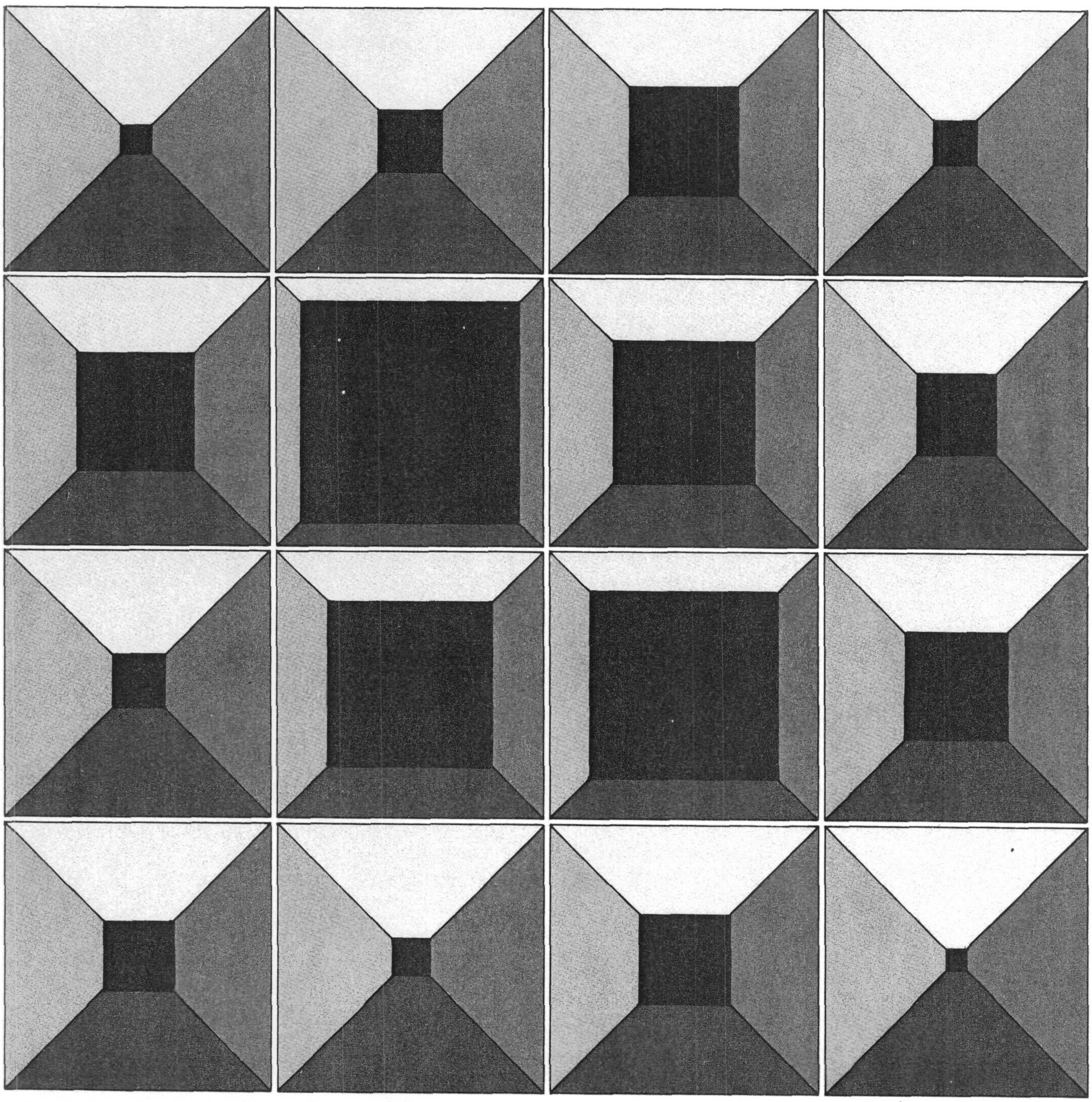
A CBO STUDY

Modernizing U.S. Strategic Offensive Forces: The Administration's Program and Alternatives

May 1983

Congress of the United States
Congressional Budget Office



MODERNIZING U.S. STRATEGIC OFFENSIVE FORCES:
THE ADMINISTRATION'S PROGRAM AND ALTERNATIVES

The Congress of the United States
Congressional Budget Office

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Washington, D.C. 20402

NOTES

Unless otherwise indicated, all years referred to in this report are fiscal years. Likewise, unless otherwise noted, all dollar amounts are expressed in constant fiscal year 1984 budget authority dollars.

PREFACE

Over the next several months, the Congress will be debating the Administration's plan for upgrading U.S. strategic forces, particularly land-based missiles. At the request of the House Budget Committee, the Congressional Budget Office (CBO) has studied the Administration's strategic plan and alternatives to it. By many commonly used measures, the Administration's strategic plan will result in a substantial buildup of U.S. strategic forces. It also represents a decision to maintain a triad of forces each able to survive a Soviet first strike, thereby retaining the insurance inherent in such a combination of forces.

The scope and cost of the Administration's strategic buildup have prompted debate over alternative approaches. This study outlines three alternatives. One would forgo deployment of the 100 MX missiles in existing silos. Another would forgo deployment of the MX and development of a follow-on land-based missile; instead, it would expand the number of Trident submarines to replace the warheads lost by not deploying more land-based missiles. The study also discusses an alternative that would rely on upgrades of existing B-52 bombers and more air-launched cruise missiles instead of continued procurement of the B-1B bomber. In accordance with CBO's mandate to provide objective and impartial analysis, this study makes no recommendations.

A summary of this study was published separately. It is reproduced here with no changes.

Lawrence J. Cavaiola and Bonita J. Dombey of CBO's National Security and International Affairs Division prepared the study under the general supervision of Robert F. Hale and John J. Hamre. Bill Myers of CBO's Budget Analysis Division provided detailed cost analysis. Rich Davison, formerly of CBO, participated in earlier stages of the analysis. Valuable assistance was also provided by Julie Carr, Roberta Drews, T. Keith Glennan III, Stephanie Martin, and Greg Schulte. Thomas A. Brown of the Rand Corporation provided helpful comments. (The assistance of external reviewers implies no responsibility for the final product, which rests solely with CBO.) Robert L. Faherty and Francis Pierce edited the manuscript, assisted by Nancy H. Brooks.

Alice M. Rivlin
Director

May 1983

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SUMMARY

In October 1981, the Administration announced its plan to modernize all parts of the U.S. strategic deterrent. Representing the most comprehensive and far-reaching such effort in the past 20 years, the plan would expand and upgrade the triad of strategic "offensive" forces: land-based and sea-based intercontinental ballistic missiles plus long-range bombers. It would also improve the triad's communications and control systems, and strengthen U.S. defenses against attack by Soviet bombers.

U.S. strategic forces are primarily intended to deter the Soviet Union from initiating a nuclear war. To do so, they must be able to survive a Soviet nuclear strike and retaliate in an appropriate and timely manner. In recent years, the Soviets have expanded and improved their strategic forces. The Administration apparently believes that in response the United States must increase not only the numbers of its forces and their chance of surviving a Soviet strike, but also their destructive capability, endurance, and responsiveness. The broad scope of the buildup--and the relative share of the nation's resources to be devoted to defense in general--has sparked debate, as has the high cost of individual weapons systems. Most recently, debate has centered on the Administration's proposal to deploy the MX missile.

This study assesses the scope and costs of the Administration's planned modernization, taking into consideration the effects that arms control agreements could have on it. The study also considers proposals to modify the Administration's program by (1) dropping the MX missile, (2) focusing modernization efforts on submarine-based missiles rather than land-based missiles, or (3) terminating the B-1B bomber program in favor of improving existing bomber capability.

THE ADMINISTRATION'S MODERNIZATION PLAN

Scope of the Effort

The Administration's plan would involve all three of the triad forces. While not all of the details are available on an unclassified basis, this study assumes that modernization would include the following programs:

- Deployment by 1988 of 100 MX intercontinental ballistic missiles (ICBMs) in silos formerly housing Minuteman missiles;

- Deployment in the early 1990s of a new, single-warhead, small ICBM (SICBM) in one or more basing modes;
- Deployment by the late 1980s of 100 B-1B bombers and in the early 1990s of 132 Advanced Technology--or "stealth"--bombers;
- Deployment by the early 1990s of about 3,200 air-launched cruise missiles, initially on refitted B-52 bombers and eventually on both B-52 and B-1B bombers;
- Continued procurement through 1993 of Trident submarines at the current rate of one per year to a total of 20, and deployment on most Trident submarines by 1996 of the new, larger Trident II (or D-5) missile currently being developed;
- Deployment by 1988 of about 400 nuclear-armed, sea-launched cruise missiles on some attack submarines and surface ships.

Costs of the Plan

The Congressional Budget Office (CBO) estimates that it would cost approximately $50 billion a year in budget authority--or a total of about $250 billion over fiscal years 1984-1988--to build, modify, and operate all of the strategic forces and their associated elements. The estimates include both direct costs and indirect costs, such as personnel support. (These approximations are based on estimates made last year, since details of direct and indirect costs beyond 1984 are not available for the Administration's latest five-year defense plan. The costs should, however, provide a rough guide to likely totals under the latest program.)

Within this total, investment costs of strategic offensive forces would reflect the timing and production of key systems: the MX missile and B-1B bomber in the mid-1980s; the Advanced Technology bomber, Trident II missile, and SICBM in later years. Operating costs would increase during the late 1980s and early 1990s as new forces were added and only a few older systems were retired. Later, when many currently deployed systems are retired, operating costs would decrease.

A Major Expansion

The Administration's modernization plan would represent a quantitative and qualitative buildup of U.S. strategic forces. It would mean not only an increase in the numbers of nuclear warheads that could be delivered in the event of a Soviet attack, but also a response to changes in

Soviet strategic forces and doctrines and a decision to maintain the U.S. strategic nuclear triad.

The Buildup in Quantitative Terms. The quantitative effects of the Administration's proposed buildup on capabilities can be assessed using two measures common to strategic analysis:

- Total number of warheads, a measure that serves as a rough guide to the number of targets that can be attacked; and

- Number of "hard-target" warheads that can destroy targets hardened against nuclear effects, such as missile silos and command bunkers.

The Administration's plan would result in a substantial increase in U.S. strategic capabilities, relative to current levels. The size of the increase depends on the scenario assumed for a nuclear war. In one plausible scenario, the Soviets mount a major nuclear attack on U.S. weapons, but the attack comes after a period of warning long enough so that almost all U.S. forces are poised to retaliate. In these circumstances, the Administration's plan would increase the numbers of surviving U.S. warheads available for retaliation by 65 percent, from 6,000 in 1983 to 9,900 in 1990 (see Summary Figure 1). By 1996, the number of available surviving warheads would fall back to 9,300 as some older submarines and bombers were retired. (These results assume that the follow-on SICBM land-based missile supplied 600 surviving warheads--approximately the midpoint of survivability estimates attributed last fall to the Air Force for MX missiles deployed in the closely spaced basing mode.)

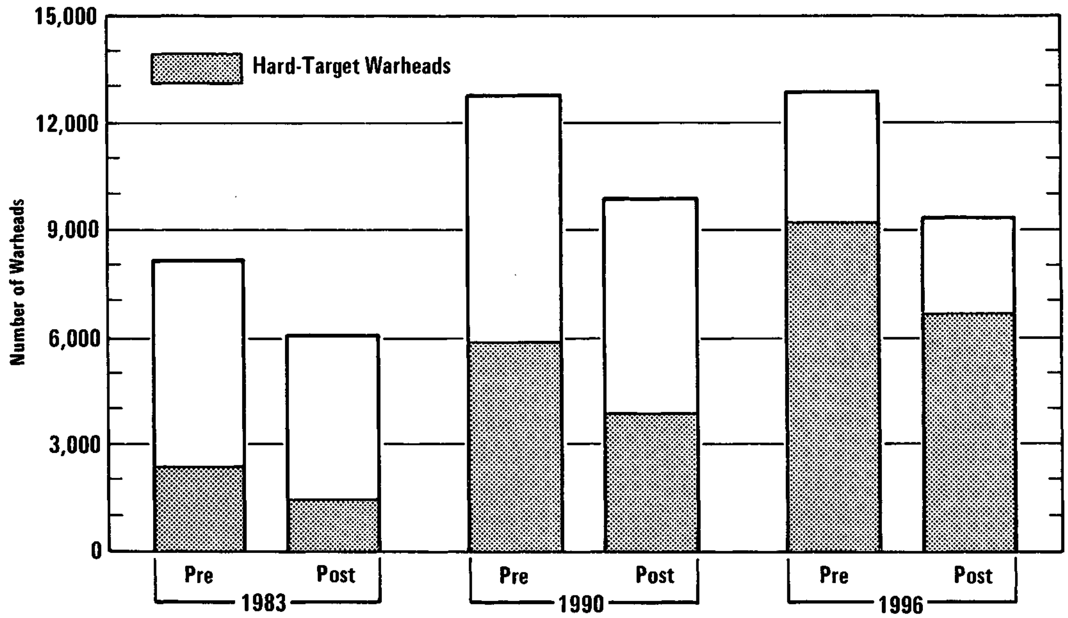
The increase in capabilities would be more dramatic if measured by the numbers of available surviving warheads that could destroy hardened targets. That number would rise from 1,400 in 1983 to 3,900 by 1990 (an increase of more than 175 percent) and to 6,700 by 1996 (an increase of more than 375 percent).

The subset of these surviving hard-target warheads that are considered "prompt" would grow even more substantially. Prompt warheads are those that can be launched and delivered to a target in a relatively short period of time, possibly destroying Soviet military forces before they launch another strike.

If the Soviets were to attack with no warning at all, the Administration's plan would still result in a buildup over today's levels. The measures of effectiveness would, however, be roughly 60 percent of those in an attack with warning, because fewer forces would be poised to escape

Summary Figure 1.

Administration's Strategic Force Buildup, 1983-1996
(Pre- and Post-Attack, With Warning)



SOURCE: Congressional Budget Office.

the Soviet attack. Although such a scenario must be considered in planning, many believe that a "bolt-out-of-the-blue" attack is less plausible than one occurring after a period of tension, nonnuclear war, or other warning.

Finally, the Administration's plan would increase the total counts of warheads available before any attack from 8,800 today to about 14,000 in 1990 and 1996. These simple counts of pre-attack warheads are not the best measure of strategic capability, though they are useful for comparative purposes.

The Buildup in Perspective. The scope of the Administration buildup must be judged in the perspective of changing Soviet forces and in terms of what might be needed to deter the Soviets from initiating a nuclear war. Since the early 1960s, the Soviets have been engaged in a consistent expansion of their strategic offensive and defensive forces. Land-based ICBMs have been the centerpiece of this modernization, but the Soviets have also deployed a substantial sea-based force and are modernizing their strategic bomber force. Within the past ten years or so, they have more than quadrupled the number of nuclear warheads in their strategic offensive forces, to a present level of about 9,000 strategic warheads. By the mid-1990s, in the absence of arms control limits, regular replacements and additional force expansion could result in another doubling of this inventory.

Over the same period, U.S. defense planners have modified their view of the forces and strategies needed to deter the Soviets. In the early 1950s, plans called for striking urban areas. Under the mutual assured destruction (MAD) philosophy of the 1960s and 1970s, deterrence rested on the threat of inflicting "unacceptable damage" on the Soviet Union if it attacked. Current strategic doctrine holds that deterrence requires that the United States not only have the capability to wage an all-out attack, but also the means to engage in a nuclear war that could involve a series of limited attacks. Not everyone agrees with this view, however. Some, for example, would prefer simpler, more direct approaches such as retaining an assured capability to destroy a large number of Soviet cities and industrial facilities. By this last metric, both superpowers have many times the needed numbers of nuclear warheads.

This study does not attempt to measure the deterrent capability of the Administration's program or alternatives to it. Instead, it concentrates on quantifying the changes in U.S. strategic weapons inventories that would be brought about by these approaches and on explaining their qualitative effects.

Important Qualitative Aspects of the Administration's Plan. The Administration's plan has some aspects that cannot be readily quantified. Most important, it seeks to maintain a triad of strategic nuclear forces, each able to survive a Soviet first strike. A survivable triad serves as a hedge against a technological breakthrough that might neutralize any one element; it also complicates Soviet planning for both attack and defense; and it requires the Soviets to spread their research and development efforts against three different types of systems. Moreover, in a nuclear war the triad of forces would act in concert; for example, an attack on U.S. land-based missiles could provide several minutes of warning that would enable the bomber force to respond. The Administration also argues that maintenance of the traditional force configuration is essential to the U.S. bargaining position in arms control negotiations.

The modernization of all three triad elements over a number of years would also provide open production lines for the manufacture of additional systems should the threat increase. Finally, modernization would decrease the average age of U.S. forces and equipment, presumably improving their

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reliability and maintainability. In 1990, for example, 60 percent of bomber weapons would be carried by aircraft less than 15 years old, compared with only 10 percent today.

HOW THE ADMINISTRATION'S PLAN WOULD BE AFFECTED BY ARMS CONTROL

Arms control agreements could be expected to modify the Administration's modernization program, but not to a great extent. The Administration's proposals in the Strategic Arms Reduction Talks (START) would limit both the United States and the Soviet Union to 5,000 ballistic missile warheads--half of which at most could be on land-based missiles--and 850 ballistic missiles.

It might be necessary to change the ballistic missile limit to accommodate the follow-on land-based missile (SICBM), especially if it has only one warhead. This could be done by raising the limit to more than 850 missiles, changing to a new type of limit, or relying solely on the warhead limits.

With this exception, the Administration's modernization program could be completed under START, so long as enough older systems were retired first. Because of the high priority accorded strategic modernization, the Administration might choose to implement a START agreement by retiring older systems, though it has not publicly said so. This might mean 15 to 20 percent fewer surviving warheads, but would not greatly affect the numbers of surviving hard-target warheads because these are primarily on new systems. Investment costs would not be much reduced. Operating costs would decrease as older systems were retired, but there would probably be added costs to dismantle these systems. On balance, costs would be lower by about $16 billion through the year 2000--a few percent of total strategic costs in this period.

Continued adherence to the numerical limits of the Strategic Arms Limitation Talks (SALT) would have less effect on the modernization program than would START. For example, relative to the Administration's program unconstrained by SALT, counts of surviving warheads after a Soviet first strike would be 6 percent less under the SALT limits in 1990, and there would be almost no difference by 1996.

ALTERNATIVES TO THE ADMINISTRATION'S PLAN

The scope and high cost of the modernization program has led to some alternative proposals. The Congress could terminate the MX missile.

It could make an even more far-reaching decision and discontinue funding for new land-based missiles, emphasizing submarine-based missiles instead. Or it could terminate the B-1B bomber program, in favor of upgrading existing B-52 bombers and expanding the air-launched cruise missile program.

Alternative 1: Adopt the Administration's Plan Without the MX Missile System

As part of its modernization of the land-based missile force, the Administration proposes to substitute 100 MX missiles for currently deployed Minuteman missiles in silos near Cheyenne, Wyoming. The system would probably be fully deployed by 1988. An alternative would be to cancel production and deployment of the MX missile, but provide for research and development--and possible production and deployment--of the small ICBM recommended by the President's Commission on Strategic Forces.

Arguments Favoring the MX. Although the discussion below suggests that few of the 100 MX missiles would be likely to survive a Soviet first strike should the United States choose to ride out the attack, deploying the MX would nonetheless provide some advantages. The calculations of Soviet ability to attack and destroy Minuteman silos are theoretical. In an actual attack, the Soviets could not be certain of destroying all or even most of the MX missiles, and this might contribute to deterrence. They might be further deterred by the consideration that the United States could conceivably launch all of the MX missiles after receiving warning of a Soviet attack but before Soviet missiles reached their ICBM targets. This could occur if the United States launched its ICBMs on warning--which is neither assumed nor precluded by current U.S. policy--or if it launched them after other strategic forces had been attacked.

Deployment of the MX missile, the first new U.S. land-based missile in 13 years, might also facilitate reaching an arms reduction agreement with the Soviets. This, according to the President's Commission on Strategic Forces, would hold down the costs of deploying a survivable land-based missile force using the SICBM. Deploying the MX would facilitate arms reduction by showing determination to keep pace with Soviet deployment in recent years of a whole new generation of land-based missiles, plus continuing Soviet modernization of its ICBM force. The MX would also give the United States the capability to destroy those Soviet targets most hardened against nuclear blast, just as the Soviets can destroy such targets in the United States with their modern, land-based missiles.

In addition, deploying the MX would open a production line for land-based missiles, which would facilitate expansion of the land-based missile force if required by Soviet actions or by problems with other U.S. forces. Finally, proponents of the MX point to the positive attributes of a land-based missile force such as sureness of command and control, accuracy of warheads, high peacetime alert rates, and targeting flexibility.

Small Quantitative Contribution of the MX. Despite these advantages, the MX in Minuteman silos would be no more survivable in the face of Soviet attack than the missiles they replaced. CBO estimates that a major Soviet strike that the United States rides out could destroy all but 10 percent of them in 1990, and all but 5 percent by 1996 as accuracy continues to improve.

This limited survivability, coupled with the major buildup in other U.S. strategic forces, means that deploying the MX would contribute relatively little to U.S. retaliatory capabilities. Specifically, 100 MX in Minuteman silos would contribute:

- 3 percent in 1990, and less than 1 percent in 1996, of all U.S. hard-target warheads that would be expected to survive and be available for retaliation in the nuclear scenario considered most likely--a Soviet first strike occurring after some warning.

- 5 percent in 1990, and 1 percent in 1996, of all hard-target warheads that would be expected to survive a Soviet attack occurring without warning.

By other measures, the contribution of the MX would be larger, though in most cases still modest. In 1990, for example, MX would contribute 11 to 52 percent of all prompt, hard-target capability that would survive a Soviet first strike that occurred after warning of the attack; the total warheads of this type contributed by MX, however, would be fewer than 100. By 1996, as many new submarines and land-based missiles entered the force, the contribution of MX would fall to between 1 percent and 7 percent of the prompt, hard-target capability remaining after a Soviet first strike. The ranges depend on whether or not Trident submarines equipped with the new Trident II missile are counted, and assume that 600 surviving warheads are provided by SICBM. Prompt, hard-target weapons could be most important in deterring, or, should deterrence fail, in fighting a limited nuclear war involving a series of exchanges with the Soviets.

The MX would contribute more substantially if the United States chose not to ride out a Soviet first strike. If the United States launched all land-based missiles, including the MX, before they came under actual attack, then the contribution of the MX would increase significantly. It would contribute between 17 and 35 percent of available surviving prompt, hard-target weapons in 1996 under this assumption. The range depends again on whether or not Trident II missiles contribute to this measure. U.S. policy neither assumes nor precludes such a launch-on-warning strategy.

Qualitative Arguments Against the MX. Some fear that the MX missile, if deployed in a nonsurvivable basing mode, would be destabilizing in a crisis. According to this view, the Soviets might be tempted to launch first to preclude a U.S. first strike. Moreover, even without the MX, the United States would retain some of the advantages of land-based missiles with the 1,000 remaining Minuteman missiles. In reply to the argument that the MX is needed to keep the Soviets interested in arms control, opponents contend that the rest of the U.S. strategic buildup may be enough to ensure serious negotiations.

Savings from Terminating the MX. Terminating the MX would mean spending no more money on missiles or basing in 1984 and beyond. According to the Air Force, this would yield total savings in 1984-1988 of $17.9 billion in budget authority (see Summary Table 1). This would represent about 7 percent of total strategic costs in this period. Total savings in 1984 and beyond would be $18.4 billion. There would be no significant change in operating costs, because the United States would continue to operate the Minuteman missiles scheduled to be replaced by the MX.

For consistency with recent Administration announcements, this study shows savings relative to the current MX plan. Savings relative to the President's January 1983 Budget would be higher because that budget assumed an earlier, more expensive version of MX. In 1984 and beyond, savings relative to the budget would total $28.6 billion of budget authority.

An Alternative Approach. The Congress could decide to spend some of these savings on improving existing Minuteman missiles. At least the same increase in prompt hard-target capability generated by the MX could be obtained at lower cost by upgrading the present force of Minuteman III missiles. Specifically, by installing the MX guidance system on 550 Minuteman IIIs, and higher-yield warheads on 250 missiles not currently having them, a force of hard-target Minuteman IIIs could, according to the Air Force, be in place by around fiscal year 1993 at a cost of about $14 billion. This would save about $4.4 billion over the Administration's current MX plan.

Nevertheless, the upgrading might not produce a force with as much operational flexibility as the MX system. Neither would it be deployed as

SUMMARY TABLE 1. SAVINGS FROM ALTERNATIVES TO THE ADMINISTRATION'S STRATEGIC PROGRAM (By fiscal year, in billions of 1984 budget authority dollars)

	1984	1985	1986	1987	1988	Total 1984 to 1988	Total 1984 to 2000
Alternative I--Cancel MX a/							
Investment	4.6	5.0	3.6	2.8	1.8	17.9	18.4
Operating	--	--	--	--	--	--	--
Total	4.6	5.0	3.6	2.8	1.8	17.9	18.4
Alternative II--Substitute Sea-based Forces for Land-based Forces a/							
Investment	4.9	4.1	3.9	2.4	4.6	19.9	41.4
Operating	--	--	--	--	--	--	19.6
Total	4.9	4.1	3.9	2.4	4.6	19.9	61.0
Alternative III--Cancel B-1B Bomber							
Investment	3.9	7.0	4.3	-1.6	-2.0	11.7	10.8
Operating	--	b/	0.1	0.4	0.6	1.1	4.8
Total	3.9	7.0	4.4	-1.2	-1.3	12.8	15.5

SOURCE: Congressional Budget Office.

NOTES: Numbers may not add to totals because of rounding. Costs do not include those funded by the Department of Energy.

a/ Savings would be higher relative to the President's January 1983 Budget, which assumes an earlier, more expensive MX plan.

b/ Less than $100 million.

soon nor offer all of the qualitative benefits that might come from deploying the MX missile, such as a demonstration of steadfastness of purpose that would strengthen the hand of U.S. arms control negotiators.

Alternative 2: Substitute Missiles on Submarines for Land-Based Missiles

For more than a decade, the United States has sought a basing mode for a land-based missile that could guarantee survivability against a Soviet first strike and also respond to environmental and political concerns in this country. Cost considerations, plus continued difficulties in meeting the other concerns, might prompt the Congress to abandon the quest for a survivable land-based missile force in favor of increasing the capability of the submarine-based forces. The following discussion examines the consequences of terminating all efforts toward new land-based missiles--including the MX and the small ICBM--in favor of building more Trident submarines equipped with the new Trident II (D-5) missile.

Quantitative Contributions of Submarine-Based Missiles. Deploying additional submarines would roughly compensate for the loss of the land-based missiles. CBO estimates that five to nine additional Trident submarines, equipped with the new Trident II missile, would about equal the surviving capability of the 100 new MX missiles plus the 600 surviving warheads assumed to be contributed by the follow-on SICBM land-based missile planned for the 1990s. Five additional submarines would be needed to match the number of hard-target warheads, while nine additional submarines would be needed, given current operating procedures, to match the number of prompt, hard-target warheads.

Assuming production of Trident submarines was increased to three every two years starting in 1985, these added submarines could be produced with existing shipyard capability and would all enter the fleet around the turn of the century. This would be just a few years later than the full deployment of the follow-on SICBM land-based missile, to occur in the middle to late 1990s.

Savings from Submarines. Five additional Trident submarines and their missiles would cost about $12.8 billion to buy and $0.3 billion a year to operate, for 20-year costs of $18.8 billion. Nine additional submarines would cost roughly twice as much.

The cost of land-based missiles would be substantially more than even the nine additional Tridents. The cost for the Administration's current MX plan alone would be $18.4 billion in 1984 and beyond. Should a road-mobile, small ICBM eventually be deployed as part of the Administration's plan, its cost would be substantial. According to the Department of Defense, fielding 1,000 such missiles would cost $46.2 billion to buy, plus about $3 billion in annual operating costs, for a 20-year life-cycle cost of $107 billion. Taken together, the life-cycle costs of the MX and small ICBM would exceed those of nine additional Tridents by a factor of more than three.

Aside from its potential long-term savings, this approach would clearly cut costs over the next five years. Despite the added costs of beginning even a nine-submarine addition, net savings would amount to a total of $19.9 billion in budget authority (see Summary Table 1). Most of the savings would come from terminating deployment of the MX missile.

Forgoing the Key Advantages of a Survivable Triad. Giving up attempts to develop a survivable, land-based missile would mean forgoing many of the important advantages of a triad of U.S. forces, each able to survive a Soviet first strike. A triad hedges against a loss of capability in any single element, and makes it more difficult for an opponent to develop a successful attack. Striving for survivability in each triad leg also minimizes the risk of a future Soviet technological breakthrough. Moreover, land-based missiles have an advantage over the other legs of the triad in greater responsiveness and more assured command and control.

Under this alternative, the United States would be concentrating more of its strategic deterrent in the submarine force. Even though submarine-based missiles are thought by many to be invulnerable through the 1990s, there can be no absolute certainty of it. Again, some maintain that failure to deploy a new land-based missile would show a lack of resolve on the part of the United States.

This alternative would not, however, mean forgoing all of the advantages of land-based missiles. The United States would still have 1,000 Minuteman missiles, with their 2,100 warheads, at least through the end of this century.

Alternative 3: Cancel B-1B and Upgrade Existing Bomber Force

The Administration proposes to buy and deploy 100 B-1B bombers by 1988, to be followed in the early 1990s by deployment of 132 Advanced Technology--or "stealth"--bombers (ATBs). Given the promise of a capable ATB and the ability to upgrade the B-52 and air-launched cruise missile (ALCM) forces to provide some of the near-term capabilities of the B-1B, the Congress might elect to cancel the B-1B program.

Upgrading the B-52 and ALCM Forces. The United States could upgrade its existing bomber force by further improvements to B-52s so that more could be retained through the 1990s, and by converting them to carry more air-launched cruise missiles. In addition, the total number of cruise missiles could be expanded and the rate of buy maintained at current levels in the near term.

These actions, along with termination of the B-1B, would leave U.S. forces with about the same number of weapons before a Soviet first strike. After a Soviet attack without warning, this alternative would contribute 4 percent fewer warheads to U.S. retaliatory capability than the Administration's program in 1990, and 3 percent fewer in 1996. These differences would be smaller if the attack came after some warning. The difference occurs primarily because the B-1B would be better able to escape a Soviet attack on its bases than would the B-52, and because the newer force would presumably be able to sustain a somewhat higher peacetime alert rate.

Savings from Terminating B-1B. Stopping further production of the B-1B would cut costs. Even when offset by the added costs of improving the B-52 force and buying more cruise missiles, this alternative would save a total of about $12.8 billion in budget authority in 1984-1988 and $15.5 billion through the end of the century (see Summary Table 1). Critics of the B-1B argue that these savings may be needed, in a period of constrained defense budgets, to ensure that sufficient funds are available to develop and deploy the ATB, which they see as offering the greatest long-run promise.

Key Advantages of the B-1B. These cost and effectiveness differences do not necessarily capture the whole issue. For example, if the B-1B were canceled in favor of upgrading the current force of B-52 bombers and ALCMs, there would be only a modest reduction in warheads able to survive a Soviet first strike and retaliate. But this does not take into account the B-1B's greater ability to penetrate Soviet air defenses and deliver its warheads. Unclassified estimates of the B-1B's greater potential are not available, but it may be substantial.

The B-1B would also, as a new bomber, offer a hedge against the risk that the technically sophisticated ATB might not be developed on time or at a reasonable cost. Moreover, the B-1B would hold down the average age of the U.S. bomber fleet, leading to improved reliability and maintainability. By 1996, even with the ATB, the fleet would average 23 years without the B-1B, but only 14 years with it.

Finally, the B-1B could make a substantial contribution to U.S. nonnuclear forces. It would, for example, provide a highly capable aircraft for the long-range missions envisioned in support of the Rapid Deployment Forces.

CHAPTER I. U.S. PLANS FOR STRATEGIC FORCE MODERNIZATION

On October 2, 1981, President Reagan announced the most comprehensive and expensive plan for upgrading and expanding U.S. nuclear offensive and defensive forces since the strategic buildup that occurred in the late 1950s and early 1960s. This new modernization effort, requiring an estimated $250 billion during 1984-1988, would expand and modernize each of the three legs of the triad of strategic offensive forces: land-based missiles, submarine-based missiles, and bombers.

U.S. strategic forces are primarily intended to deter the Soviets from initiating a nuclear war. They are designed to survive a Soviet nuclear strike in numbers sufficient to retaliate in a manner deemed appropriate by the national command authority. In recent years, the Soviets have increased the numbers of their nuclear weapons and their capability to destroy some U.S. weapons in a first strike. The Administration feels that the United States must now expand and improve its forces and increase their capability of surviving a first strike. This means finding a way to deploy land-based missiles that would allow them to survive against more accurate Soviet land-based missiles, improving the abilities of U.S. bomber forces to evade increasingly sophisticated Soviet air defenses, and deploying more capable sea-based weapons.

The modernization plan has five elements: three deal with the land, air, and sea components of the strategic triad, and the other two with U.S. air defenses and strategic command and control. Because of their cost and importance, this study focuses on the first three components--the upgrading of the so-called strategic offensive forces.

The 98th Congress will face several fundamental decisions regarding strategic force modernization. These decisions will affect the composition and scope of the U.S. nuclear arsenal through the end of this century. This study begins by reviewing the Administration's proposals for modernization and the criteria for judging them (Chapter I). It then evaluates the strategic force buildup and the contribution of each of the components (Chapter II). The paper also analyzes the likely effects of arms-control agreements on overall force levels (Chapter III). Finally, it discusses three ways in which the Administation's program could be modified to reduce costs: by terminating the MX missile, by focusing on submarine-based missiles and forgoing modernization of the land-based leg of the triad, or by terminating the B-1 bomber program (Chapter IV). The study assesses the three alternatives in terms of their impact on force effectiveness, their costs, and their compatibility with arms-control agreements.

ADMINISTRATION PLANS FOR STRATEGIC OFFENSIVE FORCES

For more than two decades, U.S. nuclear offensive forces have consisted of the triad of land-based intercontinental ballistic missiles (ICBMs), long-range bomber and tanker aircraft, and submarine-launched ballistic missiles (SLBMs). All of these have been modified over the years for strategic and technological reasons. Even with continuous upgrading, however, the inventory is becoming old--based on outdated technology and limited in the extent to which it can incorporate further modifications.

Although replacement systems in all three areas have been suggested and developed during the last decade, major replacements have been undertaken only in the submarine fleet, where Polaris submarines are being retired as the new Tridents are introduced. The Administration's modernization plans call for a number of important changes in each of the three "legs" or parts of the triad. Table 1 shows the fielding dates of the current and projected inventory of nuclear weapons systems under the Administration plan.

The Intercontinental Ballistic Missile (ICBM) Force

U.S. land-based intercontinental ballistic missiles today include 1,000 Minuteman missiles and 47 Titan missiles. These are based in underground silos, mostly located in the midwestern United States. In recent years there has been rising concern that the Soviet Union, with its large and accurate ICBM warheads, could destroy most U. S. ICBMs during a nuclear first strike.

No part of the Administration's program has received more attention than its proposal to modernize the ICBM force by deploying the MX missile, possibly followed by deployment of a new, small ICBM. Considerable controversy has arisen over an appropriate basing system for ICBMs to ensure that a sufficient number of missiles could survive a Soviet first strike.

The problem of ensuring the survivability of U.S. land-based missiles began to arise as early as the mid-1960s, when Soviet deployment of the SS-9 ICBM pointed toward the day when--at least in theory--combinations

TABLE 1. STRATEGIC FORCES INVENTORIES FOR FISCAL YEARS 1983, 1990, AND 1996 (In the absence of nuclear arms-control limits) a/

Inventory	First Deployment	End of Fiscal Year		
		1983	1990	1996
Land-Based Missile Force				
Titan	1962	43	0	0
Minuteman II	1965	450	450	450
Minuteman III	1970	550	450	450
MX	1986	0	100	100
SICBM	1993	0	0	1,000
Bomber Force				
FB-111	1969	56	56	0
B-52 G	1959	170	105	0
B-52 H	1961	96	96	96
B-1B	1986	0	100	100
ATB	1991	0	0	132
Submarine Force b/				
Poseidon (C-3)	1971	19/304	19/304	8/128
Poseidon (C-4)	1979	12/192	12/192	5/80
Trident (C-4)	1982	3/72	8/192	3/72
Trident (D-5)	1990	0/0	4/96	16/384

a/ A detailed description of force structure evolution is contained in Appendix B.

b/ Values show numbers of submarines/launchers, and dates indicate missile deployment dates.

THE ICBM FORCE

Titan II. Introduced in 1962, the 47 operational Titan IIs are the oldest ICBMs in the U.S. inventory, and the only liquid-fueled ones. Each carries a single, large-yield, relatively inaccurate warhead. These are to be retired by the end of fiscal year 1987. According to present plans, their silos will be maintained in a caretaker status.

Minuteman II. The 450 single-warhead Minuteman IIs were deployed starting in 1965. Their warheads are relatively large but inaccurate.

Minuteman III. At present, the only operational U.S. ICBMs equipped with multiple independently targetable reentry vehicles (MIRVs) are the 550 triple-warhead Minuteman IIIs, of which 250 carry the Mk 12 warhead and 300 the higher-yield and more accurate Mk12A.

The MX. The MX missile is considerably larger than Minuteman, more than tripling the throwweight and doubling the accuracy of its predecessor. One MX can deliver up to ten Mk 21 warheads. Initially the Administration plans to field 100 MX in existing Minuteman silos starting in 1986. Additional MX missiles could be deployed at a later date.

The SICBM. Administration plans call for engineering development on a new, small ICBM (SICBM). It would probably be about half the length of the MX missile and weigh only 15 percent as much. It would carry a single warhead, probably have the accuracy needed to destroy hardened targets, and--by virtue of its small size--be deployable in a variety of fixed and mobile modes. Initial operational capability could come in the early 1990s.

of larger warhead yields and improved ballistic guidance systems would place all but the hardest of fixed installations at risk. 1/ In 1972 the Air Force developed a requirement for a new ICBM--known as the MX--that not only would be capable of destroying targets hardened against nuclear blasts but would itself be able to survive a similar attack. The linkage between the MX missile and its basing was forged at the outset. 2/

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1. See Office of Deputy Undersecretary of Defense for Research and Engineering (Strategic and Space Systems), ICBM Basing Options, December, 1980, p. i. The "hardness" of an installation refers to its ability to withstand nuclear effects, primarily blast and overpressure.

2. See House Appropriations Committee, DoD Appropriations for FY 1983, 97:2, Part 4, February 25, 1982, p. 611.

Each Administration since the mid-1970s has wrestled with the problem. Over 30 possible deployment plans have been examined; each has been rejected, either because it was not cost-effective, was not politically feasible, or would alter the unique contribution of land-based missiles to the triad. In 1979 the Carter Administration, believing it had a workable plan, proposed deployment of 200 MX in the multiple protective structures (MPS) mode. This proved controversial because it would have required a vast land area and prevented access to natural resources where it was located. It also suffered from its association with the SALT II agreement. The Reagan Administration cancelled MPS in 1981, citing these factors plus its belief that MPS would not be survivable. Instead it called for examination of a number of basing proposals and a choice of one by 1984, while in the interim deploying 40 MX missiles in Minuteman silos. In the fall of 1982, the Administration--directed by the Congress to find a survivable basing mode for the MX--announced its decision to deploy 100 MX in the closely spaced basing (CSB)--or "Dense Pack"--mode. CSB also became highly controversial, again because of the survivability issue.

The long-standing problem of finding an acceptable ICBM basing mode led the Congress, in the 1983 Defense Appropriations Act, to require that the Administration reexamine virtually the entire concept of land-based missiles and specifically revisit the MX basing decision. In response, the Administration convened the President's Commission on Strategic Forces to provide recommendations on a long-term course of action.

Based primarily on the Commission's recommendations, the Administration has proposed a multi-faceted approach to modernizing the land-based missile force. 3/ Initially 100 MX missiles would be deployed in existing Minuteman ICBM silos, starting in 1986. Engineering design on a new, small ICBM (SICBM) would begin almost immediately, leading to full-scale development in 1987. Additional research would be done on basing alternatives for the SICBM and on the superhardening of missile silos. Depending on the results of these research efforts, as well as on the status of the arms control process and the Soviet missile threat, a decision would be made later either to proceed with the deployment of additional MX missiles in superhardened silos (possibly in a CSB-like system) or to move ahead with the SICBM. Should the latter course be chosen, a decision would then be made on whether to base the new missile in superhardened silos (perhaps with additional silos for deception), in a mobile mode, or in a combination of fixed and mobile basing. Once again, the decision would hinge on the results of research and development and on the status of the

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3. For details see the Report of the President's Commission on Strategic Forces (April 1983).

strategic balance at the time. Ballistic missile defense might also be incorporated, if one of the non-mobile basing modes was chosen. Deployment of the new ICBM could begin in the early 1990s.

Because of the uncertainty surrounding the ultimate size and shape of the future ICBM force, it is difficult at this time to characterize the outcome of the Administration program. In order to illustrate its potential effects, this study assumes that a new, small ICBM will be chosen for development, and that 1,000 of these SICBMs will be ultimately deployed in a land-mobile mode. 4/ The study assumes that the total system would provide approximately 600 surviving warheads after a Soviet first strike. 5/ This is also similar to estimates attributed to the Air Force for MX in CSB. Appendix A discusses the parameters that are important in designing such a system and their relation to the system's size, cost, and political feasibility. Further details are included in the discussion of alternatives to the Administration's approach in Chapter IV.

The Administration's plan would continue to maintain the remaining force of 900 Minuteman missiles. It would also continue retiring the 47 older, single-warhead Titan missiles during the early and mid-1980s.

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4. This assumption is based on the force size used in the DoD Strategic Forces Technical Assessment Review of March 31, 1983.

5. General Brent Scowcroft, Chairman of the President's Commission on Strategic Forces, and Dr. Harold Brown, former Secretary of Defense and a consultant to the commission, testified before the Senate Armed Services Committee on April 18, 1983, that it would not be feasible to deploy the SICBM in the present arms-control environment because of the staggering costs of the number of missiles required and the extensive use of non-military land in peacetime. CBO has estimated that, given an illustrative arms-control-constrained threat of 2,000 half-megaton weapons, a system of 1,000 mobile launchers hardened to approximately 30 psi (as indicated in the DoD Strategic Forces Technical Assessment Review of March 31, 1983), and deployed on approximately 17,000 square nautical miles of available military land in the west would provide about 600 surviving warheads. (See Appendix A for details.) CBO has assumed that if a decision was made to deploy the SICBM in the early 1990s, even in the absence of an arms-control agreement that would limit the threat, the decision would be made to incur the financial or environmental costs necessary to provide about this level of survivability. For example, doubling the size of the threat would require roughly twice as much land area, meaning the addition of non-military property.

The long-run costs of the ICBM modernization program are difficult to assess because the nature of the follow-on missile has yet to be determined. Deployment of 100 MX in existing silos would, however, cost $18.4 billion.

The Strategic Bomber Force

At the end of 1983, U.S. bomber forces will consist of about 266 B-52s, 56 smaller FB-111s, and about 500 air-launched cruise missiles. The bombers were designed to penetrate Soviet air defenses and deliver bombs or short-range attack missiles. With their improving air defenses, however, the Soviets may have become capable of destroying many of these aircraft before they reach their targets.

In response, some B-52s are being refitted to carry air-launched cruise missiles that can be delivered at long distances from the target, thereby avoiding most of the air defenses. Cruise missiles would complicate Soviet air defense problems by presenting large numbers of small targets. The Administration believes however, that it is necessary to maintain an ability to penetrate Soviet air defenses with a manned bomber as well. Such a capability would be useful in attacking mobile targets and in other missions where a manned system is preferable. Accordingly, it proposes to deploy two new bombers. 6/

Indeed, this is the most expensive set of proposals in the Administration plan. The Department of Defense estimates the investment and operating costs over the six-year period 1982-1987 at $63 billion in 1982 dollars. 7/ One hundred new B-1B bombers would be fielded in the mid-1980s, followed by 132 Advanced Technology Bombers (ATB)--also known as "stealth" bombers--starting in the early 1990s. 8/ Additionally, the Administration would deploy 3,200 air-launched cruise missiles (ALCMs), carried initially on B-52 bombers refitted for this mission, and eventually on the B-1B. The Administration further proposes to develop and deploy a longer-range advanced cruise missile, also having stealth characteristics, which would

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6. The Congress, in the DoD Appropriations Act for Fiscal Year 1981, directed the DoD to field a new manned bomber by 1987.

7. CBO estimates of the costs of selected parts of the Administration's plan are presented in Chapter IV.

8. See remarks of Senator Carl Levin, Congressional Record, December 3, 1981, p. S14378.

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THE BOMBER FORCE

FB-111A. A medium bomber first introduced in 1969, the FB-111A is expected to remain on duty as a strategic asset through the 1980s, and to phase into a tactical role in the early 1990s.

B-52G. Delivered between 1959 and 1961, the B-52Gs have received extensive structural and avionics modifications over the years. Equipping of 105 B-52Gs to carry 12 cruise missiles (ALCMs) on external wing pylons will be completed by the end of 1984. The remaining B-52Gs will probably retain their nuclear roles until the late 1980s, and will also become the primary conventional/maritime support force. The ALCM-equipped B-52Gs will probably also carry nuclear bombs and short-range attack missiles until the B-1B becomes available to take over part of the penetrator role. Used thereafter as standoff ALCM carriers, these B-52Gs would probably be retired in the 1990s.

All B-52s will receive hardening against electromagnetic pulse (EMP), avionics upgrades like the Offensive Avionics System (OAS), new radio receivers, and updated electronic countermeasures equipment.

B-52H. These were delivered between 1961 and 1962. Beginning in 1985, all 96 B-52Hs are slated for modification to carry ALCMs externally--like the B-52Gs--as well as eight missiles internally. While continuing their role as penetrating bombers into the late 1980s, these aircraft would begin taking on more of a cruise missile carrier role as newer bombers are fielded.

B-1B. Although similar to its predecessor, the cancelled B-1A, the B-1B will be a subsonic aircraft with better range and payload characteristics. It will have offensive avionics systems like those being installed on the B-52G/H, updated engines, and lower radar detectability. It will penetrate Soviet air

make up about one-half of the total cruise missile force mentioned above. It would also re-engine a large portion of the KC-135A tanker fleet, thus increasing U.S. ability to refuel bombers in midair and so extend their range.

The major intent of the two-bomber program is to ensure the capability for penetration of Soviet air defenses. The B-1B, with its smaller radar detectability and improved countermeasures, should provide such a capability into the 1990s, according to Administration spokesmen. It would be a very capable conventional bomber as well. The ATB or "stealth" bomber should provide a follow-on capability even in the face of improving Soviet air defenses.

defenses into the 1990s, and then will have cruise missiles added to its weapons mix when the Advanced Technology Bomber is fielded. The first B-1Bs would be delivered in 1985, and all 100 would be in the inventory by 1988.

Advanced Technology Bomber (ATB). The ATB, or "stealth" bomber, incorporates material and design technologies that would make detection by radar and infrared sensors quite difficult. The Administration chose the ATB program as the second part of its two-bomber modernization approach. It will be fielded starting in the early 1990s, with an ultimate force size of 132. Details are classified.

Air-Launched Cruise Missile (ALCM). The ALCM is a small, low-flying, nuclear-armed, unmanned aircraft to be carried by B-52 and B-1B bombers. Launched hundreds of miles from its target, it guides itself by comparing topographical features measured in flight with preprogrammed terrain information. The Administration plans to purchase a total of 3,200 ALCM of all types, which will provide about 2,880 deployed missiles--somewhat fewer than planned by the previous administration. This plan also represents a decrease of about 900 deployed missiles as against the Administration's 1983 program. The plan includes the substitution of an advanced cruise missile (ACM) starting in the mid-1980s, which reportedly will have longer range and even lower radar detectability than its predecessor. About half of the total inventory would eventually be this new ACM.

Short-Range Attack Missile (SRAM). Deployed in the early 1970s, these short-range nuclear-armed missiles can be launched from penetrating bombers to suppress enroute air defenses and to attack--from a distance--targets having their own air defenses.

The Sea-Based Strategic Force

At present the U.S. force of submarine-based missiles consists of 31 Poseidons, each carrying 16 missiles, and 2 Trident submarines each carrying 24 missiles. At any one time, about half of these are at sea and on patrol. Through the 1990s, at least, the U.S. strategic submarine force is expected by many to remain undetectable by the Soviets and thus invulnerable to attack. The Administration seeks to capitalize on this invulnerability by increasing submarine-based capability.

Probably its most important proposal for the sea-based force is to develop and deploy the large, accurate Trident II (D-5) missile--starting in

THE SEA-BASED FORCES

Poseidon Submarines. Of the 31 Poseidon submarines, 12 have been converted from carrying the Poseidon (C-3) missile to the newer, more accurate, longer-range Trident I (C-4) missile. The Navy plans to operate its 31 Poseidon submarines well into the 1990s, for an average lifetime of about 30 years.

Trident Submarines. The newest addition to the ballistic missile submarine (SSBN) fleet is the Trident submarine. Considerably larger than the Poseidon, it has 24 launch tubes (instead of 16) that are larger than those found on any previous U.S. SSBN. The first Trident, USS OHIO, made its initial patrol in the fall of 1982. The second, USS MICHIGAN, is scheduled to deploy in the summer of 1983.

Ten of these submarines have been authorized through fiscal year 1983. Long-lead funds have been authorized for two more. The Administration projects a procurement rate of one submarine per year. The Navy plans to base the first ten Tridents in Bangor, Washington, and is building a second Trident base at King's Bay, Georgia. This study, therefore, assumes that two squadrons of ten SSBNs each will be deployed.

The first eight Trident submarines will be initially fitted with the Trident I (C-4) missile. During their first regular overhaul periods they will be converted to carry the larger Trident II (D-5) missile. All Tridents after number 8 will have the Trident II missile system installed during construction.

1989--as the follow-on SLBM for the fleet of new Trident submarines. This missile would take full advantage of the large missile launch tubes on the new submarines, which the Administration plans to procure at the rate of one per year over the next five years. By the end of 1983, three of these will have been delivered to the Navy. An ultimate goal for the size of the Trident force has not been stated publicly, but CBO assumes for the purposes of this study that the force will reach 20. 9/ Additionally, the Administration would begin deployment of a limited number of nuclear-armed, sea-launched cruise missiles (SLCMs) on selected nuclear-powered

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9. See testimony of Rear Admiral William A. Williams III, USN, Subcommittee on Strategic and Theater Nuclear Forces, Senate Armed Services Committee, "Strategic Force Modernization Programs," October,1981, 97:1, p. 175.

Poseidon (C-3) SLBM. The oldest deployed submarine-launched ballistic missile (SLBM), the 2,500-mile-range Poseidon (C-3) was introduced in 1971. It can deliver ten relatively low-yield warheads, and is carried on 19 Poseidon submarines.

Trident I (C-4). Twelve Poseidons carry the longer-range--4,000 miles--Trident I (C-4) missile, introduced in 1979. Each of the first eight Trident SSBNs will carry the C-4 for their first nine years of service until it is replaced by the Trident II (D-5). The Trident I can deliver eight warheads.

Trident II (D-5). The D-5 missile--to be deployed starting in 1989--will be significantly larger than its predecessor, the C-4, and will have a greater payload capability (up to 75 percent more than C-4), much better accuracy, and comparable range at maximum load. It is assumed to carry up to eight Mk21 reentry vehicles (RVs) to 4,000 miles and have an accuracy approaching 400 feet circular error probable (CEP). This accuracy, together with the yield of the Mk21 warhead, will give Trident II "hard-target" destruction capabilities.

Sea-Launched Cruise Missile (SLCM). The Administration plans to deploy approximately 400 nuclear-armed Tomahawk land attack cruise missiles aboard some Los Angeles-class (SSN 688) attack submarines and selected surface ships beginning in 1984. These nuclear-armed SLCMs will be assigned to a non-primary nuclear targeting role.

attack submarines and surface ships, starting in 1984. The Department of Defense estimates the cost of all these efforts in the period 1982-1987 at approximately $42 billion (in 1982 dollars) for investment and operations. 10/

MEASURING THE NEED FOR U.S. STRATEGIC FORCES: HOW MUCH IS ENOUGH?

The U.S. Buildup

If the program just described is carried out, U.S. strategic offensive forces will be expanded and modernized substantially over the next 10 to 15

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10. Note that, as with the bomber and ICBM forces, significant costs would be incurred beyond this period for both procurement and operations and maintenance.

years. Specifically, the count of warheads on all U.S. systems, before any losses in a Soviet first strike, totals about 8,800 in 1983. That number would grow--in the absence of arms control limits--to about 14,000 by 1990 when the MX missile and B-1B bomber would be deployed, and, after further modest growth in the early 1990s, level off again in 1996 when all the programs described above would be completed. Other numerical measures and scenarios may be considered, and these are discussed more fully in the next chapter. But this rough measure suggests the degree of the planned U.S. expansion.

It is important to consider the context within which the Administration plan is presented. One part of that context is the magnitude of the Soviet buildup in strategic weaponry over the past two decades, coupled with a developing U.S. understanding of the Soviet doctrine for employing those forces. Another part--of perhaps greater importance--is the change in the belief about what is needed to deter the Soviets, especially in view of their expanded forces.

The Soviet Buildup

Since the early 1960s, the Soviets have been consistently building up their strategic offensive and defensive forces, in terms both of quantity and of capability. 11/ The centerpiece of this effort has been their ICBM force. Over the past ten years, for example, they have developed and deployed three new ICBMs capable of carrying multiple warheads--including the world's largest deployed ICBM, the SS-18. Ongoing modification and improvement programs have increased the accuracy of these missiles to the point that a fraction of them could, in theory, destroy most of the Minuteman force of land-based missiles in the United States. Recently the Soviets have begun testing two new solid-propellant ICBMs (one of which could be deployed in a mobile mode). They may soon begin testing follow-on versions of their existing SS-18 and SS-19 missiles.

The Soviets have also deployed a substantial sea-based force, recently augmented by installation of the multiple-warhead SS-N-18 missile on relatively new Delta III submarines. By the end of 1983, they will begin to field their newest, longest-range submarine-launched ballistic missile, the SS-NX-20, on their new large submarine, Typhoon. A follow-on submarine-launched ballistic missile will probably begin testing in 1983.

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11. Much of the material in this section is drawn from Department of Defense, Soviet Military Power 1983 (Government Printing Office, 1983).

Although the Soviet strategic bomber force does not have the prominence of its U.S. counterpart, it is also undergoing modernization with the addition of the Blackjack A bomber, expected to be deployed by the mid-1980s. A multi-role aircraft similar to but larger than the B-1B, the Blackjack may carry a new, long-range air-launched cruise missile that could be deployed at about the same time.

By these actions the Soviets have, within the past eight or ten years, more than quadrupled the number of nuclear warheads in their strategic offensive forces. The vast majority of these warheads are carried on systems that are less than ten years old, while replacement systems appear with regularity. CBO estimates that, in the absence of arms-control limits, the Soviets could more than double their current strategic inventory of nearly 9,000 strategic warheads by the mid-1990s, most of which would be capable of attacking targets hardened against nuclear blast (see Appendix C for details).

In addition to expanding its offensive capability, the Soviet Union has developed an extensive active and passive strategic defensive system. To counter U.S. strategic bombers, it has deployed a very large air defense network of radars, surface-to-air missiles, and interceptor aircraft. Soviet civil defense efforts are also significant, with heavy emphasis on protecting the country's leadership in numerous hardened and dispersed shelters.

These substantial efforts have seriously eroded the survival prospects of U.S. land-based missiles and undercut the ability of bomber forces to operate against Soviet air defenses. The efforts of the past decade have also left the Soviet Union with a more modern force, with all the advantages that new-generation systems have over those they replace.

The Deterrent Capability of U.S. Strategic Forces

These numerical comparisons are useful in providing a picture of the strategic competition between the United States and the Soviet Union, but they do not suffice to show whether U.S. strategic forces are strong enough to carry out their primary mission: to deter the Soviets from venturing upon nuclear war or using their forces to coerce the United States. The measure of deterrence is more than numerical; it requires a judgment as to the retaliatory capability that would be necessary to convince the Soviets of the futility of using their nuclear forces.

Over the years, that judgment has changed. Through the early 1950s, when nuclear weapons were in limited supply, U.S. retaliatory plans called for striking 100 urban areas with up to 300 weapons. 12/ Under the mutual assured destruction (MAD) philosophy of the 1960s and 1970s, deterrence was based on the threat of inflicting "unacceptable damage" on the Soviet Union in response to an attack. Although early in this period the Department of Defense contended that as few as 400 one-megaton weapons could do the job, by the mid-1970s the task expanded such that about 25,000 potential targets had been identified. Some maintain that this increase primarily reflected the growth in the number of U.S. warheads during this period. They contend that the number of significant targets was actually many times fewer than 25,000. 13/ Others hold that as U.S. retaliatory strategy evolved from one aimed primarily at destroying cities to one aimed primarily at destroying the Soviet military and economic base, more facilities became potential targets, many of which were more difficult to destroy.

In the past few years, dependence on MAD alone has lost its credibility, in the view of many, as an acceptable strategy for deterring the Soviets. Opponents of MAD argue the need to respond in more flexible, perhaps limited, ways to Soviet initiation of nuclear war. They hold that the capability to do so might be critical in deterring the Soviets from launching a nuclear conflict or seeking leverage in regional situations through "nuclear blackmail." Some contend that Soviet military writings demonstrate a belief that nuclear conflict could begin with a series of limited strikes and counterstrikes against military targets, such as missile silos or command bunkers, most of which are heavily hardened against nuclear attack. Those advocating a strengthening of U.S. capabilities to wage a nuclear war of this type argue that a president faced with a limited strike against a few military targets might not be willing to unleash a massive U.S. counterattack knowing that it would call forth a similar massive response from the Soviets. If the Soviets were to believe that the United States would be so paralyzed, they might not be deterred from launching a limited strike.

The need for a choice of ways to respond to a limited strike, while also maintaining the capability for a massive strike, has increased the demands placed on nuclear weapons in two ways. First, the number of

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12. For details see Thomas Powers, "Choosing a Strategy for World War III," The Atlantic Monthly (November 1982), p. 91.

13. Ibid., p. 109. Note that the number of targets is not necessarily synonomous with the number of weapons needed to attack them successfully.

potential targets in the Soviet Union included in U.S. targeting plans has continued to grow, and is now estimated by some to be over 40,000. (Added types of targets include key communications nodes, military and political headquarters, war-supporting industries, storage sites for nuclear weapons, and rear-area conventional military support.) 14/ Second, new attack strategies have been created that place greater operational demands on the forces, such as the capability of being employed over a protracted period of time in many and highly selective attack options. 15/ These added demands are responsible in part for the Administration's plans to add more warheads and make those warheads better able to attack hardened targets. More important, these added demands motivate U.S. efforts to field systems that will be more survivable. Greater survivability would lower Soviet confidence in the success of a first strike and lower the U.S. inventory necessary to accomplish targeting objectives.

Nevertheless, some do not agree that changes in strategic doctrine, with attendant demands for more and better weapons, are needed to deter nuclear war. They argue, for example, the implausibility of limited nuclear war or the need for striking small, selected sets of targets. Instead, they contend that simpler, more direct approaches might deter, such as ensuring great damage to the things the Soviets value most highly, like their political leadership structure. Still others argue that just having the capability to destroy a large part of an opponent's cities and industrial facilities would deter. 16/ By this last metric, both the United States and the Soviet Union have many times the numbers of nuclear warheads needed.

This paper does not try to measure the deterrent capability of the Administration's program or of alternatives to it. Instead, CBO estimates the effects of different programs in terms of changes in U.S. strategic weapons inventories, a method of judging capabilities frequently used by the Department of Defense. The strengths and limitations of this method are described in the next chapter, as are some of the qualitative features of the Administration's plan that cannot be captured in quantitative terms.

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14. For details see Desmond Ball, "U.S. Strategic Forces: How Would They Be Used?" International Security, vol. 7, no. 3 (Winter 1982/1983), p. 36.

15. Ibid., p. 37.

16. See, for example, Maxwell D. Taylor, "Build Up the Forces We Really Need," Washington Post, March 6, 1983, p. C8, and Stansfield Turner, "The 'Folly' of the MX Missile," New York Times Magazine, March 13, 1983, p. 84.

CHAPTER II. WHAT MODERNIZATION WOULD ACCOMPLISH

The Administration's strategic force modernization plan would provide for a substantial increase in nuclear weapons over the next decade. Inventories of surviving warheads--that is, the numbers expected to survive a Soviet first strike--would increase by approximately 55 percent, while surviving warheads capable of attacking hardened targets would nearly quadruple between 1983 and 1996. Older warheads would be substantially replaced by new, larger, and more accurate warheads, particularly in the submarine force. Though there would be fewer submarines in 1996 than today, most would carry the larger D-5 missile, which can deliver larger and more accurate warheads. The bomber force would also be substantially modernized, as would the ICBM force although to an uncertain degree.

All the analysis in this chapter assumes that the Administration's program would not be constrained by any arms-control limits. The Administration has, however, proposed substantial reductions in the nuclear arsenals of both sides, and the potential effects of such reductions are the subject of the next chapter.

In making this study, CBO developed several computer models, primarily to assess the potential effect of a Soviet strike on the survival prospects of U.S. forces. The assumptions used in that analysis, together with a description of the study methodology, are contained in Appendix D.

METHOD FOR MEASURING THE BUILDUP

In quantifying the nuclear buildup that would result from the Administration's plan, CBO used certain measures of effectiveness that need to be precisely defined. The study also made certain assumptions about force postures--or scenario conditions--that can greatly affect the analysis.

Specific Measures Used

The primary measures of effectiveness used in this study are numbers of warheads and numbers of hard-target warheads. 1/ Each is described in detail below.

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1. CBO also investigated other measures for their usefulness in describing the capabilities of a nuclear arsenal. One such measure,

Warheads. One of the more elemental units of measure is warhead count, which indicates the potential number of targets that can be struck. 2/ If targets were highly susceptible to nuclear effects and not very large in area--like military supply depots--then warhead count would also serve as a final measure of destructive capability. Such targets are called "soft point" targets. But many targets are not as easily susceptible to nuclear blast. For these targets, destructive capability also depends on the yield of the warhead and the accuracy with which it is delivered. For these reasons, warhead count must be supplemented by more specialized measures. Counts of surviving warheads used in this study are provided in the context of what U.S planners could expect to have available for use in a retaliatory strike. 3/

Hard-target Warheads. Hard-target warheads are those capable of destroying targets specifically designed to withstand nuclear effects. A substantial number of key Soviet installations could be classified as hard targets, among them ICBM silos and many command and control facilities. In this study, hard-target warheads are defined as those with at least a 50 percent probability of destroying a nominal target hardened to withstand 4,000 pounds per square inch of static overpressure. 4/ This hardness is

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adjusted equivalent megatonnage (AEMT), is an estimate of the potential ability to destroy targets dispersed in area and relatively susceptible to damage by nuclear weapons. The investigation demonstrated that the mix of yields in the current and projected U.S. arsenals is such that AEMT correlates well with warhead counts, and so AEMT is not discussed further.

2. More correctly, this is "aim points" struck, since more than one target might be damaged by a properly placed weapon, or more than one weapon might be required to destroy a single target.

3. Counts of pre-attack warheads, unless otherwise noted, also take into account system availability factors.

4. This hardness value is representative of published estimates for modern Soviet ICBM silos. See Aviation Week and Space Technology (October 12, 1981), p. 22. A single-shot probability of destruction of 0.5, compounded for two weapons, provides a two-shot probability of destruction of 0.75. After allowing for the probability of weapon arrival, this would probably provide a reasonable level of damage expectancy. Testimony from the Joint Chiefs of Staff and the Department of Defense indicates that all of the U.S. weapons that CBO assumes to be hard-target weapons are indeed capable against hardened Soviet targets.

likely to characterize many Soviet military targets. Hard-target warheads may also, of course, be used against other, less fortified targets.

At times hard-target warheads are differentiated as "prompt" or "non-prompt" in an effort to distinguish other capabilities. Prompt capability usually includes weapons on land-based ICBMs that could be used in an immediate counterstrike on Soviet targets. Non-prompt weapons include those on bombers, which would take hours to travel to their destination, and some on submarines, which might be delayed because of the time required to communicate with the submarines.

Scenario Conditions

A major objective of strategic force modernization efforts is to improve the survival prospects of current and future forces. The buildup must therefore be measured in terms of the conditions likely to precede and accompany nuclear conflict. These can be summarized in "scenarios" of attack and response. In this study, CBO considered several scenarios involving a Soviet attack against U.S. forces. (Details on the scenarios are presented in Appendix D.) Two important scenario-related variables were examined:

Measurement of Weapons Inventories. Because it is U.S. policy to use strategic nuclear forces only in retaliation for a strike on the United States, post-strike inventories of weapons are an important measure of capability. Post-strike inventories not only measure expectations as to the survivability of U.S. forces but also incorporate the capabilities of attacking Soviet forces. 5/ Pre-strike inventories are also useful, however, especially in arms-control discussions.

Warning of an Attack. A Soviet first strike might come as a total surprise, or "bolt out of the blue," though this is widely regarded in the technical community as less likely than an attack for which there has been some warning. In a surprise attack, fewer forces would survive, since fewer are on "alert"--that is, poised to react promptly to escape a Soviet attack.

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5. The analysis assumes that U.S. ICBMs are launched neither on warning of a Soviet attack nor during the course of an attack. Since it is not U. S. policy to rely on launching its land-based missiles in such a manner--although it maintains the option to do so--this analysis assumes that the ICBMs would "ride out" the Soviet attack before retaliating. Launching sooner would likely provide more surviving capability, but at possibly greater risk of misuse.

Only about a third of the bomber force and half of the strategic submarine force is on alert in peacetime; those systems not on alert--as well as those in overhaul--would presumably be destroyed at their bases within minutes of a Soviet first strike.

It is generally considered that a nuclear attack would be more likely to come after a period of tension or perhaps limited hostilities, during which time both parties would have an opportunity to increase the readiness of their strategic forces. Under these circumstances, more U.S. forces would survive, even in the face of a larger attacking Soviet arsenal, since on-line bombers and submarines could be brought to a war footing to escape destruction. (Appendix E presents a detailed discussion of the survival prospects for the bomber force.)

Limitations of the Measures

When using numbers of warheads to assess the capabilities of forces surviving an attack--either a surprise attack or an attack with warning--some limitations should be kept in mind.

- This study assumes that none of the U.S. strategic submarine forces at sea are destroyed in an attack. Most would agree with this assumption for the 1980s, and Administration spokesmen have indicated that it is a reasonable assumption through the 1990s. 6/

- As is the case with most other studies of this type, CBO assumes that the command and control system would be able to direct U.S. forces to retaliate in the desired manner after a Soviet first strike. If it could not, large portions of U.S. forces could be rendered useless.

- CBO has estimated the numbers of weapons that would be available for launch after a Soviet first strike, not those that might be expected to arrive on target. Thus, the effects of Soviet air defenses against U.S. strategic bombers are not incorporated; neither are the possible effects of antiballistic missile systems against ballistic missile warheads.

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6. This assumption is based on numerous citations of this assessment. See, for example, the testimony of Secretary of the Navy John F. Lehman, Jr., before the Senate Defense Appropriations Subcommittee, March 8, 1983.

- For the strategic bomber forces, no attempt is made to account for the effects of Soviet attack on aerial tankers. Bombers are severely restricted in their scope of action if they are unable to receive aerial refueling.

The effects of these limitations are discussed in more detail where-ever they might influence the choice among alternative systems.

ASSESSING THE QUANTITATIVE EFFECTS OF THE ADMINISTRATION'S PLAN

Substantial Expansion in Capability After an Attack with Warning

Expansion in Warheads. The increase in U.S. capability associated with the Administration's plan varies with the scenario for the nuclear conflict. As a base case, this study begins with one plausible scenario, which assumes that nuclear war starts after a period of warning that allows U.S. forces to be on alert. The Soviets launch a first-strike attack, and only warheads that survive the attack are counted.

Under this scenario, the Administration's program would substantially increase total numbers of surviving warheads available for a retaliatory strike. From a 1983 level of about 6,000, the expected number of surviving warheads would grow to 9,900 by 1990--an increase of 65 percent--and then decline slightly to 9,300 by 1996 (see Figure 1). The modest decline in the mid-1990s reflects planned retirement of some older submarines.

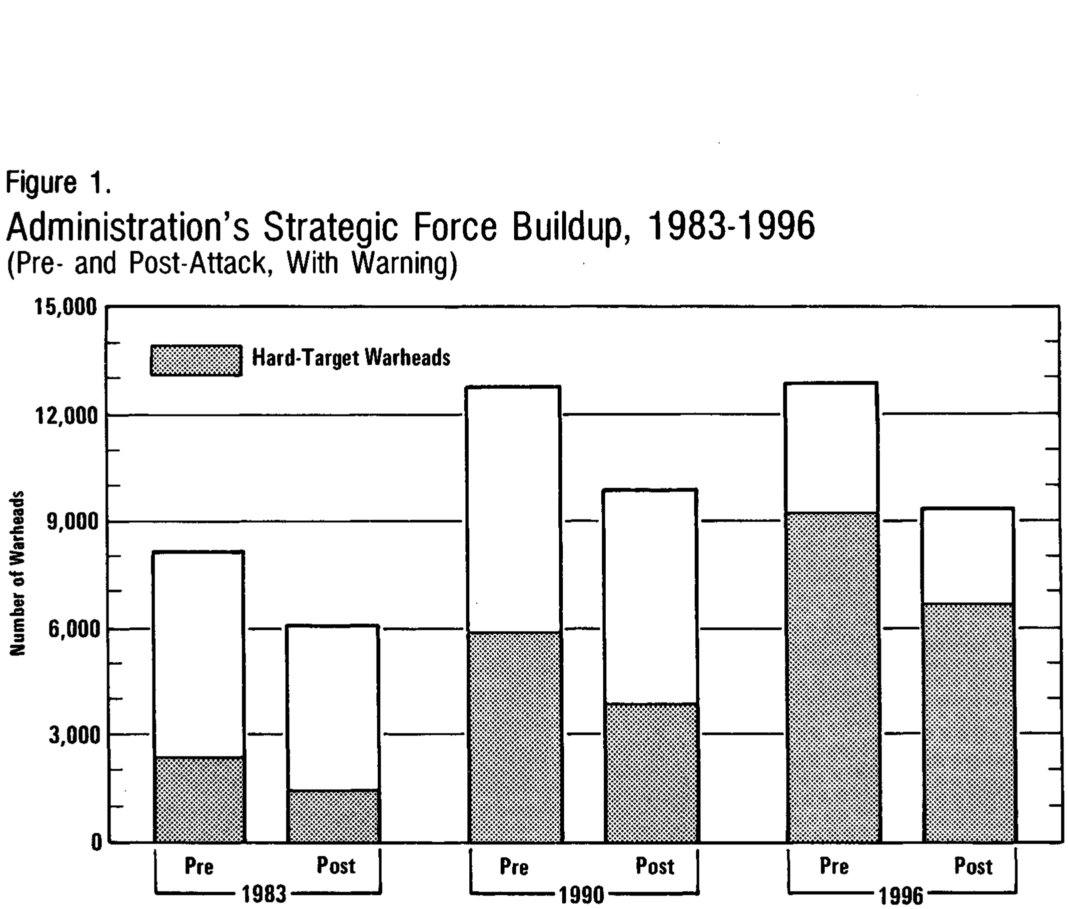
Along with the increase in warheads, a nearly complete modernization of weapons would take place by the end of the century. For example, by 1996 in the sea-based forces, the large accurate Trident II (D-5) missile would replace almost all currently deployed SLBMs. Trident submarines would take the place of most of the existing Poseidon submarines. The strategic bomber fleet of B-1B and Advanced Technology Bombers would replace nearly the entire current inventory of long-range bombers. And while the plan apparently does not call for a large-scale replacement in the ICBM force, more MX missiles or a new, small ICBM would eventually make up a significant fraction of that force.

Growth in Hard-Target Weapons. While warhead counts would grow sharply, a more significant increase would occur in surviving warheads able to destroy hard targets (the shaded portions in Figure 1). Surviving hard-target warheads would rise from 1,400 in 1983 to 3,900 by 1990--an increase of over 175 percent--and to 6,700 in 1996, an increase of over 375 percent. The dramatic growth from today's low levels would occur because all the

Figure 1.

Administration's Strategic Force Buildup, 1983-1996

(Pre- and Post-Attack, With Warning)



SOURCE: Congressional Budget Office.

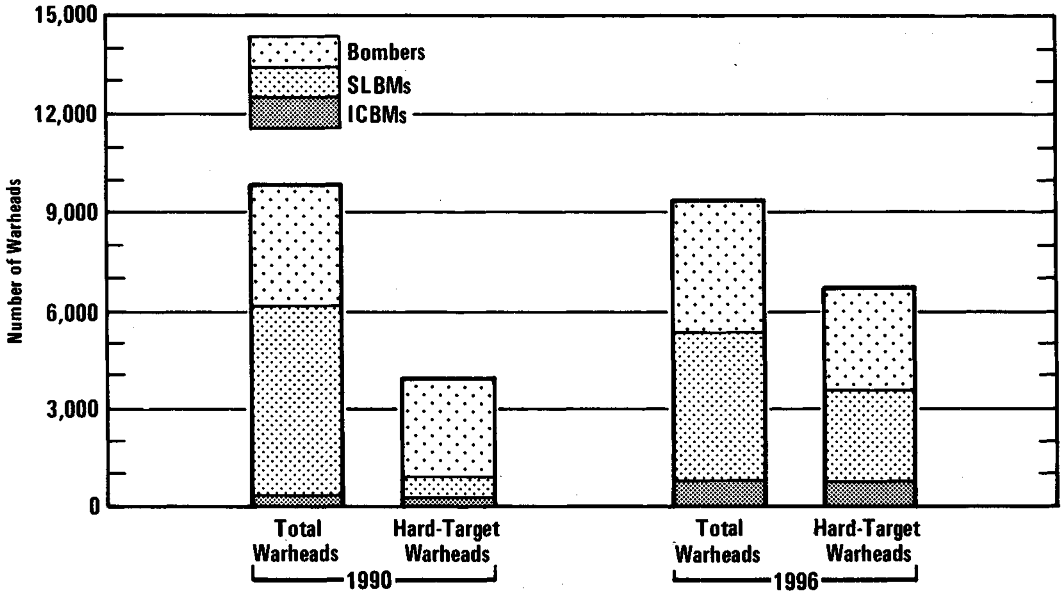
new systems noted in the first chapter--B-1B, ATB, cruise missiles, MX, SICBM, and Trident II--would be able to deliver warheads capable of destroying hard targets, and also because of the general trend toward better survivability.

As noted in Chapter I, this buildup in hard-target capability reflects both technological progress, which makes possible improving the accuracies of existing and future systems, and heightened interest in hard-target weapons as critical to deterrence in the future.

Buildup Concentrated in Bomber and SLBM Forces. The buildup in surviving warheads and in hard-target weapons would be most substantial in the bomber and submarine forces, as can be seen in Figure 2. Hard-target weapons illustrate the point. Today, virtually all surviving hard-target weapons are carried by bombers. Although about one-third of the existing Minuteman land-based missiles have weapons that could destroy hard targets, they are thought to be vulnerable to a Soviet first strike; submarines have no hard-target weapons. In contrast, by 1996 all three of the

Figure 2.

Contribution of Triad Elements Under the Administration's Program, 1990 and 1996 (Post-Attack, With Warning)



SOURCE: Congressional Budget Office.

triad forces would provide surviving hard-target weapons, with Trident II contributing, for the first time, significant hard-target capabilities. The contribution of the land-based missile force seems likely to remain relatively small. The bulk of surviving hard-target weapons would be carried by the bomber force and submarine force.

More Substantial Expansion in Prompt Hard-target Weapons. The initial deployment of MX and subsequent land-based systems might, however, provide a larger fraction of another important measure: warheads that can destroy hardened targets and do so promptly. Weapons carried on bombers would take many hours to get to their targets. The sea-based forces would have to await the introduction of the Trident II (D-5) missile in the 1990s to achieve a hard-target capability; also, timely communication with some of these forces might be uncertain in a time-urgent situation. This slower response capability would not be acceptable if the targets were critical command centers or missile silos that could launch further attacks during the delay. Thus prompt (or time-urgent) hard-target capability might be important, especially in scenarios that involve fighting a so-called

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limited nuclear war or, more importantly, deterring one. Such a war might include limited exchanges of nuclear weapons--ordered on a reactive basis--rather than one massive exchange.

Numbers of prompt, hard-target weapons surviving a Soviet first strike would increase from about 150 today to 690 by 1996 (see Table 2). This assumes an attack with warning, and that the follow-on land-based missiles ultimately supply most of this type of weapon. If Trident II missiles are assumed to have adequate communications so as to be classed as prompt, then numbers increase from 150 today to 890 by 1990 and continue to grow to 3,500 by 1996.

TABLE 2. PROMPT HARD-TARGET WEAPONS SURVIVING A SOVIET FIRST STRIKE: WITH WARNING OR WITHOUT WARNING

Force and Alert Status	1983	1990	1996
ICBMs only			
With warning	150	180	690
Without warning	150	180	690
ICBMs plus Trident II			
With warning	150	890	3,470
Without warning	150	450	1,770

Expansion in Capability After a Surprise Attack

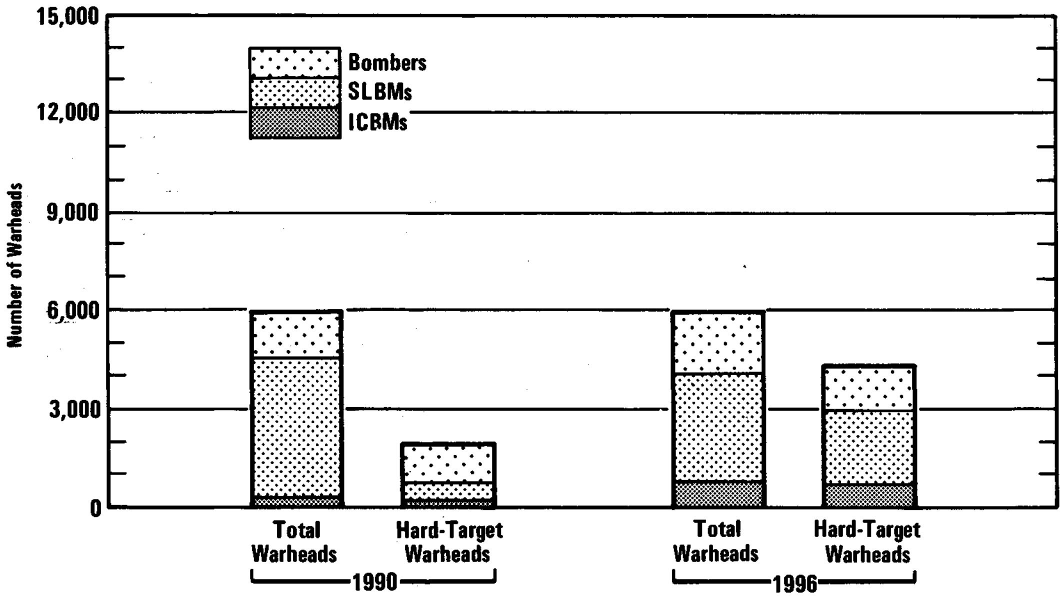
The previous discussion noted the significant increase in surviving warheads under the Administration's plan, particularly in hard-target weapons. It was assumed that U.S. commanders would have advance warning of the attack and be able to take force-survival actions by placing more bombers on alert and sending more submarines to sea where they would escape destruction.

While an attack with warning is widely felt to be the more plausible scenario, planners must also consider the possibility that a Soviet attack might come as a complete surprise. Survivability of land-based ICBMs would not be changed appreciably by a surprise attack, but that of air and sea forces would. Only bombers on immediate alert (approximately 30 to 40 percent) and submarines at sea (about two-thirds of those not in overhaul) would be expected to survive the attack. This would lower surviving warhead counts significantly.

While the numbers of surviving warheads would be lower, the general outcome of the Administration's plan would be similar to that of an attack with warning. Sustained growth in the number of hard-target warheads would occur throughout the period (see Figure 3). Total warhead count would increase steadily through 1990, then decrease somewhat with the retirement of older systems in the mid-1990s.

Figure 3.

Contribution of Triad Elements Under the Administration's Program, 1990 and 1996 (Post-Attack, Without Warning)



SOURCE: Congressional Budget Office.

The relative contributions of the parts of the triad would change under this scenario (see Figure 3). After an attack without warning, the ICBMs, including the new MX and the assumed follow-on land-based missiles, would provide a larger relative share of surviving warheads, since almost all land-based missiles are continually on alert, even in peacetime. For example, in 1990, land-based missiles would provide 5 percent of the surviving hard-target capability after an attack with warning, but about 10 percent after an attack without warning. Nevertheless, the Administration's plan would result in a substantial increase in surviving warheads on bombers and sea-based forces, even in this surprise attack scenario.

Counts of Weapons Available Before a Soviet First Strike

Yet another way of assessing the quantitative effects of the Administration's plan is to count the weapons that would be available before a Soviet first strike. These counts may be less useful than measures of retaliatory capability, but they are frequently used in public discussions of arms control, which often ignore the problem of estimating the effects of a first strike.

Figure 4 shows that pre-attack warhead inventories would increase, in the absence of arms control, from about 8,800 today to over 14,000 by 1990 under the Administration's plan. By 1992, the peak year of the buildup, over 14,800 warheads would be available--a 68 percent increase over 1983 levels. The number would decline afterward with retirements of older systems, but in 1996 it would still be about 60 percent higher than in 1983. The effect of arms control on these inventories is the subject of Chapter III.

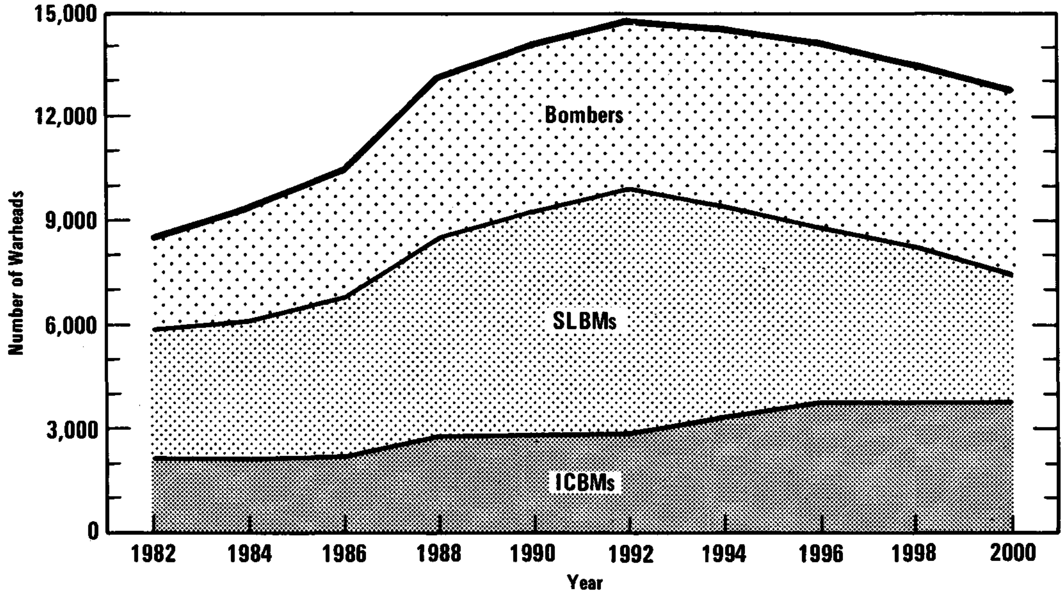
QUALITATIVE FACTORS

The quantitative measures presented above do not capture all of the important features of the Administration's strategic plan. One of the major goals is to modernize all elements of the triad with newer, more capable systems. This would not only increase reliability and maintainability, with resulting lower operating costs; it would also open production lines for at least one new ICBM and two new bombers, thus leaving the United States in a better position to respond to an accelerated Soviet arms buildup.

Modern forces would also be more survivable against a Soviet first strike; a survivable triad of forces has been the goal of every administration over the past 20 years. In addition to complicating Soviet defensive problems in trying to deal with three diverse types of systems, a survivable triad of forces would also provide a hedge against the possibility of a Soviet

Figure 4.

Evolution of Strategic Force Buildup Under the Administration's Program, by Triad Element, 1982-2000



SOURCE: Congressional Budget Office.

technological breakthrough that could neutralize one (or more) of the triad elements.

An overall effort to improve the strategic deterrent would also signal resoluteness on the part of the United States. Administration spokesmen argue that this would assure U.S. allies that the United States is committed to maintaining the deterrent, and also keep the Soviets negotiating in good faith toward a reduction in nuclear weapons.

Other specific qualitative advantages may accrue from individual weapons systems. Some of these are discussed more fully in Chapter IV.

CHAPTER III. ARMS CONTROL AND THE ADMINISTRATION'S PROGRAM

Like its predecessors in the nuclear age, the present Administration has incorporated the concept of arms control into its overall strategic force policy. While technically no general arms-control agreement limiting numbers of nuclear weapons is currently in effect, the Administration has committed the United States to various degrees of compliance with expired and unratified agreements and has begun negotiations with the Soviets on a new and comprehensive strategic arms control package. The current negotiations are known as the Strategic Arms Reductions Talks (START). This chapter will indicate how the Administration's program outlined in the last chapter might be altered, in both effectiveness and costs, by arms-control agreements--specifically, either START or the earlier Strategic Arms Limitation Talks (SALT).

The Administration's START Proposal

START negotiations began in late June 1982. As outlined in the President's May 9, 1982, speech, START seeks the following:

- A first-phase reduction on both sides to fewer than 5,000 ballistic missile warheads on no more than 850 deployed ballistic missiles; no more than 2,500 of these warheads may be on ICBMs. 1/

- These first-phase cuts would be followed by reductions in the aggregate level of ballistic missile "throwweight" to equal limits.

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1. A key point is that the Administration's START position could adapt over time through the negotiating process. Among negotiating positions yet to be announced are the manner in which warheads and deployed missiles would be counted, whether an attempt would be made to count stored as well as deployed missiles, whether verification would rely solely on national technical means (generally meaning satellite coverage), and the expected time period over which the reductions would be made. It should be noted that the Administration proposal does not address mobility of ICBMs. Faced with a large buildup in U.S. hard-target capability, the Soviets might choose mobility as a response. There are press reports that the United States has also proposed collateral constraints on fourth-generation Soviet ICBMs.

(Throwweight is a measure of ballistic missile payload.) Further reductions in warheads and missiles could also be made. 2/

The Administration's proposals deal mainly with ballistic missiles. Some observers believe that bombers--including the Soviet Backfire--will not be treated until the second phase of the negotiations. 3/ Recent press reports indicate, however, that the Administration may have already proposed a limit of 400 bombers on each side. 4/

As with earlier talks, little official discussion of specific negotiating points is available in open sources. According to press reports, however, the Soviet Union is at present pursuing a negotiating tack based on reductions implemented through SALT-type limits, plus additional restrictions on bombers and cruise missiles. 5/

Table 3 compares current forces on both sides, including bombers, with the proposed START limits. Generally, the limits imply a reduction of about one-third in the number of warheads on deployed ballistic missiles.

Earlier SALT Agreements

While negotiating under START, the Administration has agreed not to "undercut" the provisions of two earlier agreements--SALT I and SALT II--so long as the Soviets observe the same restraint.

SALT I--signed and ratified in 1972--is an umbrella term for two major agreements. The first, a treaty of indefinite duration, limits deployments of

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2. U. S. Senate, Committee on Foreign Relations, Report No. 97-493, "Nuclear Arms Reductions," July 12, 1982, p. 7.

3. See, for example, Clarence A. Robinson, Jr., "U.S. to Press MX Deployment During START Talks," Aviation Week and Space Technology (June 14, 1982), p. 25.

4. Hedrick Smith, "Movement Is Cited on Strategic Arms," New York Times, April 7, 1983, p. A14.

5. See Leslie H. Gelb, "Offer by Moscow to Curb Bombers and Missiles Cited," New York Times, August 1, 1982, p. 1; Flora Lewis, "Soviet Arms-Control Expert Asks Nuclear Balance," New York Times, September 2, 1982, p. 3, and Gelb, "The Cruise Missile," New York Times, September 2, 1982, p. 3.

TABLE 3. COMPARISON OF CURRENT U.S. AND SOVIET STRATEGIC FORCE INVENTORIES AND THE PROPOSED START LIMITS

	United States		Soviet Union	
	Warheads	Deployed Missiles	Warheads	Deployed Missiles
Current Numbers of Missiles				
ICBMs	2,150	1,047	5,904	1,398
SLBMs	4,960	544	1,496	924
Total	7,110	1,594	7,400	2,322
START Limit	5,000	850	5,000	850
Current Number of Bombers	--	400	--	220
Assumed Bomber Limit a/	--	400	--	400

a/ The START proposal includes no bomber limits at this time. This study assumes 400 per side.

antiballistic missile (ABM) systems. The other establishes numerical limits on the number of ICBM and SLBM launchers and modern nuclear submarines; this part, the Interim Agreement, expired in 1977.

SALT II was signed in 1979 but withdrawn from active consideration for Senate ratification in 1980. It placed various numerical limitations on strategic offensive forces, including:

- An overall limit of 2,250 on Strategic Nuclear Delivery Vehicles, including long-range heavy bombers, ICBM launchers, and SLBM launchers;
- A sublimit of 1,320 on launchers capable of accommodating ballistic missiles with MIRVs (multiple independently targetable reentry vehicles) together with long-range heavy bombers capable of launching cruise missiles;

- A further sublimit of 1,200 on launchers of MIRVed ballistic missiles (both land- and sea-based); and

- A further sublimit of 820 on launchers for MIRVed land-based missiles.

EFFECTS OF START ON THE ADMINISTRATION'S PROGRAM

In order to assess the Administration's modernization plan in terms of its-arms control proposals, CBO has assumed a feasible set of outcomes for the START negotiations, recognizing that they are only an example of what could occur. CBO has assumed that:

- The U.S. proposal is accepted, with the addition that strategic bombers are included as part of the reductions with a ceiling of 400 bombers as the ultimate goal.

- The agreement would enter into force no earlier than the end of fiscal year 1985.

- The reductions would be phased in over a ten-year period, beginning in 1985, and agreed data bases for counting deployed warheads and missiles would be used.

- Phased reductions would be spread evenly over ten years. For example, if the United States possessed 8,000 ballistic missile warheads in 1985, the Defense Department would reach 5,000 by 1995 by retiring 300 a year. A similar reduction formula would apply to the bomber force.

With relatively minor adjustments to its unconstrained program--mainly, continued and timely dismantling of ex-Polaris nuclear submarines in compensation for the new Tridents--the Administration's plan would probably exceed none of the numerical limits of the SALT agreements until the end of 1985, when START is assumed to take effect. This analysis therefore takes as its 1985 point of departure the unconstrained force levels discussed in Chapter II, modified to include the Polaris dismantling.

No Effect on Modernization if a Sufficient Number of Older Systems Are Retired

Most of the limits of a START-constrained force would accommodate the full scope of the Administration's modernization efforts. Full modernization could result in 20 Trident submarines with Trident II (D-5) missiles plus 100 MX missiles in existing silos and, by the mid-1990s, either more MX missiles or a number of small ICBMs (SICBMs) deployed in one or more of a variety of modes. Allowing for retirements as discussed below, this force could fall within the limits of 5,000 warheads overall and 2,500 ICBM warheads. The final strategic bomber force could contain 100 B-1Bs plus 132 Advanced Technology Bombers--together with some older B-52s--and still be within the assumed limit of 400 bombers.

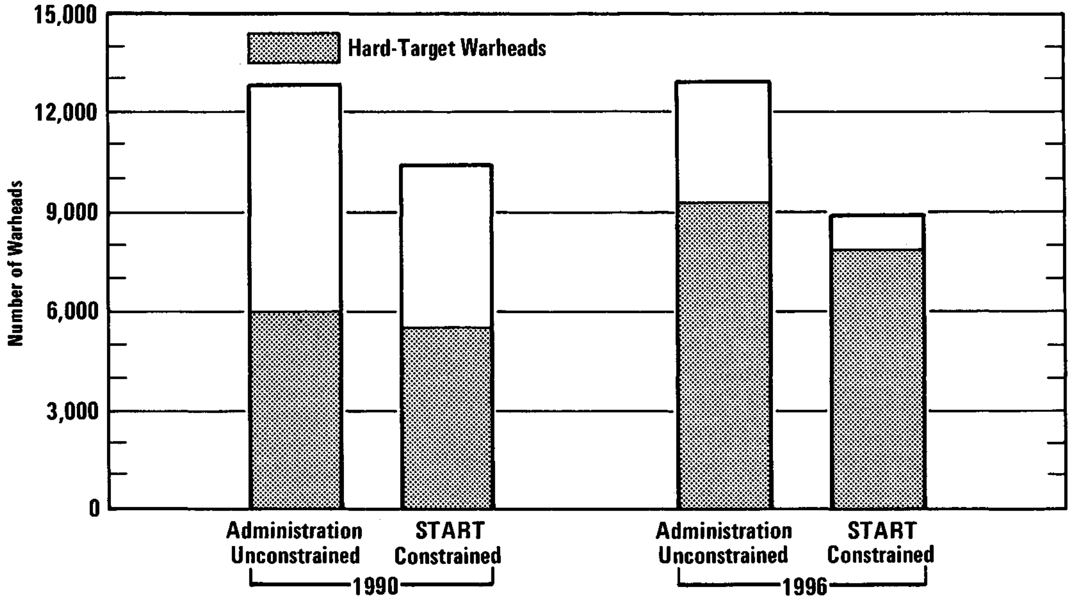
In contemplating the eventual deployment of the single-warhead SICBM, however, the Administration may have to amend its START position partially. The ratio of allowed warheads to missiles in START militates against the fielding of large numbers of the SICBM, something that might be necessary to ensure adequate numbers of surviving warheads. The President's Commission on Strategic Forces noted that the limit on deployed ballistic missiles was not compatible with its recommended move toward a small ICBM. To accommodate the single-warhead missiles, therefore, the Administration might have to amend the proposed limit of 850 deployed missiles, or shift emphasis to a different kind of limitation on missile capability such as missile throwweight. A review of these issues is currently underway within the Administration. New types of verification procedures on numbers of deployed missiles might also be needed. This study assumes that the limits would be increased so as to allow the deployment of the mobile force of SICBMs described in Chapter I.

Full modernization under START would necessitate retiring a larger number of existing systems than in the absence of modernization. Probably all Minuteman ICBMs and their launchers would have to be decommissioned between 1986 and 1995. No retirements of Minuteman missiles appear to be planned during this period in the absence of arms-control constraints. Under START limits, the Poseidon submarines would have to be retired, on average, around five and one-half years earlier than without arms-control limits. Should a substantial number of SICBMs be deployed, either MX missiles would need to be retired or some Trident submarines forgone in the late 1990s (for illustrative purposes CBO assumes the former). The strategic bomber force and other force elements in the Administration's program would not need to be changed.

The Administration has not indicated how it would implement a START agreement. For purposes of analysis, however, this study assumes that full modernization would continue and the older systems discussed above would be retired. This is consistent with the high priority the Administration attaches to strategic modernization.

Figure 5.

Effect of START Constraints on the Administration's Strategic Force Buildup, 1990 and 1996 (Pre-Attack, With Warning)



SOURCE: Congressional Budget Office.

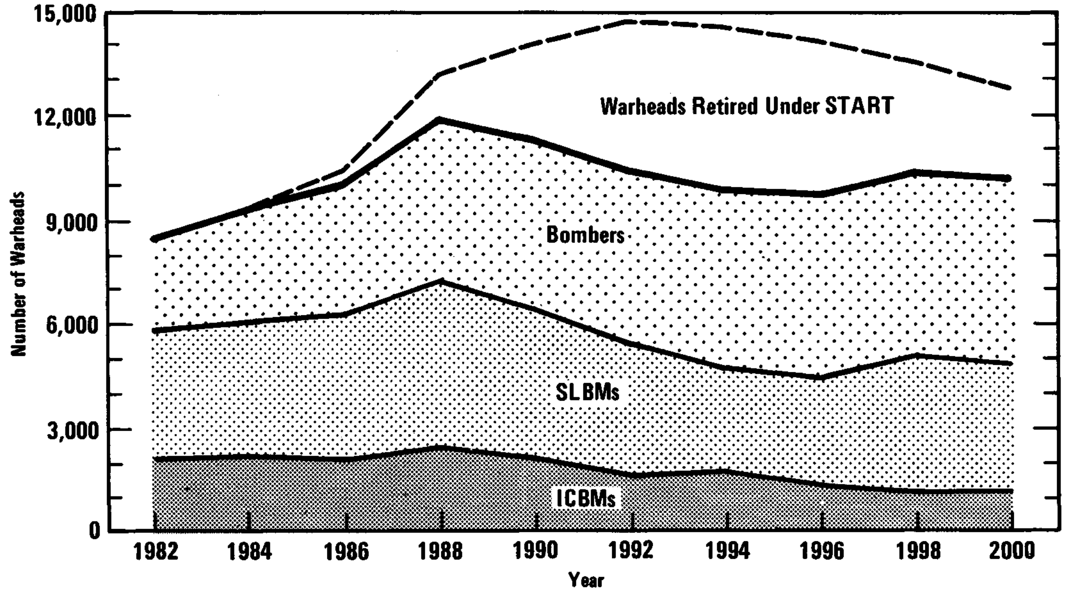
Reductions in Warheads

The primary effect of a START agreement on fully modernized strategic forces would be a reduction in the total number of warheads, with a much smaller reduction in the number of hard-target warheads. For example, in 1996 total warheads would be 32 percent fewer than without START, while hard-target warheads would be down 16 percent (see Figure 5).

Figure 6 shows the year-by-year effect on pre-attack warheads of the START limits under the assumptions discussed above. The measure used here is a simple count of warheads before any are lost to a Soviet first strike, excluding only those carried by systems in overhaul. The START-constrained force grows more modestly than the force without START. In the 1988-1992 period, it is about one-third larger than in 1983, compared to about two-thirds in the unconstrained case; by the end of the century, a 15

Figure 6.

Evolution of Strategic Force Buildup Under START Constraints, by Triad Element, 1982-2000



SOURCE: Congressional Budget Office.

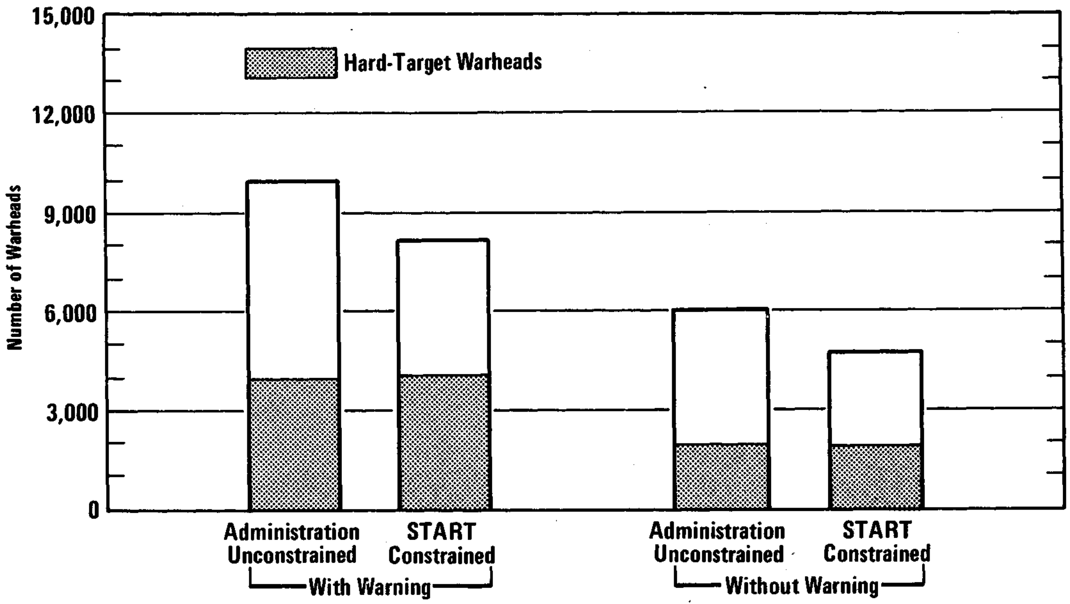
percent increase in pre-attack warheads is sustained under START compared to 45 percent without START. The decrease in START-constrained warheads between fiscal years 1992 and 1996 is due primarily to retirement of older Poseidon submarines as Trident submarines enter the force. While warhead totals are lower, the force is still much more modern than today's force, containing mostly forces built in the 1980s and early 1990s.

Because START constraints on the ballistic missile forces would be tighter than those postulated for bombers, the START-limited posture would place increasing emphasis on the bomber portion of the triad. There would be some increase in the emphasis on bombers even in the absence of START, as Table 4 shows. By 1996, however, bombers would account for 54 percent of the pre-attack warheads under START as compared to 38 percent without START.

In terms of simple inventory counts of warheads, often used in arms-control debates, a START-constrained force would be smaller than one not

Figure 7.

Effect of START Constraints on the Administration's Strategic Force Buildup, 1990 (Post-Attack, With and Without Warning)



SOURCE: Congressional Budget Office.

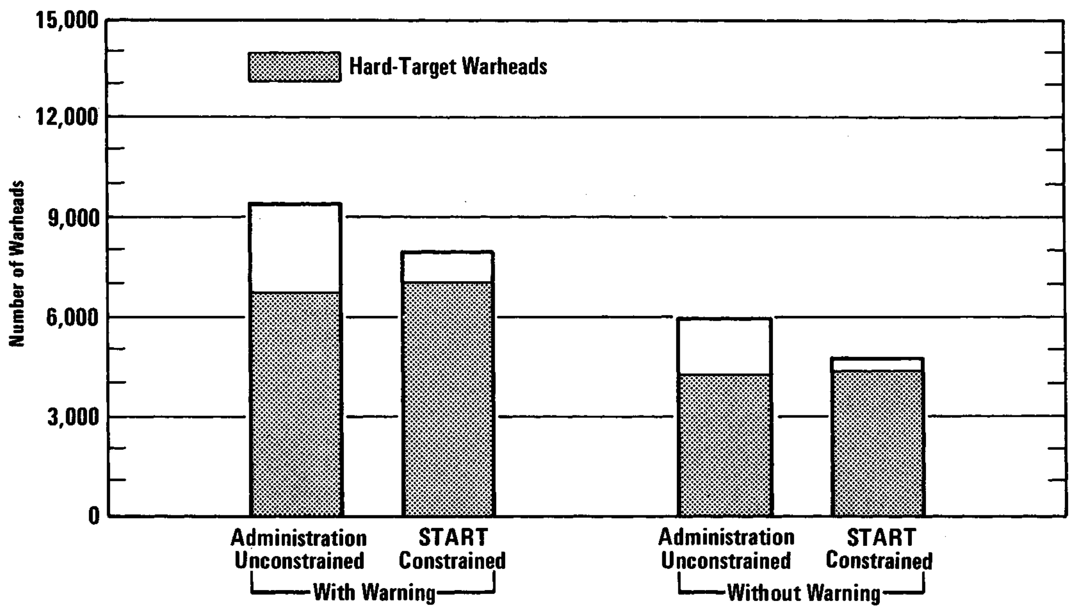
constrained by START. Other measures, however, suggest that key capabilities would not be reduced. Figures 7 and 8 show the effect START would have on counts of warheads likely to survive a Soviet nuclear strike in 1990 and 1996, including warheads that can attack hardened targets. (The representative START-constrained Soviet force used in making these calculations is shown in Appendix C.) These counts are most influenced by

TABLE 4. PERCENTAGE OF PRE-ATTACK WARHEADS CONTRIBUTED BY EACH TRIAD ELEMENT UNDER ARMS CONSTRAINTS

	1983			1990			1996		
	ICBM	SLBM	BMR	ICBM	SLBM	BMR	ICBM	SLBM	BMR
Administration Unconstrained	24	45	31	20	46	34	27	35	38
START-Constrained	24	45	31	19	39	43	14	32	54
SALT-Constrained	24	45	31	16	46	38	21	37	42

Figure 8.

Effect of START Constraints on the Administration's Strategic Force Buildup, 1996 (Post-Attack, With and Without Warning)



SOURCE: Congressional Budget Office.

the new systems that the Administration is proposing, which are not limited by the implementation of START assumed in this analysis. The number of warheads likely to survive a Soviet first strike with warning would be 18 percent less in 1990 and 15 percent less in 1996 than for the unconstrained force, and the number of surviving hard-target capable warheads would be much the same in either year. This is true because even though by pre-attack measures the START-constrained force has been reduced, the force contains many more hard-target warheads that are survivably based.

Cost Savings Associated with START Compliance

If full modernization is pursued, START would not lower procurement costs because it would allow all programs to be carried out. START would, however, save some operating costs because it could mean retirement of the existing ICBM force and the early retirement of most of the current fleet of nuclear submarines. These savings would be reduced by the costs of dismantling systems in accordance with specific arms-control procedures. Such procedures include disassembling silos and cutting up bombers and submarines in order to ensure that they are no longer useful as strategic launchers. Under SALT provisions, for example, dismantling would cost approximately $1.5 million per ICBM silo, $13,000 per B-52 bomber, and $21.7 million per Poseidon submarine. 6/ Costs could change depending on the procedures developed in a START agreement; they would almost certainly be higher than the costs of simply putting the systems out of commission.

Even with these added costs there would be net savings of about $15 billion through the end of the century (see Table 5). In total, however, this would amount to a few percent of total strategic spending.

TABLE 5. ESTIMATED OPERATING COST SAVINGS RESULTING FROM START COMPLIANCE (By fiscal year, in millions of fiscal year 1984 dollars)

Cost Category	1984	1985	1986	1987	1988	Total 1984-2000
Budget Authority	--	--	46	249	500	15,438
Outlays	--	--	27	155	349	a/

a/ Outlay savings provided for 1984-1988 only.

IMPACT OF SALT LIMITS COMPARED TO THAT OF START LIMITS

SALT restrictions, which did not specify direct reductions in numbers of warheads, would have even more modest effects if applied to the modernization program than would START limits. On key measures like numbers of

6. Estimates provided by respective service staffs.

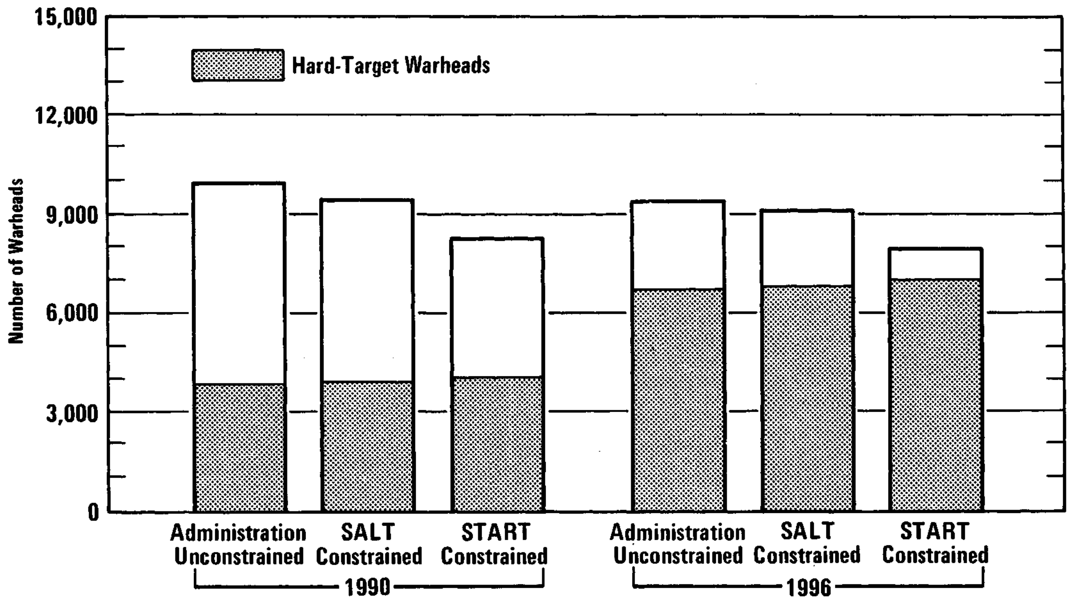
surviving hard-target warheads, however, SALT and START could have nearly identical effects. Figure 9 compares the size of U.S. forces in 1990 and 1996 under the numerical limits imposed by SALT and START with the unconstrained force. In both instances of arms controls, full modernization is assumed to be achieved; numerical limits are met primarily by retiring older existing systems. In both SALT- and START-constrained cases, surviving hard-target warhead counts grow substantially. In terms of surviving hard-target capability, forces under SALT limits and START limits differ by at most 3 percent. (See Appendix F for a technical discussion of current arms-control restrictions and the potential impact of SALT on U.S. forces.)

CONCLUSION

Arms-control constraints would not have much effect on the Administration's modernization program. Numerical limits--with the possible exception of the START limit of 850 on ballistic missiles--under either

Figure 9.

Comparison of Forces Under Arms Control Constraints, 1990 and 1996 (Post-Strike Attack, With Warning)



SOURCE: Congressional Budget Office.

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SALT or START could be met by retiring older existing weapons systems, with only modest effects on capabilities to destroy hardened targets. These approaches to meeting arms-control limits would not greatly reduce costs.

The Congress may, however, wish to consider alternatives to the Administration's strategic program that would reduce costs beyond the savings obtainable from arms limitations. The next chapter outlines some alternative approaches.

CHAPTER IV. THE ADMINISTRATION'S PROGRAM AND ALTERNATIVES

The previous chapters examined the Administration's program for strategic offensive force modernization and the potential effects on it of arms limitations. The program would engender a substantial buildup in weapons in the 1980s, primarily from modernization of the bomber and submarine forces. In the 1990s, however, the deployment of additional Trident submarines with Trident II (D-5) missiles and possibly a new land-based ICBM would be partially offset by retirements of older systems. Nonetheless, all three legs of the triad would enter the 21st century with major systems less than 15 years old.

Some have argued that this buildup is too broad--since it involves modernizing one or more systems in each leg of the triad--and introduces some systems that are technically risky. Others argue that the buildup is unnecessary because U.S. forces and weapons are already sufficient to deter a Soviet first strike. These arguments are reinforced by cost considerations: total spending on strategic forces in the next five years alone would cost an estimated $250 billion. During these years the federal government's annual budget deficits are projected, by both the Administration and CBO, at between $100 billion and $200 billion.

This chapter reviews the Administration's proposal and considers alternatives that would hold down costs. One such alternative would eliminate the near-term modernization of the land-based missile force by cancelling the proposed deployment of 100 MX missiles in Minuteman silos. A second alternative would forgo totally the Administration plan for modernizing the land-based missile force, substituting sea-based forces for this capability. A third alternative would terminate plans to deploy the B-1B bomber, choosing instead to rely more heavily on B-52s armed with cruise missiles and later on the Advanced Technology Bomber.

THE ADMINISTRATION'S PROGRAM

Scope and Effects

The Administration's plan--outlined in detail in Chapter II--is far reaching, both in breadth and in time. It would, within the next decade and a half:

- Deploy 100 large, counterforce-capable MX missiles;

- Deploy a yet undetermined number of follow-on ICBMs--perhaps more MX missiles or a small ICBM (SICBM);

- Field two new bombers and about 3,200 air-launched cruise missiles;

- Build and deploy about 20 Trident submarines armed with a new missile that will, for the first time, bring to the sea-based forces the capability to destroy targets hardened against nuclear blasts.

This modernization program would greatly increase U.S. strategic capability (see Chapter II for details). Total warheads likely to survive a major Soviet attack and be available for retaliation would rise from about 6,000 today to 9,900 in 1990, falling to 9,300 in 1996 as older systems were retired. Surviving warheads able to destroy targets hardened against nuclear blast would rise much more quickly, from about 1,400 today to 3,900 in 1990 and 6,700 in 1996.

By the 1990s, U.S. forces would also be substantially more modern than today. One gauge of modernization is the percentage of total warheads carried on forces less than 15 years old. This percentage captures not only the age of forces but also the extent to which newer forces carry a larger number of warheads (15 years being a reasonable midpoint in the lives of many strategic systems). Under the Administration's program, the percentage of warheads carried by strategic bombers less than 15 years old would rise from 10 percent today to 60 percent by 1990 and 65 percent by 1996, as the B-1B and Advanced Technology Bomber entered service. For submarines, the measure would rise from 10 percent today to 32 percent in 1990 and 58 percent in 1996, as the Trident submarine with the large D-5 missile entered the fleet and existing Poseidon submarines were retired in the 1990s. Only land-based missiles would show an opposite trend. Warheads carried on systems less than 15 years old would go from 77 percent today to 36 percent in 1990; the exact percentage in 1996 would depend on how many follow-on missiles were deployed, but the effect of new deployments would probably be overshadowed by the 900 existing Minuteman missiles that would remain in the force.

As noted in Chapter I, this buildup and modernization of strategic forces would parallel actions taken by the Soviet Union over the last decade.

Costs

CBO estimates that it would cost approximately $50 billion a year in budget authority--or a total of about $250 billion over fiscal years 1984-

1988--to build, modify, and operate all of the strategic forces and their associated elements. The estimates include both direct costs and indirect costs, such as personnel support. (These approximations are based on estimates made last year, since details of direct and indirect costs beyond 1984 are not available for the Administration's latest five-year defense plan. The costs should, however, provide a rough guide to likely totals under the latest program.)

Within this total, investment costs of strategic offensive forces would reflect the timing and production of key systems: the MX missile and B-1B bomber in the mid-1980s; the Advanced Technology bomber, Trident II missile, and SICBM in later years. Operating costs would increase during the late 1980s and early 1990s as new forces were added and only a few older systems were retired. Later, when many currently deployed systems are retired, operating costs would decrease.

ALTERNATIVE 1: TERMINATE THE MX MISSILE PROGRAM

As the initial effort in its major program to modernize the ICBM force, the Administration proposes to deploy 100 MX missiles in existing Minuteman underground silos located in Wyoming and Nebraska. The first of these missiles would be available in about 1986; all would be in place by about the end of 1988. According to the Administration plan, the follow-on modernization of land-based missile forces could involve further deployment of MX missiles beyond this initial increment or possibly deployment of a new small ICBM, depending on the outcome of research and development on the SICBM as well as progress on arms control.

The Congress has previously considered the deployment of MX missiles in Minuteman silos. The Department of Defense budget request for 1983 recommended deployment of 40 MX on an interim basis, but the Congress ultimately rejected this--largely out of concern that the MX would be unable to survive a Soviet first strike.

The alternative described here would also reject the deployment of MX missiles, but would retain the rest of the Administration's strategic program--including deployment of a follow-on land-based missile intended to preserve the triad of strategic forces. Forgoing the MX would mean giving up certain qualitative advantages that some believe are important. But, by most quantitative measures, it would have little effect on the measurable capabilities of U.S. retaliatory forces after riding out a Soviet attack, largely because MX missiles in silos would not be likely to survive a Soviet first strike.

The Case for Deploying the MX

The Contribution of Uncertainty to Deterrence. Estimates of what might happen to MX missiles in a first strike are based on theoretical calculations. The Soviets might well be uncertain as to their ability to destroy all or even most of the MX missiles, and this very uncertainty could contribute to deterrence.

Moreover, the Soviets could not be certain that the United States would choose to ride out a first strike rather than launch its MX missiles promptly in response to an attack. If, for example, all 100 missiles were launched early enough to avoid the entire Soviet attack, then about 950 warheads would survive and retaliate (some would presumably be lost because of malfunction during launch). In 1990 and 1996 this would represent about 8 percent of all U.S. strategic warheads available for retaliation in an attack with warning, and 17 and 11 percent of warheads able to destroy hardened targets in those years.

U.S. policy neither assumes nor precludes such a "launch on warning" or "launch under attack." Reportedly, the United States already has the capability to launch Minuteman missiles in this manner. 1/ Even if it did not plan to adopt such a strategy with the MX, the possibility that it might would add uncertainty to Soviet decisions and hence could contribute to deterrence.

Qualitative Advantages of the MX. The MX system would offer some other qualitative advantages. The President's Commission on Strategic Forces stated that deploying the MX in Minuteman silos would be an important step toward achieving the long-term goal of a survivable land-based missile force. With the MX, the United States would field a missile capable of destroying promptly even the hardest known Soviet installations--most notably ICBM silos and command and control facilities--comparable to present Soviet capability. The Administration has argued that this would give the Soviets a strong incentive to conclude an arms-control agreement.

At a minimum, the MX could be a signal of U.S. determination to maintain its nuclear stance. It has been 13 years since the United States last fielded a new land-based ICBM. During that period the Soviets have introduced an entirely new generation of ICBMs, and are apparently testing two more ICBMs of another new generation. Deploying the MX may be

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1/ See U.S. House of Representatives, House Appropriations Committee, Department of Defense Appropriations for 1983, 97:2, Part 1, pp. 340-41.

necessary to convince the Soviets that the United States is serious about maintaining a strong land-based force. The decision would also be a positive signal to the European allies as the time approaches for deploying new intermediate-range nuclear forces on the continent.

In addition to providing some capability relatively soon, deploying a substantial number of the MX in silos would open an ICBM production line so that production could be expanded later should conditions dictate. Examples of situations that could create a demand for more MX missiles are: lack of success in developing or deploying an SICBM, a rapid buildup in Soviet anti-ballistic missile (ABM) capability, or failure to reach an acceptable arms-control agreement.

Finally, those who favor deploying the MX in silos point to the need to maintain and strengthen the land-based missile force, with its desirable attributes such as assured command and control, accuracy of warheads, high alert rates, and targeting flexibility. Land-based missiles have long been thought to offer the most reliable command and control, since this does not entail communicating with an airborne bomber or a submarine at sea. Land-based missiles, with their fixed locations, also offer the most accurate warheads, although the new Trident II (D-5) missile in Trident submarines should approach the accuracy of the MX. Finally, land-based missiles provide targeting flexibility. With their reliable and rapid communications, they can be retargeted very quickly.

The Case Against Deploying the MX

Low Survivability. U.S. strategic forces traditionally have been designed to survive a Soviet first strike and then retaliate. This is thought to provide the greatest deterrent, since it is not clear that a president would launch U.S. forces before actual nuclear explosions confirmed a Soviet attack. Neither is it clear that uncertainty about U.S. actions would deter the Soviets as fully as knowledge that U.S. forces could survive and retaliate after an attack.

Thus, the growing vulnerability of Minuteman ICBMs to a Soviet first strike has been of concern for a number of years; indeed, it was primarily this concern that led to development of the MX missile and the search for a survivable basing mode for it. The MX itself, however, would be no more survivable than its predecessors. Assuming that the United States "rode out" a Soviet first strike on its ICBMs, CBO estimates that about 10 percent of the MX missiles would survive such an attack in 1990, and about 5 percent would survive in 1996 as the accuracy of Soviet missile systems improved. These estimates assume that the MX missiles would be placed in existing Minuteman silos, where they would be about as blast-resistant as Minuteman missiles are today. 2/

Recently, Administration spokesmen have indicated that it might be possible to "superharden" existing Minuteman silos containing the MX to levels nearly 13 times their current hardness. 3/ Indeed, the Administration's modernization plan includes funds for further research on silo hardening over the next five years, although not for actual hardening.

Superhardening would be very effective against today's Soviet threat, but CBO estimates that the combination of improving accuracy and potentially higher warhead yields will eventually render even superhardened silos vulnerable (see Table 6). This would be especially true if the number of such targets was limited--say, to 100 MX missiles--because the Soviets could concentrate on them more easily. For example, if in 1990 (when the MX would be deployed) the Soviets were to attack a superhardened Minuteman silo with a very large, accurate warhead--such as the 25-megaton warhead that has been tested on existing Soviet SS-18 missiles--its probability of survival would be about 6 percent. Superhardening might, however, contribute something to deterrence by increasing the uncertainty in Soviet calculations of the expected outcome of an attack, or by causing the Soviets to trade off multiple warheads for large, single warheads on some of their larger missiles. The remainder of this discussion assumes neither superhardening of missile silos nor extraordinary responses by the Soviets.

In the framework of the Administration's modernization plan and the attendant strategic buildup, the quantitative contribution of MX missiles after a Soviet first strike would be very small. In the scenario thought most likely--in which U.S. forces are alerted in anticipation of a major Soviet attack and then ride out such an attack and retaliate--100 MX missiles in silos would contribute less than 1 percent of all available surviving strategic warheads in 1990 and 1996. Of warheads able to destroy structures hardened against nuclear blast, the MX would contribute about 3 percent in 1990 and less than 1 percent in 1996.

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2. Air Force officials have previously indicated this to be the case. See, for example, testimony of Lt. Gen. Kelly Burke, House Armed Services Committee, DoD Authorization for Appropriations for Fiscal Year 1983, 97:2, p. 256.

3. Based on testimony of Dr. Richard DeLauer, Undersecretary of Defense for Research and Engineering, before the House Defense Appropriations Subcommittee, May 3, 1983.

TABLE 6. TWO-SHOT DAMAGE EXPECTANCY FOR VARIOUS WARHEAD AND SILO HARDNESS CHARACTERISTICS a/

Accuracy b/	Silo Hardness (psi): Today (2,000 psi)	Hardened (5,000 psi)	Superhardened (25,000 psi)
		Yield 0.5 Megatons	
Today	0.77	0.55	0.21
1990	0.88	0.70	0.33
1996	0.94	0.90	0.57
		Yield 5.0 Megatons	
1990	0.95	0.95	0.81
1996 c/	0.95	0.95	0.93
		Yield 25.0 Megatons d/	
1990 c/	0.95	0.95	0.94
1996 c/	0.95	0.95	0.95

a/ Assumes two-shot compound missile/warhead reliability would be 95 percent for two groundburst weapons. Probabilities of destruction would be greater if optimal airbursts were used.

b/ Approximate accuracies assumed are: today = circular error probable (CEP) of 900 feet, 1990 = CEP of 720 feet, and 1996 = CEP of 480 feet.

c/ In addition to damaging silos by overpressure, these yield/accuracy combinations would be expected to produce blast craters sufficiently large and deep to envelop the silos.

d/ The Soviets are estimated to have deployed warheads with yields of approximately 25 megatons on a limited number of their SS-18 ICBMs.

In other scenarios, the contribution of the MX would be slightly higher. Because ICBMs are capable of maintaining higher percentage alert rates than bombers and submarines, their contribution in case of a surprise attack would be greater than in an attack with warning. Nonetheless, even in a surprise attack, 100 MX missiles in Minuteman silos would contribute only 5 percent of all surviving hard-target warheads in 1990 and 1 percent in 1996.

The MX would make its greatest contribution--albeit in most cases a modest one--in the prompt, hard-target warhead category. This measure indicates the number of weapons able to destroy targets hardened against nuclear blast, and to do so promptly after a Soviet first strike. Prompt, hard-target kill capability could be important in a limited nuclear war that involved a series of strikes and counterstrikes similar to those of a non-nuclear battle. In such a limited war, it might be important to destroy hardened Soviet targets--like missile silos and command bunkers--quickly in order to minimize Soviet capabilities in subsequent strikes. Even greater, however, would be the deterrent value of this capability, because it could prevent the Soviets from coercing the United States with threats of limited nuclear war.

The percentage contribution of the MX to prompt, hard-target capability would reach a peak in the late 1980s and early 1990s, and then decline. Unfortunately, the definition of "prompt" varies with the scenario, and so is very uncertain. Some might argue that land-based missiles are the only systems that can retaliate promptly after a Soviet first strike, in which case the MX would contribute about 50 percent of U.S. capability in 1990, but only 7 percent in 1996 with the assumed deployment of the small ICBM. Others would argue that Trident submarines with the new D-5 missile could also offer prompt, hard-target kill capability. If so, by 1996 the MX would contribute between 2 and 3 percent of surviving U.S. capability, depending on whether the attack occurred with or without warning.

Under the START limits, the relative contribution of the MX would likely be less because the numbers of MX might have to be reduced to accommodate a substantial number of SICBMs and a 20-submarine Trident force. Continued U.S. adherence to SALT, on the other hand, would not affect the MX. Table 7 summarizes the strategic warhead inventories with or without the deployment of the MX and with or without START limits.

Other Arguments for Terminating the MX. Even without the MX, the United States would retain some of the advantages of a triad of forces through the early 1990s, when the SICBM might be deployed, because it would still have 1,000 Minuteman missiles. These could be retained at least through the end of the century. 4/ While Minuteman missiles would theoretically be no more survivable than MX missiles in the same silos, the

4. See U.S. Senate, Senate Armed Services Committee, DoD Authorization for Appropriations for Fiscal Year 1983, 97:2, Part 7, p. 4591.

TABLE 7. U.S. STRATEGIC FORCE WARHEAD INVENTORIES UNDER THE ADMINISTRATION'S PLAN AND UNDER ALTERNATIVES IN 1996 a/

	Without START Limits				With START Limits			
	Admin.	Alt.I	Alt.II	Alt.III	Admin.	Alt.I	Alt.II	Alt.III
Land-Based Force								
Minuteman II	450	450	450	450	0	0	0	0
Minuteman III	450	550	550	450	0	117	370	0
MX	100	0	0	100	35	0	0	35
SICBM	1,000	1,000	0	1,000	1,000	1,000	0	1,000
Bomber Force								
B-52								
(cruise missile)	96	96	96	201	96	96	96	201
B-1B	100	100	100	0	100	100	100	0
ATB	132	132	132	132	132	132	132	132
Sea-based Force								
Poseidon (C-3)	8	8	8	8	0	0	0	0
Poseidon (C-4)	5	5	5	5	0	0	0	0
Trident (D-5)	19	19	20	19	19	19	20	19

a/ Assumes that the proposed START limit of 850 ballistic missiles would be increased or eliminated to accommodate deployment of the SICBM.

Soviets would still have to target them in a first strike, and could not be certain of destroying all of them. Terminating the MX would therefore not mean forgoing all the diversity and synergism inherent in the triad.

The argument that terminating the MX would weaken the U.S. hand at the bargaining table is rejected by some. They argue that unless the United States makes it clear that it would launch these missiles rather than risk their destruction in a Soviet first strike--a position the United States has avoided in the past--then the Soviets would not have a strong incentive to bargain on this point. Moreover, the U. S. program to deploy bombers, cruise missiles, the Trident II missile, and a follow-on land-based missile--all of which are unchanged in this option--might provide incentive enough.

Finally, some fear that deployment of the potent MX missile in a non-survivable basing mode could be destabilizing. In a crisis, the Soviets could not be sure that the United States was not about to launch a first strike with the large, accurate MX, even though this would be contrary to its stated policy. If they also believed that they could destroy the MX in silos in a preemptive strike, they might be tempted to launch quickly even though it would mean precipitating a nuclear war. 5/

Effects on Costs of Terminating the MX System

Terminating the MX program would mean that, in 1984 and beyond, no funds would be spent on research or production of the MX missile or on finding a way to base it. Furthermore, 1983 funds for basing research and development for the missile, which have been held up pending a final decision on the basing mode, are assumed not to be spent.

Such an alternative would offer substantial savings over the next five years and beyond, as can be seen in Table 8. In terms of budget authority, cancellation of the MX system could save approximately $17.9 billion over the coming five years. Outlays would also be reduced by about $15.1 billion over the next five years. Over the life of the program, terminating the MX would save about $18.4 billion. There would be no significant change in operating costs, because the United States would continue to operate the Minuteman missiles scheduled to be replaced by the MX.

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5. On the other hand, if the Soviets were to believe that the number of MX warheads was insufficient to present a credible first-strike threat, this concern could be diminished.

TABLE 8. SAVINGS FROM ALTERNATIVES TO THE ADMINISTRATION'S STRATEGIC PROGRAM (By fiscal year, in billions of 1984 budget authority dollars)

	1984	1985	1986	1987	1988	Total 1984 to 1988	Total 1984 to 2000
Alternative I—Cancel MX a/							
Investment	4.6	5.0	3.6	2.8	1.8	17.9	18.4
Operating	--	--	--	--	--	--	--
Total	4.6	5.0	3.6	2.8	1.8	17.9	18.4
Alternative II—Substitute Sea-based Forces for Land-based Forces a/							
Investment	4.9	4.1	3.9	2.4	4.6	19.9	41.4
Operating	--	--	--	--	--	--	19.6
Total	4.9	4.1	3.9	2.4	4.6	19.9	61.0
Alternative III—Cancel B-1B Bomber							
Investment	3.9	7.0	4.3	-1.6	-2.0	11.7	10.8
Operating	--	b/	0.1	0.4	0.6	1.1	4.8
Total	3.9	7.0	4.4	-1.2	-1.3	12.8	15.5

SOURCE: Congressional Budget Office.

NOTES: Numbers may not add to totals because of rounding. Costs do not include those funded by the Department of Energy.

a/ Savings would be higher relative to the President's January 1983 budget, which assumes an earlier, more expensive MX plan.

b/ Less than $100 million.

For consistency with recent Administration announcements, these savings are shown relative to the current MX plan. Savings relative to the President's January 1983 budget would be higher because that budget assumed an earlier, more expensive version of MX. Over the next five years, savings relative to the budget would total $27.5 billion ($22.9 billion in outlays) and $28.6 billion for 1984 and beyond.

These potential savings represent about 7 percent of total spending on all strategic force programs in the period 1984-1988. A judgment on the MX system must weigh these savings against the relative quantitative and qualitative contributions of the MX as outlined above.

Another Approach to Increasing Capability in the Near Term

The Congress could improve the capability of the ICBM force at less cost by upgrading the existing force of Minuteman III missiles. This is currently the only MIRVed ICBM in the U.S. arsenal. It could be improved to a level of capability roughly equal to MX on a warhead-by-warhead basis. An improved Minuteman III could play a part in an arms-control context similar to that of the MX.

Specifically, the guidance system developed for the MX missile--called AIRS--could be installed on Minuteman III missiles instead. Taken together with the installation of the Mk12A warhead on 250 more Minuteman IIIs (300 missiles carry it now), the upgraded Minuteman warheads would have the same accuracy and yield as those planned for installation on the MX. The Air Force estimates that the cost to complete this plan for 550 Minuteman IIIs would be approximately $14 billion. This would compare with the $18.4 billion cost of deploying 100 MX in silos.

At first glance this plan would also appear to provide roughly 50 percent more pre-attack, prompt hard-target-capable warheads than would deployment of MX missiles in silos. DoD officials have indicated, however, that a warhead--in some cases, two--would have to be removed from certain missiles to compensate for the increased weight of the heavier Mk12A warheads and AIRS guidance set. 6/ Even so, the upgraded Minuteman force might then provide at least the same number of pre- and post-attack war-

6. See U.S. Senate, Senate Armed Services Committee, DoD Authorization for Appropriations for Fiscal Year 1983, 97:2, Part 7, p. 4222.

heads as 100 MX missiles. It might not have the same targeting flexibility, however, thus limiting the options for its use. 7/

According to the Air Force, upgrading the Minuteman force would take longer than deploying the MX. Whereas the force of 100 MX in silos would probably begin deployment in 1986 and be in place around 1988, the Minuteman upgrade would not begin deployment until five years after a decision to start the program and would not be completed until roughly four years later. A fiscal year 1984 decision would, therefore, see the upgraded force in place around 1993.

Funds spent to upgrade the Minuteman would not garner all of the qualitative benefits of deploying the MX: they would not open a missile production line or make the larger missile available in case conditions warranted. They would, however, add a quantitative capability that would be at least comparable to deploying the MX in silos, and at somewhat lower cost.

ALTERNATIVE 2: FORGO MODERNIZATION OF LAND-BASED MISSILES AND RELY INSTEAD ON ADDITIONAL SEA-BASED FORCES

In addition to deploying 100 MX missiles in Minuteman silos, the Administration proposes further modernization of the land-based missile force, perhaps by deploying additional MX missiles in a more survivable basing mode or by introducing a small ICBM that would be mobile enough to survive. A survivable land-based missile would offer the important qualitative and quantitative advantages inherent in a triad of forces each able to survive a Soviet first strike.

Unfortunately, the history of the last decade suggests that it will be very difficult to design a survivable land-based missile that will meet domestic environmental and security concerns and be reasonable in price.

The alternative discussed below proposes to terminate further investment in land-based missiles beyond some limited research and development, assumed to amount to a few million dollars a year. It would keep the 1,000 existing Minuteman missiles, but would not deploy the MX or any follow-on land-based missile. Instead, it would build more Trident submarines, armed

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7. Flexibility is indicated by missile "footprint"--the area over which it is feasible for a MIRVed missile to deliver its warheads--as well as missile range and throwweight.

with the new Trident II (D-5) missile. By substituting submarines for land-based missiles, this alternative would attain the same or better capabilities by many quantitative measures at less cost. But it would not offer all the qualitative advantages of a survivable triad.

Reasons for Accepting the Administration's Proposal

Maintaining a Survivable Triad. Those who favor development of a follow-on land-based missile see it as essential in enabling the United States to maintain a triad of strategic offensive forces, each able to survive a Soviet first strike. Since a substantial portion--perhaps up to 95 percent--of the Minuteman force is predicted to become vulnerable to a Soviet first strike within the next few years, a survivable follow-on missile would be needed to maintain a survivable triad.

A survivable triad would provide insurance against technological breakthroughs that, if they occurred rapidly and without time for development of countermeasures, could jeopardize U.S. retaliatory capability. A triad of forces also requires the Soviets to spread their defensive research efforts over three different groups of weapons systems, reducing the chance of a breakthrough against any one. Abandoning the quest for survivable land-based missiles would mean forgoing these advantages.

Other advantages that would be forgone have been noted earlier in this chapter. These include reliable command and control, accuracy, and targeting flexibility. Also noted earlier is the potential contribution of such a program to the arms-control process: its indication of U.S. steadfastness of purpose, providing an incentive to the Soviets to conclude an arms-control agreement.

Quantitative Contribution. A survivable follow-on missile could add a substantial number of surviving warheads able to destroy targets hardened against nuclear blast. They could be launched promptly after a Soviet first strike. As with the MX missile, the contribution of a follow-on missile to survivable, prompt, hard-target kill capability would depend on what other systems could act "promptly." If only land-based missiles are assumed to provide this capability, then a follow-on missile such as the SICBM would offer nearly 90 percent of U.S. surviving prompt, hard-target kill weapons, assuming that most existing Minuteman and MX silo-based missiles would have been destroyed. On the other hand, if Trident submarines with the D-5 missile were also available, then by 1996 a follow-on land-based force that provided 600 surviving warheads would contribute between 17 and 34 percent of surviving U.S. prompt, hard-target capability, depending upon whether the Soviet first strike occurred after some warning or as a bolt out of the blue.

Future Vulnerability of Submarines. Under the proposed alternative, the United States would be concentrating more of its strategic deterrent in the submarine force. Even though submarine-based missiles are thought by many to be invulnerable through the 1990s, there can be no absolute certainty of it.

Reasons to Forgo Further Modernization of Land-Based Missiles

Despite the advantages of a survivable land-based missile force, the problems associated with achieving one are formidable. These difficulties may be illustrated by a discussion of the problems associated with one possible follow-on missile, a small ICBM deployed in a mobile mode.

The rationale of a mobile system is to make the location of the missiles uncertain. This would force the Soviets to barrage large areas with nuclear weapons in order to defeat the system, thus complicating their targeting problem and requiring them to dedicate a much larger percentage of their missile force to the attack. This contrasts with the current situation in which there is a high probability that one or two Soviet warheads targeted on a fixed silo could destroy a multiple-warhead ICBM.

One problem is that mobile systems are inherently costly, mostly because of the large numbers of specialized transporter vehicles and numbers of personnel required to man the system. For example, the Department of Defense estimates that the cost of developing and deploying a force of 1,000 SICBMs in a land-mobile mode would be $46.2 billion. Annual operating costs would be approximately $3 billion. The estimates are subject to certain decisions and technical findings not yet available, notably the land area that would be available for deploying the missiles and the degree to which the transport vehicles could be hardened against nuclear blast. Substantial limits on either of these could raise the costs of achieving the desired level of survivability. The absence of effective arms-control limitations could drive the costs needed to maintain a given level of survivability still higher, because the Soviets could deploy more weapons to attack the system.

Nor is cost the only problem. Air Force officials have indicated that 1,000 single-warhead SICBMs would be needed to replace the previously planned MX in closely spaced basing. They have also indicated that there may not be enough land on government installations to base such a system safely. In this case, it might be necessary to include areas outside govern-

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ment installations, with all the attendant concerns regarding adequate security and public acceptance. (See Appendix A for a discussion of some considerations for mobile systems.)

Certain desirable attributes of a land-based system might be diminished with a land-mobile basing mode. For instance, some reliability in command and control might have to be sacrificed for the ability to roam around freely in an unpredictable fashion; some promptness might have to be yielded if missiles must remain stationary for a time in order to align their guidance systems before retaliating; and survivability, owing to the uncertain location of the missiles, might suffer if many missiles were kept in garrison or had to be moved to pre-surveyed sites in order to launch. Issues such as these become very relevant when the argument for deploying such a system rests heavily on the assertion that it is necessary in order to preserve the attributes of a survivable land-based system.

Other Arguments for Terminating Further Investment in Land-Based Missiles

Even without modernization of the land-based triad leg, the United States would retain its 1,000 Minuteman missiles, with 2,100 warheads, through the end of this century at least. This means that even without a survivable follow-on missile the United States would retain enough of the diversity and synergism of the triad to complicate Soviet attack plans. For example, as the President's Commission on Strategic Forces pointed out, a Soviet ICBM attack on the U.S. land-based missile force would, because of the 30-minute flight time involved, alert the bomber force and allow a substantial portion of it to escape. Likewise, a Soviet attack on U.S. bomber bases with submarine-launched missiles would provide time to launch U.S. land-based missiles before the later arrival of Soviet ICBMs.

The argument that a follow-on missile would contribute to negotiations on arms control is not convincing to everyone. Deployment of a SICBM would not begin until the early 1990s, and near-term modernization would, in this view, probably be of more concern to the Soviets.

Submarines as an Alternative.

Unlike the problematic land-based systems, strategic submarines offer relatively certain capabilities. The Trident II (D-5) submarine-launched ballistic missiles (SLBM), which will enter operation by 1989, will have a capability to destroy hardened targets almost equalling that of the best land-based missiles. The Trident II will be deployed on Trident submarines, which are widely considered invulnerable when at sea and are likely to remain so at least through the 1990s.

Rather than pursuing further modernization of the land-based leg of the triad, the Congress could decide to rely on the Minuteman force to retain some of the advantages of a triad, while expanding the Trident submarine fleet to achieve the level of effectiveness--in terms of surviving hard-target-capable warheads--that would have been provided by the follow-on missiles.

The number of Trident submarines that would be needed depends on the measure used to determine equivalence. This study assumes the follow-on missile system would have provided about 600 surviving, hard-target warheads. Five Trident submarines armed with Trident II missiles would provide approximately the same number of surviving hard-target warheads under an attack-without-warning scenario, assuming that only the force on patrol survived. 8/ If, on the other hand, equivalence is measured in terms of hard-target warheads available for prompt retaliation, then it would take nine additional Trident submarines (beyond the assumed force of 20) to provide the requisite number of surviving warheads. This is because more submarines would have to be continuously at sea in order to have 600 warheads available promptly under current operating conditions. It would be possible, however, to operate the Trident fleet in a way that would reduce the number of submarines needed. 9/

Five to nine additional Trident submarines could be produced using existing shipyard capacity. This assumes that Trident submarines would be procured at the rate of three every two years, rather than one per year as the Administration plans, with a revised 25 to 29 vessels rather than the goal of 20 assumed for the Administration plan. 10/ The Congress might not

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8. This assumes about 74 percent of the on-line Trident submarines are at sea on a day-to-day basis.

9. U.S. SSBNs currently operate so that approximately 50 percent of those at sea are constantly on a prompt alert status, ready to recieve a launch order and to execute it promptly. But it would also be possible to operate an additional group of Trident submarines as a force dedicated to the role of providing prompt counterforce retaliatory capability. These submarines would all be on prompt alert status. If such an approach was taken, the number of Trident submarines needed would decrease once again to five.

10. The Navy has indicated that authorizing three submarines every two years would be the preferred rate for an increased production schedule

authorize the first additional submarines under this alternative until fiscal year 1985, primarily because of long lead times for nuclear reactor components. Deliveries would then begin in 1991 at the accelerated rate of three submarines every two years. Deliveries of five additional submarines above the baseline goal of 20 would be complete by 1999, and delivery of nine by the year 2002. This might be somewhat longer than the time required for a follow-on land-based missile, which would be initially deployed, under Administration plans, in the early 1990s, but probably not fully deployed and fully survivable until the mid-1990s or later. The difference in availability between the two systems would be small for a requirement of five Tridents, and somewhat greater for the complement of nine Tridents.

Savings from Choosing the Alternative

Choosing the alternative would be likely to save money both in the long run and in the next five years. A force of five additional Trident submarines with Trident II (D-5) missiles would cost about $12.8 billion to build and an additional $6 billion to operate for 20 years, for a total of $18.8 billion. With nine additional Tridents, investment costs would rise to $23.1 billion and 20-year operating costs to $10.8 billion, for a total of $33.9 billion.

Land-based missiles are likely to be more expensive than additional Tridents. The costs of deploying 100 MX missiles in silos in 1984 and beyond would amount to $18.4 billion. It is difficult to determine the costs of the follow-on missile system until it is more fully defined. But both the investment and the operating costs of any mobile system would be substantial. A mobile system would be expensive to build and operate because of the large numbers of missiles, transporters, personnel, and support facilities required. The Department of Defense estimates for the costs of a land-mobile system of 1,000 SICBMs cited earlier would yield a 20-year life-cycle cost of $107 billion. Taken together, the life-cycle costs of the MX and small ICBM would exceed those of nine additional Tridents by a factor of more than three.

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for Trident submarines. It has also noted that production capability could be built up over a three-year period to a rate of two submarines per year with no adverse effect on the Administration's planned SSN-688 attack submarine program.

The alternative would also offer substantial short-run savings. Even with the additional procurement costs for nine additional Trident submarines, savings in budget authority in the period 1984-1988 would total $19.9 billion (see Table 8). Most of these savings would stem from cancellation of the MX deployment.

ALTERNATIVE 3: CANCEL THE B-1B AND RELY MORE HEAVILY ON B-52s AND CRUISE MISSILES

The Administration is proposing the purchase of 100 B-1B bombers as the initial part of its modernization effort for the strategic bomber force. Of these, 90 would be deployed as primary authorized aircraft, with the remainder in a "pipeline" for training and maintenance. The first squadron of B-1B bombers would be ready for service in 1986; all would be available by 1988. So far the Congress has appropriated funds for eight B-1Bs; the Administration requests funds for ten more in 1984.

The B-1B is intended as a near-term modernization program that will provide capability quickly, before most other new strategic systems become available. Later, in the 1990s, the Administration plans to deploy the Advanced Technology Bomber (ATB), a "stealth" aircraft designed to make detection by enemy radars very difficult. In addition to these new bombers, the Administration plans to field about 3,200 air-launched cruise missiles in the 1980s and early 1990s. These would be carried on existing B-52 bombers and eventually on the new B-1Bs.

An Alternative Bomber Program

Questions have been raised as to the need for purchasing the B-1B bomber, given that the ATB is to be available in the early 1990s. If the B-1B program was terminated, the United States could rely on B-52s and air-launched cruise missiles (ALCMs) in the near term while awaiting the ATB in the 1990s. In conjunction with this, three actions could be taken to improve the capabilities of the existing bomber force.

First, both to maintain numbers of available weapons in the near term and to produce more ALCMs than in the Administration plan, the production rates of the ALCM could be maintained at approximately 440 per year through the mid-1980s. The Administration has proposed curtailing the production of the current-generation ALCM after 1983 in favor of an advanced cruise missile (ACM), which is apparently better able to avoid detection by enemy radar and will have longer range--an important feature. The schedule for introducing the new ACM is not yet clear because the program details of the ACM remain classified and because the Administration has not stated whether it intends to proceed with the ACM exclusively or in combination with the current ALCM. The above alternative would incorporate the ACM in the near term only if it could be made available in the numbers needed to sustain the 440 missile production rate. Otherwise, more of the current-generation ALCM would be produced, while phasing in the new advanced missile as it became available, perhaps later in the 1980s. 11/ Eventually 3,600 missiles would be deployed instead of the 2,880 apparently intended under the Administration plan.

Second, those G models of the B-52 that under the Administration's program were to be converted to carry ALCMs only externally would also be converted in the same time period to carry ALCM internally. This would expand the maximum ALCM load on B-52Gs from 12 to 20, and they would continue in service through the end of the century. The G model is the older of the two major remaining models of the B-52, and is currently scheduled for retirement in the mid-1990s.

Third, in the absence of the B-1B, the B-52H would act as the main force of penetrating bombers through the late 1980s and into the early 1990s, pending deployment of the ATB. To this end, its modification to carry cruise missiles would be delayed about two years; in the late 1980s it would carry cruise missiles as well as act as a penetrator. Only in the early 1990s, when the ATB entered the fleet, would these aircraft assume the single role of cruise missile carrier under this option. 12/

Since the B-52s would, in some cases, be retained longer or given more arduous duty under this option than under the Administration plan, additional modifications beyond those in the plan might be needed. These would increase reliability, maintainability, and survivability as well as provide more cruise missile capability for some B-52Gs. The costs of these improvements are taken account of in the savings for the alternative shown in Table 8.

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11. It might be feasible to upgrade the current ALCM to improve its flight and penetration characteristics. Such upgrades might include electronic countermeasures, a better engine, and some reduction of radar detectability.

12. Accelerating the introduction of the ATB would relieve the B-52H of the penetrating bomber role sooner, but this study does not address that issue because of the security classification of the ATB program.

Advantages of the Administration Program

With these improvements in the B-52 fleet, the alternative bomber program would provide similar numbers of warheads either before or after a Soviet first strike as would the Administration program but at less cost. It would not, however, provide some of the advantages of the Administration program.

Ability to Penetrate Soviet Airspace. Estimates of post-attack capability do not take into account differences in the ability of the B-52, B-1B, and ALCM to penetrate Soviet air defenses. The Soviets have an extensive network of radars, missiles, and interceptor aircraft designed to shoot down U.S. strategic bombers and cruise missiles. With its lower radar detectability and better countermeasures, the B-1B should have a better chance of penetrating these defenses in the event of nuclear war than B-52 aircraft. 13/ Some DoD officials even believe it to have better penetration capabilities than the current ALCM, although the ALCM is physically many times smaller than the B-1B. 14/

Other Factors Favoring the B-1B. The B-1B would also provide a hedge against uncertainties in the Advanced Technology Bomber program. The ATB, which is designed to be difficult to detect by many types of radar, might be better than the B-1B at avoiding Soviet air defenses. But Administration spokesmen argue that it would be imprudent to wait until the ATB technology matures. If that technology proved disappointing, the United States would be left with only B-52 aircraft that might find it increasingly difficult to penetrate Soviet defenses. This could eventually leave the

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13. Estimates of the probability of penetration are not publicly available. As an example, however, assuming that in 1990 the B-1B could penetrate the Soviet Union and reach its targets with a probability of 0.75, while the B-52 and ALCM had only a probability of 0.50, then in an attack with warning a force of B-1Bs would have 27 percent more warheads surviving a Soviet first strike and eventually reaching their targets than would a force of B-52s carrying the same number of warheads. Of course, many additional and complex operational factors--specific assignments of bombers to targets, the relative value of those targets, and the number of defenses encountered by each bomber--would ultimately determine the relative contributions of the B-1B, B-52, and cruise missile.

14. See testimony of General Charles Gabriel, USAF, before the Senate Armed Services Committee, February 28, 1983.

United States without a credible force of penetrating bombers, reducing the effectiveness of U.S. forces on those missions--such as attacking mobile targets--for which a manned system would be preferred.

Purchase of the B-1B would also hold down the average age of the strategic bomber fleet. With the B-1B, U.S. strategic aircraft would average about 20 years of age in 1990; without it, they would average about 28 years. By 1996, when the Advanced Technology Bomber had entered service, the bomber force would average about 14 years of age with the B-1B and about 23 years without it. There is no definite age at which bombers must be replaced, but as their average age increases more money typically must be spent to keep them flying safely and effectively.

Because of its improved sensors, better penetration capability, and enhanced range-payload characteristics, the B-1B would also make a substantial contribution to U.S. conventional forces. It would, for example, provide a new aircraft capable of long-range missions in support of the Rapid Deployment Force.

An improved B-1B could also provide an alternative to buying the ATB. 15/ Development of both aircraft is said to be important to maintaining the benefits of competition. Given the need for a bomber that can be deployed quickly, the Administration points out that much research and development, flight testing, and construction of production facilities have already been undertaken for the B-1B program; accordingly, it argues for taking advantage of the investment.

Finally, proponents of the B-1B point out that failure to purchase a new aircraft in the near term would mean ultimately having to develop and procure a replacement for the B-52s as cruise missile carriers and conventional bombers sometime in the 1990s. They argue that handling a two-bomber program later would be no easier than handling one now.

Contributions to Warhead Counts Similar Under the Administration's Plan and the Alternative

The number of warheads available under the Administration's plan and under the alternative bomber program would be about the same, especially

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15. Press reports indicate that some development work has begun on a stealth version of the B-1, known as the B-1C. See Defense Daily, September 13, 1982, p. 27.

if measured before a Soviet attack: both would contribute about 4,300 warheads in 1990 and 4,800 warheads in 1996. All but about 1,000 of these weapons would be hard-target-capable. Both bomber forces would contribute about 34 percent of pre-attack warheads in 1990, and 37 percent in 1996. But the alternative bomber force would have more cruise missiles and the Administration force more gravity bombs. 16/ In fact, the number of weapons carried by the Administration force could be increased significantly--and a dominance established over the alternative--if more SRAMs (or a successor standoff weapon) were available. There are, however, no plans at present to build more SRAMs. 17/ Differences in the mix of weapons--cruise missiles as against bombs and SRAMs--carried by the two forces could lead to differences in the way the forces might be used and the way the Soviets might react to them. Cruise missiles, for example, are not amenable to ad hoc targeting, while bombs and SRAMs must be carried into Soviet air space for delivery.

Measured after a Soviet first strike, the number of surviving weapons in the Administration force would be somewhat greater than in the alternative. This is primarily because the B-1B is capable of escaping from its bases faster than the B-52, is more resistant to nuclear effects, and could probably sustain somewhat higher peaceime alert rates (see Appendix E for details). The post-attack contributions of each force to overall U.S. retaliatory capability are shown in Table 9. These results would not be substantially different under the proposed START agreement or under SALT.

Costs and Technology

Critics of the B-1B assert that developments in Soviet air defenses could conceivably make the B-1B obsolescent at the time of its deployment. Because of its inherent radar detectability, the B-1B would have to rely increasingly on electronic countermeasures--much as the B-52s do today--for survival. If these proved ineffective, the B-1B might be unable to penetrate Soviet airspace in large numbers. Others argue that U.S. ballistic

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16. In 1996, measured before a Soviet first strike, cruise missiles would make up about 70 percent of the weapons mix of the alternative force, instead of about 50 percent of the Administration force.

17. There have been press reports that the Air Force plans to develop a follow-on SRAM. See Clarence A., Robinson, Jr., "Technology Key to Strategic Advances," Aviation Week and Space Technology (March 14, 1983), p. 24.

TABLE 9. CONTRIBUTIONS OF TWO BOMBER FORCE ALTERNATIVES TO U.S. RETALIATORY CAPABILITY UNDER DIFFERENT SCENARIOS, 1990 AND 1996 (In percentages of surviving warheads)

	Surprise Attack		Attack with Warning	
	1990	1996	1990	1996
Administration Force	26	30	39	44
Alternative Force	22	27	38	43

missiles would have reduced Soviet air defenses by the time the bomber force arrived.

Relying on B-52s and air-launched cruise missiles would avoid much of the cost of near-term modernizing with the B-1B. The Administration estimates that it can procure 100 B-1B bombers for an investment of $20.4 billion in 1981 dollars ($27.8 billion in 1984 dollars). The General Accounting Office, citing independently derived estimates by the Air Force and the Office of the Secretary of Defense, suggests that the cost could amount to as much as $26.7 billion in 1981 dollars. The higher estimate is due mostly to a higher baseline estimate, as well as to the addition of items not currently funded in the B-1B program.

Critics of the B-1B also fear that its high cost may impede funding of the Advanced Technology Bomber, which they believe ought to be fielded as soon as possible. They contend that the ATB probably offers the best chance of penetrating Soviet air defenses, especially in the 1990s.

Savings from Terminating Procurement of the B-1B and Relying on B-52s and Cruise Missiles

If the Congress terminated further production of the B-1B at the end of fiscal year 1983, it would forgo the purchase of all but 8 aircraft of the 100 planned. By then, because of the program's structure, about one-fourth of the total program cost would have been appropriated. In addition, the Air Force estimates that there would be termination liability costs of approximately $2.8 billion. 18/ Nonetheless, substantial savings could still be made in procurement as well as in operations and support funding.

Some of these savings would be offset by the costs of the alternative approach. B-52 aircraft would be kept in the fleet longer, and changes would be made to them. More cruise missiles would be purchased in the near term, as well as over the life of the program. Even so, termination of the B-1B would reduce budget authority by $12.8 billion from 1984 to 1988 and by $15.5 billion through the end of the century (see Table 8).

In the long run, of course, some of these savings might also have to be used to maintain the current size and capabilities of the bomber fleet: to procure a replacement for the B-52 in its cruise-missile carrying and conventional bomber roles, or to modify the B-52 further so as to keep it in service. Although these expenditures could be substantial, they might not be required until the late 1990s or the early 2000s.

SUMMARY AND CONCLUSIONS

The Administration's plan for the strategic offensive forces represents a buildup exceeding that experienced in this country in the past 20 years. The major thrust is force modernization: the addition of newer, more potent weapons systems and the eventual retirement of older, assured-destruction-type systems of the 1960s and 1970s. Contributing primarily to the buildup--and undergoing modernization in the process--would be the strategic bomber force (in the 1980s) and the sea-based forces (in the 1990s). Land-based forces would also be modernized in the 1980s with the MX and later, perhaps, with a follow-on missile such as the SICBM. By the mid-1990s the vast majority of strategic weapons would be capable of destroying hardened Soviet installations.

In examining alternatives to the Administration's plan, it appears that a substantial amount of money could be saved through the 1980s, with little change in the post-attack, quantitatively measurable attributes of the

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18. Termination liability costs would include contractor expenditures and non-cancellable commitments, special termination costs and indemnification costs for capital investment incentives, unexpired lease/rental costs, and idle facilities.

forces, by choosing not to build and deploy the MX missile. Again, savings over the Administration's plan could be generated--also with little change in post-attack quantitative measures--by choosing other courses of action than fully modernizing the land-based missile force with a follow-on ICBM or than deploying the B-1B bomber. While any specific alternative would entail some change in quantitative capabilities, these may seem modest in comparison to the substantial buildup in overall capabilities.

Nonetheless, the Congress must weigh the choice of any alternative against the need to maintain the credibility of the U.S. strategic deterrent. For example, undertaking the apparently very large initial and ongoing costs of maintaining a land-based missile force may be necessary in order to minimize certain risks. Technological breakthroughs in anti-submarine or anti-air warfare that would render large portions of the sea-based and bomber forces ineffective represent one such set of risks. A devastating Soviet surprise attack or an attempt effectively to disarm the United States with a limited strike on its forces represent another set of risks that could be reduced by maintaining a survivable land-based missile force, with its high alert rate.

Likewise, the near-term modernization of the bomber force with the B-1B could be seen as helping to avoid the risk of a breakthrough in anti-submarine warfare, a failure of "stealth" technology to mature sufficiently, or continued difficulty in deploying a credible force of ICBMs.

In short, the Congress should avoid viewing decisions on specific strategic weapons systems in isolation. Rather, it should judge each alternative in terms of its effect on overall capabilities and risks, and hence on the ability of the United States to deter nuclear war.

APPENDIXES

APPENDIX A. SOME FUNDAMENTAL CONCEPTS OF LAND-MOBILE MISSILE SYSTEMS

The Administration's plan for modernizing the land-based missile force contains much uncertainty as to the missile system that will follow up on the initial deployment of the MX. It seems clear, however, that should the small, single-warhead ICBM proposed in the plan eventually be developed and deployed, a land-mobile system of some type would be the prime contender for the basing mode. Indeed, the rationale for moving toward small ICBMs (SICBMs) in the first place is the improved survivability achieved by their relative ease of mobility. The primary purpose of this Appendix is to highlight some of the important variables, characteristics, assumptions, and unknowns that would enter into the calculation of system effectiveness, and ultimately into the determination of the size of the system and its cost.

In order to demonstrate the potential effects of completing the Administration's plan, CBO assumes in this study that the SICBM would be deployed in the early 1990s in a land-mobile mode, the system sized to provide the roughly 600 surviving warheads projected by the Air Force for the MX in the closely spaced basing (CSB) mode.

SURVIVABILITY OF LAND-MOBILE MISSILES

The basic premise behind the land-mobile basing concept is to improve survivability by dispersing the missile force over an area large enough to make a successful attack unlikely. There are many ways of doing this. A system might roam the interstate highways; be confined to roads on federal or military lands; or be truly off-road mobile, again perhaps on federal lands. The missiles might be moved periodically in an unpredictable manner over the deployment area; or be kept in garrison, ready to dash out on warning of a Soviet attack.

The underlying principle in every case would be to confront Soviet targeters with large areas of uncertainty. Rather than pinpointing specific targets, they would be forced to barrage these areas. Depending on specific deployment characteristics, such an attack could deplete Soviet missile forces considerably. This would be the opposite of the situation that currently exists with vulnerable, silo-based MIRVed missiles, where one or two warheads aimed at each MIRVed missile have the potential to destroy several times the number of warheads used in the attack. 1/

Many factors contribute to the deterrent value of a land-mobile system. With the exception of the threat itself (which is an exogenous variable), each of these system parameters ultimately requires tradeoffs of cost and political feasibility with potential effectiveness. The list of these factors below, while not all-inclusive, indicates the scope of the problem.

Key Mobile System Parameters

Deployment Area. Of vital importance is the amount of land area available for deployment, the terrain and/or road characteristics, and the general physical security of the area. A truly road-mobile system could roam virtually the entire public highway system; a system requiring off-road mobility might be restricted to relatively flat terrain. Public acceptance would be vital in some of these deployment schemes.

Missile Transporter. The transporter vehicle parameters of interest would be resistance to nuclear effects (hardness), the speed at which the vehicle could travel in its normal mode (on- or off-the-road), physical security from sabotage, maintainability and reliability, and the vehicle's degree of endurance.

Missile. Missile characteristics affecting overall system survivability relate primarily to their guidance systems--two key issues being whether a missile has to be fired from a predetermined site and how long the missile has to remain stationary to align its guidance system.

Concept of Operation. Although not totally independent of the factors listed above, much flexibility remains in choosing the manner in which the mobile system would be operated. Some of the more interesting issues relate to the fraction of the force that would be kept out of garrison and dispersed, along with the manner in which it would be manned and maintained.

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1. The Office of Technology Assessment (OTA) points out that the area that could be barraged to a given level of overpressure is directly related to the amount of equivalent megatonnage (EMT) used in the attack. Thus, accuracy of delivery and numbers of warheads used are not as important. EMT, in turn, is correlated with missile

Threat. The expected threat--both the immediate threat and the potential threat that might develop in reaction--is obviously integral to determining the size and survivability of the mobile system. Key parameters here are the numbers and characteristics of the potential attacking force, and the form an attack might assume. For example, would the Soviets be likely to attack the system with short-time-of-flight, submarine-launched weapons, or would they choose to employ their more substantial land-based missile force? The degree to which the threat would be limited by arms control is also pertinent. Although it probably would not depend totally on arms limitations for its survivability, a land-mobile system could be made more cost-effective by constraints on those force characteristics--such as equivalent megatonnage (EMT)--that are most threatening.

Of vital interest would be the ability of the Soviets to detect out-of-garrison missiles and translate such information into usable targeting data. The time it takes to do this, plus missile time of flight, is called the "intelligence cycle" time. 2/ If this time interval was short, the survivability of the system could be reduced significantly.

Interrelationship of Factors

Decisions about each of the above factors are likely to be heavily interdependent. The amount of land needed for a given deployment concept, for example, would be contingent on the characteristics of the missile transporter and the number of vehicles to be stationed in the field. Likewise, changes in the size of the Soviet threat or in Soviet intelligence capabilities could dictate alterations in the concept of operation, and so on. Ultimately, many of the system parameters will be constrained by technological and political considerations. It would do little good, for example, to postulate a transporter vehicle very heavily hardened against nuclear blast if it is not feasible to build one; neither would it be plausible to assume that the nation's highways could be used for missile deployment if adequate security could not be provided or public acceptance gained.

A simple example of how these issues relate to one another may be useful. Suppose that a given number of expected surviving warheads--say 600--is desired from the land-mobile system using the single-warhead

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throwweight. See Congress of the United States, Office of Technology Assessment, MX Missile Basing (Government Printing Office, 1981).

2. Office of Technology Assessment, MX Missile Basing, p. 261.

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SICBM. Suppose further that an attack by up to 4,000 warheads with yields similar to the MIRVed versions of the SS-18 Soviet ICBM could be mounted, 3/ and that the Soviets have no way to target missiles that are dispersed out of garrison. Then Figure A-1 shows the relationship between missile transporter vehicle hardness, dispersal land area, and the number of missiles stationed in the dispersal area. This means that for the situation represented by a given point on the chart, the Soviet targeters must assume that the associated number of missiles could be anywhere in the dispersal area, or "area of uncertainty." Thus, for example, if vehicles hardened to 20 pounds per square inch (psi) overpressure could be deployed in an area of uncertainty of 50,000 square nautical miles (nm^2), then about 1,000 of them would have to be spread throughout this area to assure the requisite number of surviving warheads. 4/ The 50,000 nm^2 area is roughly the size of the state of Oklahoma. Likewise, if only about 17,000 nm^2 of land area was available for off-road vehicle use, 5/ then over 3,000 of the 20-psi vehicles would be needed in the field; on the other hand, 1,500 vehicles of 37 psi hardness, 6/ or 900 60-psi vehicles, would be equally effective.

On the other hand, if the Soviets were constrained by arms control, for example, to an attack of roughly half the size of the previous examples, then the U.S. situation could be eased considerably. An equal number of vehicles hardened to 12 psi instead of 20 psi would do; alternately, two-thirds of the land area of the example would provide equal survivability.

These examples suggest, however, that achieving numbers of surviving warheads greatly in excess of 600--the capability attributed to a follow-on missile in this study for illustrative purposes--would require large numbers of SICBMs.

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3. This would be a 2,500 EMT attack, and would require the use of about two-thirds of the current Soviet ICBM arsenal.

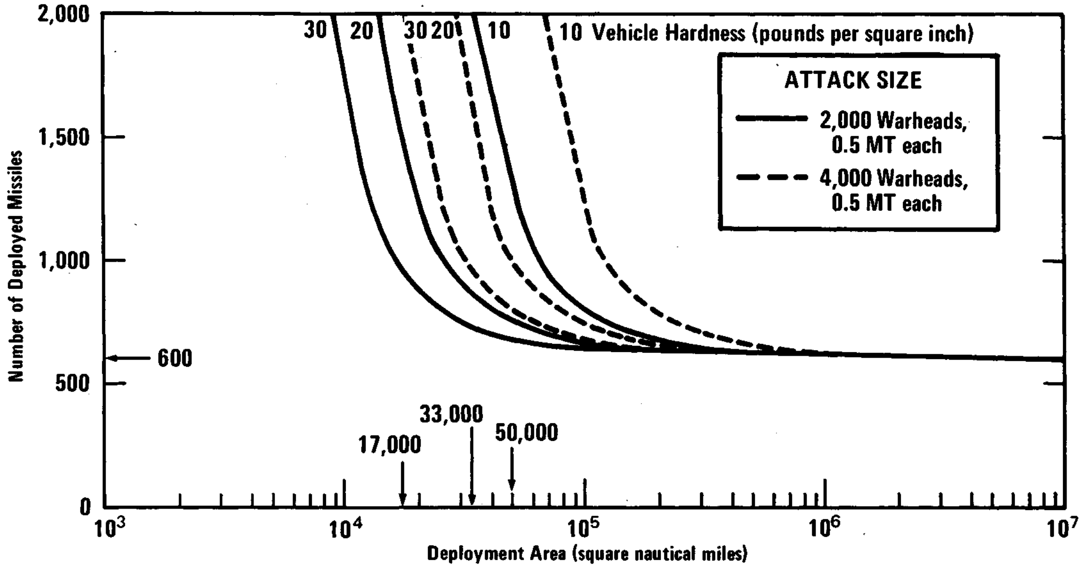
4. Many more vehicles and missiles might have to be purchased to support such a plan, depending on maintenance, personnel, and operational concepts.

5. OTA estimates that this is the amount of land owned in the southwestern United States by the Departments of Defense and Energy. See MX Missile Basing, p. 264.

6. This hardness value was given as representative of a so-called "Armadillo" mobile system. See Clarence A. Robinson, Jr., "Commission Studies Small ICBM," Aviation Week and Space Technology (February 21, 1983), p. 16.

Figure A-1.

Relationships Among Key Parameters for Deploying SICBM to Obtain 600 Surviving Warheads



SOURCE: Congressional Budget Office.

The area of uncertainty could be decreased significantly, and thus the number of required missiles increased, if a "Dash on Warning" operational concept was used for deploying the missiles. In such a scheme most transporters would be kept in garrison until receipt of warning of an attack, at which time they would disperse. Warning time and vehicle speed would then be crucial to survivability.

Soviet intelligence in targeting a land-mobile system would also affect the number of required missiles. Assume that the force of 1,000 20-psi vehicles was randomly dispersed over 50,000 nm^2. Based on the size of the attack and the characteristics of the deployed SICBM force, the expected survivability of the deployed vehicles would be about 60 percent if the Soviets had no knowledge of the missiles' whereabouts. If the vehicles could travel at an average speed of five knots, and the Soviet intelligence cycle was one-half hour, then assuming a 50 percent probability of detection of the vehicles and independence between detections--the Soviets could destroy the detected half of the force plus up to 25 percent of the undetected force--about 37 percent would survive. This example assumes virtually instantaneous retargeting of Soviet missiles. A 15-minute delay in retargeting would mean that the Soviets could not take advantage of the high probability of detection; a half-hour delay would render the Soviet system no better than the random barrage assumed earlier.

APPENDIX B. DETAILS OF THE STRATEGIC MODERNIZATION PROGRAM ASSUMED IN THE ANALYSIS

TABLE B-1. LAND-BASED MISSILE FORCE UNDER THE ADMINISTRATION'S MODERNIZATION PROGRAM (Not constrained by arms-control limits) (By fiscal year)

	1983	1984	1985	1986	1987	1988	1989
Titan II	43	34	23	11	-	-	-
MM II	450	450	450	450	450	450	450
MM III (Mk12)	250	250	250	240	200	150	150
MM III (Mk12A)	300	300	300	300	300	300	300
MX	-	-	-	10	50	100	100
SICBM	-	-	-	-	-	-	-

TABLE B-1. (Continued)

	1990	1991	1992	1993	1994	1995	1996 a/
Titan II	-	-	-	-	-	-	-
MM II	450	450	450	450	450	450	450
MM III (Mk12)	150	150	150	150	150	150	150
MM III (Mk12A)	300	300	300	300	300	300	300
MX	100	100	100	100	100	100	100
SICBM	-	-	20	200	500	800	1,000

a/ Numbers for all systems remain the same from 1996 through 2000.

TABLE B-2. STRATEGIC BOMBER FORCE STRUCTURE UNDER THE ADMINISTRATION'S MODERNIZATION PROGRAM (Not constrained by arms-control limits) (By fiscal year)

	1983	1984	1985	1986	1987	1988	1989
FB-111A	56	56	56	56	56	56	56
B-52G							
Penetrate a/	105	61	61	61	61	61	30 b/
Standoff-Penetrate c/	46	90	90	60	30	0	0
Standoff d/	0	0	0	30	60	90	90
B-52 H							
Penetrate	90	90	70	37	7	0	0
Standoff-Penetrate	-	-	20	53	83	63	13
Standoff	-	-	-	-	-	27	77
B-1B							
Penetrate	-	-	1	17	59	90	90
Standoff-Penetrate	-	-	-	-	-	-	-
ATB	-	-	-	-	-	-	-
ALCM e/	552	1,080	1,320	1,716	2,076	2,376	2,799
SRAM	1,125	1,125	1,125	1,125	1,125	1,125	1,125

NOTES: All values are in terms of primary authorized aircraft (PAA), an Air Force measure that takes account of the roughly constant 10 percent of total aircraft in the maintenance pipeline and thus not available for use. Unless otherwise noted, bombers are assumed to use penetration tactics for weapon delivery.

a/ "Penetrate" refers to the tactic of overflying the target area to deliver the weapon.

b/ The B-52G penetrators are shown retiring from their strategic nuclear force role. It is not clear at this point whether they would be retired altogether or become purely conventional bombers.

TABLE B-2. (Continued)

	1990	1991	1992	1993	1994	1995	1996 f/
FB-111A b/	56	56	30	0	0	0	0
B-52G							
Penetrate a/	0	0	0	0	0	0	0
Standoff-Penetrate c/	0	0	0	0	0	0	0
Standoff d/	90	90	90	90	60	30	0
B-52 H							
Penetrate	0	0	0	0	0	0	0
Standoff-Penetrate	0	0	0	0	0	0	0
Standoff	90	90	90	90	90	90	90
B-1B							
Penetrate	90	90	90	90	60	30	0
Standoff-Penetrate	0	0	0	0	30	60	90
ATB	-	-	15	47	79	111	120
ALCM e/	2,880	2,880	2,880	2,880	2,880	2,880	2,880
SRAM	1,125	1,125	1,125	1,125	1,125	1,125	1,125

c/ "Standoff-penetrate" means that the aircraft carries a mixed load of standoff weapons (ALCM) and bombs, and would remain clear of most defenses while launching the ALCM and prior to penetration.

d/ "Standoff" aircraft carry ALCM only and do not overfly the target area.

e/ These PAA numbers were derived from ALCM inventory numbers provided in Department of the Air Force Congressional Data Sheets for the President's fiscal year 1984 budget.

f/ Numbers for all systems remain the same from 1996 through 2000.

TABLE B-3. SEA-BASED STRATEGIC FORCE STRUCTURE UNDER THE ADMINISTRATION'S MODERNIZATION PROGRAM (Not constrained by arms-control limits) (By fiscal year) a/

	1983	1984	1985	1986	1987	1988
Poseidon C-3						
On line b/	15	15	15	15	13	14
Overhaul c/	4	4	4	4	6	5
Poseidon C-4						
On line	9	7	7	7	10	12
Overhaul	3	5	5	5	2	0
Trident C-4 d/						
On line	2	3	5	6	8	8
Overhaul	0	0	0	0	0	0
Trident D-5 Backfit e/						
On line	-	-	-	-	-	-
Overhaul	-	-	-	-	-	-
Trident D-5						
On line	-	-	-	-	-	-
Overhaul	-	-	-	-	-	-
SLCM (Nuclear-Armed) f/	-	30	82	185	297	400

(Continued)

a/ According to the terms of SALT I, the United States may have no more than 44 modern, nuclear-powered SSBNs with 656 tubes. It can increase this to 710 tubes by retiring ICBM launchers deployed prior to 1964 (for example, Titan II).

b/ The status of submarines is shown as of the last day of each fiscal year. Submarines not in overhaul or in post-overhaul shakedown periods are considered to be on line. This includes Poseidon submarines in extended refit periods (ERPs).

TABLE B-3. (Continued)

	1989	1990	1991	1992	1993	1994
Poseidon C-3						
On line b/	15	16	17	19	16	14
Overhaul c/	4	3	2	0	0	0
Poseidon C-4						
On line	12	12	12	12	11	9
Overhaul	0	0	0	0	0	0
Trident C-4 d/						
On line	8	8	7	6	5	3
Overhaul	0	0	1	2	2	3
Trident D-5 Backfit e/						
On line	-	-	-	-	1	2
Overhaul	-	-	-	-	0	0
Trident D-5						
On line	1	2	4	5	6	7
Overhaul	0	0	0	0	0	0
SLCM (Nuclear-Armed) f/	400	400	400	400	400	400

(Continued)

c/ Submarines are considered to be in overhaul if they are actually in overhaul or in post-overhaul shakedown periods. The Poseidon overhaul schedule was provided by Navy staff officials.

d/ Delivery dates for Tridents 1 through 15 are from Department of the Navy Congressional Data Sheets for the President's fiscal year 1984 budget. Data for Tridents 16-20 are extrapolated from these data. Based on data supplied by Navy officials, CBO assumes the initial Trident overhauls will occur nine years after delivery; overhauls last 12 months plus an eight-month post-overhaul shakedown period, and there is a nine-month post-delivery shakedown period after delivery and before the submarine goes on patrol. See also testimony of RADM

TABLE B-3. (Continued)

	1995	1996	1997	1998	1999	2000
Poseidon C-3						
On line b/	11	8	5	3	0	0
Overhaul c/	0	0	0	0	0	0
Poseidon C-4						
On line	7	5	3	1	0	0
Overhaul	0	0	0	0	0	0
Trident C-4 d/						
On line	2	0	0	0	0	0
Overhaul	2	3	1	0	0	0
Trident D-5 Backfit e/						
On line	4	5	7	8	8	8
Overhaul	0	0	0	0	0	0
Trident D-5						
On line	8	9	10	10	10	9
Overhaul	0	0	0	2	2	3
SLCM (Nuclear-Armed) f/	400	400	400	400	400	400

James D. Murray, Jr., USN, before the Subcommittee on Defense, House Appropriations Committee, DoD Appropriations for 1980, Part 3, p. 418, March 15, 1979.

e/ Trident D-5 Backfit submarines are shown here to distinguish these conversions from the delivery of D-5-equipped Tridents.

f/ Because of its importance to the Administration's strategic program, the nuclear-armed version of the Tomahawk land-attack missile (TLAM-N) is assumed to be introduced at an annual rate of triple its fraction of the total Tomahawk production. That is, approximately 400 TLAM-N of a total SLCM purchase of 4000 are introduced at a rate of 30 percent instead of 10 percent of annual production.

TABLE B-4. CHARACTERISTICS OF U.S. BALLISTIC MISSILE FORCES a/

System	Number of Reentry Vehicles	Yield per RV (KT)	CEP (Nautical Miles)	Throwweight (pounds)	System Availability	Silo Hardness (PSI)
Titan II	1	9,000	0.8	8,275	0.85 b/	c/
Minuteman II	1	1,200 d/	0.34	1,625	0.95 e/	2,000 f/
Minuteman III						
Mk12	3	170	0.12	1,975	0.95	2,000
Mk12A g/	3	335	0.12	1,975	0.95	2,000
MX g/	10	335	0.05	7,900 h/	0.95	2,000
SICBM i/	1	475	0.07	1,000	0.90	N/A
Poseidon (C-3)	10	40	0.25	3,300 j/	0.62 k/	N/A
Trident I (C-4)	8 l/	100	0.25	2,900	0.62/0.70 m/	N/A
Trident II (D-5)	8 n/	475 o/	0.07-0.11 p/	5,075 q/	0.70	N/A
SLCM (TLAM/N) r/	1	200	.05	N/A	N/A	N/A

NA = Not Applicable

a/ Unless otherwise noted, characteristics are drawn from John M. Collins and Thomas Peter Glakas, U.S./Soviet Military Balance, Statistical Trends, 1970-1981, Congressional Research Service, Report No. 82-162S (October 1981, updated September 1982).

b/ Because it is liquid-fueled, Titan II is probably less available than solid-propellant ICBMs. This figure is drawn from Representative Thomas J. Downey, "How to Avoid Monad," as reprinted in Congressional Record, September 20, 1976, pp. S31250-31258.

c/ Less than Minuteman. See testimony of Gen. David C. Jones, USAF, before the Senate Armed Services Committee, DoD Authorization for Appropriation for Fiscal Year 1983, Part 1, February 2, 1982, p. 55. At least one estimate holds that the hardness is 300 pounds per square inch. See Representative Les Aspin, "Judge Not by Numbers Alone," The Bulletin of the Atomic Scientists (June 1980), p. 30.

d/ Collins provides only a one to two MT estimate. Many sources cite the 1.2 MT figure. See, for example, A.A. Tinajero, U.S./U.S.S.R. Strategic Offensive Weapons and Projected Inventories Based on Carter Policies, Congressional Research Service, Report No. 81-238F (September 1981).

(Continued)

e/ Minuteman alert rates are said to be "well above 90 percent" and "virtually 100 percent" by DoD officials. See, respectively, Office of the Joint Chiefs of Staff, Military Posture for 1983, p. 71, and testimony of Lt. Gen. Kelly Burke, USAF, before the House Armed Services Committee, February 25, 1982.

f/ Testimony of Secretary of Defense Caspar W. Weinberger before the House Armed Services Committee, October 6, 1981.

g/ Tinajero, op. cit.

h/ Testimony of Lt. Gen. Kelly Burke, USAF, op.cit. This is within the 3,600 kilogram ceiling for light ICBMs that the United States established unilaterally in the SALT II negotiations.

i/ CBO estimate based on general characteristics needed for a small, counterforce-capable ICBM.

j/ SLBM throwweights from testimony of Paul Nitze before the Senate Committee on Foreign Relations, July 12, 1979.

k/ CBO estimate of availability of on-line submarine-launched missiles on peacetime alert based on Navy testimony.

l/ Most estimates provide this number. See, for example, Downey, op. cit., Tinajero, op. cit., and Nitze, op. cit.

m/ The two values shown are for deployment of on-line Poseidon and Trident SSBNs, respectively.

n/ CBO estimate based on 10-RV loading for the previous D-5 baseline warhead, the Mk12A, which provided a lower yield. The 10-RV estimate is from Tinajero, op.cit.

o/ Aviation Week and Space Technology (January 17, 1983), p. 26.

p/ The lower estimate has appeared in many sources. See, for example, Aviation Week and Space Technology (March 22, 1982), p. 18.

q/ Estimate based on testimony of RADM William A. Williams III, USN, before the Subcommittee on Strategic and Theater Nuclear Forces, Senate Armed Services Committee, October 30, 1981.

r/ Assumptions drawn from Nitze, op.cit., and Aspin, op.cit., as well as Richard K. Betts, ed., Cruise Missiles: Technology, Strategy, Politics (Brookings Institution, 1981).

TABLE B-5. CHARACTERISTICS OF U.S. STRATEGIC BOMBER FORCES

System	Weapons Carriage (Maximum) Bombs	SRAM	ALCM	Weapon Yield (KT)	CEP a/ (NM)
FB-111A b/	2	4	0	1,000	0.10
B-52G					
Penetrate	4	8	0	1,000	0.10
Standoff-Penetrate	4	8	12	1,000	0.10
Standoff	0	0	12	-	-
B-52H					
Penetrate	4	8	0	1,000	0.10
Standoff-Penetrate	4	8	12	1,000	0.10
Standoff	0	0	20	-	-
B-1B					
Penetrate c/	8	16	0	1,000	0.10
Standoff-Penetrate	8	16	14	1,000	0.10
Standoff	0	0	22	-	-
ATB d/	5	10	0	1,000	0.10
ALCM	-	-	-	200	0.05 e/
SRAM	-	-	-	200	0.20

(Continued)

(Footnotes to Table B-5)

NOTE: Unless otherwise indicated, weapons carriage parameters are based on Undersecretary of Defense Richard A. DeLauer, letter of November 17, 1981, to Senator Ted Stevens, Congressional Record, December 1, 1981, pp. S14171-2. Other parameters are from testimony of Paul Nitze before the Senate Committee on Foreign Relations, July 12, 1979.

a/ Circular Error Probable (nautical miles). The Offensive Avionics System (OAS) for B-52G/H aircraft came into being after publication of Nitze's estimates. It is said that it will, among other things, "significantly improve B-52G/H weapons accuracy." (See Harold Brown, DoD Annual Report for FY 1982, January 19, 1981.) This will affect all weapons carried by B-52G/H as well as B-1B, which will be OAS equipped. A reduction in these CEP estimates of 25 percent is assumed in fiscal years 1990/1996 to account for OAS installation. See "Keeping the Boeing B-52 Operational Until the End of the Century," Interavia (December 1978), pp. 1181-84.

b/ Estimates based on data from Air Force Magazine (December 1977), p. 50.

c/ Estimates assume no weapons carried externally in a penetrator mission. Up to 14 additional bombs/SRAM could be carried externally.

d/ The ATB is said by some to be capable of carrying less than half the payload of the B-1B. See Representative Bill Chappell, Jr., statement in Congressional Record, November 18, 1981, p. H8488.

e/ This is a composite estimate based on Nitze: op. cit.; information in Richard K. Betts, ed. Cruise Missiles: Technology, Strategy, Politics (Brookings Institution, 1981); and Representative Les Aspin, "Judge Not by Numbers Alone," Bulletin of the Atomic Scientists (June 1980), pp. 28-33.

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APPENDIX C. SOVIET STRATEGIC FORCES

TABLE C-1. ILLUSTRATIVE ON-LINE SOVIET BALLISTIC MISSILE FORCES AND CHARACTERISTICS
(Not constrained by arms-control limits) a/

System	Number Deployed 1983	Number Deployed 1990	Number Deployed 1996	No. of Reentry Vehicles	Yield per RV(KT) b/	CEP(NM) c/ 1983	CEP(NM) c/ 1990	CEP(NM) c/ 1996	Throw-weight (pounds) d/	System Availability e/
SS-11	550	520	520	1	950	0.76	0.76	0.76	2,200	0.85
SS-13	60	60	60	1	600	1.0	1.0	1.0	1,500	0.85
SS-17	150	150	150	4	750	0.17	0.14	0.10	6,025	0.95
SS-18 MOD 1	24 f/	24	24	1	2,500	0.15	0.12	0.08	16,500	0.95
MOD 2/ Follow-on g/	284	284	284	10	500	0.15	0.12	0.08	16,700	0.95
SS-19/ Follow-on g/	330	360	360	6	550	0.15	0.12	0.08	7,525	0.95
New Solid 1- Silo h/	0	100	300	10	500	--	0.10	0.08	8,000	0.95
New Solid 2- Mobile h/	0	100	300	4 i/	500	--	0.10	0.08	3,000	0.90
SS-N-6 (YI)	448	448	160	1	750	--	0.5 j/	--	1,600	0.40
SS-N-8 (DI, DII)	280	280	268	1	750	--	0.5	--	1,800	0.40
SS-N-18 (DIII)	176	240	240	3	500	--	0.3	--	2,500	0.40
SS-NX-20 (Typhoon)	20	200	440	9	100	--	0.3	--	7,500	0.40

a/ Except as noted, ICBM estimates are based primarily on Department of Defense, Soviet Military Power 1983. SLBM estimates are based primarily on Aviation Week and Space Technology (June 16, 1980).

b/ Mainly from John M. Collins and Thomas Peter Glakas, U.S./Soviet Military Balance, Statistical Trends, 1970-1981. Congressional Research Service Report No. 82-162S, October 1981 (Updated September 1982).

c/ Circular Error Probable, in nautical miles, from estimates provided in Aviation Week and Space Technology June 16, 1980; Testimony of Paul Nitze before the Senate Committee on Foreign Relations, July 12, 1979; and Collins and Glakas, U.S./Soviet Military Balance, Statistical Trends, 1970-1981. The major point is that there is a trend, through modification of existing missiles and development of new generations, toward ICBM accuracy of under 0.1 nm. See Representative Les Aspin, "Judge Not by Numbers Alone," Bulletin of the Atomic Scientists (June 1980), p. 39.

d/ ICBM estimates from Collins and Glakas, op.cit.; SLBM estimates from Nitze, op.cit.

e/ Older liquid-fueled ICBM systems assumed analogous to Titan II; newer systems assumed similar to U.S. ICBMs. Estimates for SLBMs are for on-line missiles in peacetime alert.

f/ Estimate based on top-line Soviet RV count provided in Department of State, "Fact Sheet on START," May 1982, and the number of RVs deployed on other systems.

g/ Soviet Military Power 1983 indicates that follow-on missiles to the SS-18 and SS-19 are to begin testing soon.

h/ CBO estimates based on numerous press reports on these two new missiles.

i/ See Defense Daily, February 22, 1983, p. 276. At least one other estimate holds that the mobile missile carries a single-warhead. See Newsweek (March 14, 1983), p. 15. Based on historical Soviet ICBM production rates reported by DIA (see Defense Daily, July 26, 1982, p. 126), it is conceivable that the Soviets could produce replacements for their existing ICBM force as well as the numbers of new missiles shown.

j/ Single estimates are for all years and reflect lack of data regarding trends in SLBM accuracy; estimates from Nitze, op.cit.

TABLE C-2. ILLUSTRATIVE ON-LINE SOVIET BALLISTIC MISSILE FORCES--CONSTRAINED BY SALT I AND SALT II (By fiscal year) a/

System	1983	1990	1996
SS-11	550	430	0
SS-13	60	0	0
SS-17	150	100	100
SS-18 MOD 1	24	0	0
MOD 2/Follow-on	284	308	308
SS-19/Follow-on	330	360	360
New Solid 1 - Silo b/	0	200	600
SS-N-6 (YI)	448	230	0
SS-N-8 (DI, DII)	280	280	268
SS-N-18 (DIII)	176	240	240
SS-NX-20 (Typhoon)	20	200	320

a/ The illustrative force is based on the following assumptions:

- The Soviets would develop the one "new type" ICBM allowed under SALT II and modernize their ICBM force with it and with updated versions of the SS-18 and SS-19.
- They would retain their large-throwweight SS-18 ICBM force as a hedge against a U.S. breakout.
- They would proceed with modernization of their SSBNs and SLBMs.
- They would modernize their long-range bomber force with the ultimate substitution of approximately 100 Blackjack bombers for older Bear/Bison types; the new bombers would be ALCM-capable.

b/ Constrained by SALT II, the new solid ICBM would probably have a throwweight of less than 7,900 pounds (3,600 kilograms) to remain within the ceiling established by U.S. unilateral SALT II understanding.

TABLE C-3. ILLUSTRATIVE ON-LINE SOVIET BALLISTIC MISSILE FORCES--CONSTRAINED BY START (By fiscal year) a/

System	1983	1990	1996
SS-11	550	290	0
SS-13	60	30	0
SS-17	150	75	0
SS-18 MOD 1	24	0	
MOD 2/Follow-on	284	124	60
SS-19/Follow-on	330	150	0
New Solid 1 - Silo	0	100	150
New Solid 2 - Mobile b/	0	100	100
SS-N-6 (YI)	448	224	0
SS-N-8 (DI, DII)	280	140	0
SS-N-18 (DIII)	176	160	128
SS-NX-20 (Typhoon)	20	100	220

a/ The illustrative force is based on the following assumptions:

- o The Soviets would continue to maintain the position of relative importance accorded their ICBM force, both by developing the two new types noted in Table C-1 and continuing improvements to older types.

- o They would retain some portion of their large-throwweight SS-18 ICBM force as a hedge against a U.S. breakout from the agreement.

- o They would modernize their sea-based force with the Typhoon/SS-NX-20 system.

- o They would modernize their long-range bomber force with the ultimate substitution of approximately 100 Blackjack bombers for older Bear/Bison types; the new bomber would be ALCM-capable.

b/ Assumes deployment of mobile ICBMs is allowed under START.

APPENDIX D. ATTACK SCENARIOS

Two scenarios are used in this study to aid in the assessment of modernization plans for U.S. strategic offensive forces: attack without warning and attack with warning. Each is representative of types of scenarios that have evolved over the years as rubrics for strategic force analysis. Taken together they represent the range of attack possibilities for which U.S. forces need to be prepared.

The attack without warning (or peacetime alert) is considered by many to be the greater challenge to U.S. capabilities because much of the strategic force is not maintained on constant alert. In this scenario only about a third of the strategic bombers and their crews would be ready for launch within a few minutes. Of the strategic submarine force, because of turnarounds between patrols, refit periods, and so on, roughly two-thirds (for Poseidon SSBNs) to three-quarters (for Trident SSBNs) of the on-line SSBN force would be on patrol and ready to respond. Only the ICBM force is assumed to be at virtually 100 percent alert on a day-to-day basis. This latter assumption is also applied to Soviet ICBMs, which represent about three-quarters of Soviet nuclear warheads. Soviet SSBNs are assumed to maintain a less than one-third-at-sea rate because of geographical and operational factors. Some small additional covert deployment of Soviet SSBNs might be possible without alerting U.S. forces. 1/

The attack without warning is assumed to occur at a Soviet-determined H-hour, when they simultaneously launch their ICBMs and SLBMs upon U.S. strategic nuclear forces and supporting elements, a so-called counterforce strike. On receipt of the tactical warning that an attack has been initiated, U.S. alert bombers begin to take off and escape from their bases. Bombers not on alert perish in the ensuing attack; so, too, do off-line SSBNs. For purposes of assessment, the ICBM force is assumed to "ride out" the attack, although the option always exists to launch on warning of an attack or while the attack is in progress. 2/

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1. This may also be true of the Soviet bomber force, although it will not be apparent in this assessment.

2. An alternative view holds that because of the extremely high risks involved in conducting a perfectly coordinated attack with thousands of ballistic missiles--some at the geographic limits of their command

In assessing the consequences of such an attack, CBO assumes that it would be conducted in the following fashion. Soviet SSBNs patrolling U.S. coasts would expend the majority of their missiles in attacking strategic bomber bases and likely bomber flyout areas. Some of their SLBMs might be used to attack time-sensitive command, control, and communications (C3) facilities. Soviet ICBMs, on the other hand, would conduct a two-on-one attack on Minuteman and MX silos, as well as striking the less time-sensitive C3 and other military installations. More sophisticated ICBM attack modes might be necessary against follow-on deployments of MX missiles or small ICBMs in super hardened silos. Should the small ICBM be based in a mobile mode, the Soviets might barrage large areas potentially containing the missiles.

The generated alert--or attack with warning--is thought by many technical specialists to be more representative of the manner in which a nuclear conflict could occur. In this scenario a steadily increasing level of tension over time between the superpowers would probably cause each of them to bring their central strategic nuclear forces--as well as other forces--to their highest states of readiness. A conflict in central Europe or the Persian Gulf region, in which perhaps both chemical and theater nuclear weapons are used, might then cause the Soviets to attempt to gain a decisive advantage through a preemptive strike on strategic and other forces in the United States.

The distinguishing feature in this scenario is the significantly higher fraction of U.S. bomber and strategic submarine forces that would be poised for retaliation. For example, virtually all SSBNs not actually in overhaul would have made ready and put to sea. Nearly all strategic bombers would have been readied. Some or all of these aircraft might have been dispersed to other airfields and/or had their reaction times reduced through a series of special measures. 3/

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and control system--the Soviets would never attempt it. Added to this would be Soviet uncertainties about a potential U.S. "launch on warning" or "launch under attack" of its ICBMs, plus unknowns about ballistic missile accuracy.

3. U.S. forces would have attained their highest level of readiness. Obviously an attack could occur when they are somewhere "between" the peacetime and generated-alert postures described here. A subsidiary issue is how long U.S. forces could sustain the higher alert posture.

On the Soviet side it is likely that a much larger fraction of the SSBN force would be at sea, as well as a fully alerted strategic bomber force. 4/ Because most Soviet firepower is concentrated in the high-alert ICBM force, however, the Soviet forces in generated alert would not be radically different from the peacetime alert force. For this reason, the exemplary Soviet attack structure remains much the same as that outlined in the attack-without-warning scenario, either increasing in intensity or else remaining much the same but with a larger reserve force withheld.

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4. This analysis does not specifically take into account the Soviet bomber force in assessing U.S. retaliatory capability.

APPENDIX E. BOMBER LAUNCH SURVIVABILITY

To assess the pre-launch survivability of the U.S. strategic bomber force, the Congressional Budget Office has developed a computer model--AWAVES 1/--that simulates an attack on U.S. strategic bomber bases by Soviet ballistic missile submarines (SSBNs) patrolling off the U.S. coast. The submarine-launched ballistic missiles (SLBMs) carried by these SSBNs pose the most significant threat to the bomber force before encountering Soviet air defenses, since intercontinental ballistic missiles (ICBMs) and SLBMs launched from Soviet home waters--with their nominal 30-minute flight time--would arrive to find alert bombers long since departed. 2/

Scenario for Attack

The general sequence of events involving a submarine-launched ballistic missile attack on U.S. bomber bases is relatively straightforward. At some predetermined hour, the Soviets would begin launching their SLBMs with the objective of destroying as many of the weapons carried by the bomber force as possible. Once the missiles were launched, U.S. warning systems would detect the attack, and U.S. command and control centers would transmit the warning to the strategic bomber bases. Detection and warning require approximately 90 seconds; all bases would be alerted simultaneously. 3/

An attack might occur during peacetime as a bolt out of the blue, or it might be precipitated during a period of rising hostilities. In the former case, the bomber fleet would receive only tactical warning--the message from command and control centers that an attack had been initiated. In the

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1. Attacker's Weapons Allocation Versus Escaping Strategic Bombers.

2. Soviet air defenses are considered a threat to the retaliatory capability of the surviving bomber force and so are not relevant in assessing bomber pre-launch survivability--that is, the survival of the force prior to its retaliatory attack on the Soviet Union.

3. Alton Quanbeck and Archie Wood, Modernizing the Strategic Bomber Force: Why and How (Brookings Institution, 1976), p. 46.

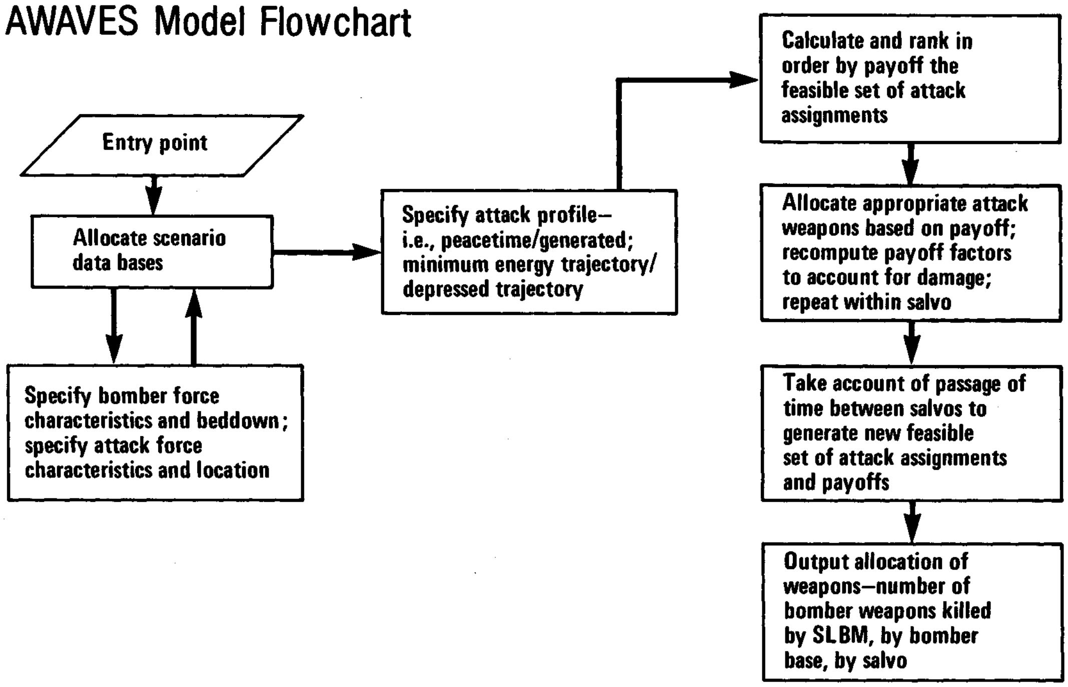
latter case, the bomber fleet would also have had the benefit of strategic warning--advance intelligence regarding an increased risk of attack. On a day-to-day basis, about 30 percent of the bomber force stands 24-hour alert; that is, the bomber and its crew are constantly ready to take off within a short time. During a period of tension or crisis, up to 95 percent of the force can be placed on alert status. Additional measures can be taken to reduce the time between warning and flyout, such as placing alert crews in the cockpits of the aircraft, keeping the engines running, and so on. In either case, bombers not on alert at the time an attack is initiated are likely to be destroyed.

Assessing Survivability

Assessing the survivability of the bomber force in an attack is much less straightforward than describing the events involved. A major reason for this is the dynamic, temporal nature of the process to be modeled. For example, a submarine cannot launch all of its missiles simultaneously; it requires a short interval to recover from the force of launching a missile before it can fire another. 4/ For a submarine carrying 16 ballistic missiles, four minutes could elapse between its first and sixteenth salvo. Coupled with this is the time-sensitive nature of the targets. On the ground, bombers are almost sure targets; once they begin to fly away, their vulnerability decreases continually as they gain altitude and distance. There are two reasons for this: first, assuming the bombers fly out in a random pattern from the base, their location is no longer known with certainty and the attacker must target an exponentially increasing area; second, the lethal effects of the attacking weapons themselves decrease significantly at higher altitudes (above a few hundred feet). The importance of this from a defender's point of view is immediately apparent: time is of the essence. For the attacker allocating his weapons, time is also important. Presumably, the attacker's objective is to destroy as many bomber weapons (rather than bombers) as possible, since it is these that provide the threat. The value of a B-52G that carries up to 20 ALCMs is greater, in an absolute sense, than an FB-111A that carries no more than 6 weapons. But if the B-52 is located at an inland base, by the time the SLBM arrives on target it may be at such an altitude and distance that the attacker would have to expend more weapons--with a lower probability of kill--than if he went for the FB-111 situated at a much closer coastal base. In this perspective, the

4. Assumed to be approximately 15 seconds. See James A. Winnefield and Carl H. Builder, "ASW-Now or Never," U.S. Naval Institute Proceedings, vol. 97, no. 9/823 (September 1971), p. 21.

Figure E-1.
AWAVES Model Flowchart



FB-111 becomes the more valuable target. Thus, to the attacker, the time-relative value of the target is likely to be different from the absolute value of the target.

A flowchart of the AWAVES model is shown in Figure E-1. Accurate modeling of an attack on U.S. bomber bases requires taking account of as many factors as possible that contribute to and/or are affected by variability with time. In AWAVES, allocation of the attacker's weapons is done on a salvo-to-salvo basis, assigning weapons to the most advantageous targets for that salvo, noting the damage from previous salvos, and registering the changing profiles of the targets over time (see Figure E-1). The algorithm allocates the attacker's weapons to bomber bases according to the rank ordering of the expected "buy"--the number of bomber weapons expected to be destroyed per attacker's weapon expended--at any base. The damage algorithm, upon which the expected destruction is based, utilizes what is known as a "cookie-cutter," or ratio of areas, calculation. Such a calculation considers the relationship between the aircraft escape area--the area of uncertainty within which an attacker must allocate his weapons to destroy aircraft--and the lethal area that his attacking missiles can create. The distance from base of the first bomber to have flown out describes the radius of an ever-expanding circle within which all subsequent bombers might be found. This is the area of uncertainty. Likewise, each attacking weapon has an associated area within which its nuclear effects are assumed to be lethal to a particular target (see Figure E-2).

The variables affecting the bomber escape area or area of uncertainty are: the distance of the submarine from the bomber base, the missile time-of-flight, and the bomber flyout characteristics. These variables are, in turn, dependent upon a number of other variables as follows:

- o Distance of submarine from bomber base
  - location of base
  - distance of submarine from U.S. coast (and location)

- o Time of flight of SLBMs to their target
  - flight distance
  - type of missile--range
  - missile trajectory characteristics

- o Bomber take-off and flyout
  - attack detection and warning time
  - alert status/reaction time
  - flyout characteristics (speed, rate of climb, etc.)

The lethal area of the attacker's weapons is a function of the following variables:

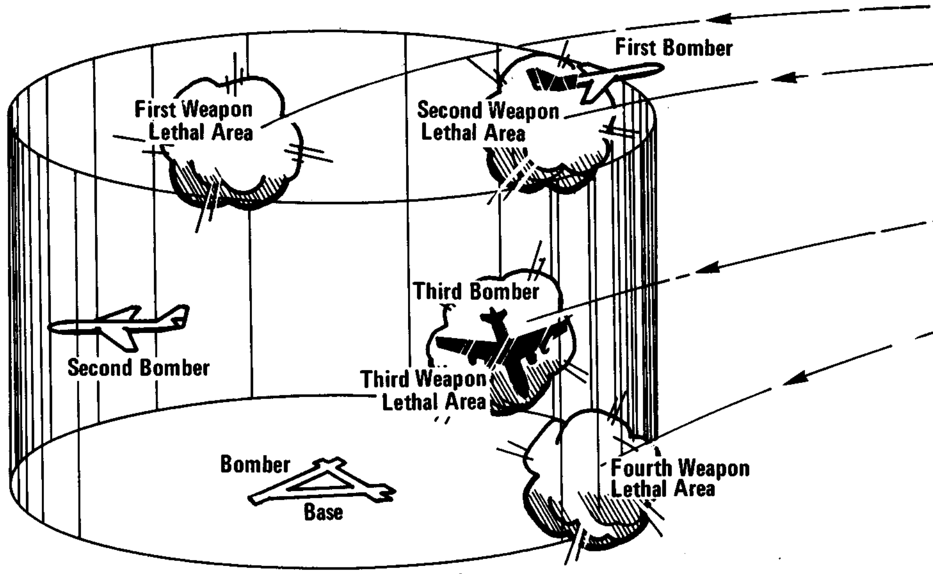
- o Yield of the warhead

- o Hardness (or resistance) of the aircraft to nuclear effects

- o Altitude of the aircraft (assuming a co-altitude burst)

Employing these variables (see Table E-1), AWAVES assigns the appropriate SLBM (if available) to the most lucrative target on the rank-ordered list of feasible assignments. If the SLBM is no longer available in that salvo, the next most advantageous target for which an SLBM is available is chosen. Damage must be taken account of on both an intra- and inter-salvo basis. This is accomplished by recomputing the payoff factors (for other SLBM types) at the base just attacked to take account of the damage, and then placing these new values in their proper places in the ordered list. After making the assignments of weapons to bases in a salvo, information on the

Figure E-2.
Illustration of "Cookie-Cutter" Damage Calculation



residual force at each base and the passage of time between salvos is used to generate a new set of feasible weapons assignments. 5/

The two scenarios described above were used in the effectiveness analysis portion of this study. These involve a surprise (peacetime alert posture), and an anticipated (generated alert posture) attack on U.S. bomber bases. In a generated case, more bombers are on alert, and their reaction time to an attack would be much shorter; conversely, the number of attacking SLBMs would likely be greater, and they might be launched from points closer to the coast. In the generated case, about 95 percent of

5. It is important to note that although most parameters in quantitative models like this are treated as point estimates--for instance, bomber reaction time--there is, in fact, a great deal of uncertainty associated with them. Thus, while the results of force survivability are also presented as point estimates, the cumulative effect of these uncertainties renders them more useful for comparative assessments than for definitive statements.

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TABLE E-1. ASSUMED VALUES FOR SELECT VARIABLES

Peacetime Alert	Generated Alert
90-second attack detection and warning time	same
30% of B52s on alert; 40% of B-1s and ATBs on alert	95% of all aircraft (PAA) on alert
1.5 PSI hardness for B-52s; 3.0 PSI hardness for B-1/ATB	same
6.5-minute bomber reaction time from SLBM breakwater to first bomber takeoff	2.2-minute bomber reaction time
15 seconds between bomber takeoffs	same
15 seconds between SLBM launches	same
SLBM yields: 750 KT for SS-N-6/8; 500 KT, 3 RVs for SS-N-18; 100 KT, 9 RVs for SS-NX-20	same
Soviet SSBN patrol area: 700 miles of U.S. coast	Soviet SSBNs 300 miles off U.S.coast

the force is assumed to be on alert, the reaction time of the bombers is about 4 minutes faster, and the submarines are about 400 miles closer to the coast. Table E-1 shows the assumed values for some of the variables in AWAVES.

RESULTS

Table E-2 illustrates, by year, bomber pre-launch survivability expectations for the Administration force and for the alternative force without

TABLE E-2. BOMBER PRE-LAUNCH SURVIVABILITY (In percent)

	Peacetime Alert			Generated Alert		
	Non-Depressed Trajectory 6.5 Min. Reaction Time	Depressed Trajectory 6.5 Min. Reaction Time	Non-Depressed Trajectory 9.9 Min. Reaction Time	Non-Depressed Trajectory 2.2 Min. Reaction Time	Depressed Trajectory 2.2 Min. Reaction Time	Depressed Trajectory 6.5 Min. Reaction Time
Administration Force						
1983	94	65	74	85	73	16
1990	95	73	80	89	79	34
1996	92	71	78	85	76	23
Alternative Force						
1983	same	same	same	same	same	same
1990	92	62	74	88	77	21
1996	89	63	74	84	70	20

NOTE: These numbers represent the percentages of the alert bomber force expected to survive. All of the force not on alert--60 to 70 percent of the force in the day-to-day alert case and 5 percent of the force in the generated alert case--are presumed not to survive a Soviet attack. While the results of force survivability are treated here as point estimates, the cumulative uncertainties in the underlying parameters render them more useful for comparative assessments than for definitive statements.

the B-1B but with some improvements to the B-52s and with more ALCMs. Along with the assumed baseline peacetime and generated alert cases, two more stressful situations are displayed. The first of these cases assumes, for each of the alert postures, that the Soviets could fire their SLBMs on a so-called depressed-trajectory flight path. 6/ The Soviets have not, to date, demonstrated the capability to fly their ballistic missiles along this shallower, accelerated trajectory, but these results illustrate the implications for the survivability of the bomber force were such a threat to develop. The second of these cases assumes that the bomber response time to an attack is delayed beyond that assumed in the base case. Delayed bomber reaction time could occur as a result of warning system malfunction, human error, and the like. In the peacetime alert posture, the effect of delayed reaction time is illustrated under the current, non-depressed trajectory threat from Soviet SLBMs. In the generated alert case, the effect of delayed reaction time is illustrated under a depressed-trajectory SLBM threat. This represents the most stressful scenario for the bomber force.

Survivability Will Not Change Dramatically Over Time

One result suggested by the analysis is that the survivability of aircraft on alert will not change dramatically between 1983 and 1996. For example, the only case in which survivability changes by more than 10 percent is under the most stressful scenario--a depressed-trajectory, generated-alert threat with a delay in bomber reaction time. In this case, survivability more than doubles by 1990 with the introduction of the harder, faster B-1B bomber but declines again by 11 percentage points by 1996 as a result of the growth in the threat in the absence of arms-control limits. However, survivability remains quite high through the 1990s in all the other scenarios even with the increased threat. Nor will survivability change dramatically over time under the alternative program (without the B-1B but with improvements to the B-52s and an increased buy of ALCMs). Again, with the exception of the most stressful scenario, differences in survivability over time are within 11 percentage points and indeed, in most cases, are less than 5 percentage points.

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6. Depressed trajectories are powered missile flight paths that could decrease significantly the time of flight to target. Programming SLBMs to fly these trajectories is difficult, and it is reported that the Soviets have not yet developed this capability.

Survivability Does Not Differ Dramatically Between Options

Survivability does not differ dramatically between the Administration's force and the alternative force. In the alternative force, the alert rates are somewhat lower because there are more older aircraft; also, fewer alert aircraft survive. This occurs, in part, because the B-1B, which is not present in the alternative force, can escape from its base more quickly and is more resistant to nuclear effects. However, differences are relatively small. Except in the most stressful scenario mentioned above, in which the contributions of a harder, faster airplane become more important, differences in survivability between the two forces are less than ten percentage points and, in most cases, are less than five percentage points.

Reaction Time Is Key Variable

Figures E-3 and E-4 show representative cases that illustrate the effect of changing one variable. Two cases illustrate the effects of time-dependent variables on bomber pre-launch survivability (PLS) and two illustrate the effects of structural variables on bomber PLS.

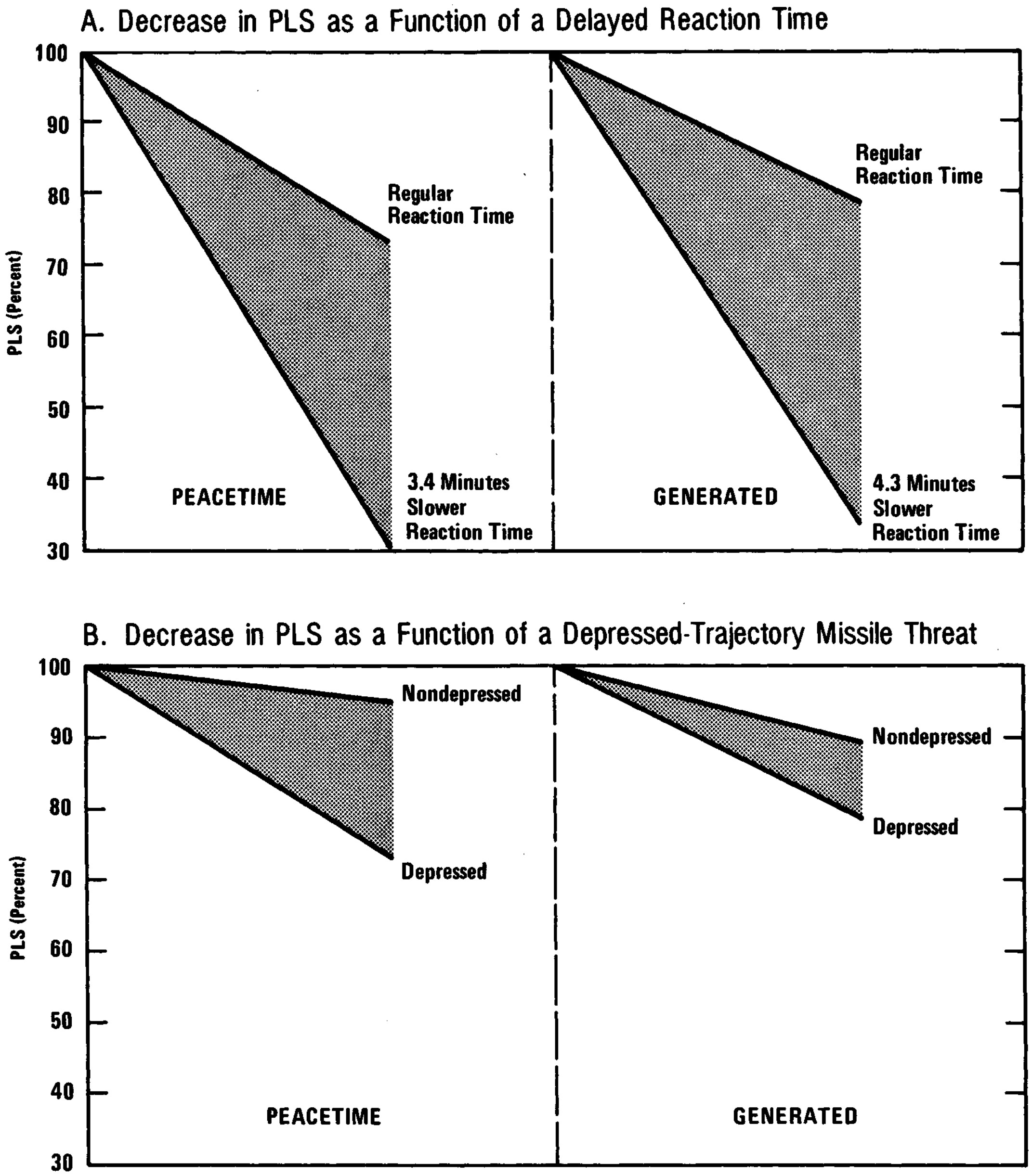
The effects of changes in reaction time are substantial. The upper chart in Figure E-3 illustrates, with the 1990 Administration force, the expected decrease in bomber PLS from a delayed reaction time to warning of an attack. In the peacetime alert case, which represents a 3.4 minute increase in reaction time under a depressed-trajectory SLBM threat, PLS decreases 43 percentage points. In the generated alert case, which represents a 4.3 minute increase in reaction time (equal to a peacetime alert reaction time) under a depressed trajectory SLBM threat, PLS decreases 45 percentage points.

The potential future ability of the Soviets to fire missiles on depressed trajectories is also important. The lower chart in Figure E-3 illustrates, with the 1990 Administration force, the expected decrease in bomber PLS from a depressed-trajectory threat from Soviet SLBMs. In the peacetime alert case, the expected decrease in survivability, from this effect alone, is 22 percentage points. In the generated alert case, the expected decrease in survivability is 10 percentage points. For the generated case, where the bomber reaction time is assumed to be about four minutes faster, the faster flight time of the attacking missiles does not have as great an effect on bomber PLS.

Figure E-4 illustrates the effects of changes in structural variables. The upper chart in Figure E-4 shows the expected decrease in bomber PLS from an older as compared to a newer composition of bomber force. In the

Figure E-3.

Time-Dependent Variables

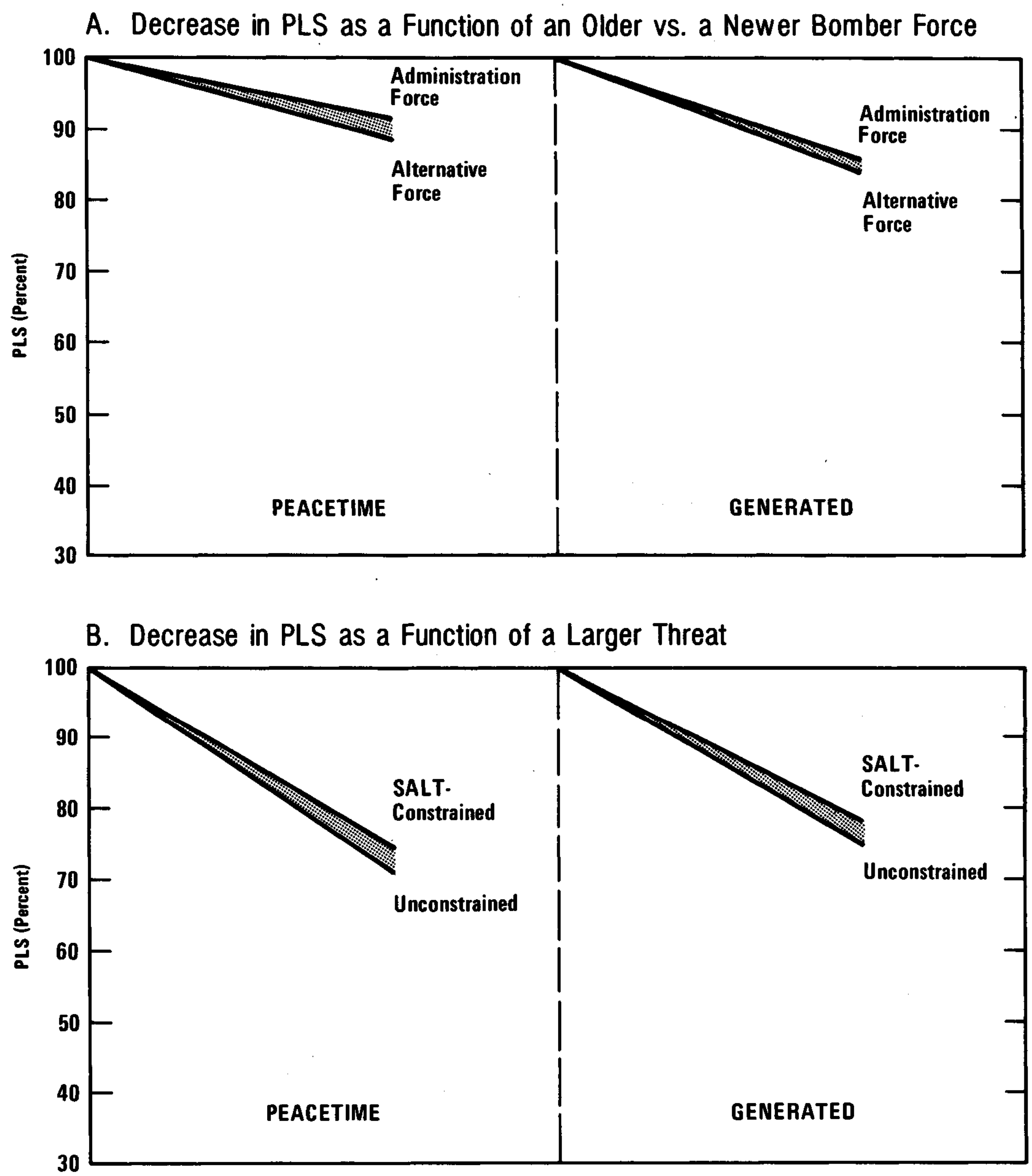


SOURCE: Congressional Budget Office.

NOTE: PLS = Pre-launch survivability.

Figure E-4.

Structural Variables



SOURCE: Congressional Budget Office.

NOTE: PLS = Pre-launch survivability.

1996 alternative force, older B-52Gs take the place of B-52Hs, and B-52Hs take the place of B-1Bs. Both forces have the same number of Advanced Technology, or "stealth" bombers, and the basing locations and threat are identical. Thus, the effect of the older force is to reduce expected bomber PLS by three percentage points in the peacetime alert case and by one percentage point in the generated case. Under a depressed-trajectory missile threat (not shown), these figures become eight and six percentage points respectively.

The lower chart in Figure E-4 illustrates the expected decrease in bomber PLS from an increase in the size of the threat or number of attacking SLBMs. Under an unconstrained threat, bomber PLS is about three percentage points less for the 1996 Administration force in both the peacetime and generated alert cases than under a SALT-constrained threat. This is the result of an increase of about 300 attacking SLBM warheads in the peacetime case and about 550 attacking SLBM warheads in the generated case. These differences in the effects of time-dependent variables as compared to structural variables on bomber survivability appear consistently throughout the analysis. The important caveat is that these results are only applicable to bomber pre-launch survivability. The importance of structural changes, such as the introduction of harder, faster aircraft may be profound for the bomber's retaliatory mission when it must face a stressful flight profile, air defense threats, and so on. However, the results indicate that those factors that lengthen or shorten the interval between first missile launch and first bomber flyout are the most critical to the initial survivability of the bomber force in a submarine-launched attack.

APPENDIX F. EXISTING ARMS-CONTROL AGREEMENTS

The two Strategic Arms Limitations Treaties, SALT I and SALT II, have in the past influenced the shape of U.S. strategic offensive and defensive forces and may continue to do so in the future. Although none of their limitations on strategic offensive arms are legally in force, a brief review of the important features of the treaties will help in understanding their possible effects on Administration plans.

The SALT I Treaty 1/

SALT I--signed, ratified, and entered into force by the United States and the Soviet Union in 1972--is an umbrella term for its two major agreements, the Anti-Ballistic Missile (ABM) Treaty and the Interim Agreement on Strategic Offensive Arms. 2/ The ABM Treaty and its 1974 Protocol, by limiting each party to only one ABM site with no more than 100 interceptor missiles and launchers, effectively precludes either side

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1. Much of the material in this section is drawn from United States Arms Control and Disarmament Agency, Arms Control and Disarmament Agreements. Other treaties and agreements to which the United States is a party can also influence the structure of U.S. strategic forces, albeit in a more indirect way than SALT. For example, the Outer Space Treaty, Seabed Arms Control Treaty, Limited Test Ban Treaty, Threshold Test Ban Treaty, and the "Hot Line" agreements all affect in some way the kinds of forces built and how they are operated. The focus here is on the SALT agreements because of their more direct limitations structures.

2. The complete titles of these agreements are, respectively, the "Treaty Between the United States of America and the Union of Soviet Socialist Republics on the Limitation of Anti-Ballistic Missile Systems" and the "Interim Agreement Between the United States of America and the Union of Soviet Socialist Republics on Certain Measures With Respect to the Limitation of Strategic Offensive Arms."

from deploying a wide-area, nationwide ballistic missile defense network. 3/ Further limitations contained in the Treaty and its agreed statements set specific limits on research and development, dual use of surface-to-air missiles in an ABM role, and exploitation of other environments for ABM deployment. One of the more interesting features of the ABM Treaty is its establishment of the Standing Consultative Commission (SCC) for discussion and resolution of questions and problems raised by either party concerning the ABM Treaty or the Interim Agreement. The ABM Treaty is subject to review every five years and contains specific provisions for amendment and withdrawal; it is of unlimited duration.

The Interim Agreement (IA), on the other hand, establishes certain numerical limits on the number of ICBM and SLBM launchers and modern SSBNs. The IA sought, in effect, to freeze for five years the further deployment of ballistic missile launchers, while allowing some latitude for substitution of SLBMs for ICBMs. The freeze having been imposed, it was believed that a follow-on agreement could then be negotiated. Numerically the Agreement limits the United States to no more than 1,054 ICBM launchers and 656 SLBM launchers in 41 SSBNs (or 710 launchers in 44 SSBNs if the Titan II ICBM silos were to be dismantled). 4/ Of perhaps equal interest is the codification of certain arms-control concepts in the IA, including that of using missile launchers as the primary unit of measurement; "heavy" ICBMs; land-mobile launchers; modern SSBNs; and verification provisions, all of which have been applied in subsequent agreements. Other definitions and procedures--especially those for retiring existing systems--have been developed through the SCC.

SALT II

The follow-on, more permanent agreement envisioned in SALT I took shape as SALT II, signed in 1979.5/ Withdrawn from active consideration for

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3. A 1974 Protocol to the Treaty reduced the number of ABM sites allowed each side from two to one, either the national capital or an ICBM site. The United States chose Grand Forks, North Dakota, as its site, while the Soviets chose Moscow.

4. The Soviets are limited to 1,618 ICBM launchers and 740 SLBM launchers. They are permitted to trade up to 210 ICBM launchers of "older types" (that is, pre-1964) for SLBM launchers, which they have done.

5. Officially called the "Treaty Between the United States of America and the Union of Soviet Socialist Republics on the Limitation of Strategic Offensive Arms."

ratification consent by the Senate since early 1980, SALT II consists of three major sections: a Joint Statement of Principles, a now-expired Protocol, and a main agreement with a December 31, 1985 termination date. 6/ In brief, the Protocol banned mobile ICBM launchers, deployment (but not testing) of cruise missiles capable of ranges in excess of 600 kilometers, and testing or deployment of air-to-surface ballistic missiles (ASBMs). The main Treaty contains the codification of numerical limitations on strategic offensive forces. Simply put, these include:

- Overall limit on Strategic Nuclear Delivery Vehicles (2,250): long-range heavy bombers, ICBM and SLBM launchers.
- Sublimit 1 (1,320): Launchers of MIRVed ballistic missiles, plus long-range heavy bombers capable of cruise missile carriage.
- Sublimit 2 (1,200): Launchers of MIRVed ballistic missiles.
- Sublimit 3 (820): Launchers of MIRVed ICBMs.

In addition, each side was allowed to develop and deploy only one new type of ICBM--limited to carrying 10 RVs--and could load no more than 14 RVs on its SLBMs. Numerical limits were established for the RV loadings of existing ICBMs, and a limit of 20 ALCMs per B-52 and B-1 type bomber was imposed.

SALT II also expanded upon some of the concepts outlined in SALT I, among them a ban on additional fixed ICBM launchers; certain ceilings and limits on heavy ballistic missiles; and non-interference provisions related to verification. Thus, SALT II attempted to create a set of ostensibly equal limits, while at the same time allowing some freedom for each side to structure its forces along traditional lines. Two apparent asymmetries in the agreement do exist, namely a Soviet monopoly on heavy ICBMs (set at 308) and the classification of the Soviet Backfire bomber as a non-strategic system. Both points are contentious. Some believe that these differences provide both de facto and de jure advantages to the Soviets, while others view them either as providing no real advantage or as necessary for the culmination of the Treaty.

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6. As with SALT I, SALT II, in its Joint Statement of Principles, contains language that looks forward to future agreements; thus, a finite expiration date was not considered unreasonable.

How SALT Could Affect the Administration Program

Leaving aside for the moment a discussion of the Administration policy on compliance with the SALT accords, it is useful to see how these agreements might affect the Administration modernization initiatives. Because a primary goal of this plan is, in fact, modernization and revitalization of the capital stock in U.S. strategic forces, the discussion here assumes that new forces are preferred to existing forces when a tradeoff must be made.

Beginning with the numerical limits of the SALT I Interim Agreement, the Administration plan could potentially exceed the SLBM launcher limit by the end of 1984 unless, among other actions, the United States either retires the seven remaining ex-Polaris SSBNs--currently operating as SSNs--or removes their launchers in a timely manner in compensation for new Trident submarines. 7/ Given Polaris deactivations, the limit might not be exceeded until 1987 if the silos housing the Titan II ICBMs, scheduled for retirement under the Administration plan, are dismantled in accordance with agreed procedures. 8/ The Administration's plan currently does not include this provision. In the post-1987 period, a revised plan for retirement of some Poseidon submarines would be needed. In contrast to the retirement plan assumed in Chapter II for constructing the illustrative Administration program, approximately 30 percent of these submarines would have to be retired before 1993.

The Administration ICBM program poses no obvious problems with SALT I ICBM launcher limits. Plans for the deployment of the MX in Minuteman silos call for no changes in volume or other dimensions in violation of the Interim Agreement. As for the follow-on deployment of a SICBM in a mobile mode, the IA does not limit mobile missiles. Fixed-point basing of the SICBM in new silos would be inconsistent with the IA.

As for the SALT II accords, the December 1981 expiration of the Protocol allows both the deployment of the ALCM and any mobile missile

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7. In accordance with agreed procedures, the retiring submarine must be located in an industrial facility, capable of performing the required work, by the time the new submarine commences sea trials. Dismantling of the compensating submarine must then be completed within six months.

8. As noted earlier, this would allow the limit on SLBM launchers to increase from 656 to 710, and on modern SSBNs from 41 to 44.

deployments to proceed. Testing and deployment of both the MX and the SICBM would violate the "one new type" rule for light ICBMs permitted for each side.

Meeting the numerical limits of SALT II would pose some difficult choices on the Administration program in the mid-1980s, not only because of the buildup in the sea-based force noted earlier, but also because of the air-launched cruise missile program and the potential for deploying a relatively large number of small ICBMs. The difficult choice would occur in attempting to satisfy simultaneously the 1,320 and 1,200 MIRV sublimits. Because most existing systems would be retained and new weapons added in numbers from the mid-1980s through the mid-1990s, these limits would be exceeded unless action was taken to cut back. This would have to involve reducing the numbers of multiple-warhead ballistic missiles or cruise missile-capable bombers. As an example, retirement of about 350 Minuteman III missiles in the late 1980s would maintain compliance with the limits. If it is assumed that the Administration takes the actions noted above for SALT I compliance, it would likely be able to meet the limit on strategic nuclear delivery vehicles throughout the remainder of the century.

In summary, the SALT agreements would appear to place significant constraints on the retention of some existing strategic systems if the Administration wishes to modernize according to its plan. In addition to the already planned retirement of B-52Ds, Titan IIs, and perhaps ex-Polaris SSBNs, the Administration might also have to retire some ballistic missile launchers in the late 1980s and early 1990s to remain within the numerical limits of both agreements. Aside from these constraints--with the possible exception of the "one new type" rule of SALT II--the provisions of neither treaty would appear to hamper the Administration modernization program to any great extent.

Cost Differences Associated with SALT Compliance

Pursuing the major modernization initiatives of the Administration plan while simultaneously observing the SALT limits would not cause significant changes in the cost of the program either in the near term or later. By assumption, the major development and investment costs would remain virtually unchanged; operating costs, on the other hand, would be expected to decline somewhat because of the early retirement of some systems. These savings, in turn, would probably be offset by the additional cost incurred by retiring systems in accordance with SALT-prescribed criteria. Table F-1 shows the cost differences between the Administration program as outlined in Chapter I and the SALT-constrained illustrative program described above.

TABLE F-1. OPERATING COST SAVINGS OF THE ADMINISTRATION'S PROGRAM CONSTRAINED BY SALT (By fiscal year, in millions of fiscal year 1984 dollars)

Cost Category	1984	1985	1986	1987	1988	Total 1984-2000
Budget Authority	--	--	32	87	118	5,651
Outlays	--	--	18	57	91	a/

a/ Outlay savings provided for 1984-1988 only.

Effectiveness of the SALT-Constrained Administration Plan

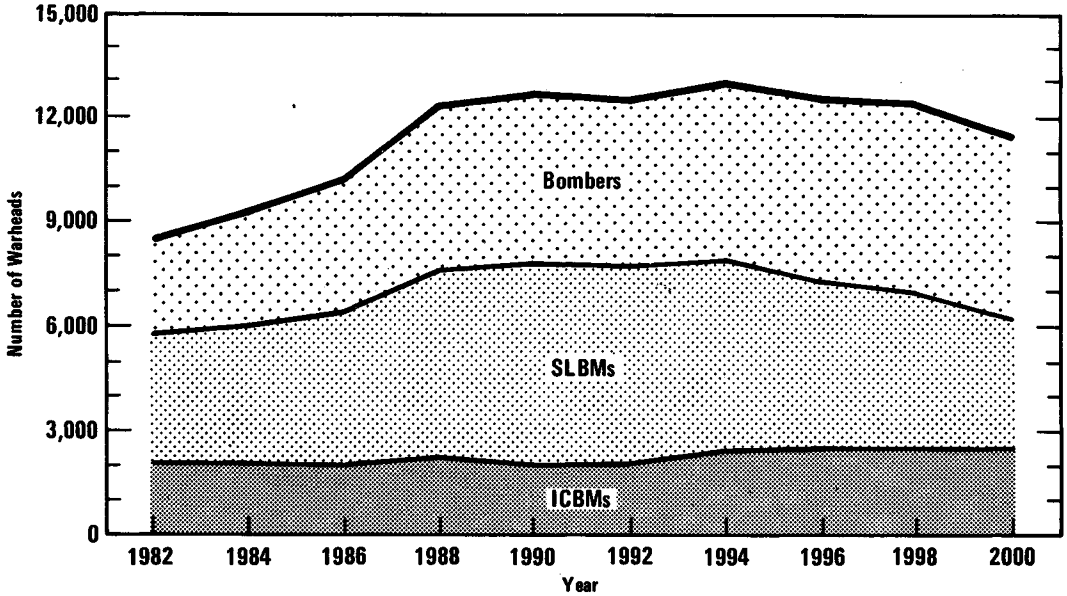
Using the same measures of effectiveness and methodology as introduced in Chapter II, CBO examined the effectiveness of the force created through the illustrative series of program modifications outlined above. Figure F-1, for example, shows how the number of on-line warheads would change over time under this modified plan. The effects of retiring some ICBM and SLBM forces in the late 1980s and early 1990s are apparent. While a substantial buildup in on-line warheads would still occur through the early 1990s, the increase--and subsequent decrease out to the end of the century--would not be as dramatic as in the unconstrained case shown in Figure 4; the peak warhead count would decline from over 13,000 to around 11,600. This peak would be some 48 percent higher than 1983 warhead levels, and the warhead count at the end of the century would be about 32 percent higher than in 1983.

After absorbing a Soviet first strike launched either with or without warning, the SALT-constrained force would have about 6 percent fewer warheads than the unconstrained Administration force in 1990. 9/ Since planned retirements and continued modernization would be similar for both

9. The illustrative SALT-constrained forces used in making these estimates are shown in Appendix C.

Figure F-1.

Evolution of Strategic Force Buildup Under SALT Constraints, by Triad Element, 1982-2000



SOURCE: Congressional Budget Office.

forces in the late 1990s, the surviving warhead levels by 1996 would be much the same. Because all Administration modernization plans could fit under the SALT numerical limits, surviving hard-target weapons would be virtually equal for the two forces in 1990 and 1996.

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