Section 8

DEFENSIVE GOALS 1: THE PERFECT" DEFENSE

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No assessment of whether a defensive system "works" or not is meaningful without a clear and direct statement of the goal of the deployment. Though there has been much discussion of the feasibility of boost-phase BMD, proponents and skeptics alike frequently leave unstated the standards against which they are judging the technical prospects. A "successful" BMD deployment could be defined as anything from a truly impenetrable shield, to a silo defense that merely costs less to build than it costs the Soviets to overcome, to a tangled deployment that just "creates uncertainty" for the attacker.

The most ambitious conceivable goal for BMD would be to take at literal face value the words of President Reagan in his so-called "Star Wars" speech of March 23, 1983, when he called for development of a defense capable of making nuclear weapons "impotent and obsolete."[1] It is not clear that the President intended his words to be taken literally, nor that the Administration or anyone else is suggesting the United States seek a truly perfect or near-perfect defense.[2] Nonetheless, so much writing and debate focuses on this prospect, and its importance is so great, that it is taken up in this section. Section 9 treats the many other possible goals for less-than-perfect defenses.

There is some confusion in the literature about the use of the term "mutual assured destruction" (MAD) in connection with the notion of perfect defense. In common strategic parlance, MAD refers to the ***technological circumstance*** of mutual vulnerability to catastrophic damage from nuclear weapons, not to a ***chosen policy*** **to** promote such vulnerability. There is a strategic school of thought that advocates a policy usually called "minimum deterrence, " maintaining that the capability for assured destruction of Soviet society is the ***only*** requirement of U.S. strategic forces. However, many experts believe that effective deterrence and other national security objectives require nuclear forces capable of many other tasks than assured destruction. This section addresses itself to the question of whether MAD is an avoidable technological circumstance, ***not*** to whether minimum deterrence is a prudent strategic policy.

A sensible start at judging the prospect for near-perfect defense must involve two steps: first, an exact statement of what perfect defense means in the context of attack on society with nuclear weapons; second, some way of gauging the likelihood of success when the technological future cannot be accurately predicted.

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[1] *Week/y Compilation of Presidential/ Documents,* Vol. 19, *No.* 12, March 28, 1983, pp. 447-448, The text of the relevant part of the speech is reprinted as Appendix A.

[2] Defense Secretary Caspa r Wei nberger appeared to confirm a literal interpretation in a March 27 interview on NBC's *Meet the Press,* when he said (as reported in the *Baltimore Sun,* March 28, 1983, p. 1).

> The defensive **systems the President is talking about are not** designed to be partial What we want to try to get is a system which will develop a defense [sic] that is thoroughly reliable and total, I don't see any reason why that can't be done.

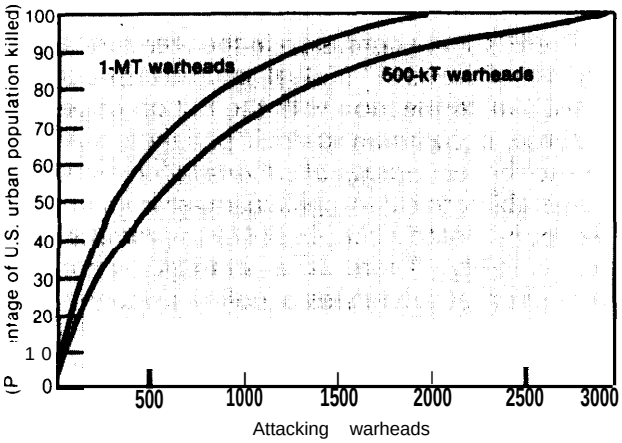
Later, the Defense Department stated that the purpose of the President's initiative was not to save lives, but to deter war. Responding to the "Congressional Findings" section of the proposed "People Protection Act" (H.R. 3073, 98th Congress, 1st session) which stated, "The President has called for changes in United States strategic policy that seek to save lives in time of war, " Defense Department General Counsel William H. Taft IV wrote:

> **It is clear that** portions of **the "Congressional** findings'' **section [of H R** 3073] **vary from the** purpose **of the President's** initiative **First, and most importa** ntly, **the purpose of the President's i** nitiative **is to strengthen our** ability **to deter war by, as the President has said,** '' rendering **[ha** llistic **m is; iles] impoten' and obsolete. 1 n short, the purpose of the Administration's policy is to reduce the** likelihood **of war. The finding [of** H.R. **3073] that the purpose** is to "sa~ e liv es i n ti me of **war' departs from our goal of deterri ng war**

Dr. Charles Townes, a frequent adviser to Secretary of Defense Weinberger and leader of two DOD task forces studying basing modes for the MX missile, said that a perfect defense proposal is "quite impractical. There is no technical solution to safeguarding man kind from nuclear explosives. (New *York Times,* April 11, 1983, p. **14).**

8.1 NUCLEAR ATTACK ON SOCIETY

Figure 8.1 .-The Effect of Attack Size on the Extent of Prompt Fatalities in U.S. Urban Areas



Note: Aimpoints chosen to maximize prompt human fatalities. U S. urban population is estimated to be 131 million, as in the 1970 census.

SOURCE. Arms Control and Disarmament **Agency, U.S.** *Urban Population Vulnerability* **(ACDA, 1979),** quoted **in Arthur M.** Katz, *Life After Nuclear War: The Economic and Social Impacts of Nuclear Attacks on the U.S* **(Ballinger, 1982) Adapted from Ashton Carter and David N. Schwartz, eds , *Ballistic Missile Defense* (The Brookings Institution, 1984), p 168**

Suppose one wants to take literally the goal of removing from the hands of the Soviet Union the ability to do socially mortal damage to the United States with nuclear weapons, so that the Soviet Union no longer possesses the elemental capability of assured destruction.) What does this mean?

Figure 8.1 shows how the percent of the U.S. urban population (about 130 million people in the 1970 census) killed promptly increases with the number of Soviet warheads detonating over U.S. cities. No such curve of the effects of nuclear attacks on cities should be taken as anything but suggestive: uncertainties are very great in such estimates, and no attempt has been made to reflect long-term and indirect effects of the detonations.[3] The curve also accounts only for fatalities, not for the many additional people injured. If one wishes to account for the possibility of civil defense evacuation, then the curve should be taken to represent not the number of people killed, but the number of people whose homes, businesses, historic monuments, schools, and places of worship have been destroyed.

No one supposes that the Soviet Union actually chooses aim points for its nuclear weapons with the goal of maximizing human fatalities, as has been done in preparing Figure 8.1. if the United States possessed a defense capable of intercepting all but a few of the 8,000 to 10,000 Soviet nuclear warheads, however, the Soviet Union might retarget its forces to wreak the most destruction possible with its few penetrating warheads. At any rate, any defense promising U.S. society genuine immunity from nuclear attack must reckon with Soviet determination to keep its arsenal from being "rendered impotent, " and therefore with targeting plans contrived to do the most damage to the fabric of U.S. society.

Where on the curve of Figure 8. 1–after how many detonations—does one locate the boundaries of "assured destruction, " "assured surviva l," "impotent and obsolete, " and similar phrases? Clearly there is no analytical prescription for these boundaries: they are the subject of **a broader human judgment. 500 half-megaton warheads kill half the urban population, injure most of the rest, and totally destroy all American cities and large towns. Just 5 megatons, about one two-thousandth of the Soviet arsenal, detonated over the 10 largest U.S. cities could kill several million people and wound over 10 million more.**

For the sake of discussion, we shall use 100 megatons—about 1 percent of the Soviet Union's arsenal and 1.5 percent of its ICBM force—as the level of penetration for which a defense would

[3]For discussion of some of the effects of nuclear weapons on population and cities, see: U.S. Arms Control and Disarmament Agency, *An Analysis of Civil Defense in Nuclear War* (ACDA, 1978); OTA, *The* Effects *of Nuclear War* (GPO, 1979); ACDA, *The Effects of Nuclear War* (ACDA, **1979); "Economic and Social Consequences of Nuclear Attacks on the United States, " prepared for the joint Committee on Defense Productlon, 96** Cong. **1** sess., **1979;** J. Carson Mark, "Global Consequences of Nuclear Weaponry, " *Annual Review of Nuclear* Science, Vol. 26 (1976), **pp.** 51 -87; **National** Research Council, *Long-Term Worldwide Effects of Multi-p/e Nuclear- Weapons Detonations* (National Academy of Sciences, 1975).

be judged "near-perfect." This definition is obpiously very generous to the notion of perfect defense, since most people would presumably not regard 100 megatons of explosive force as "impotent and obsolete. " Still, it is a definite reference for assessment.

8.2 THE PROSPECTS FOR A PERFECT DEFENSE

There is not and cannot be any "proof" that unknown future technologies will not provide near-perfect defensive protection of U.S. society against Soviet ICBMs. The question that needs to be answered is whether the prospects for near-perfect defense are so remote that such a notion has no place in reasonable public expectations or national policy. it is, after all, not provable that by the next century the United States and U.S.S.R. will not have patched up their political differences and have no need to target one another with nuclear weapons. The issue of the perfect defense is unavoidably one of technical judgment rather than of airtight proof,

Four misapprehensions seem common among non-technical people addressing the prospects for perfect defense.

The first misapprehension is to equate successful technology development of individual devices—lasers, power sources, mirrors, aiming and pointing mechanisms—with achievement of an efficient and robust defensive ***system.*** Millionfold increase in the brightness of some directed-energy device is a necessary, but is far from a sufficient, condition for successful defense. In the early 1960's, intercept of RVs with nuclear-tipped interceptor missiles was demonstrated—"a bullet could hit a bullet''–but ***20*** years later systems incorporating this "kill mechanism" are still considered relatively inefficient. In general, skeptics about the future of space-based directed-energy BMD do not confine their doubts to, or even emphasize, unforeseen problems in developing the individual components.

A second misappprehension arises in attempts o equate BMD development to past technological achievements, such as the Manhattan project's atomic bomb or the Apollo moon landings. Q The technically minded will recognize a vital difference between working around the constraints imposed by nature, which are predictable and unchanging, and competing with a hostile intelligence bent on sabotaging the enterprise. A dynamic opponent makes of BMD, first, a more difficult design problem, since the offense constructs the worst possible barriers to successful defense; and second, not one problem but many problems that need to be sidestepped simultaneously in the design, since the designer cannot be certain which tactics the offense will use.

A third misapprehension concerns the prospect for a "technological breakthrough" that would dispel all difficulties. Such breakthroughs are not impossible, but their mere possibility does not help in judging the prospects for the perfect defense. For one thing, an isolated technological breakthrough creating a new defensive component would not necessarily alleviate the system issues—vulnerability, dependability, susceptibility to countermeasures, cost—that determine overall effectiveness. Second, one can just as easily imagine offensive "break throughs," sometimes involving the same technologies. Thus the x-ray laser, if it matures, might turn out to have been

[4]Defense Secretary Caspar Weinberger has w ritten *(Air Force Magazine, Nov. 1983):*

> **The nay-sayers have already proclaimed that we will never have such technology, or that we should never try to acquire it Their arguments are hardly new In 1945 President Truman's Chief of Staff, Adm William Leahy, said of the atomic bomb "Thatrs the biggest fool thing we've ever done. The bomb will never go off, and I speak as an expert in explosives. " In 1946 Dr. Vannevar Bush, Director of the Office of Scientific Research and Development said of Intercontinental ballistic missiles, "1 say technically I don't think anybody in the world knows how to do such a thing, and i *feel* confident it will not be done for a long time to come " These critics were proved wrong; what is more, they were proved wrong quickly**

better termed a breakthrough in strategic offense than a breakthrough in strategic defense.

A fourth misapprehension concerns the confidence with which predictions could be made about the performance of a complex system once in place. The "performance" of a system, as quoted in analyses, is the most likely outcome of an engagement of offense versus defense. Other outcomes, though less likely, might still be possible. Computing the relative likelihoods of all possible outcomes would be difficult even if one could quantify all technical uncertainties and statistical variances. Still, there would remain a residue of uncertainty about the performance of a system that had never been tested once in realistic wartime conditions, much less in a statistically significant ensemble of all-out nuclear wars. The defense would also have no chance to learn and adapt. In World War II, by contrast, air defense crews learned in raid after raid to inflict losses of several percent in attacking bombers. The only reason these modest losses assumed strategic significance was that they accumulated over many raids. Of course, the same uncertainties plague the offense as plague the defense. In general, the offense would tend to overestimate the defense's capability. This natural tendency toward "offense conservatism" is probably vitally important to the psychological and deterrent value of BMD as it is applied to less-than-perfect goals. For the perfect defense goal (as defined above), however, it **would seem that the uncertainty** weighs heaviest on the defense. To the reckless, non-conservative defense, a wrong estimate of defense performance spells the difference between safety and socially mortal damage (or between deterrence and war). The reckless offense, on the other hand, is presumed desperate enough to try to inflict such damage on its enemy and willing to accept the consequences: it stands to lose little if its estimates are wrong and the defense does work perfectly after all.

With these misapprehensions out of the way, and recognizing clearly that there can be no question of "proof," it would seem that four major factors conspire to make extremely remote the prospect that directed-energy BMD (in concert with other layers if necessary) will **succeed** in reducing the vulnerability of U.S. population and society to the neighborhood of 100 megatons or less.

1. **Near-perfect defense of society is much harder and more expensive than partial defense of military targets.** That is, the marginal cost exchange is much higher for near-perfect defense than for partial defense (see also Fig. 5.2). There are two reasons behind this well-known statement.

The first reason is illustrated schematically in Figure 8.2. **In going from partial silo defense to perfect city defense, the BMD loses the leverage of preferential defense. Additionally, the offense gains the leverage of preferential offense against the terminal and midcourse layers with their limited geographic coverage, although not against the boost-phase layer. In Figure 8.2(a), the defense aims to save only 10 percent of the ICBM** force, or one silo. Assuming perfect interceptors and adopting the tactic of adaptive preferential defense (using all its interceptors to save just one silo chosen randomly from the ten at the moment of attack), the defense concludes it needs to prepare to make one only intercept to counter the offense's 10 RVs. **In Figure 8.2(b), the offense can focus all 10 of its** RVs on any one of ten cities. The defense must prepare to make 10 intercepts for each city, buying a total of 100 interceptors, if it wants to try to save all the cities. If the Soviets double their **RV arsenal, the United States must** buy just one interceptor to satisfy the defense goal of Figure 8.2(a), but the United States must buy 100 **interceptors to satisfy the defense goal of Figure** 8.2(b). The cost exchange ratio is thus 100 times worse for the city defense, even though it uses the same technology **as the silo defense.**

The second reason why a near-perfect defensive goal shifts the cost burden in favor of the offense is that the offense can turn all its resources to improving or replacing just a portion of its ICBMs to sidestep the defense. The Soviet Union could therefore harden just 1 percent of its boosters, perhaps concealing exactly which ones were hardened. Moreover, it could deploy a few fast-burn boosters immune to x-ray lasers and neutral particle beams; build a few different ASAT de-

Figure 8.2

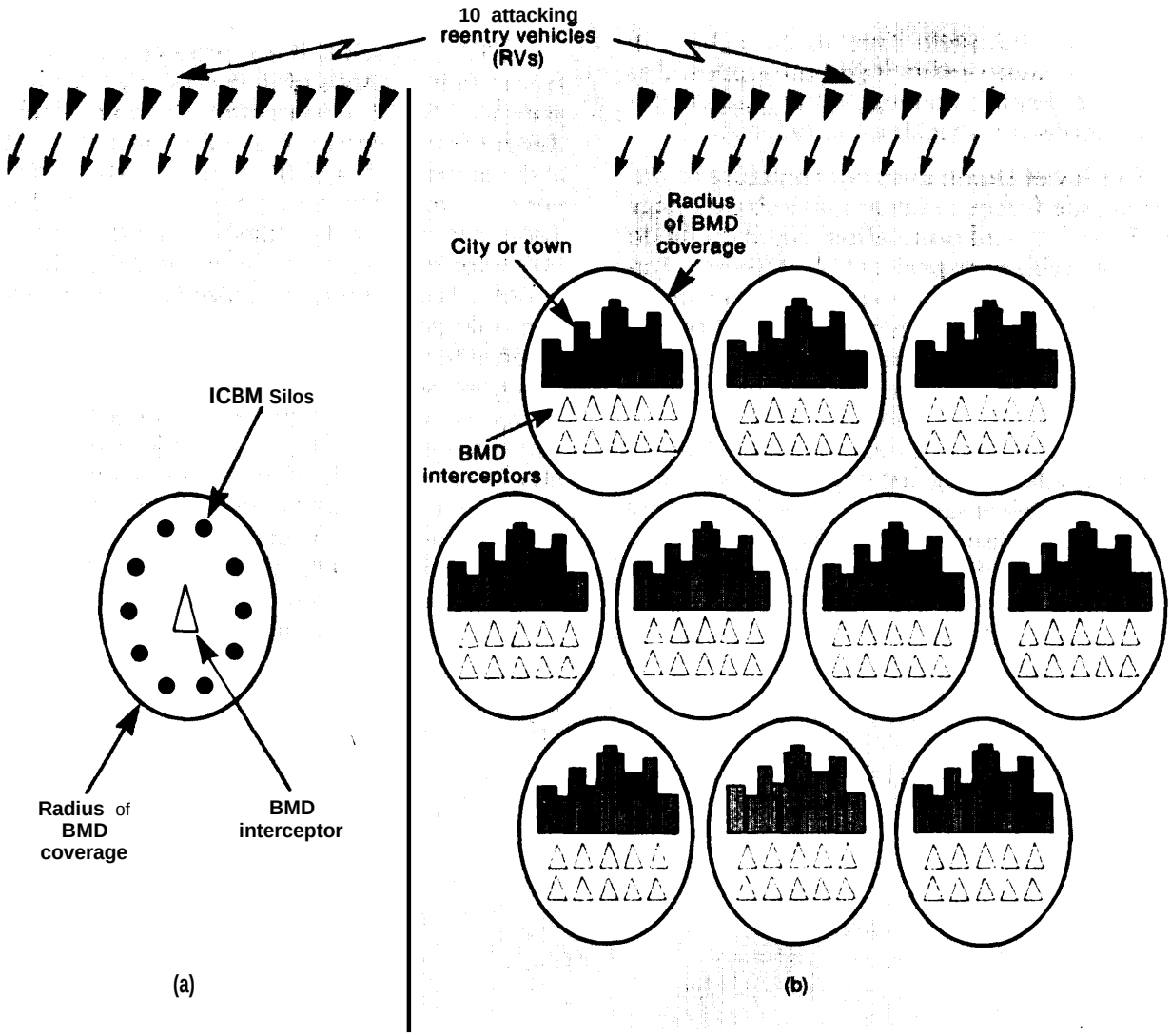


Figure 8.2. The cost to a U.S. reentry BMD to compete with increases in the size of the Soviet arsenal (the "marginal cost exchange") is much greater for near-perfect city defense (b) than for partial silo defense **(a).** In going from (a) to (b), the **U.S. loses** the leverage of preferential defense and the Soviet Union gains the leverage of preferential offense.

vices; and so on. More costly countermeasures are available to the offense if the countermeasures need only be implemented on a small scale rather than throughout the ICBM force. The offense can "experiment" with a number of different tactics with different portions of its force. The defense's costs also grow much larger if it must plan to face a ***variety*** of offensive countermeasures. In short, the defense must be able to stop all kinds of attack, but the offense only has to find one way to get-through.

2. **For every defense concept proposed or imagined, including all of the so-called "Star wars" concepts, a countermeasure has already been identified.** These countermeasures were enumerated in Section 5 and will not be repeated here. Three further generalizations about these countermeasures reinforce a poor prognosis for cost-effective near-perfect defense: 1) In general, the countermeasures could be implemented with today's technology, whereas the defense itself could not; 2) In general, the costs of the coun-

termeasures can be estimated and shown to be relatively low, whereas the costs of the defense are unknown but seem likely to be high; 3) In general, the future technologies presupposed as part of the defense concept would also be potent weapons for attacking the defense.

3. **The Soviet Union does not configure its nuclear missile forces today to maximize damage to U.S. society and population, but it could do so if faced with near-perfect U.S. defenses. Targeting plans could** focus exclusively on damaging cities. High missile accuracy would be unnecessary, **lowering offense costs. Nuclear weapons** could be designed to maximize harmful fallout. ICBM survivability measures–silos, racetracks, densepacks, etc.—would be unnecessary to a side striking first or possessing its own defense effective at saving many missiles (but not ***all*** cities); thus basing costs could be diverted to the city-kill goal, Presumably the Soviet Union would take these and any other measures necessary to prevent itself from being effectively disarmed by a U.S. defense, since otherwise it would be at its enemy's mercy.

4. **BMD by itself will not protect U.S. society from other methods of delivering nuclear weapons to U.S. soil or from other weapons of mass destruction.** Bombers and cruise missiles (and to a significant extent SLBMs and IRBMs) present very different defensive problems than ICBMs. Today the technical problems of air defense are no better resolved than the technical problems of BMD. Novel future offensive delivery vehicles can only be conjectured along with the future defense technologies discussed in this Paper. A desperate Soviet Union could introduce nuclear weapons into the United States on commercial airliners, ships, packing crates, diplomatic pouch, etc. Other methods of mass destruction or terrorism would be feasible for the U. S. S. R., including sabotage of dams or nuclear power plants, bacteriological attack, contaminating water, producing tidal waves with near-coastal underwater detonations, and so on.