existing defenses.[54] For such a breakout to be effective it would have to be completed within a relatively short period of time. Should such a breakout be based on new technologies (i.e., combining technological breakthrough with a breakout deployment) the Soviets would face the problem of uncertainty associated with as yet untested technology. Additionally, the possibility of detection before the deployment were completed would always be a prominent factor in Soviet calculations.

Soviet Interest in ABM Treaty Modification or Abrogation

The central problem around which the issue of a change in the ABM Treaty has arisen is the increasingly rapid move towards counterforce capabilities with the resulting negative implications for strategic stability. It has been suggested that the United States seek to modify the ABM Treaty to allow some form of active, hard-site defense in the ICBM fields, or even a preferential defense of a mobile ICBM. It appears unlikely that any program could be implemented under the conditions mandated by the current ABM Treaty. The United States is left with the options of (1) doing nothing and in effect accepting the vulnerability of the ICBM leg of the Triad; (2) seeking a revision of the Treaty, or; (3) considering its outright abrogation.

Given that the concern over U.S. ICBM vulnerability derives from the Soviet ICBM development and deployment programs, which in turn are directed by a strategy based on the need to attain a preemptive counterforce capability, it would appear unlikely that the Soviet Union would acquiesce to a revision of the ABM Treaty permitting hard-site defense. Even the prospect of MX need not change the Soviet opposition to ICBM defense. Since MX is not slated for deployment until the late 1980s, the Soviet Union need not concern itself with its own ICBM vulnerability until around 1990. In the meantime the Soviet Union can take measures to ensure its counterforce capability against U.S. ICBMs even if they are in a mobile basing mode (i.e., by increased accuracy and the capability to further fractionate Soviet ICBM payloads). Since the Soviet Union retains a payload advantage due to its larger ICBMs, it can continue to have some confidence that should it desire a mobile basing deployment to offset a U.S. counterforce capability it will have the net advantage over the United States. However, the combination of U.S. multiple aimpoint deployment and hard-site defense will pose a particularly thorny problem for Soviet penetration. Thus, it is unlikely that the

Soviets will now or in the foreseeable future agree to a revision of the ABM Treaty based simply on hard-site defenses.

Asymmetrical deployments offer a greater potential for piquing Soviet interest. They might offer a possible opening for Treaty revision if Moscow were interested in completing its defensive deployments by the addition of a nationwide BMD. A U.S. program to defend the ICBM fields might be offered in exchange for a Soviet system designed for a light nationwide countervalue defense. However, this option carries major drawbacks for Moscow since it poses a threat on Soviet counterforce strategy. Although some have speculated about Soviet interest in a Safeguard-type system as a response to a European or Chinese countervalue threat, this is considered unlikely. Instead the Soviet Union might respond with an ATBM, to which the ABM Treaty might not apply. Although Moscow is undoubtedly concerned about the non-U.S. strategic threat, the overriding Soviet straiegic problem remains the United States. Moscow will respond to the non-U.S. threat in that context. Thus, it is unlikely that the Soviet Union would actively seek to deploy an ABM system to defend against European or Chinese ballistic missiles if the price were, for example, a U.S. hard-site ABM.

Soviet sensitivity to U.S. ABM technology and to efforts to increase the survivability of the ICBM might provide an opportunity to use the ABM Treaty and, in particular, the threat of a U.S. abrogation as the basis for seeking greater restraint on offensive systems in SALT III. Conversely, Soviet concern for increased U.S. competition in offensive systems might provide the leverage for a relaxation of the ABM Treaty. This would depend on our ability to influence Soviet perceptions. The price for increasing Soviet certainty as to U.S. strategic intent, no small consideration for Moscow, might be ABM Treaty revision. For example, the United States might consider the option of extending the Protocol to the SALT II Treaty in return for Soviet acquiescence to a revision of the ABM Treaty. The problem of assessing the trade-offs between limits on offensive forces and relaxation on ABM is by no means a simple one for either the United States or the Soviet Union. Soviet flexibility would be conditioned, first by their confidence in the ability to maintain their strategic objectives in the face of structural changes to the superpower nuclear balance, and second, by their perception of the relevant technological balances and Soviet capabilities to compete against a revitalized U.S. ABM development program.

The signatories to the ABM Treaty have the right, under Article 15, to abrogate the agreement upon giving six months notice of their intention.[55] Such a move by the United States, even were it linked to Soviet intransigence on the issues of counterforce, would likely imperil further movement on limitations of offensive systems. Soviet concerns for a U.S. ABM deployment would likely lead Moscow to pursue offensive options to counter U.S. defenses. The future of

SALT in general is still tied directly to the ABM Treaty; prospective limitations on offensive systems, particularly throwweight and MIRV constraints, are justifiable, if for no other reason, on the basis of the salutary effect of the ABM Treaty on the penetration problem. But the edifice of strategic arms control is extremely fragile, and progress has been achieved only by a narrow front. Although it is difficult to project the manner in which the Soviet Union might respond to a U.S. decision to abrogate the ABM Treaty, we cannot expect Moscow to stand by while the United States moves to deploy systems that directly threaten the principle objective of Soviet strategy.

Previously it was noted that Soviet interest in abrogation of the Treaty appeared to be a function of the prospects for strategic breakout or technological breakthrough. The former condition clearly would be a violation of the Treaty, while in the event of a technological breakthrough providing a reasonable prospect for a workable BMD, Moscow might adhere to Article 15 in the hopes of maintaining some prospect for future arms control. It hardly seems likely that Moscow would undertake such a move save with the expectation that the United States would respond with a BMD program of its own. However, were the Soviets to feel confident in their ability to "beat the United States to the punch," the prospects for breakout might be quite different. Since advance warning would vitiate much of the expected gain from a unilateral BMD deployment, the Soviets could view the constraints resulting from adherence to the Treaty as outweighing the advantages of a deployment. The short-term pressure on Moscow to avail itself of a workable solution to the vulnerability problem might be greater than long-term interests in arms control.

Conclusions

For the Soviet Union, damage limitation is an integral part of a warfighting and warwinning strategy. Soviet strategy requires not only the destruction of the enemy's means of waging war, but also the protection of the Soviet Union via active and passive defenses. While no single component of the Soviet defense network will provide an impenetrable defense, taken in aggregation Soviet defenses may be increasingly effective in defeating the U.S. policy of assured destruction. When tied to preemptive counterforce, a significant alteration in the effective balance of military power may be in the offing. Future Soviet BMD activities should be examined in this light.

U.S. efforts to gain additional limitations on Soviet defenses are not likely to meet with much success. It is beyond reasonable expectation to believe that having been permitted to establish superiority in overall strategic defenses—due to U.S. neglect or indifference—the Soviet Union would acquiesce to U.S. measures designed to reinstate a condition of mutual vulnerability. Measures short of reducing the Soviet advantage in strategic defenses or permitting the United States compensatory offensive forces would have little or no impact on the balance. Indeed, if we assume continued or even more stringent limitations and reductions of offensive forces—launchers, missiles, and warheads—then the expansion of Soviet defenses could, over time, further increase U.S. difficulties in maintaining an effective assured destruction capability.

This paper has attempted to highlight Soviet interests in maintaining the current ABM Treaty against U.S. attempts to revise it. A U.S. BMD, particularly a system for hard-site defense, could seriously complicate Soviet strategy and threaten Soviet ability to achieve preemption. In addition, the Soviets must be concerned that a defense arms race, one perhaps engendered by the decision to deploy a BMD, might not prove advantageous in the long run, despite the present Soviet lead in deployed defenses. For the present, the Soviet Union appears more than satisfied with the current state of limitations on ABM and is unlikely to encourage U.S. efforts to revise the ABM Treaty during the 1982 Treaty review. Some questions for U.S. planners and negotiators in the future are: whether a limited BMD deployment (hard-site defenses) is in our *net* interest; whether the Soviet Union would countenance limited BMD deployments; and what "price" would the Soviets try to extract and/or would the United States be willing to pay for a hard-site defense option. The Soviets do not appear to be so concerned about the Chinese and European ballistic missile threats as to desire to amend or abrogate the ABM Treaty.

At least through 1985, the Soviets are unlikely to take any initiatives for modifying or changing the ABM Treaty, and will resist any U.S. efforts to gain even limited BMD deployments. Indeed, the Soviet Union may have ample reason to look towards 1985 and the expiration of the SALT II Treaty with optimism, particularly if, in addition to improvements in its offensive forces, Moscow is able to achieve a workable (rapidly-deployable) ABM system. The current Soviet program of improvements in offensive and defensive capabilities might provide the Soviet Union with its long-sought-after warfighting/warwinning capability. At the very least, this would allow the Soviets to feel they could enter SALT III from a position of strength. However, such a posture might also diminish the importance of strategic arms control in Soviet calculations to such an extent that Moscow might feel secure in dispensing with SALT III altogether.

Notes

1. C. L. Sulzberger, "Interview with Khrushchev," *New York Times*, September 8, 1961.
2. Raymond L. Garthoff, *Soviet Strategy in the Nuclear Age* (New York: Frederick A. Praeger, 1958), pp. 228-231. Garthoff notes that Soviet writings on BMD offered no hope of a short-term solution but emphasized long-term efforts as an answer.

3. Robert A. Kilmarx, *A History of Soviet Air Power* (New York: Frederick A. Praeger, 1962), pp. 227-230, 263-268. Also Thomas Wolfe, *Soviet Power and Europe*, 1945-1970 (Baltimore, Maryland: Johns Hopkins Press, 1970), pp. 183-185.
4. Jack Raymond, "U.S. Says Russians Plan Anti-Missile," *New York Times*, October 5, 1960; Wolfe, *op. cit.*, p. 187. The Griffon was first seen during the Red Square Parade on November 7, 1963.
5. For a discussion of the elements of current Soviet strategy, see Fritz L. Ermarth, "Constras.s in American and Soviet Strategic Thought," *International Security*, Volume 7, No. 2, Fall 1978; Leon Gouré, "Soviet Military Doctrine," *Air Force Magazine*, Volume 60, No. 3, March 1977; and William T. Lee, "Soviet Military Policy: Objectives and Capabilities," *Air Force Magazine*, Volume 62, No. 3, March 1979.
6. V.D. Sokolovskiy, *Soviet Military Strategy* (New York: Crane, Russak and Company, Inc., 1975), pp. 282-284, 298. The formulation cited is unchanged from the original edition in 1962.
7. Edward L. Warner, III, *The Military in Contemporary Soviet Politics: An Institutional Analysis* (New York: Praeger Publishers, 1977), pp. 188-189. Also Wolfe, *op. cit.*, p. 182.
8. Ibid., p. 190. Also Norman Polmar, *Soviet Naval Power* (New York: National Strategy Information Center, 1972), pp. 31-40.
9. Wolfe, *op. cit.*, p. 188.
10. Johan J. Holst, "Missile Defense, the Soviet Union, and the Arms Race," in Holst and Schneider, *Why ABM* (New York: Pergamon Press, 1969), p. 151.
11. Marshal of the Soviet Union R. Ya. Malinovskiy, *Stenographic Record: 22nd Congress of the Communist Party of Soviet Union* (Moscow: Politizdat, 1962), p. 117.
12. Theodore Shabad, "Khrushchev Says Missiles Can "Hit A Fly' in Space," *New York Times*, July 17, 1962.
13. Sokolovskiy, op. cit., p. 285. Note the changes between the 1962 and 1968 versions.
14. N. Talensky, "Anti-Missile Systems and the Problems of Disarmament," *International Affairs* (Moscow), No. 10, October, 1964, pp. 28-37.
15. Sokolovskiy, *op. cit.*, p. 286.
16. Marshal of the Soviet Union R. Ya. Malinovskiy, *Stenographic Record: 23rd Congress of the Communist Party of Soviet Union* (Moscow: Politizdat, 1966), p. 412.
17. G. Gerasimov, "About the ABM System, *Pravda Ukrairy*, March 27, 1969. Gerasimov is a long-time critic of Soviet ABM development.
18. Major General V. I. Zemskov, "Wars of the Nuclear Era," *Military Thought*, No. 5, May 1969, p. 89.
19. Speaking in 1975 about the Soviet MIRVed ICBM program, Secretary of Defense James Schlesinger: "by the early 1980s or mid-1980s they [the Soviet Union] will have, if they continue the present program, a very formidable force structure." "MIRV Warhead Seen Successful in Soviet Test," *Washington Post*, August 18, 1979, p. A1.
20. Thomas Wolfe, *The SALT Experience* (Cambridge, Massachusetts: Ballinger Publishing Company, 1973), p. 10.
21. John Newhouse, *Cold Dawn: The Story of SALT* (New York: Holt, Rinehart and Winston, 1977), p. 177. Newhouse states: "In return for *indulging Moscow's preference on ABM*, Washington hoped to get what it wanted most: a ceiling on the Soviet offensive-missile program. . . ." [emphasis added].
22. Cited in Wolfe, *The SALT Experience*, p. 21.
23. Leon Gouré, et al., The *Role of Nuclear Forces in Soviet Strategy* (Coral Gables, Florida: Center for Advanced International Studies, University of Miami, 1974), pp. 115-118.
24. Marshal of Aviation G. V. Zimin, *The Development of the Air Defense* (Moscow: Voyenizdat, 1976), p. 192.
25. See for example, Marshal A. A. Grechko, "On Guard Over Peace and Socialism," *Pravda*, February 23, 1974.
26. A more detailed discussion of the issue of offensive-defensive synergism is provided in *Daniel Gouré and Gordon H. McCormick, Soviet Strategic Defense: The Neglected Dimension of the U.S.-Soviet Balance*, forthcoming.
27. The counterforce potential of the new Soviet family of ballistic missiles has only recently been officially acknowledged in the United States. "Brown Says Soviets

Long Sought Way to Knock Out U.S. Missiles," *New York Times*, May 31, 1979.
28. Newhouse, *op. cit.*, p. 237.
29. Lee, *op. cit.*; Wolfe, *The SALT Experience*, pp. 127-135.
30. Sokolovskiy, *op. cit.*, p. 299.
31. Cited in Gouré, et al., *op. cit.*, p. 110.
32. Wolfe, *The SALT Experience*, p. 112.
33. *Military Balance 1978-1979* (London: International Institute for Strategic Studies, 1978), p. 9. Also Robert P. Berman, *Soviet Air Power in Transition* (Washington, D.C.: The Brookings Institution, 1978), pp. 15-20.
34. Central Intelligence Agency, National Foreign Assessment Center, "Estimated Soviet Defense Spending: Trends and Prospects," SR 78-10121, June 1978; Secretary of Defense Harold Brown, *Annual Report, Fiscal Year 1980*, Department of Defense, p. 73.
35. Collins, *op. cit.*, p. 144.
36. P. Evans and R. Novak, "Does Russia's SA-10 Eclipse the Cruise Missile?" *Washington Post*, February 17, 1978. Also, "Soviet Union's SA-10," *Aviation Week and Space Technology*, March 20, 1978, p. 11.
37. Director of Central Intelligence, *Soviet Civil Defense*, July 1978, pp. 1-5, 8, 11.
38. Paul Nitze, "Assuring Strategic Stability in an Era of Detente," *Foreign Affairs*, Volume 54, No. 2, January 1976, p. 225.
39. Leon Gouré, *War Survival in Soviet Strategy*, (Coral Gables, Florida: Center for Advanced International Studies, University of Miami, 1977).
40. Malcolm R. Currie, New Conference, February 20, 1976.
41. Arthur J. Alexander, *Decision-making in Soviet Weapons Procurement* (London: International Institute for Strategic Studies), Adelphi Papers 147 and 148, 1979.
42. Clarence R. Robinson, Jr., "Soviets Push ABM Development," *Aviation Week and Space Technology*, April 7, 1975, p. 12.
43. Henry S. Bradsher, "Soviet ABM Efforts Have Pentagon Worried," *Washington Star*, February 16, 1978, p. A4.
44. "BMD, ASAT Links May Pose Tough Arms Control Questions, Study Says," *Aerospace Daily*, January 11, 1975.
45. Secretary of Defense Harold Brown, *Annual Report, Fiscal Year 1979*, Department of Defense, 1978, p. 125 and "Soviets Have Operational Anti-Satellite Capability, Brown Says" *Aerospace Daily*, October 5, 1978.
46. On the optimistic side are: "Soviets Press Laser ABM Development," *Aviation Week and Space Technology*, April 21, 1978, p. 11, and Clarence A. Robinson, Jr., "Soviets Push for Beam Weapon," *Aviation Week and Space Technology*, May 2, 1979, p. 17. On the pessimistic side are: Richard L. Garwin, "Charged-Particle Beam Weapons?" *Bulletin of the Atomic Scientists*, October, 1978, pp. 24-27 and George C. Wilson, "MIT Physicists Scoff at Charged Particle Beam Weapons," *Washington Post*, January 11, 1979.
47. Philip J. Kloss, "Anti-Satellite Laser Use Suspected," Aviation Week and Space *Technology*, December 8, 1978, pp. 12-13.
48. Clarence A. Robinson, Jr., "Soviets Boost ICBM Accuracy," *Aviation Week and Space Technology*, April 7, 1978.
49. Zimin, *The Development of the Air Defense*, pp. 87-88.
50. Major General V. Zemskov, "Characteristic Features of Modern War and Possible Means of Conducting Them," *Military Thought*, No. 7, July 1969.
51. Newhouse, *op. cit.*, p. 173.
52. Michael J. Deane and Mark E. Miller, "Science and Technology in Soviet Military Planning," *Strategic Review*, Vol. 5, No. 3, p. 77.
53. *Ibid.*, p. 80.
54. For a discussion of the issue of breakout, see Abraham S. Becker, *Strategic Breakout as a Soviet Policy Option* (Santa Monica, California: The Rand Corporation), R-2691-ACDA, March 1971.
55. "ABM Treaty," *Arms Control and Disarmament Agreements* (Washington, D.C.: U.S. Arms Control and Disarmament Agency, 1977), 1977 edition, p. 135.

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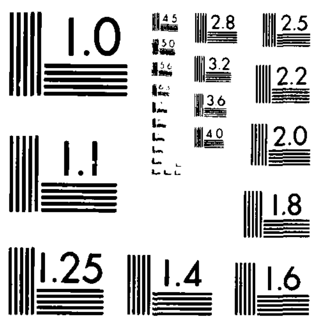

MICROCOPY RESOLUTION TEST CHART
NATIONAL BUREAU OF STANDARDS 1963 A

Applications of BMD Other Than ICBM Defense

Wayne R. Winton

Twenty years ago the United States successfully tested its first antiballistic missile (ABM) interceptor, the Nike Zeus. The event marked the start of a decade of intense development activity on defenses to protect the nation from ballistic missile attack. In parallel, the Soviets were developing similar defenses and they proceeded rapidly into deployment, reaching an operational capability at their first site near Moscow in the late 1960s. In 1967, President Johnson announced the decision to field our own national defense, Sentinel, ostensibly to defend the nation against a postulated future Chinese ICBM threat. However, this decision precipitated a storm of controversy on ABMs. It was argued that Sentinel could not work, would be prohibitively expensive, would fuel a defensive and offensive arms race, and would be destabilizing. Regardless of whether these arguments were right or wrong, Sentinel clearly represented a confusion of U.S. policy—the deployment of Sentinel was inconsistent with the adoption of a strategic policy of Mutual Assured Destruction.

President Nixon ended this decade of activity and controversy on national defenses in 1969 by changing the mission of Sentinel to Minuteman defense, re-naming the resultant system Safeguard. That event also marked the initiation of serious negotiations with the Soviets on banning area defenses and severely restricting the deployment of any type of ABMs. It also represented the beginning of the end for U.S. air defense and any last vestiges of an active civil defense program. In the decade since President Nixon's conversion of Sentinel to Safeguard, the United States has continued ballistic missile defense (BMD) development activities, although at a much lower pace than in the 1960s. The U.S. BMD advanced development activities have been oriented almost exclusively to Minuteman (MM) defense. Since the signing of the ABM Treaty in 1972, the principal role and justification for the U.S. BMD R & D program have been (1) to conduct sufficient advanced system development activities to maintain a MM defense deployment hedge option against a failure to achieve adequate offensive arms agreements or Soviet abrogation of those agreements; and (2) to conduct a broad technology development effort to guard against technological surprises by the Soviets. In contrast, the Soviets have continued to operate their Moscow defense site and to conduct an extensive development effort.

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Thus, in the last decade, many in the United States have become conditioned to think of defenses as black or white, in terms of "good" defenses or "bad" defenses. Defenses of ICBMs, because they are stabilizing, because they are consistent with Mutual Assured Destruction, are "good" defenses, even though precluded by the ABM Treaty (in sufficient numbers to be useful). Other types of ballistic missile defenses are "bad" defenses, even though some might be permitted by the ABM Treaty. This mindset was derived from the strategic circumstances and the arms control expectations of the late 1960s and early 1970s and from the picture of BMD as Sentinel. However, the international and strategic circumstances and expectations have changed substantially and the technology of BMD has changed substantially. It is time to re-think the roles of BMD.

The following pages will describe four applications of new BMD technologies for roles other than defense of ICBMs. Each of these roles has been viewed in the past as destabilizing. The writer will argue that under the proper conditions, they need not be so; that in fact, they could be stabilizing contributors to our security and to international security. The four roles are (1) restricted Light Area Defense, (2) Anti-Tactical-Ballistic-Missile Defense, (3) Exportable Defense, and (4) Heavy Area Defense. All four are nonnuclear defenses, based on the developing BMD technologies. The first and the last are BMD systems employing exoatmospheric optical homing; the second and third would employ the BMD technology that is under development for endoatmospheric homing but would not be considered ballistic missile defenses under the terms of the ABM Treaty. The first three could be allowable within the letter of the ABM Treaty. The fourth, Heavy Area Defense, is not and would require major modifications to the ABM Treaty, modifications that, if properly structured and accompanied by continuing offensive arms limitations, would permit defenses that could both maintain and improve mutual deterrence and reduce damage if deterrence fails.

The writer has adopted in this paper a position of advocacy for propositions that currently run counter to official U.S. policy. It is recognized that there are many questions not addressed here that are relevant to decisions on the future roles of BMD in U.S. strategic planning. The point of this paper is that these questions must be addressed in the context of the strategic circumstances and technologies of the 1980s and 1990s, rather than those of the 1960s and 1970s.

Restricted Light Area Defense

Light Area Defense, in the context of a thin defense of the nation against ballistic missiles, is potentially the most destabilizing of defensive systems. The motivation for a Light Area Defense is to provide a shield against accidental or unauthorized launches and to preclude nuclear coercion or successful ballistic missile attack from Nth countries. But in the strategic nuclear relationship between the United States and the Soviet Union, a Light Area Defense of 100 or 200 missiles cannot have appreciable effectiveness in defending against a counterforce first strike on ICBM silos. The defense becomes effective in this relationship only if the possessor also has a strong counterforce first-strike capability. The presence of the Light Area Defense, as a means of shielding against limited retaliation, could motivate a counterforce first strike in a crisis if the counterforce first-strike capability were highly effective. This philosophy is, of course, well understood in the United States. Because of the destabilizing potential of Light Area Defense, each proposal in the last decade to initiate any type of associated development activity has been soundly rejected. However, it may become important in the future to reconsider this question, to balance potential counterforce first-strike instabilities against improved security in other scenarios.

Because of its geography, the Soviet Union will be more vulnerable than the United States to the threat of ballistic missile attack from Nth countries. It is reasonable to expect that the Soviets would wish to protect against this threat. If the Soviets were to propose modification of the ABM Treaty to permit a more widely distributed 100-interceptor defense so as to enable thin coverage of most of their country, could it be in the interest of the United States to agree to have equal defenses of this type? The issue is the degree to which the presence of this thin Soviet defense could induce the Soviets to attempt a counterforce first strike in time of crisis. This is a question of threshold. One hundred interceptors can never intercept more than 100 warheads. If 100 warheads were to be a substantial fraction of our total survivable retaliatory force, the presence of a Soviet Light Area Defense of 100 interceptors could well be above the threshold to attempt a first strike. But if our survivable retaliatory force were, for example, 1000 or 2000 SLBM warheads, it would seem incredible that the presence of 100 ABM interceptors could be a factor in a first-strike decision.

Another factor in this instability assessment would be the existence of the corollary U.S. Light Area Defense. If, against the postulated Soviet first strike, the presence of the U.S. defense ensured the survival of 100 additional warheads, e.g., 30 MM or 10 MX missiles, the presence of the Soviet defense would be offset. If more than 100 additional retaliatory warheads were protected by the U.S. defense, Light Area Defense would have a stabilizing rather than destabilizing influence.

Thus, it is possible to argue that a Light Area Defense, in net sum, need not be destabilizing, particularly if limited to some small, below threshold level of deployment. It could also be argued that an agreement on Light Area Defenses could conceivably help to achieve a SALT III agreement for real reductions in offensive arms levels. The presence of Nth country ballistic missile threats to the Soviet Union is a factor motivating a larger Soviet offensive force than required solely against the United States. The ability to field an active defense against these threats could encourage Soviet acceptance of lower offensive arms totals.

Despite these arguments for reconsideration of Light Area Defenses, other issues may be overriding—the question of confidence in defense, the increased difficulty of verification, the increased potential of a Soviet breakout, the practical difficulty of negotiating a satisfactory modified ABM agreement, and the implications for major changes in U.S. strategic policy. These make it improbable that the United States could or would move toward Light Area Defense in the foreseeable future. But the United States does have the unilateral choice of adopting the restricted level of defense permitted within the letter of the ABM Treaty, without being affected by these issues.

Light Area Defense is felt to be inconsistent with a policy of Mutual Assured Destruction. But so is a massive air defense system. And so is an extensive civil defense system. Over the last several years, the United States has unilaterally operated in the spirit of arms control to assure the mutuality of Mutual Assured Destruction. The Soviets have operated at the limit of the letters of the arms agreements to diminish that mutuality. It now seems certain that the Soviets will not follow our lead in further dissolution of strategic defenses. If they will not, we should, while negotiating offensive arms equality, take steps to correct our defensive inequality. The letter of the ABM Treaty permits us a mirror-image of the Moscow ABM system—a deployment that would reduce the risk of a catastrophe from an accidental or unauthorized launch, that would reduce the future threat of ballistic missile attack by an Nth country, and that would increase Soviet uncertainties about the success of a counterforce first strike.

The ABM Treaty permits one ABM site location with 100 interceptors. The Soviets have elected to maintain operation of their ABM site around Moscow, equipped with long-range interceptors. The United States has the option to deploy the equivalent defense in the vicinity of Washington, D.C. (by declaring that location as our single allowed ABM site). If this defense employs the new technology of long-range exoatmospheric optical homing and nonnuclear intercept under development for Minuteman defense applications in the Ballistic Missile Defense Program, it could be capable of defending a substnatial portion of the eastern United States. A major percentage of the population and economic capacity of the United States could be protected against an accidental or unauthorized launch from the Soviet Union or a future Nth country ballistic missile threat.

This defense could not prevent a Soviet counterforce first strike but it could create some difficult complications for the Soviets. A counterforce first strike is very likely to include attacks on four types of time-urgent strategic targets in addition to ICBMs: the National Command Authority (NCA), SAC bomber bases, command and control centers, and strategic communications nodes. The NCA and substantial numbers of each of the other types of targets would be under the coverage of this eastern area defense. To ensure destroying any given target, the Soviets would have to target to ensure 101 arriving reentry vehicles (RVs) on that target. Since they could not do this for more than a small fraction of the time-urgent strategic targets, that would have to target several warheads per aimpoint, granting that some will likely survive. For example, if we assume that 50 time-urgent strategic targets are under the coverage of the defense, the Soviets might respond to the defense by increasing their attack from 50 to 500 warheads—10 per target. The Soviets would have to assume that as many as 10 of these targets might survive. These could be, for example, 10 SAC bases with 5 bombers each. Clearly, the preferential defense capability of this small defense exerts significant pressure on the attacker. The 100 interceptors would force, for the example given, 450 additional Soviet warheads to be expended without confidence of destroying 10 of 50 key strategic targets.

A Soviet alternative to suffering this high defense leverage would be to attack the defense first. The defense could preferentially defend itself against up to about 300 warheads. But more importantly, the long flyout range of the defense would force the Soviets to delay their main attack on the time-urgent targets by 5–10 minutes, presumably long enough for bombers to escape or command, control, and communications functions to be completed.

In the absence of arms control agreements, it is reasonable to postulate that the Soviets would respond to the limited defense by deploying 500 or 1000 additional warheads. While the defense might enjoy a cost-exchange ratio advantage, the result would be higher levels of arms without increased security. But this defense is permitted by the ABM Treaty; with offensive arms limitations, its effect cannot be other than to improve deterrence.

Light Area Defense tends to be destabilizing. Yet the restricted Light Area Defense permitted to us within the ABM Treaty and achievable with maturing BMD technology cannot help but improve our security. We would be better off with it than without it.

Anti-Tactical-Ballistic-Missile Defense

As American nuclear superiority has passed to "rough equivalence" on the way to what many regard as a degree of nuclear inferiority by the mid-1980s, the credibility of the American nuclear umbrella over Europe is disappearing. Thus, the present Administration, in placing increased spending for NATO defenses at the highest priority, has tacitly acknowledged that an attack on NATO is going to have to be deterred in Europe. NATO's ability to withstand conventional attack is at best uncertain. NATO is best prepared to fight a protracted war while the Warsaw Pact quite apparently has optimized its forces for a Blitzkrieg. As a consequence, the theater nuclear forces (TNF), now becoming the ultimate deterrent to attack on NATO by the Warsaw Pact, assume much greater importance. This is unfortunate. To quote Jeffrey Record in describing our theater nuclear forces: "No more tempting array of high-value targets has been offered a potential adversary since the Navy lined up the Pacific Fleet for slaughter at Pearl Harbor in 1941."

The TNF are, in the main, immobile, and even the limited degree of available mobility is useful only with extended tactical warning. The command and control difficulties for first use preclude even the plausible threat of a launch under attack option. Thus, if the Soviets believe they can overrun NATO, and since NATO has rightly refused to agree to non-first-use of nuclear weapons, it seems only reasonable that the Warsaw Pact would preempt against the TNF at the opening of an attack. Logically, the Soviets are deploying the proper weapons to accomplish this in their tactical ballistic missiles (TBMs)—the SS-20s added to the older deployments of FROGs, SCUDs, and SCALEBOARDs.

One option, and possibly the only effective option, to restore a reasonable degree of survivability for the TNF is to develop and deploy a defense against TBMs—anti-tactical-ballistic-missiles, or ATBMs. One possibility would be to redevelop Patriot to provide this capability. But the command and control delays for nuclear release make a nuclear intercept option questionable. Thus, it seems more reasonable to take advantage of the emerging BMD technology for endoatmospheric nonnuclear intercept of ballistic missiles. William Davis has described the LoAD system for defense of MX and the prospect for growth to a nonnuclear intercept capability, based on a parallel technology development effort planned to demonstrate the feasibility of low altitude nonnuclear intercept against reentry vehicles. This technology seems directly applicable to the NATO TBM defense problem. The ABM Treaty precludes the upgrade of air defense systems to ABM capability or the transfer of ABM components to other countries, but it does not restrict the application of technology.

There is a second, and perhaps more important reason for getting on with the development of ATBMs. There is every reason to suspect that the Soviets would develop, and possibly already have developed, their own ATBM capability. The longer range TBMs have essentially the same reentry characteristics as SLBMs; thus, an ATBM tends to have inherent capability to defend against SLBMs.

Until the late 1980s when MX, if deployed, would restore U.S. land-based survivability, we will be relying primarily on SLBMs as our ballistic missile second-strike force. Since ATBM deployments are restricted neither by the ABM Treaty nor by MBFR agreements, ATBMs could potentially jeopardize our deterrent capability in the 1980s, representing, in effect, a loophole in the ABM Treaty. It seems improbable that we could negotiate limits on ATBM deployment without an ATBM of our own.

Exportable Defenses

In the mid-1970s, the prospect of widespread nuclear proliferation among the Third World countries was a matter of great concern in the U.S. strategic community. More recently, this long-term issue has been overshadowed by the more imminent questions of SALT II, MX, and other near-term strategic issues. However, the nuclear proliferation problem has not gone away—if anything, the likelihood of widespread nuclear proliferation in the 1980s and 1990s has been increased by the actions of OPEC. It is generally acknowledged that nuclear or atomic weapons technology and design information is available to many Third World countries. Considering the increasing dependence of the Third World on nuclear reactors for power—and the associated opportunities for accumulation of weapons materials—many countries that conclude they need nuclear weapons for security will likely be able to develop them. Herman Kahn has projected nuclear proliferation based on "hostile pairs" (e.g., India-Pakistan, South Korea-North Korea, Israel-Libya, Brazil-Argentina), in which the development of nuclear capability by one country (or suspicion of that development) will drive its natural enemy also to attempt to develop the capability.

How can the United States reduce the motivation of Third World countries to acquire nuclear capabilities in response to real or imagined threats? One possibility is to offer them a means to defend themselves against nuclear delivery systems launched from a hostile neighbor as an alternative to acquiring their own. For the Third World, two kinds of nuclear delivery systems are most practical and most available—aircraft and tactical ballistic missiles (TBMs). However, adequate conventional air defense systems and ATBM systems would be prohibitively expensive for most Third World countries, because of the large number of sites required. Two emerging technologies offer the possibility of an effective, inexpensive defense against both aircraft and TBMs well-suited to the needs of Third World countries.

The BMD Program has initiated development of the technology for a high-performance nonnuclear homing interceptor capable of intercepting down to low altitudes at ranges of several tens of miles. Space-based sensor technology may soon allow detection and tracking of aircraft or TBM boosters from satellites. A direct link between the satellite system and the interceptor site would permit the interceptor to be launched toward a predicted intercept point tens of miles away, acquire the threat with its seeker, and home to a nonnuclear kill. One or two sites, equipped only with interceptors and satellite receiving stations, would be adequate to defend many of the Third World nations. If the satellite sensor system were deployed by the United States, the cost of defense would be small for any given country. Furthermore, by control of the satellite system, the United States would retain a degree of insurance against political realignments. The feasibility of the technologies embodied in this concept remains to be proven and, if feasible, systems probably could not be fielded before 1990. However, the possibility seems worth exploring as a mechanism to reduce the motivation for Third World proliferation of nuclear and nonnuclear arms.

Heavy Area Defense

The three types of defenses described up to this point are systems that would be permitted by the letter of the ABM Treaty and that conceivably could contribute to achieving broader, more complete controls and reductions of nuclear arms. These defenses, properly limited, could fit within the framework of Mutual Assured Destruction. Heavy Area Defense is, of course, the object of the ABM Treaty constraints and can only be considered as a part and a necessary mechanism of a strategic policy of Mutual Assured Survival. It was the ban achieved by the ABM Treaty on "heavy" area defenses that permitted progress on offensive arms control. But the existence of offensive arms limitations, coupled with new BMD technology, makes it possible to reconsider heavy area defense as a means of achieving Mutual Assured Survival.

One of the strongest arguments against Heavy Area Defense in the late 1960s was that area defenses would not only lead to a defensive arms race but also accelerate the offensive arms race. This problem disappears if both offensive and defensive systems are adequately restricted by agreement. A second argument is that area defenses would be destabilizing—the existence of a defense to handle retaliation would motivate a counterforce first strike in a crisis. This is certainly plausible if only one country has the defense or, even if the two countries have equal defenses, the defenses are only useful against second-strike attacks. The Sentinel system was an area defense in which no more than 20 percent of the defense would have been sited to defend against counterforce attackers; it was primarily useful for defense against countervalue attacks of limited size. The prospect of a Soviet replica of Sentinel was clearly a basis for concern.

However, if a defense is primarily effective against counterforce first-strike attacks, then such defenses would be a stabilizing factor.

Hardsite defenses are an example of this. But hardsite defenses cannot reduce the damage of war if deterrence fails. But consider defenses with the following properties: (1) if deterrence failed, they could limit damage sufficiently against a countervalue strike to ensure national survival and recovery, and (2) they could not prevent serious damage by second-strike retaliation. These defenses would both deter a first strike by either country and contribute to national survival if a first strike occurred. In that reducing the risk of war and reducing damage if war occurs are the primary objectives of arms control, a defense with the above properties would be compatible with arms control, even if not compatible with Mutual Assured Destruction.

The maturing technology of exoatmospheric optical homing for nonnuclear intercept, being developed for MM defense, could be extended to long-range interception to offer the possibility of an area defense with these properties.

Suppose the ABM Treaty were revised to permit two interceptor sites, each containing 500 interceptors, located at prescribed regions in the interior of the two countries. A representative defended coverage attainable by long-range exoatmospheric interceptors against ICBMs and SLBMs is shown in Figure 1. All 1000 interceptors could be used to defend American ICBMs against Soviet ICBMs and to defend SAC bombers at interior bases against Soviet SLBMS. *Without* the defense, 2000 ICBM warheads and a few tens of SLBM warheads could destroy our MM and the SAC bases, including some percentage of the alert bombers. If the Soviets had a total of 6000 ICBM warheads, 4000 would remain available against other American military and urban/industrial targets. *With* the defense, up to all of the SAC bases and about 450 of the MM would survive. Since this result would seem unacceptable for a first strike, the Soviets would have to attempt to offset the defense by targeting additional warheads at our ICBMs and bomber bases. If they targeted, for example, 4000 ICBMs at our MM and 600 SLBMs at the SAC bases, we could save half the SAC bases and about 150 of the MM. Alternatively we could choose to give up the ICBMs and SAC bases against this heavy attack, reserving the defense to preferentially defend critical post-war survival elements against the remaining 2000 Soviet ICBMs.

Figure 2 shows an assumed estimate of loss in U.S. war recovery capability as a function of the number of critical aimpoints destroyed. Without defense, 4000 Soviet warheads would destroy virtually all of our economic capacity. With the 1000 interceptor defense (reserved to preferentially defend the economy if the Soviets attack our strategic forces heavily), economic damage from Soviet ICBMs would be reduced to about 20 percent, for the assumed damage curve. Since an exoatmospheric area defense based in the interior cannot protect the east and west coasts against Soviet

Figure 1 Heavy Area Defense Coverage

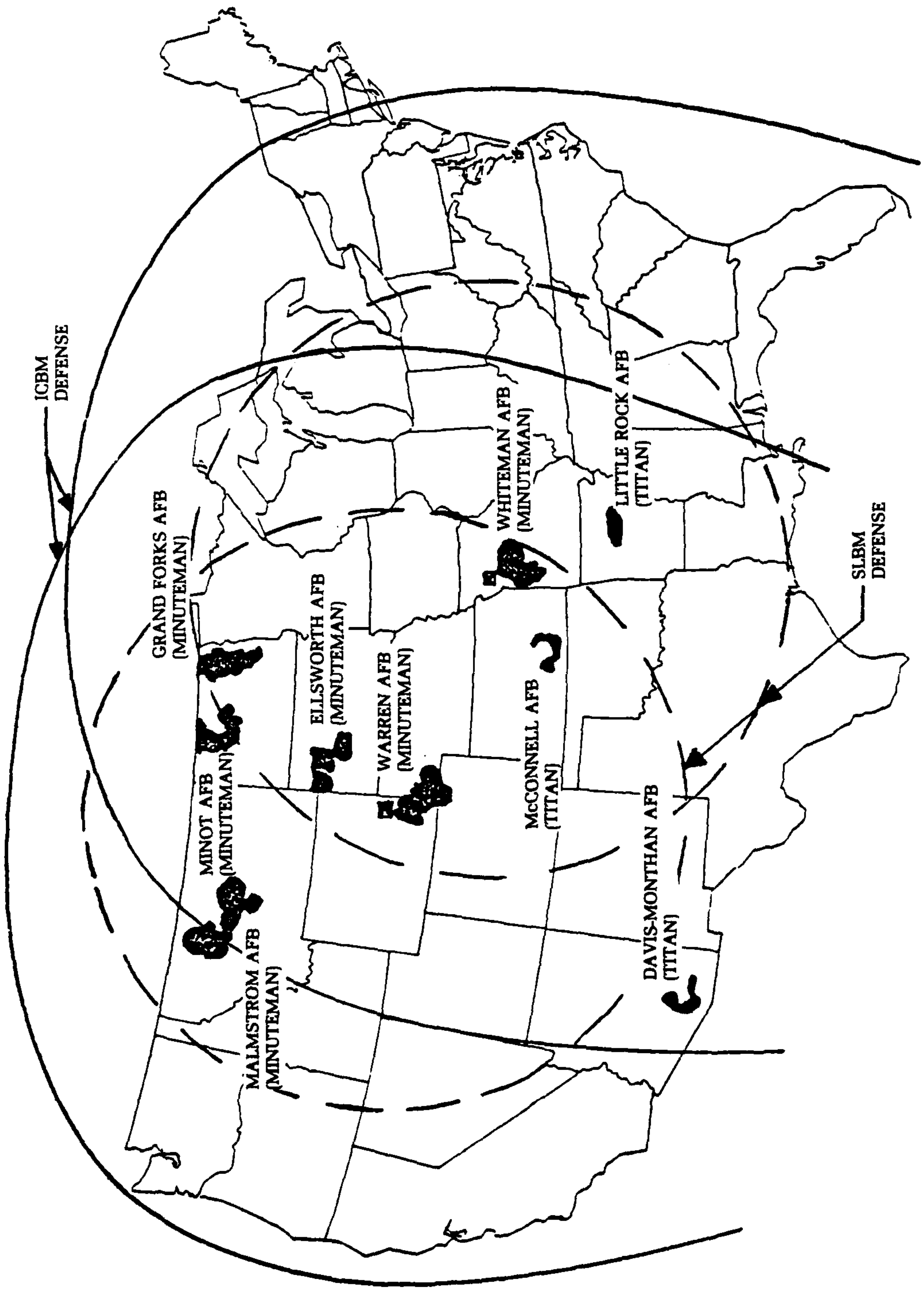
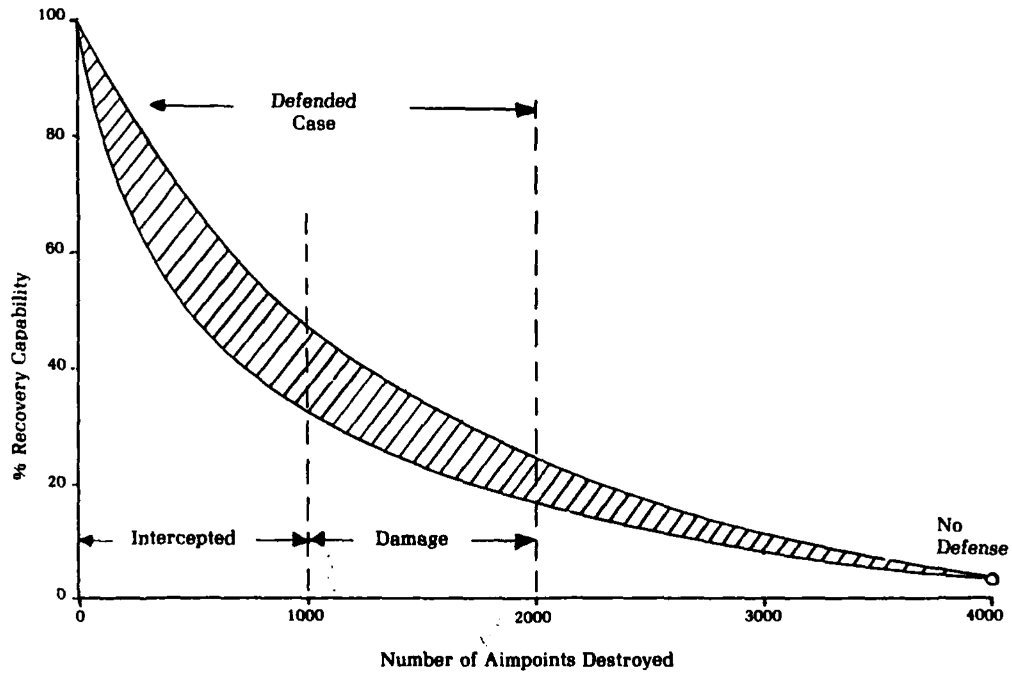


Figure 2 Counterforce/Countervalue Defense Damage-Limiting



SLBMs, the total damage would be somewhat higher, but substantially less than that resulting without defense.

Clearly, the presence of a U.S. defense of this type would substantially diminish the effectiveness of a Soviet first strike. Would a parallel Soviet defense still motivate them to attempt the first strike? If the Soviet sites were similarly restricted by treaty to preclude defense of important perimeter cities against our primary second-strike weapons, the SLBMs, then a first strike on their part would not substantially diminish our SLBM retaliatory effectiveness. Thus, a treaty-constrained area defense could be deployed, with the new BMD technology, to be a stabilizing factor in the strategic relationship while providing a better chance of national survival if deterrence fails. The possibility of such a defensive capability is of interest only in the context of a U.S. policy shift from Mutual Assured Destruction to Mutual Assured Survival. But the availability of the option for such defenses is a likely prerequisite to future serious consideration of a Mutual Assured Survival policy.

The Arms Control Implications of New Ballistic Missile Defense Technologies

Herbert Scoville, Jr.

The ABM Treaty of 1972

Any analysis of the arms control implications of new technologies for ballistic missile defense must first consider the ABM Treaty of 1972, since this is currently in force and has no expiration date. The basic purpose of this Treaty was to limit U.S. and Soviet ballistic missile defenses to such low levels that neither nation could have effective nationwide protection from any ballistic missile attack. Thus neither nation could contemplate launching a first strike with the hope that it could survive even a retaliatory attack from strategic offensive forces that had been seriously reduced in strength. Article I of the Treaty called on each party "to undertake not to deploy ABM systems for a defense of the territory of its country and not to provide a base for such a defense." This provision combined with the many provisions dealing with new types of ABMs and the specific provisions in Article XV that the Treaty should be of unlimited duration were all designed to reduce the risk of nuclear war through support of a posture of mutual deterrence between the United States and the Soviet Union not only for the present but also for the foreseeable future. This fundamental objective of the Treaty has been a cornerstone of our strategic security. It should be continuously kept in mind as we look at new ABM technologies and consider modifications to the Treaty.

The Treaty also has a number of specific provisions that must be examined in applying new technologies to possible ABM needs. For example Article V, paragraph 1, places a prohibition on the development, testing, and deployment of ABM systems or components that are sea-based, air-based, space-based, or mobile land-based. At the present time no serious thought is being given to sea- or air-based ABMs, but advances in ballistic missile defense technology and the increased vulnerability of fixed land-based ICBMs have given new impetus to considering mobile land-based systems. Similarly Article V, paragraph 2, bans the development, testing, and deployment of systems involving multiple or automatic launchings of ABM interceptors. Thus these provisions will almost certainly require amendment or abrogation were some of the new ideas for ICBM defense to proceed beyond the design to the development stage.

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Similar problems will exist for ballistic missile defenses to provide area protection. Article III of the Treaty was specifically phrased in such a way as to ban the deployment of any types of ABM systems except for limited numbers of specific types of fixed land-based systems. This together with Agreed Interpretation [E] was included to ensure that if ABM systems based on other physical principles and including components capable of being substituted for the standard ABM interceptor missiles, launchers, or radars were created in the future, then the Treaty would have to be amended in accordance with Article XIV before such systems could be deployed. It should be noted, however, that development and testing of such systems is not precluded provided that they are fixed land-based. Testing would be banned, however, if they were based in space. Article V, paragraph 1 referred to above would forbid even the development and testing of space-based systems. In sum the Treaty has many provisions designed to limit a continuing qualitative race in ballistic missile defenses and to support thereby the unlimited duration of the Treaty.

New Types of ABM Systems

Recently attention has been focused on two new generic types of ABM systems. First, renewed attention has been given to ABMs designed to protect hard point targets, particularly ICBM launchers. This revival of interest has resulted from the projected theoretical vulnerability of land-based ICBMs in the 1980s as both the United States and the Soviet Union deploy MIRVed ballistic missiles with a sufficient number of accurate, high yield warheads to threaten the ICBM force of the other side. ICBM defense was, of course, the stated U.S. objective in 1969–1972 of the proposed Safeguard ABM system. Safeguard would never have been an effective defense of the Minuteman ICBMs, and with the advent of the ABM Treaty, which allowed only one such ICBM site defense with 100 interceptors, the concept was dropped. The then existing installation at Grand Forks, North Dakota (the only site allowed under the Treaty protocol of 1974) was put in inactive status in 1975. However, R & D programs since 1972 have improved the feasibility of such systems, particularly when used in conjunction with multiple-launch-point ICBM basing, such as currently proposed for the MX missile (see the article in this volume by William A. Davis, Jr., "Current Technical Status of U.S. BMD Programs").

The second generic type of ABM that has attracted attention has been one designed to give area defense on a nationwide scale. Area defense systems that employ contemporary technology—albeit about 20 years in advance of that used in the Sentinel ABM of the 1960s, the last system designed specifically for this purpose—have arms control implications not significantly different from those considered at the time the ABM Treaty was negotiated. However, in recent years other radically different types of nationwide ballistic missile defenses have had considerable public discussion even *though their feasibility* is *highly* uncertain and in some cases even scientifically unsound. None would be deployable for many tens of years. Such systems contemplate the use of directed energy beams, probably at least partially based in space.

The characteristics and implications of the hard point ABMs and the area defense systems are quite different and thus should be analyzed separately; both would require revisions in the ABM Treaty before any deployment could occur. If the directed energy beam systems were not space-based, they could be developed and tested, but Treaty amendment would be required before deployment. Hard point defense systems, provided that they were not mobile, were based on land, and did not involve launching multiple interceptors, could be developed and tested, but some current concepts call for mobility and multiple kill mechanisms and will present Treaty adherence problems. The exact point at which the development of such a system would begin, and therefore be banned, has not been defined in the Treaty or any of its Interpretations. As far as it is known the Standing Consultative Commission, set up by the ABM Treaty to discuss ambiguous situations, has not addressed this issue. However, at some point questions would certainly be raised on this score since it is inevitable that such components, even if tested in a fixed mode, would be linked with mobile systems in the public press. Therefore, their relationship to the ABM Treaty must be carefully considered as the United States moves out of the design state for such defenses.

ABM Defense of ICBM Launchers

The objective of ABM defense of ICBM launchers would be to reduce the vulnerability of the land-based missile component of the strategic deterrent triad. Such a defense would improve the stability of the strategic balance provided that it were really effective and that it did not produce any compensating side effects. An ICBM force vulnerable to a first strike against its silos creates incentives for the other side to launch a preemptive attack in time of crisis, but as long as the submarine missile and long-range bomber legs of the triad remain, then a first strike is still deterred, since they alone can retaliate against most military and industrial targets with unacceptable consequences. However, a situation where both the United States and the Soviet Union have vulnerable ICBM forces would be much more dangerous, since the incentives to preempt would then be greatly magnified. If one country knew that its ICBMs could be decimated by the other's first strike, it would be under strong pressure to launch its countersilo missiles first in order to eliminate this threat. Were only one nation to have such a countersilo capability it would be under much less pressure to use it since there would be no threat to precipitate such a first strike. Paradoxically the strategic balance will be far less stable when both nations have countersilo capabilities, and thus vulnerable ICBMs, than it would be when only one is in such a position. The proper security response to the procurement by one country of the countersilo capability is not to match it but to reduce the vulnerability or limit the threat through arms control. Unfortunately, at the present time both the Soviet Union and the United States are acquiring countersilo ICBMs, and the 1980s could become an increasingly unstable and precarious period.

If arms limitations to reduce the vulnerability of ICBMs do not turn out to be feasible, then a defense of ICBMs could be a constructive approach. In this case the ideal solution would be one in which both the United States and the Soviet Union had invulnerable ICBMs protected by ABMs that were unambiguously local, hard point defenses without any existing or potential large area capabilities. National technical means should be able to independently verify that the ABMs could not have other functions or even that they could provide an ability for rapid deployment of a nationwide system.

An ABM defense of ICBM launchers must not simultaneously provide a nationwide defense because this could decrease confidence in both the ICBM and SLBM legs of the deterrent triad, and there would be a net loss of crisis stability. It must not even give the appearance of providing such defense or even being readily expandable or upgradable into such a capability. The United States was concerned about this so-called "SAM Upgrade" problem during the negotiation of the ABM Treaty and inserted several provisions into the Treaty to allay these worries. The Safeguard ABM system proposed for deployment in the early 1970s did not satisfy these criteria, and was in fact clearly designed to be expandable into a nationwide system. Its components were originally designed for the Sentinel thin area defense system and only converted into an ICBM defense in 1969 when the Sentinel system was redesigned into Safeguard. Furthermore, Safeguard, because of the vulnerability of its few radars, would not have been an effective defense of ICBMs and could have become a provocative target for a first strike. Its expansion beyond a single site was banned by the ABM Treaty, and it has since been abandoned.

Two new types of hard point ABM are currently being designed. One of these, the low altitude defense system, or LoADS, would be strictly designed for point defense and probably not readily expandable to a nationwide system. Because of its limited range it would have to be deployed in the middle of ICBM launch fields such as those that might be constructed for the "race track" deployment of the MX missile. Were the MX to be deployed in remote areas of eastern Nevada and western Utah, LoADS would provide little or no protection to urban industrial centers of the United States. The rapid deployment of such an ABM in other areas to defend urban targets would probably be neither practical nor possible. Thus an initial analysis of the LoADS would indicate that it was not per se destabilizing.

An alternative to LoADS that might be even more unambiguously a defense only of ICBM launchers would be the use of barrage systems in place of more conventional interceptor missiles. These would be placed close to the point being defended and use concentrated nonnuclear means of destroying the incoming warhead when it is relatively near its target. The system would not require long-range, highly sophisticated, target tracking radars and other hardware required for area defenses. Effectiveness of such systems for ICBM defense has not been thoroughly explored, but because of their unequivocal application for ICBM defense only, and perhaps because of their potential lower cost, they should be given serious consideration.

The other system being discussed is a layered defense, which would be a terminal defense coupled with an exoatmospheric system to thin the number of warheads that a terminal defense would have to deal with. While such a system might be more effective in reducing the number of warheads that penetrate and thus the vulnerability of the ICBMs, it could be quite ambiguous as to its purpose and capabilities. The exoatmospheric system, of necessity, would almost certainly provide wide area coverage and give rise to fears that the system could be expanded to provide nationwide coverage. Thus deployment of such a system could be destabilizing, and even though it were highly effective, it could in the long run provide less security.

The ABM Treaty would have to be revised in order to permit the deployment and testing of all such hard point systems, and the amendment process could be the opening of Pandora's box. A U.S. proposal to amend the Treaty to permit [illegible] ABMs to defend ICBMs probably would lead to a Soviet [illegible] proposal to deploy ABMs with area coverage. If accepted this could result in a breakdown in the present mutual deterrent posture. The resultant loss in the reliability of retaliation by both ICBMs and submarine missiles would more than offset any gains from the improved invulnerability of ICBMs. The Soviet ABM program has historically and currently concentrated its attention on nationwide defenses and paid little attention to ICBM protection. It is the judgment of Graybeal and Gouré (see their article in this volume) that the Soviets would be very unlikely to agree to an ABM Treaty revision that only allowed ABM defense of ICBMs. Unilateral U.S. action to withdraw from the Treaty would almost certainly lead to Soviet programs for nationwide ABM defenses, and the advantages of a U.S. hard point program would have been more than offset. Certainly the United eastern Nevada and western Utah, LoADS would provide little or no protection to urban industrial centers of the United States. The rapid deployment of such an ABM in other areas to defend urban targets would probably be neither practical nor possible. Thus an initial analysis of the LoADS would indicate that it was not *per se* destabilizing.

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The ABM Treaty would have to be revised in order to permit the deployment and testing of all such hard point systems, and the amendment process could be the opening of Pandora's box. A U.S. proposal to amend the Treaty to permit the deployment of mobile ABMs to defend ICBMs probably would lead to a Soviet counterproposal to deploy ABMs with area coverage. If accepted this could result in a breakdown in the present mutual deterrent posture. The resultant loss in the reliability of retaliation by both ICBMs and submarine missiles would more than offset any gains from the improved invulnerability of ICBMs. The Soviet ABM program has historically and currently concentrated its attention on nationwide defenses and paid little attention to ICBM protection. It is the judgment of Graybeal and Gouré (see their article in this volume) that the Soviets would be very unlikely to agree to an ABM Treaty revision that only allowed ABM defense of ICBMs. Unilateral U.S. action to withdraw from the Treaty would almost certainly lead to Soviet programs for nationwide ABM defenses, and the advantages of a U.S. hard point program would have been more than offset. Certainly the United

States should not jump into the development and deployment of an ICBM defense without having very carefully explored all its broad ramifications and at least informally explored Soviet views on its impact on the ABM Treaty.

Even were it possible to develop some mechanism for proceeding with hard point defense of ICBM sites without risking the loss of the stability that the ABM Treaty now provides the United States, this still may not be the best solution to the ICBM vulnerability problem. Such defense would inevitably be an expensive armaments approach to dealing with this problem. Before taking this step, and also before making a firm commitment to deploy multiple launch point schemes for deploying mobile ICBMs—which may in the end require such defenses in order to be effective—the alternative of using arms control to limit the threat should be thoroughly explored. The arms race approach of building new offensive missile systems and new missile defenses can be a never-ending and prodigiously expensive method of seeking a will-o'-the-wisp security.

Arms limitation can be much more satisfactory in the long run. If the United States had selected this approach in SALT I and seriously sought to negotiate MIRV limitations, then we might not now be proposing to spend a minimum of $33 billion for the "race track" deployment of the MX missile and untold billions more on an ABM defense of these missiles in their "race tracks." The task of limiting MIRVs today is far more difficult than it would have been in 1970, and only the first step could be taken in the SALT II Treaty. History has shown that it is much easier to stop a weapons program before it starts than it is to eliminate it after it is under way. Since the threat to the entire fixed land-based ICBM force is theoretical rather than real (to be able to rely on knocking out 1000 ICBMs in a surprise attack is a fantasy) and since in any case the other two legs of the deterrent triad are still invulnerable, the United States can afford to explore thoroughly the opportunities for limiting the threat. Certainly the arms control approach should be carefully examined before we allow the ABM Treaty to come unraveled and let both the submarine and the land-based portions of our deterrent become less secure.

Nationwide Area Ballistic Missile Defenses

In the near term the only types of wide area ABM defenses that could be built would be based on extensions of the principles considered for the Safeguard and other systems designed in the 1960s. A number of possible such systems have been discussed in Wayne R. Winton's contribution to this volume, "Applications of BMD Other Than ICBM Defense." The most innovative concept, which was not seriously considered in the past, would be the use of nonnuclear kills for exoatmospheric intercept. This would have the advantage of not crossing the nuclear threshold were such a system used to deal with accidental launches or very small attacks.

Light but wide area defenses that might be deployed without going beyond the limitations of the ABM Treaty would tend to be destabilizing, even though they could easily be overwhelmed by any attack by either the Soviet Union or the United States. If such defenses were deployed, fears would undoubtedly arise that they could be rapidly expanded after abrogation of the Treaty. While it can be claimed that such a system could be useful to cope with Nth country threats or with accidents, it does not appear that such light systems are of sufficient value to warrant the problems that their deployment would potentially present. The argumentation on this issue has not altered much from that which led to the cancellation of the Sentinel anti-Chinese system in 1969. It would seem unlikely that an emerging nuclear nation would threaten an attack on the United States or the Soviet Union with ballistic missiles since many other less expensive methods of delivery would be available for the few weapons they might have. Any larger nuclear capability, such as that of China, the United Kingdom, and France, could penetrate a light ABM system. The Soviet ABM system around Moscow has some wide area coverage, but it is not readily expandable to provide nationwide coverage and for that reason was permitted under the ABM Treaty.

New Technologies

Looking much farther into the future, consideration must be given to directed energy beam ballistic missile defenses, which could have, in theory, the capability of providing a total defense. Attention has been given recently to laser beam systems, which might station at least some components in space, and to high energy particle beams. The latter may contravene basic scientific principles, but the former are at least scientifically sound, although they would require a number of technological advances that are orders of magnitude beyond the present state of the art.

If directed energy beam systems could provide a total defense against ballistic missiles, they could transform the present mutual deterrent strategic posture into a defense-dominated one. At the present time, when neither side can hope to defend its homeland against nuclear attack under any circumstances, world security has been forced to depend on deterrence to prevent the outbreak of a nuclear conflict. This policy has been successful in avoiding the use of nuclear weapons since World War II, and no nation has even seriously contemplated using nuclear weapons because of the realization that a nuclear conflict would be a disaster for aggressor and victim alike. Such a mutual deterrent posture is not psychologically very satisfying since it leaves the world subject to catastrophic devastation were this deterrence to break down. It is feared that security based on a balance of terror could in the long run result in disaster.

Thus there is a strong motivation to move into a regime in which the threat of a nuclear holocaust were no longer omnipresent. A verified elimination of all nuclear weapons would satisfy such a criterion, but this does not appear practical for the foreseeable future. Even were major reductions in stockpiles to be agreed upon, there would always be a fear that a small residual number of nuclear weapons could be hidden away and used to threaten other nations. Thus there are strong incentives to look for some total defense system, which at least might be able to cope with reduced nuclear arsenals. In theory, a laser beam system might serve such a a purpose, since it can attack its ballistic missile target with the speed of light and potentially deal with it in its early flight stages when the missile was more vulnerable and had not yet disseminated its warheads.

However, in order to serve this purpose, the ballistic missile defense must be recognized as virtually 100 percent effective. Otherwise, there would only be a continuing race between this defense and offensive means of overcoming it. Furthermore, in a defense-oriented regime the defenses cannot be circumvented by non-ballistic missile attacks using cruise missiles or bombers. This would only move the strategic competition into a new arena. If a defense-dominated strategic balance were achieved between the United States and Soviet Union, then it would be necessary to consider the effect that such a state would have on security in other areas, such as Europe. At the present time, fears that U.S. strategic forces might become involved serve as a deterrent to a large-scale conflict in Europe. NATO governments are particularly nervous about any hints that a European conflict might be decoupled from the U.S. strategic deterrent. In a defense-dominated situation, however, *de facto* decoupling would occur. The effect of this on European security is only one of many consequences of moving away from deterrence that would have to be carefully evaluated.

For a directed energy beam system to be totally effective, and thus stabilizing, its critical components must also be invulnerable to any type of attack. Since a primary attribute of such a system would be an ability to destroy ballistic missiles shortly after launch, it is almost certain that the laser source, or at least mirrors to focus it, would have to be stationed in space within line of sight of the ballistic missile launch points. Such space stations could not be vulnerable or the efficacy of the system would break down completely. Their size and expense would undoubtedly limit the number of such stations and the available redundancy. The task of making them invulnerable would be extremely difficult, and yet the first phase in any conflict would, in such a regime, inevitably be an attempt to render them inoperative. When major weapons systems are located in space, an entirely new security situation is created. The implications of moving into an era of space wars must be carefully evaluated before any decisions are made to move beyond the theoretical design phase of such laser ABMs. The economic consequences could dwarf the ones created by present military forces, which are already causing severe problems in both the United States and the Soviet Union.

The deployment of laser ABMs would not be a violation of the current Outer Space Treaty banning the stationing of weapons of mass destruction in outer space. It could, however, come in conflict with a future agreement banning the testing and deployment of antisatellite (ASAT) systems. A laser ABM would be likely to have ASAT capabilities, or at least be difficult to differentiate from a system that did. Yet, for a laser ABM system to be invulnerable, at least during the construction phase, there would need to be some agreement preventing ASAT weapons.

Perhaps the most difficult problem that must be addressed if a total laser ballistic missile defense should prove technically and economically feasible will be: How can the transition from a deterrent-oriented to a defense-dominated strategy be effected? If one nation had an effective system sooner than the other, an extremely unstable situation would be created, since the former could then threaten the latter without fear of retaliation. The danger of blackmail or even a first strike would be greatly magnified. Yet to bring both the United States and the Soviet Union nearly simultaneously to the point where their defenses are 100 percent effective and reliably so seems nearly impossible. Furthermore, the space stations, and perhaps even the land-based ones as well, could be quite vulnerable during the construction period and, therefore, be tempting targets for a preemptive attack. At this point it is hard to visualize how a balanced transition to a defense-oriented strategy could be carried out. Almost certainly it would have to be preceded by stringent phased reductions in offensive arms and probably by a radical change in the international political climate.

Recommended Actions

The ABM Treaty now serves American and international security interests well, and no steps to amend, revise, or end it should be taken at this time. The Treaty as written places prohibitions on those types of ABM systems that are being given serious consideration and could be developed and deployed in the near future. Our security would not be served by opening up the Treaty now for even minor amendments, since this would risk other revisions that might have harmful effects on the current strategic balance.

The current technical studies that are under way to investigate new systems for ICBM defense should be combined with analyses of the broad arms control implications of developing and deploying such systems. Similarly, studies looking toward the development of ballistic missile defenses using new principles, such as directed energy laser beams, should not be allowed to go beyond the study stage without not only a broad understanding of the implications of success in this field but also a clear-cut vision of how to get from here to there. Only if and when the risks and ramifications of new ballistic missile defenses have been evaluated and deemed acceptable should decisions be made to develop and deploy ABMs.

Agenda

Thursday, November 1

1:30 p.m.	Opening Remarks
2:00 p.m.	Session I Paper and Discussion: *Ballistic Missile Defense: Updating the Debate*—Albert Carnesale
3:45 p.m.	Session II Paper and Discussion: *Current Technical Status of U.S. BMD Programs*—William A. Davis, Jr.
6:00 p.m.	Dinner
7:30 p.m.	Session III Paper and Discussion: *SALT Implications of BMD Options*—E.C. Aldridge, Jr., & Robert L. Maust, Jr.
9:00 p.m.	Session Ends

Friday, November 2

9:00 a.m.	Session IV Paper and Discussion: *Soviet Ballistic Missile Defense (BMD) Objectives: Past, Present and Future*—Sidney Graybeal & Daniel Gouré
10:45 a.m.	Session V Paper and Discussion: *Applications of BMD Other Than ICBM Defense*—Wayne Winton
12:45 p.m.	Luncheon
1:45 p.m.	Session VI Paper and Discussion: *The Arms Control Implications of New Ballistic Missile Defense Technologies*—Herbert Scoville, Jr.
3:30 p.m.	Summary, Conclusions and Recommendations
5:00 p.m.	Meeting Adjourns

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