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A RAND NOTE

U.S. Strategic Forces Under the Prospective START Treaty

James Scouras

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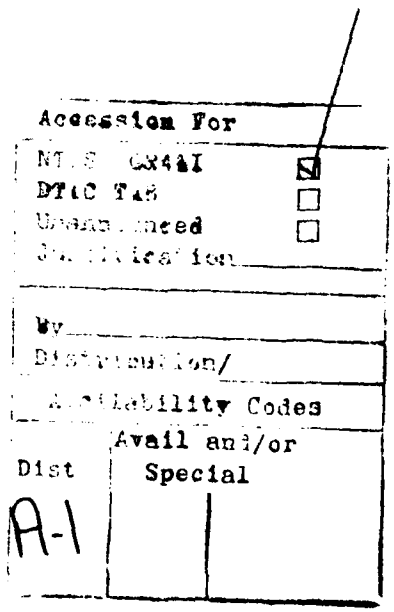
United States Air Force



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PREFACE

This Note examines strategic force tradeoffs imposed on the United States by the prospective START Treaty based on the status of the negotiations as of January 1990, develops and evaluates alternative strategic force structures for the United States that are consistent with either the U.S. or the Soviet START negotiating positions, and concludes with observations and recommendations on both the U.S. START negotiating position and U.S. strategic forces programs.

Research for this Note was sponsored by Air Force Plans and Operations, Directorate of Plans, Warfighting Concepts Strategy Division (AF/XOXWS), with Strategic Air Command, Directorate of Plans, Force Analysis Division (SAC/XPAF) serving as the office of corollary responsibility. It was conducted under the auspices of Project AIR FORCE's Aerospace and Strategic Technology Program as part of the Future Strategic Targeting Objectives project.

This Note should be of interest to analysts, planners, and policymakers concerned with U.S. strategic force planning and strategic arms control. It presumes some knowledge of current U.S. strategic forces as well as familiarity with issues regarding their modernization.

SUMMARY

The United States has been trying to negotiate a new treaty with the Soviet Union to limit strategic nuclear arms since the SALT I Interim Agreement entered into force in 1972. After numerous changes in U.S. and Soviet leadership, several negotiating forums, and one signed but unratified treaty, an agreement may finally be within reach. Under the umbrella of the current Nuclear and Space Talks, the Strategic Arms Reduction Talks (START) have made sufficient progress that by the end of the Reagan administration the overall structure of a prospective agreement had been fairly well defined.

However, as the negotiations draw ever tighter constraints about allowed forces, it becomes more difficult to proceed without projecting with some confidence which forces the United States would actually deploy under START. This Note is presented in the hope of contributing to an informed debate on planning U.S. strategic forces under START, thereby facilitating both the development of U.S. negotiating strategy and strategic force modernization planning.

THE START TREATY

The analysis is based on the status of the START negotiations as of approximately January 1990. Although the overall structure of the treaty has been agreed to, numerous unresolved issues pertaining to force structure remain. Five are investigated in this analysis—which systems will count under the delivery vehicle limit, limits on mobile ICBMs, how ALCMs will count against the warhead limit, a sublimit in ICBM reentry vehicles, and a sublimit for air weapons.

Several U.S. force structures consistent with the U.S. START position (including a ban on mobile ICBMs) were developed for further analysis. A low-cost U.S. force structure is driven by the desire to spend as little as plausibly possible. A far-term U.S. force structure is conceived without regard to the investment the United States has in existing systems. Rather, it is driven by three considerations: (1) exploiting the air weapon counting rules, (2) deploying 20 SSBNs, and (3) deploying ICBMs with single warheads. If the far-term structure is a desirable goal, it is important to not do anything to foreclose the possibility of achieving that goal. The near-term force structure

demonstrates how this could be accomplished. Finally, a balanced force structure attempts to balance various competing interests, including low-cost versus modernized forces and Navy versus Air Force systems.

U.S. force structures were also developed consistent with the Soviet START position in each of the five areas of dispute analyzed above. One emphasizes rail-based Peacekeeper, one emphasizes road-mobile Small ICBMs, and one is a compromise structure that includes both.

EVALUATIONS OF EFFECTIVENESS

Various measures of U.S. national security strategy were developed and applied to compare these force structures. These measures do not attempt to cover all aspects of national security strategy; they are intended to capture only the contributions that force structure makes.

Deterrence. U.S. national security relies on deterrence of nuclear warfare as its central strategy. The Soviets are viewed as deterred from initiating unrestrained nuclear warfare against the United States by the (certain) prospect of unacceptable damage in retaliation. Thus, we take as a measure of deterrence the number of arriving U.S. weapons in the worst plausible scenario—when the United States is on day-to-day alert status and fails to promptly launch ICBMs.

All START force structures do worse by this measure than 1989 forces. However, far-term forces come quite close, with only about 500 fewer arriving weapons. Thus, the U.S. START position can provide deterring forces if we choose to deploy them. However, some postures—low cost and near term in particular—provide substantially fewer arriving weapons than 1989 forces. Whether the Soviets would in all circumstances view a retaliation with slightly over 2000 arriving weapons as not unacceptable, no one knows. However, prudence suggests deploying forces at least up to the level of the balanced forces, to avoid gambling at such high stakes.

As for the Soviet START posture, they can apparently provide forces as good as, or better than, all other postures except for the far-term posture. As with the U.S. START posture, some force structures do better than others, although the swing is not as great. The superior force postures are the ones that include Small ICBMs since, unlike the rail-based Peacekeeper, they do not depend on prompt launch to survive a Soviet first strike in a day-to-day alert scenario. This provides also for the most balanced (among Triad elements) arriving retaliatory forces.

Crisis Stability. The logic of deterrence applies to rational decisionmakers in control of events and with correct information about the other side's intentions and capabilities. However, in an international crisis, these assumptions very well might not apply in full. It is important to structure forces that will not excessively contribute to events getting out of control or to misperceptions. The incentives to generate strategic forces and to implement a strategy to promptly launch ICBMs are measured in this analysis by the increase in U.S. arriving weapons if the United States generates and if the United States promptly launches, respectively. These measures are termed "sensitivity to generation" and "sensitivity to prompt launch." The lower these numbers, the better.

No START force structures are clearly superior by both measures of stability. The force structures that exploit the air-weapon counting rules the most tend to be the ones most sensitive to generation because of the low day-to-day alert rates for bombers. This situation could be alleviated (and contribute to the measure of central deterrence) if these rates were increased. The force structures that include fairly large numbers of silo-based ICBMs tend to be the ones most sensitive to prompt launch.

Force structures consistent with the Soviet START position have average sensitivities to generation and average to low sensitivities to prompt launch, with the notable exception of the Rail-Garrison Peacekeeper force structure in the delayed launch case. This is because Rail-Garrison Peacekeeper is not survivable in its day-to-day posture, while it is highly survivable in its generated posture. Thus, if the United States were to (plan to) not promptly launch ICBMs, it would be highly sensitive to generation of these forces. Of course, this means the United States would be more dependent on prompt launch under day-to-day alert than under generated alert.

Coercive Potential. The measure of central deterrence is based on the "worst plausible" scenario. However, in a crisis where the United States has generated forces, the Soviets must consider the possibilities that the United States might strike first or promptly launch if the Soviets strike first. In that case, the number of U.S. weapons arriving is based on the "best plausible" scenario—generated alert and prompt launch.

All START force structures are inferior to 1989 forces by this measure, although far-term forces come close. None of the other structures seem greatly worse than the others. Thus, in addition to its inherent lesser importance than deterrence and crisis stability, this measure does not afford a basis by which to prefer one structure over another.

CONCLUSIONS

Although agreed START provisions could result in U.S. force structures with up to 4000 fewer deployed weapons than in 1989, they do permit the deployment of forces that do not appear deficient in ability to support U.S. national security strategy in the areas of central deterrence, stability, and coercion. Further, for the United States, outstanding force structure issues should not present a critical impediment to an agreement. However, to wisely structure forces under START, the United States needs to determine priorities and criteria for national security objectives toward which strategic forces contribute.

ACKNOWLEDGMENTS

I want to thank RAND colleague James Mihori for his considerable efforts in setting up the computer hardware and software to perform the analysis and graphics presented in this Note. In addition, David McGarvey, Roger Molander, and James Quinlivan provided detailed, constructive critiques of earlier drafts of this document.

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I. INTRODUCTION

The United States has been trying to negotiate a new treaty with the Soviet Union to limit strategic nuclear arms since the SALT I Interim Agreement entered into force in 1972. After numerous changes in U.S. and Soviet leadership, several negotiating forums, and one signed but unratified treaty, an agreement may finally be within reach. Under the umbrella of the current Nuclear and Space Talks, the Strategic Arms Reduction Talks (START) have made sufficient progress that by the end of the Reagan administration the overall structure of a prospective agreement had been fairly well defined.

However, as the negotiations draw ever tighter constraints about allowed forces, it becomes more difficult to proceed without projecting with some confidence which forces the United States would actually deploy under START. In fact, failure to address this issue earlier may have led to some less than favorable agreed provisions that are now subject to second thoughts. For example, the agreed limit of 1600 strategic nuclear delivery vehicles may be lower than desirable for the most stable intercontinental ballistic missile (ICBM) force structure. Also, as the United States realizes the hard choices it will have to make under the agreed sublimit of 4900 ballistic missile reentry vehicles (RVs), it is considering trying to negotiate a stipulation that submarines in overhaul not count.

In terms of potential provisions not yet agreed to, the most troublesome aspect of unplanned strategic forces relates to ICBMs. If the United States negotiates a provision that allows mobile ICBMs, will Congress support deployment of rail-based Peacekeepers or road-mobile Small ICBMs (SICBMs), some of both, or neither? More generally, just how much confidence can the United States have that any modernization plan upon which a negotiating strategy may be based will be supported during the likely lengthy development and deployment processes? These concerns have led President Bush to state that a necessary condition for the United States to change its negotiating position in START to permit mobile missiles is that the administration be sure "Congress will

support U.S. mobile ICBM programs," as well as that any such limits be effectively verifiable.[1]

Other uncertainties in force structure have not slowed progress on the treaty but could have a major effect on the desirability of certain provisions. Specifically, in the final treaty there could be two major "loopholes,"[2] or provisions that allow essentially unlimited deployments. These are (1) the agreed rule that penetrating bombers count as one weapon regardless of their actual load, coupled with no effective explicit limit on the number of such bombers, and (2) the U.S.-proposed counting rule for air-launched cruise missiles (ALCMs) that ascribes an agreed count to ALCM carriers regardless of how many are actually carried. Since these loopholes are generally seen, perhaps shortsightedly, to be in the U.S. interest, they have not delayed formation of U.S. negotiating strategies. However, it is not unreasonable to ask whether the United States should propose a cap on the number of penetrating bombers or the number of ALCMs per carrier if the prospects of ever exceeding these quantities are extremely remote.

The other side of the coin is that without a completed treaty it is difficult for the administration to make hard choices among force structure elements before it is necessary. In fact, making those choices could undercut support for the treaty in the negotiation and ratification processes from whichever parties thought themselves shortchanged. Thus, it could be beneficial to maintain some ambiguity in the administration's plans. Furthermore, there is no guarantee that even with unanimity in support of a START force structure, the United States would prevail in the negotiations to devise a treaty that would permit these forces.[3]

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[1]George Bush, Letter from the President to the Speaker of the House of Representatives and the President of the Senate, 25 July 1989.

[2]In negotiations supposedly emphasizing *reductions*, I know of no better term for provisions that could, at least theoretically, result in an *increase* in weapons deployed.

[3]For the Reagan administration's perspective on the logic of not designating "*the* post-START force," see Frank Carlucci, letter to Honorable Les Aspen, 20 September 1988, written in response to the Report of the Defense Policy Panel of the House of Representatives Committee on Armed Services entitled *Breakout, Verification, and Force Structure: Dealing with the Full Implications of START*, May 24, 1988.

OBJECTIVES

This Note is presented in the hope of contributing to an informed debate on planning U.S. strategic forces under START, thereby facilitating both the development of U.S. negotiating strategy and strategic force modernization planning. It contains detailed discussions of force structure tradeoffs for the United States, the potential effect of the U.S. and Soviet positions on outstanding START issues, and measures of force structure effectiveness. An appendix provides weapon system planning factors and loadings.

A secondary goal is to demonstrate that it is possible to preserve most existing U.S. ICBM silos under the proposed START constraints and to point out the importance of being able to retain these assets.

Finally, this Note demonstrates an approach to the more comprehensive task of developing and evaluating complete START treaties and corresponding U.S. force structures. This obvious next step should be undertaken as the United States develops its START negotiating options. The time for piecemeal progress toward an agreement may be past.

SCOPE AND ANALYTICAL LIMITATIONS

The analysis includes only what is necessary to accomplish the stated objectives. Some considerations important to developing and evaluating START force structures have been only implicitly included. Primary among these is appropriate weapon system costs, but some operational issues (e.g., weapon system endurability) that could also have an important bearing on force structure assessment have also not been explicitly considered. This restricted scope precludes recommendation of a "best" force structure, except within the limited applicability of the measures of effectiveness included.

Similarly, what the *Soviets* might deploy under START is also not explicitly considered beyond assuming that any Soviet START force structure will have a sufficient number of appropriate weapons to target U.S. silos in a first strike. With this assumption the desirability of U.S. force structures is largely independent of plausible variations in Soviet force deployments under alternative START provisions.[4] However, this limitation

[4]The one major exception to this might be the increased desirability for the B-2 bomber should mobile ICBMs be permitted and should the B-2 prove capable against them. However, the B-2 and other penetrating bombers are highly desirable under START *whether or not* they are capable against such targets because of their highly favorable agreed counting rule.

prevents us from giving a net assessment of START. That is, we do not address the question of whether START provides a net advantage or disadvantage to U.S. national security interests.

APPROACH

We first explain how various START provisions impose choices, or tradeoffs, for the United States in structuring its strategic forces. As a straightforward example, the agreed sublimit of 4900 ballistic missile reentry vehicles imposes an obvious tradeoff between ICBM and submarine-launched ballistic missile (SLBM) reentry vehicles. An understanding of such tradeoffs, with the complexities brought about by the heavy investment in existing strategic forces, is essential for evaluating the merit of various negotiating positions.

Once U.S. strategic force tradeoffs under START are understood, complete force structures can be developed. This construction is as much an art as a science. This analysis takes a "bottom-up" rather than a "top-down" approach because the U.S. strategic policy community has never developed such a tightly woven link between national security strategy and strategic weapon system requirements that a top-down approach is feasible. However, these force structures are evaluated by measures that attempt to capture some critical facets of higher-level national security strategy.

Finally, implications of this analysis are drawn for the U.S. START negotiating position and for U.S. strategic force programs in the period before START is finalized.

ORGANIZATION

Section II discusses U.S. strategic force tradeoffs under START by first presenting the status of the negotiations—what has been agreed to and U.S. and Soviet positions on areas of disagreement—and then the force structure tradeoffs themselves.

Sections II and IV discuss the effects of the U.S. and Soviet START positions on U.S. strategic forces and develop alternative U.S. force structures. Comparative evaluations of these force structures are provided in Sec. V. The Note concludes with observations and recommendations on the U.S. START negotiating position and on U.S. strategic force programs.

II. STRATEGIC FORCE TRADEOFFS UNDER START

AGREED LIMITS, SUBLIMITS, AND COUNTING RULES

This section summarizes the status of the START negotiations' restricting the discussion to provisions that might have a major effect on U.S. force structure.[1]

Both sides have agreed to limit the number of strategic nuclear delivery vehicles, which include deployed ICBMs and SLBMs (and their associated launchers) and heavy bombers, to no more than 1600. Of these, no more than 154 may be heavy ballistic missiles, which category includes only Soviet SS-18 ICBMs.

These delivery vehicles may carry up to a total of 6000 "accountable" weapons, of which no more than 4900 may be on ballistic missiles (ICBMs and SLBMs) and no more than 1540 of these on heavy ballistic missiles. Each ballistic missile RV counts as one weapon and each heavy bomber that does not carry ALCMs also counts as one weapon, even though most are likely actually to carry many more weapons. Counting rules for ALCMs have yet to be agreed. Strategic bombers not carrying nuclear weapons (e.g., B-52Gs converted to carry only conventional weapons) will not count against this weapon limit.[2]

Also agreed to, but incidental to this analysis, is that the total ballistic missile throwweight of both sides will be reduced to no more than approximately 50 percent of the Soviet level.[3] None of the U.S. force structures examined in this study are constrained by this limit.

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[1]The structure of the START treaty has been treated in detail in the literature. See, for example, Robert Einhorn, *The Emerging START Agreement*, SURVIVAL, September/October 1988, pp. 387–401. For an overview of the negotiating positions of the two sides in START, as well as the other elements of the Nuclear and Space Talks, see U.S. Arms Control and Disarmament Agency, *Issues Brief/Nuclear and Space Talks: U.S. and Soviet Proposals*, January 22, 1990.

[2]Whether or not such bombers will also count against the delivery vehicle limit has not been agreed. The U.S. position is that an agreed number of heavy bombers converted to a conventional-only capability could be removed from accountability under the delivery vehicle limit. Soviet agreement to this position is contingent on U.S. acceptance of the Soviet position on ALCM range and attrition, discussed below.

[3]The U.S. and Soviet positions differ on the method of determining throwweight and the date for the baseline Soviet level. The U.S. position is that reductions will be from the Soviet throwweight level as of December 31, 1986; the Soviet position specifies the date of treaty signature.

It has also been agreed that U.S. forward-based systems will not be covered by the agreement and that, although they will be limited, SLCMs will not count against any of the aforementioned limits.

Finally, both sides have agreed that they will proceed from the following reentry vehicle loading assumptions for U.S. systems:

• Minuteman II	1	• Poseidon	10
• Minuteman III	3	• Trident I	8
• Peacekeeper	10	• Trident II	8

The United States is apparently free to change these declared quantities as verification procedures (yet to be agreed upon) will be implemented to confirm actual ballistic missile loadings.

These provisions have been agreed to over the course of over seven years of negotiations.[4] Although it is possible, and may even be desirable, for the Bush administration or the Soviets to attempt to renegotiate these agreed provisions, such a turn of events runs the twin risks of greatly prolonging the negotiations and reducing the prospects for *any* treaty.[5] Thus, for purposes of this analysis, this Note does not consider such excursions in examining tradeoffs or developing force structures.

UNRESOLVED ISSUES

Although the overall structure of the treaty has been agreed to, numerous unresolved issues remain that pertain to force structure. Five of these are investigated in this analysis. Several others are mentioned for the sake of completeness but not analyzed in greater detail.

Each side has complex motivations for taking particular negotiating positions. The U.S. positions are taken substantially at face value, largely because the United States

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[4]The START negotiations have been conducted since June 1982, except for the period December 1983 through March 1985, when the Soviets withdrew as NATO commenced intermediate nuclear force deployments in Europe.

[5]As this analysis will demonstrate, one agreed provision that may be worth these risks to try to renegotiate (to a higher level) is the limit on strategic nuclear delivery vehicles. However, to do so runs the additional risk of alienating public support for a treaty that is supposed to result in substantial *reductions*.

always runs the risk that the Soviet Union might accept just one of these positions.[6] The United States ought to be aware of the force structure implications of its own position, if nothing else.

Second-guessing the Soviet positions is another matter altogether. To be sure, there is a conventional wisdom on Soviet motivations, willingness to compromise, etc. However, this conventional wisdom must be regarded with some skepticism; in any event, it is not necessary for the purposes of this analysis. Thus, the Soviet positions are also taken substantially at face value.

(1) The United States wants the limit of 1600 delivery vehicles to pertain to only nuclear-capable systems. In concrete terms, the United States wants to be able to convert some B-52G bombers to conventional ALCM carriers without penalizing dedicated nuclear forces. The Soviet Union wants bombers that have been converted to conventional-only use also to count against the delivery vehicle limit (but not, as mentioned earlier, the warhead limit). However, it has stated that it is willing to accept the U.S. position provided the United States accepts the Soviet position on ALCM range and counting rules, discussed below.

(2) The question of ICBM mobility continues to be a major stumbling block to an agreement. The Soviet Union has proposed to allow mobile ICBMs up to the limits of 800 delivery vehicles and 1600 reentry vehicles. Although the United States recognizes the advantages in survivability of mobile ICBMs, until recently uncertain verification and funding for U.S. mobile ICBMs had led the United States to prefer a bilateral ban.

In July 1989, however, President Bush stated that if the Congress commits to supporting U.S. mobile ICBM programs, the United States will change its position in the START negotiations to allow (some) mobile ICBMs.[7] Later in 1989, the United States did change its position in the negotiations to allow mobile ICBMs subject to agreed limits on numbers and effective verification measures. *However, since such verification measures seem quite difficult and congressional funding for U.S. mobile ICBM programs remains uncertain, this study has developed U.S. force structures for the U.S. START position without mobile ICBMs.*

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[6]For example, the United States might have serious second thoughts were the Soviet Union to agree to ban mobile ICBMs. This would deny the United States the capability to deploy survivable and endurable land-based missiles.

[7]Bush, Letter to the Speaker of the House, 1989.

(3) Another major point of disagreement relates to how ALCMs will count against the warhead limit of 6000. The U.S. position is that each bomber with accountable ALCMs should count as ten weapons against this limit, regardless of how many weapons the bomber is actually carrying. This would lead to an undercounting of actual ALCMs, a situation the United States claims is warranted to compensate for the presence of unconstrained air defenses and the less threatening nature of the weapon, compared with that of ballistic missiles. The Soviet Union, for its part, wants each ALCM-carrying bomber to count as the maximum number for which it is equipped against the warhead limit.

(4) The United States wants to impose a sublimit of 3000 to 3300 ICBM reentry vehicles under the 4900 limit for ballistic missile reentry vehicles. It prefers the lower sublimit but is willing to settle for the upper one. The Soviets would prefer no sublimit at all for ICBM reentry vehicles but are willing to agree to one provided SLBMs are limited (to the same level) as well. The United States has rejected this counterproposal, claiming that only ICBMs should be constrained, since they are the more destabilizing system.

(5) Finally, since 6000 "counted" weapons are allowed and 4900 of these may be ballistic missile reentry vehicles, there is an implied sublimit of 1100 counted air weapons.[8] The Soviet Union has proposed that this be made an explicit sublimit—no more than 1100 counted air weapons be allowed. The United States rejects this sublimit.

Other unresolved issues, not examined in this study, include which ALCMs count, which bombers count, and SLCM limits. Briefly, the United States wants to count only nuclear-armed ALCMs with ranges in excess of 1500 km, while the Soviets want to count all ALCMs (conventionally armed as well as nuclear) with ranges in excess of 600 km. With regard to which bombers count, the proposed U.S. definition of a heavy bomber would include the Soviet Backfire bomber, which the Soviets want to exclude. Finally, although it has been agreed that SLCMs will be limited, little progress has been made on setting those limits or on associated verification measures.

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[8]Presuming each side would choose to maximize its ballistic missile reentry vehicles. Incentives to do this are described in Sec. II.

U.S. FORCE STRUCTURE TRADEOFFS

Air Weapons vs. Ballistic Missiles

Air weapons and ballistic missiles are treated differently under START. Gravity bombs and short-range attack missiles (SRAMs) on penetrating non-ALCM-carrying bombers have the advantage that they are heavily discounted, but their carriers have to face unconstrained Soviet air defenses. Ballistic missile RVs are not discounted, but they have essentially no defenses to penetrate. ALCMs might be discounted, though to a lesser extent than gravity bombs and SRAMs, and they have to face air defenses, but possibly with greater probabilities to penetrate than bombers carrying gravity bombs and SRAMs. Of course, each of these weapon types has different availability, alert rate, prelaunch survivability, and system reliability values.

To determine which weapon types have a net advantage under START counting rules the number of arriving weapons per counted weapon is taken as the measure. This analysis defines arriving weapons to be those that are deployed, available, and alert; survive a Soviet first strike; are reliable; and penetrate Soviet defenses. The arriving weapons per counted weapon are considered here to be a function of the probability to penetrate air defenses, the most uncertain of these performance factors, and the following nominal values are assigned to the remainder:

		Alert Rate[a]		Prelaunch Survivability[b]		
	Availability	GEN	DAY	PRL[c]	DEL[d]	System Reliability
ICBM	1.0	1.0	1.0	1.0	0.1	0.9
SLBM	0.9	1.0	0.7	1.0	1.0	0.8
ALCM carrier	0.9	1.0	0.3	1.0	1.0	0.8
Penetrating bomber	0.9	1.0	0.3	1.0	1.0	0.8

[a]For available forces.
[b]For alert forces. Nonalert forces are assumed to have zero prelaunch survivability.
[c]Prompt launch.
[d]Delayed launch.

Each ALCM carrier is assumed to carry 20 ALCMs and each penetrating bomber, 16 SRAMs or gravity bombs.

Figure 1 shows the number of arriving weapons per counted weapon as a function of probability of penetrating air defenses for ICBMs, SLBMs, ALCM carriers, and

penetrating bombers.[10] Separate graphs are shown for the generated alert case and for the day-to-day alert case.

Since the number of arriving ballistic missile reentry vehicles is independent of probability to penetrate air defenses, Fig. 1 shows ICBMs and SLBMs as horizontal lines. Figure 1 demonstrates that if ICBMs launch promptly, by the measure of arriving weapons per counted weapon, promptly launched ICBMs are notably superior to SLBMs in the day-to-day alert case, somewhat less so in the generated case. Not surprisingly, delayed-launch ICBMs perform very poorly.

Three curves are shown in Fig. 1 for ALCM carriers, each for a different counting rule. The proposed U.S. counting rule is represented in the upper of the three curves and the Soviet counting rule by the lower of the three curves.

For ALCMs, the results are mixed. In the day-to-day alert case, they do worse than SLBMs (thus also worse than promptly launched ICBMs), even for the U.S. counting rule, which provides the most ALCM "discounting," and even for the unrealistically optimistic case where ALCMs have 100 percent probability of penetrating Soviet air defenses. This is principally because of their lower day-to-day alert rates (30 percent) compared with those for SLBMs (70 percent) and ICBMs (100 percent).

In the generated case, with assumed alert rates of 100 percent, ALCMs fare much better. However, under the Soviet counting rule they still do worse than ICBMs for all penetration probabilities and worse than SLBMs except for the extreme point where penetration probability is 100 percent. Only under the U.S. counting rule or the intermediate case shown do ALCMs do better than ballistic missiles. Specifically, under the U.S. counting rule, the probability of penetrating for ALCMs must exceed 0.6 (0.5) to achieve more arriving weapons per counted weapon than ICBMs (SLBMs).

On balance, since the United States cannot depend on being able to generate its forces before Soviet attack and probability of penetrating Soviet air defenses can only be highly uncertain, ballistic missiles appear to be preferable to ALCMs by the measure of arriving weapons per counted weapon. Thus, in structuring forces it would be unwise to

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[10]In interpreting these graphs, the reader should realize that the probability of penetrating air defenses is not the same for ALCMs and for weapons delivered by penetrating bombers.

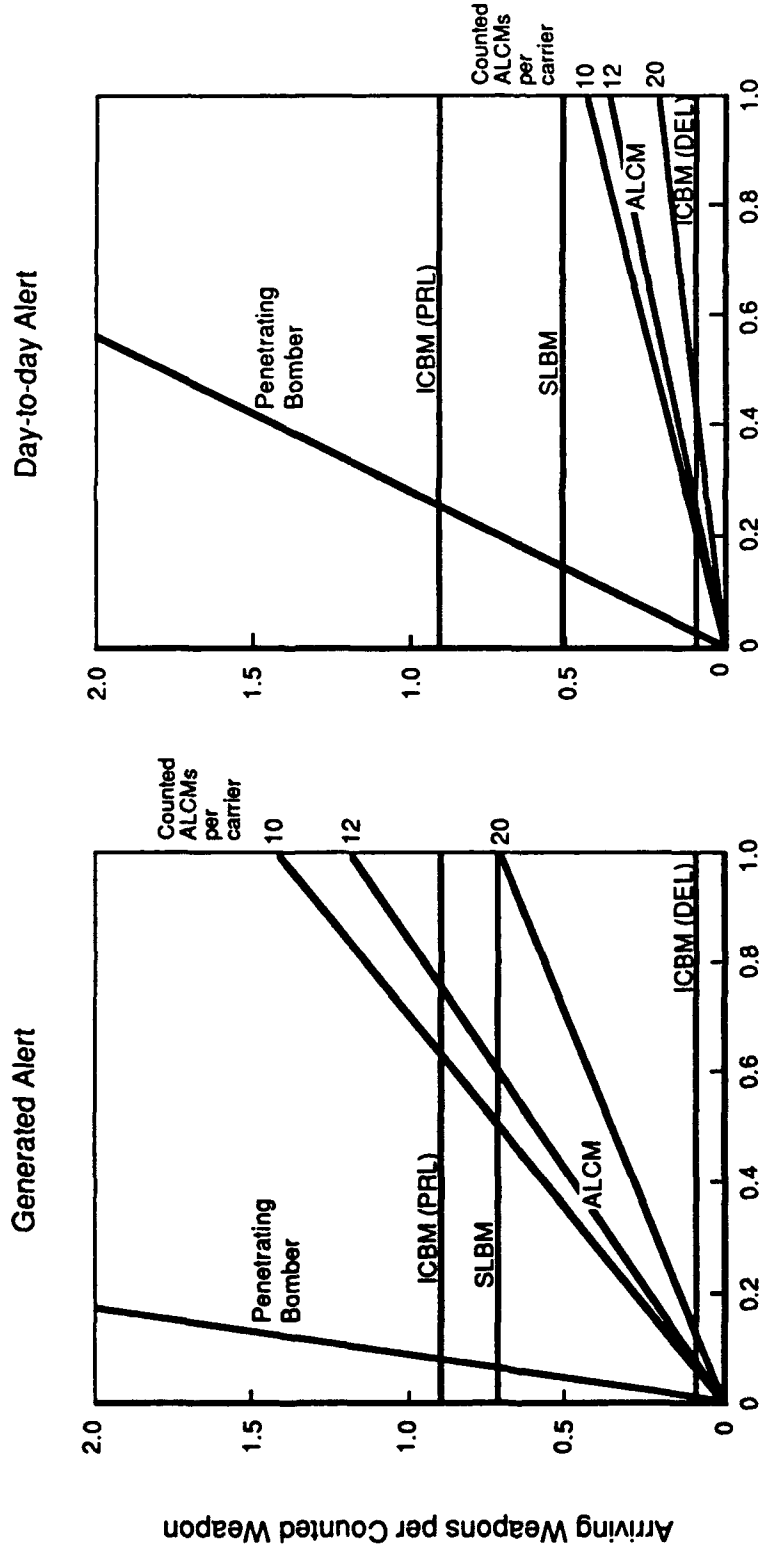

Fig. 1—Air weapons vs. ballistic missiles

greatly exceed 1100 air weapons by large deployments of ALCMs because that would reduce the number of ballistic missile weapons allowed.[10]

Gravity bombs and SRAMs carried on penetrating bombers do best under both alert states, provided only that their probability of penetrating is at least 25 percent. This is a strong argument for keeping bombers that may not have high probabilities of penetrating Soviet air defenses, rather than converting them to ALCM carriers.

Alternative Bomber Forces

From the analysis of air weapons versus ballistic missiles it would be better to deploy up to the 4900 limit for ballistic missiles, rather than exceeding the implicit limit of 1100 for air weapons. Figure 2 shows three alternative bomber force structures.

The upper line of text above the histogram for each of the force structures indicates the penetrating bombers and the lower line indicates the ALCM carriers. The first force posture has 97 B-1B penetrators and 95 B-52H ALCM carriers. This is a low-cost option, requiring no new bombers, but the B-1B must maintain a penetration role. The second posture employs 132 B-2s as penetrators, converts the 97 B-1Bs to ALCM carriers, and retires the B-52Hs. The third posture has 100 B-2s as penetrators, maintains the 97 B-1Bs as penetrators, and keeps the 95 B-52Hs as ALCM carriers.

The topmost bars for each of the three alternatives show the actual number of bomber weapons deployed. Penetrating bombers are assumed to carry 16 weapons, the B-52H to carry 20 ALCMs, and the B-1 to carry 22 ALCMs when used as an ALCM carrier.

The lower triplet of histograms for each of these bomber force structures shows the counted bomber weapons under three different counting rules. The first rule, represented by the leftmost histogram, is the U.S. position—each ALCM carrier counts ten, regardless of the actual load. The rightmost histogram is the Soviet position—each ALCM carrier counts its carriage capacity.[11] The middle histogram shows an

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[10]Of course, current aircraft alert rates are well below those sustained in the past. This judgment could be challenged were alert rates for ALCM carriers increased. For example, if the day-to-day alert rate for ALCM carriers were increased to 50 percent, under the U.S. counting rule ALCMs would contribute more arriving weapons per counted weapon than SLBMs for probabilities of penetrating in excess of approximately 0.7.

[11]Again, in this case actual loading is assumed to be equal to carriage capacity.

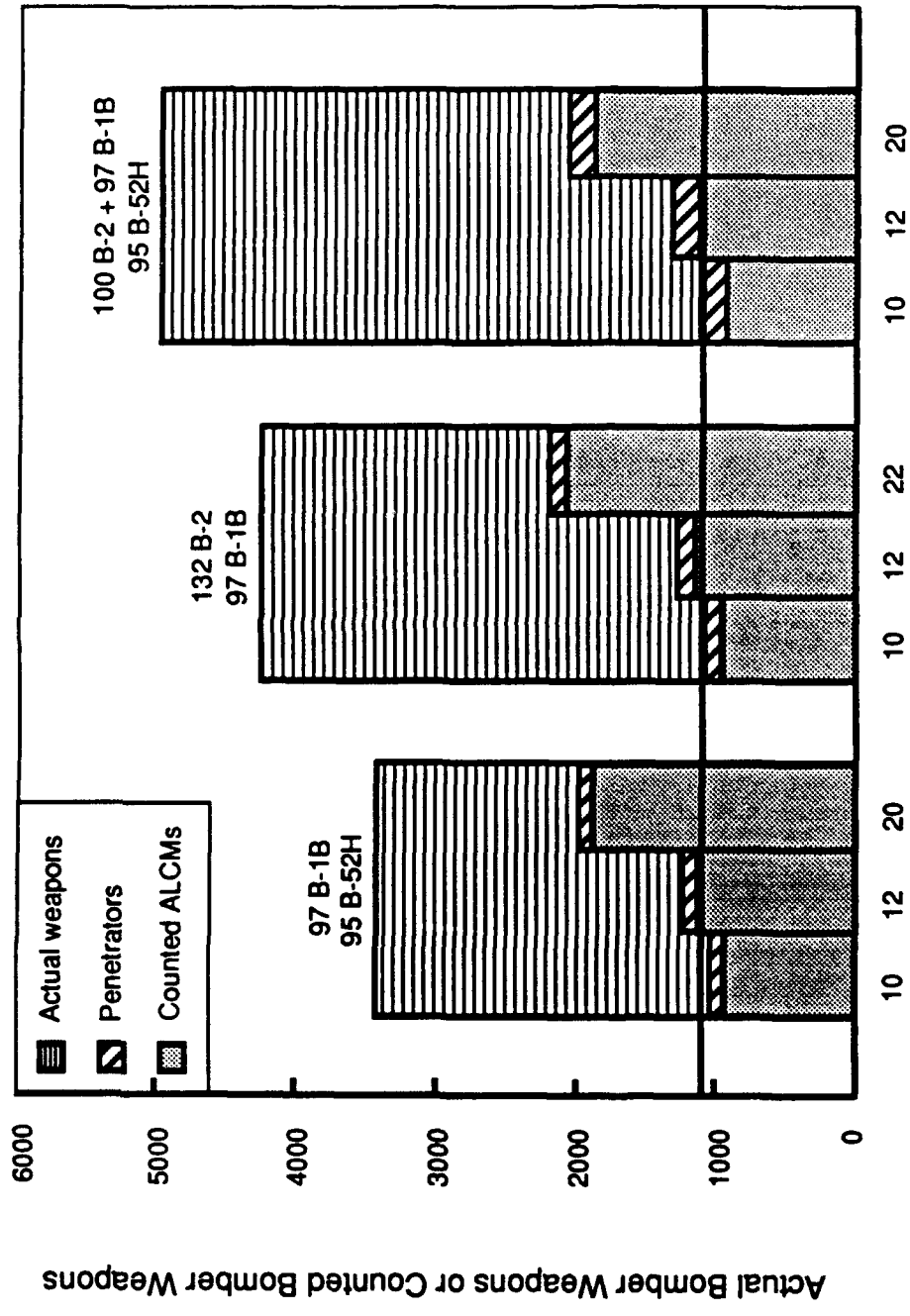

Fig. 2—Alternative bomber forces

intermediate rule, though skewed much more toward the U.S. position—each ALCM carrier counts 12. Penetrating bombers, as agreed, count one weapon each for all cases.

Several points derive from Fig. 2. First, the U.S. ALCM counting rule accommodates each of these postures without impinging more than marginally (by only 2 and 47 in the second and third bomber force structures, respectively) on the 4900 allowed ballistic missile reentry vehicles. The Soviet ALCM counting rule would result in air weapon counts of 1997 to 2266, decreasing the number of allowed ballistic missile reentry vehicles by 897 to 1166. To avoid this consequence if the United States accepted this counting rule, the United States would probably choose to either reduce the number of ALCM carriers to approximately 50 or reduce the carriage capacity of each ALCM carrier to approximately 10.

The United States could probably live with a counting rule of 12 per ALCM carrier, represented by the middle histogram for each of the alternative bomber force structures in Fig. 2. This would result in the worst case (the third bomber force structure) in a total of 1337 counted air weapons, only 237 in excess of the desirable level of 1100. This excess could be eliminated, if desired, by reducing the number of B-52H ALCM carriers from 95 to 75.

Finally, the second posture in Fig. 2 is inferior to the third posture in two respects. It has approximately 700 fewer deployed weapons, but it is also likely to be more costly than the third posture. Thus, it would be wise to maintain the B-1 as a penetrating bomber even at the expense of buying fewer B-2s.

ICBMS vs. SLBMs

As discussed earlier, the sum of ICBM and SLBM warheads cannot exceed 4900 under agreed START provisions. Figure 3 presents the tradeoff between Trident boats and ICBM warheads imposed by this sublimit.[12]

Horizontal bars indicate the number of ICBM warheads associated with existing systems stacked in the order that this analysis judges they would be kept under START.

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[12]Of course, it is possible to modify Trident boats by filling tubes or changing the number or warheads per missile, options that will be discussed briefly here and in more detail in later sections. It is also possible that current ICBMs will not be the only ones deployable under START. However, this particular tradeoff is interesting because it is difficult to imagine anything other than current ICBMs (possibly downloaded to carry fewer reentry vehicles), at least in the near term, if the U.S. position of banning mobile ICBMs prevails.

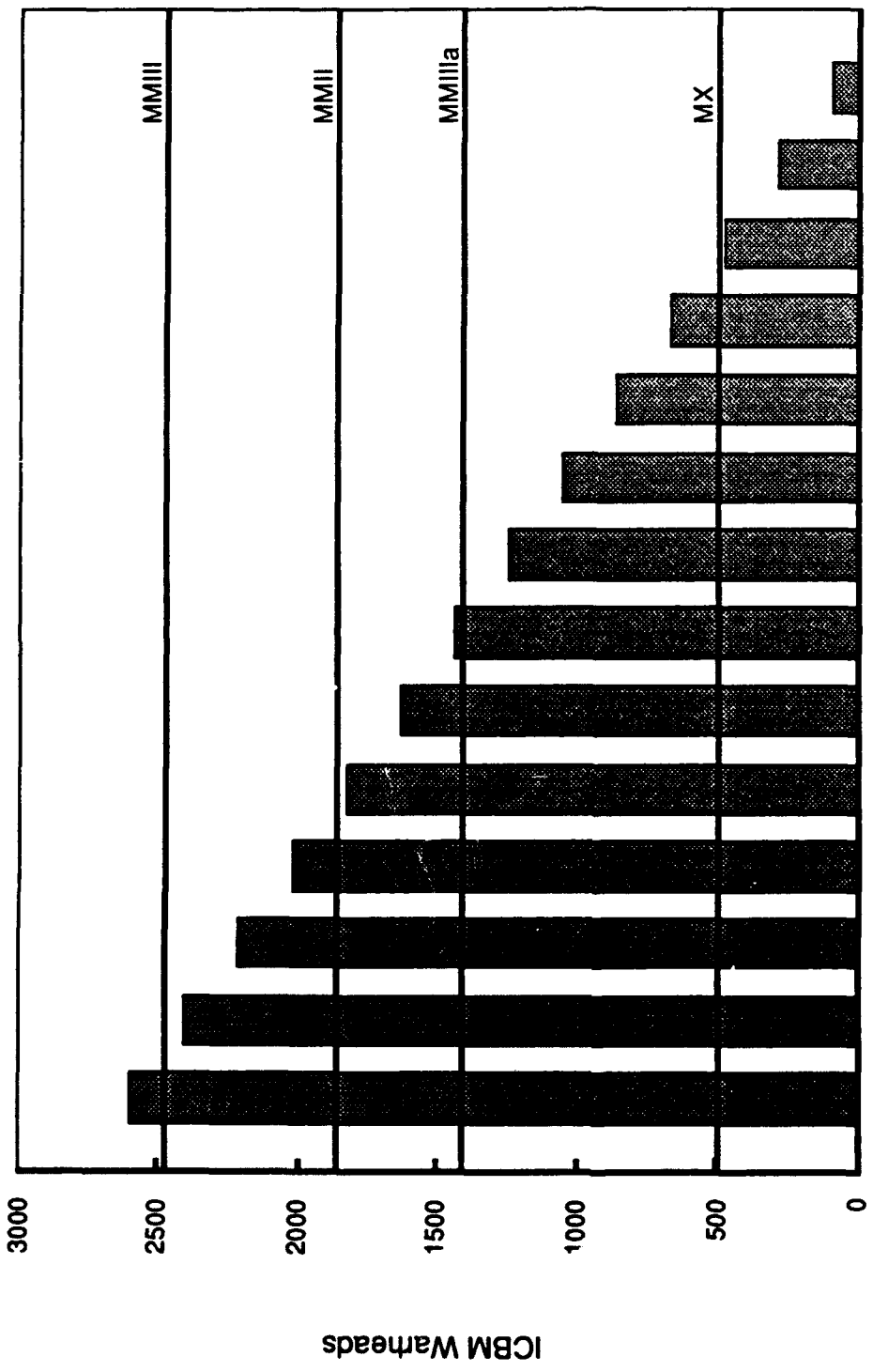

Fig. 3—ICBMs vs. SLBMs

These bars show that if only 12 Trident boats are deployed, all existing ICBMs could be deployed as well.[13] At the other extreme, a maximum of 25 Trident boats could be deployed, leaving only 100 ICBM warheads that could also be deployed.

This analysis restricts consideration of the number of boats (not necessarily Tridents) to the range 15 to 20. Although the Congress has already authorized 17 boats, it is not inconceivable that the last two boats would be canceled if START is signed soon. Fifteen boats would allow keeping all Peacekeeper, Minuteman IIIa (Mark 12A), and Minuteman II ICBMs, as well as a portion (56 out of 200) of the Minuteman III (Mark 12) ICBMs. This is a fairly low-cost option for structuring U.S. ballistic missile forces.

The major concern with this low-cost option is that 15 may be too few boats. With only 15 boats, one or two of which may be in overhaul at any one time, only nine boats may be at sea under normal (day-to-day) alert conditions. It has been argued that the Soviets could concentrate their antisubmarine warfare assets on these fewer targets, decreasing their survivability. However, this argument presumes that there would be a substantial increase in ballistic missile submarine survivability if the number of boats were increased to 20. It is implausible that if 15 boats are worrisome, 20 can be much better.

In any event, the Congress has passed a resolution stating that the minimum number of SSBNs deployed under a START agreement should be 20. Figure 3 indicates that it is not possible to both deploy this many Trident boats and keep a substantial portion of current ICBMs.[14] Current ICBMs are too highly MIRVed and/or Trident boats carry too many warheads each. Thus force structures developed in this analysis that include 20 boats have either fewer warheads per boat, (some) de-MIRVed ICBMs, or both.

The largest number of unmodified Trident boats included here in a force structure is 18. But at that level this analysis also includes downloaded Minuteman ICBMs modified to carry one warhead as well as 50 Peacekeeper missiles. If the Congress continues to authorize an additional Trident boat annually, plausible options to structure ballistic missile forces without modifying these boats become increasingly difficult to imagine.

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[13]Twelve Trident boats and 1000 ICBMs represent 1288 strategic nuclear delivery vehicles (SNDVs), leaving 312 for bombers. Other cases with more Trident boats have even fewer SNDVs. Thus the SNDV limit almost certainly will not directly affect this tradeoff.

[14]This problem would be alleviated were submarines in overhaul (typically approximately 10 percent of those deployed) not to count.

ICBM Force Structure

This section discusses the general nature of ICBM force structures for the cases where mobile ICBMs are banned by START and where they are permitted.

Mobile ICBMs Banned

If mobile ICBMs are banned by START, so that silo basing is the only possibility, ICBMs will remain vulnerable. With projected Soviet improvements in ICBM accuracy, it matters little whether the Soviets will be able to target them with one, two, three, or more warheads per silo.[15] Even ignoring the potential for other Soviet ICBMs to achieve hard target kill capability, with at least 1540 SS-18 warheads capable against hard targets and few hard targets in the United States other than silos, the Soviets will be able to target at least one such weapon (probably two) per silo, achieving a high probability of destruction.

If the United States does not want to rely on a strategy of prompt launch for ICBMs, it can only try to make the best of this situation. Two deployment strategies could mitigate the consequences of this vulnerability. The first is to deploy ICBMs with only one warhead each, forcing the Soviets to expend more weapons in attacking ICBMs than it destroys. The second strategy is to keep ICBM warheads to a low percentage of all ballistic missile warheads. This can keep the consequences of ICBM vulnerability within acceptable bounds.

Single-warhead ICBMs—some combination of Minuteman IIs, SICBMs, and Minuteman IIIs downloaded to carry one RV deployed in Minuteman and Peacekeeper silos—could realize the first strategy. Even 1000 of such ICBMs deployed would represent only 20 percent of all ballistic missile warheads, compared with 30 percent today, thereby realizing the second strategy as well.

It could be argued that even 1000 is too few ICBM warheads. However, fewer ICBM warheads than those deployed today will be needed under a START treaty that bans mobile ICBMs, primarily because the Soviets would probably have many fewer

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[15]Including one warhead per silo in this argument presumes that Soviet ICBM reliability also improves to a high level or that the Soviets develop a shoot-fail-shoot launch strategy. Otherwise, two warheads per silo would be necessary to achieve a high damage expectancy.

silos—on the order of 600[16] (if mobile ICBMs are not permitted and as few as 154 if mobiles are permitted) compared with approximately 1400 today. Furthermore, as communications to SSBNs improve, SLBMs could eventually evolve to become nearly as capable of rapid response as ICBMs. Finally, with improved guidance the damage these 1000 ICBM warheads can be expected to do against hardened Soviet silos and other targets is likely to be much greater than what today's Minuteman warheads can do.

Mobile ICBMs Permitted

If mobile ICBMs are permitted under START, the Soviets presumably will deploy some and consequently deploy fewer ICBMs in silos. Thus even fewer U.S. ICBM reentry vehicles will be needed to cover Soviet silos than for the case where mobile ICBMs are banned. More ICBM reentry vehicles could be needed in this case, however, to exploit the possibility of survivable and endurable U.S.-based missiles.

Whatever silo-based ICBMs are deployed are best deployed with one warhead for the reasons discussed above. However, mobile ICBMs could carry multiple warheads. In fact, there is a definite advantage to doing so. It would reduce the number of delivery vehicles associated with ICBMs, which would allow more to be allocated to SLBMs and bombers under the 1600 limit.

Delivery Vehicle Limit

This section discusses the effect of the delivery limit on ICBM and SLBM forces. The effect of the Soviet position that conventional strategic bombers count against this limit is also briefly discussed. Figure 4 defines the relevant interactions among force structure elements.

The graph on the left shows the tradeoff between ICBM delivery vehicles and SLBM delivery vehicles for four bomber force structures. If no bombers are deployed, then the sum of ICBM and SLBM delivery vehicles must be no greater than 1600, represented by the line labeled "no bombers." Three other bomber force structures are shown—97 B-1Bs plus 95 B-52Hs, this posture plus 100 B-2s, and this latter posture plus 167 (conventionally armed) B-52Gs, which would be counted under the Soviet position. In all cases the point representing deployed ICBMs and deployed SLBMs must lie on or below the line representing the deployed bomber force structure.

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[16]Composed of, for example, 154 SS-18s, 150 SS-24s, and 300 SS-25s.

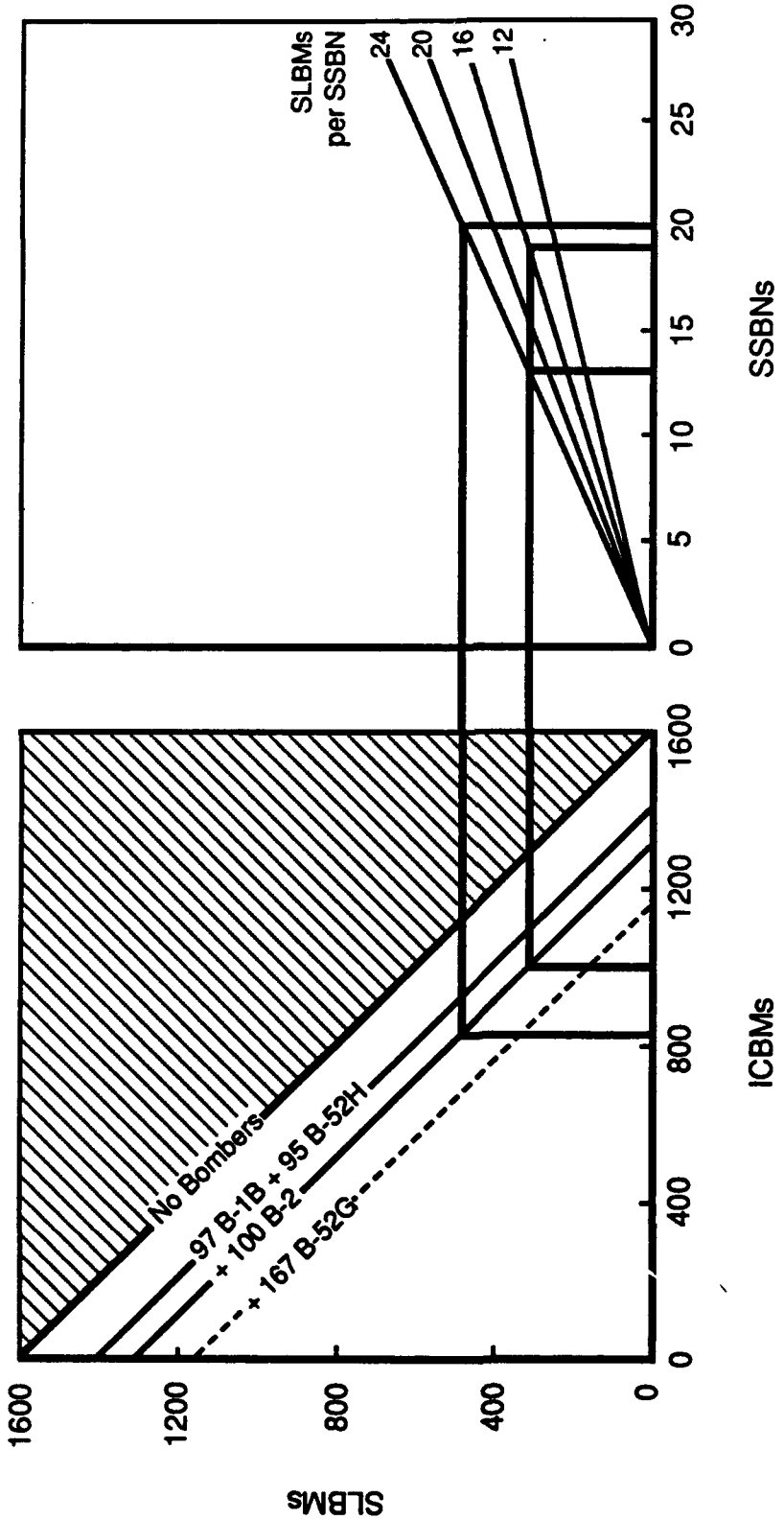

Fig. 4—Delivery vehicle limit

The graph on the right shows the relationship between SLBMs and SSBNs for four cases of missiles per boat (SLBMs per SSBN). The graphs can be used together to show the relationship between ICBM force structure and SLBM force structure for a particular bomber force structure.

If 1000 ICBMs are deployed, as well as 97 B-1Bs, 95 B-52Hs, and 100 B-2s, then 308 SLBMs can also be deployed under the SNDV limit of 1600. If existing Trident boats with 24 SLBMs each are deployed, only approximately 13 boats can be deployed. However, more boats could be deployed if the number of missiles per boat is reduced. Sixteen missiles per boat would permit deployment of 19 boats.

Alternatively, 20 boats could be deployed, without modification, as well as the same bomber force structure, provided the number of ICBMs is reduced to 828. Thus, a heavy price in terms of modification of the Trident boats is required to maintain all 1000 silos.

If one accepts the Soviet position that conventionally armed bombers count against the SNDV limit, the tradeoff becomes more difficult. The United States has 167 B-52Gs, of which 60 are planned for conventional use. This would result in either 60 fewer ICBMs deployed or two or three fewer Trident boats (with 24 tubes each) or approximately four fewer modified Trident boats (with 16 tubes each).

In summary, the SNDV limit becomes a problem if well over 800 ICBMs are desired as well as a moderately large bomber force. That would force the modification of boats to carry fewer than 24 SLBMs each to deploy approximately 20 boats. Acceptance of the Soviet position that conventional strategic bombers also count exacerbates this situation, even though only approximately 100 such bombers may be deployed.

SLBM Force Structure

Figure 5 considers the effect of the delivery vehicle limit on SLBM warhead loadings. The left and center graphs are the same as in Fig. 4, except that conventional bombers are not shown. The right graph shows four cases of SLBM warhead loadings.

As the previous tradeoff demonstrated, the number of SSBNs is determined by the number of missiles per boat and can vary anywhere from approximately 13 upward.

Having 1000 ICBMs would allow 308 SLBMs carrying 2464 SLBM warheads with existing Trident missiles. Thus, about half the ballistic missile force would be represented by SLBMs. This is not consistent with the historical split between ICBMs

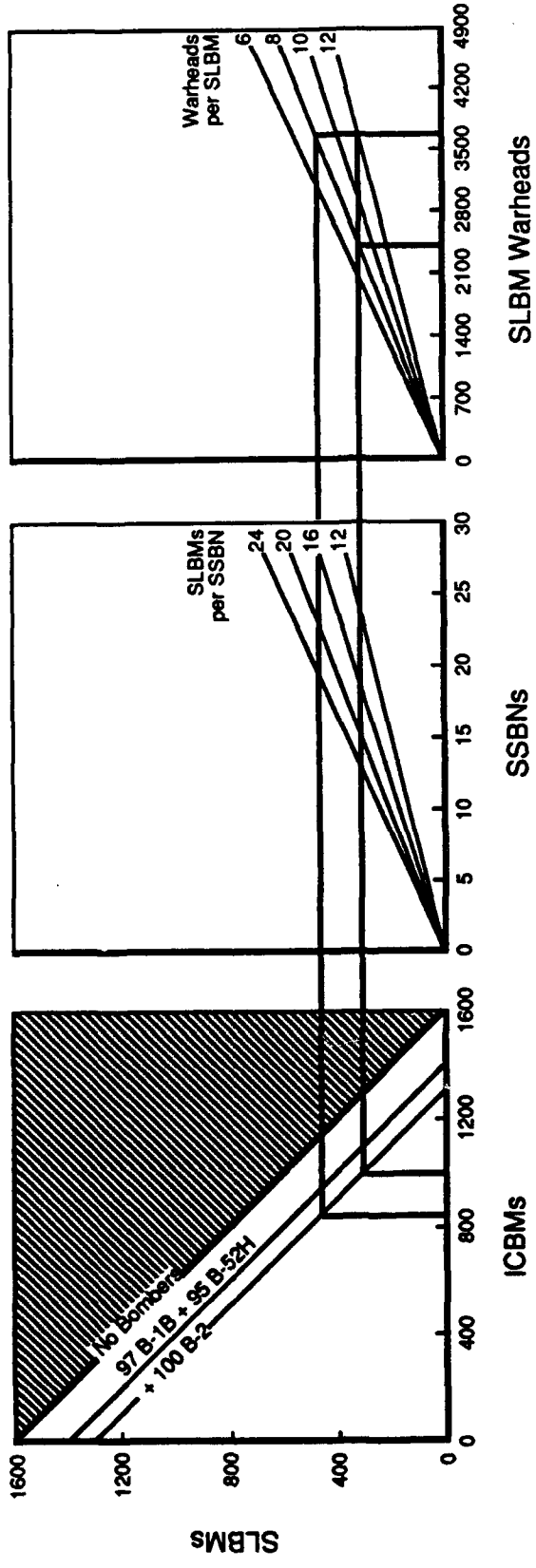

Fig. 5—SLBM force structure

and SLBMs, which put a greater fraction in SLBMs and, given the vulnerability of silo-based ICBMs, is highly implausible.

Increasing the number of warheads per SLBM to 12, however, would result in 3696 SLBM warheads, approximately 75 percent of ballistic missile warheads, a much more plausible deployment. A desire to keep 1000 ICBMs and maintain an SLBM-dominant ballistic missile force is possible, but only with an increase in the number of warheads per SLBM.

The same number of SLBM warheads would result with existing Trident missiles if the number of ICBMs were reduced to 818. Again, a heavy price would be paid in terms of SLBM modification to keep 1000 silos.

In conclusion, the delivery vehicle limits ICBMs to no more than 800 to 850, unless either substantially fewer than 20 boats are deployed, the number of missiles is decreased per boat and the number of warheads per missile simultaneously increased, or fewer than approximately 300 bombers are accepted.

III. THE U.S. START POSITION

EFFECT OF U.S. START POSITION

As discussed in Sec. II, the agreed counting rule for non-ALCM-carrying bombers causes penetrating bombers to be favored over all other delivery systems to maximize the number of arriving weapons per counted weapon. Similarly, low day-to-day alert rates for air weapons cause ballistic missiles to be favored over ALCMs, even with heavy ALCM discounting. Finally, the delivery vehicle limit favors both fewer missiles per boat to allow more boats and less than 1000 ICBMs, with some carrying more than one warhead for a balanced triad without major restructuring of sea-based forces.

If mobile ICBMs are banned (because verification procedures could not be agreed on or congressional support for U.S. mobile ICBM programs eroded to the point the United States reverted to its earlier position that no mobile ICBMs be allowed), single-warhead ICBMs, which provide less lucrative targets than those with multiple warheads, become favored. In turn, desire for a substantial number of single-warhead ICBMs causes favoring more warheads per SLBM. Finally, the U.S.-proposed ALCM counting rule favors pure penetrating bombers or pure ALCM carriers, rather than shoot-and-penetrate bombers, so that as few bombers as possible count as ALCM carriers. It also favors loading up ALCM carriers with as many ALCMs as possible.

U.S. FORCES UNDER THE U.S. START POSITION

Low-Cost U.S. Forces

The "low-cost" posture is driven by the desire to spend as little as plausibly possible. For the air weapon leg of the triad, no new bombers are purchased. Existing B-1s serve as penetrating bombers and existing B-52Hs serve as ALCM carriers. For the sea-based leg, 15 Trident boats without modification are deployed and carry Trident II missiles, also without modification. For ICBMs, all existing ICBMs are used except for 144 Minuteman IIIs (Mark 12s), which are removed.

As seen in Fig. 6, this results in a deployment of 8350 actual weapons. Of these, 2018 are ICBM warheads and 2880 are SLBM warheads, 41 and 59 percent of ballistic missile warheads. Neither the START delivery vehicle limit nor the warhead limit is reached, although this deployment does reach the ballistic missile sublimit.

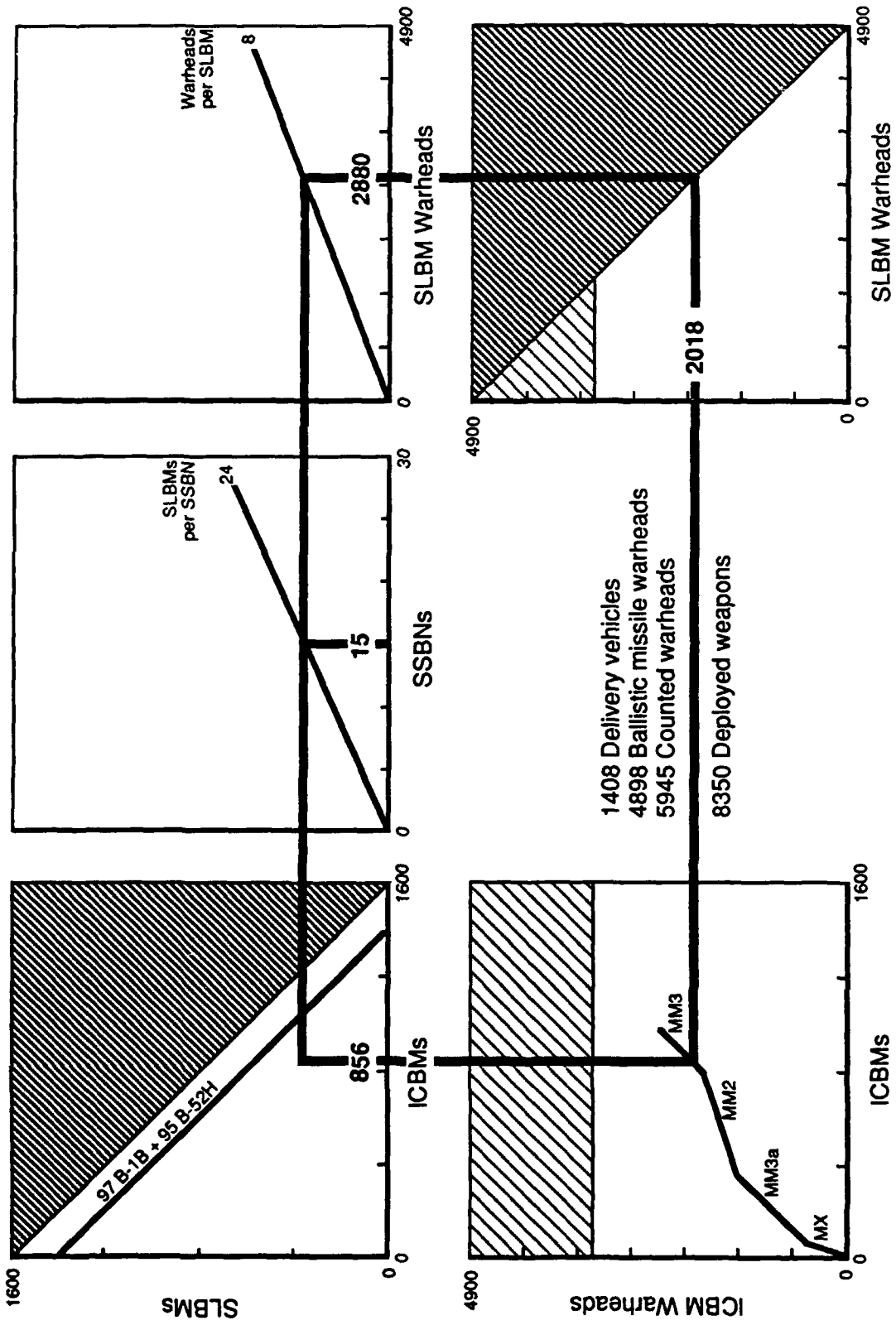

Fig. 6—*Low-cost U.S. forces—U.S. START position*

Several variants of this low-cost structure are possible. For those not satisfied with 15 boats, more SSBNs could be deployed simply by filling tubes on Trident boats. For example, rather than 15 boats with 24 tubes each, there could be 18 boats with 20 tubes each or 20 boats with 18 tubes each. For those not satisfied without more fully exploiting the counting rule for penetrating bombers, 55 B-2 bombers could be deployed, exceeding the counted warhead limit. A total of 111 B-2 bombers could be accommodated if the remaining 56 Minuteman III (Mark 12) were removed. Thus, this low-cost force structure could serve as the starting point for a considerably larger deployment.

Far-Term U.S. Forces

This "far-term" force structure is conceived without regard to the investment the United States has in existing systems. It is driven by three considerations: (1) exploiting the air weapon counting rules, (2) deploying 20 SSBNs, and (3) deploying ICBMs with single warheads.

As seen in Fig. 7, 200 penetrating bombers and 90 ALCM carriers are deployed, counting a total of 1100 toward the weapon limit. Of course, it would be even more advantageous to deploy more penetrating bombers, but fiscal considerations would presumably preclude this. Similarly, 30 ALCMs are assumed per ALCM carrier, although it is possible to deploy many more ALCMs per carrier.

SSBNs are configured to carry 16 missiles each, and missiles are loaded with 12 warheads per missile, for a total of 192 warheads per boat, the same as current Trident boats. This results in a total of 3840 SLBM warheads, theoretically leaving 1060 for ICBMs under the ballistic missile warhead sublimit. However, the delivery vehicle limit is reached before the ballistic missile warhead sublimit, restricting the ICBM deployment to 990 single-warhead missiles.

The final deployment consists of 10,730 warheads, 2380 more than the low-cost force structure. In this case, the SNDV limit is reached, but neither the warhead limit nor the ballistic missile sublimit is reached.

The Navy could balk at loading all SLBMs with 12 warheads each, but it was prepared to so load approximately half of its missiles until recently. The real question is, does the Navy require the larger yield associated with the eight-warhead version of the Trident II missile on at least some of its missiles? In any event, even if the answer is yes, a larger booster could provide both 12 warheads and large yield. A variant of this force

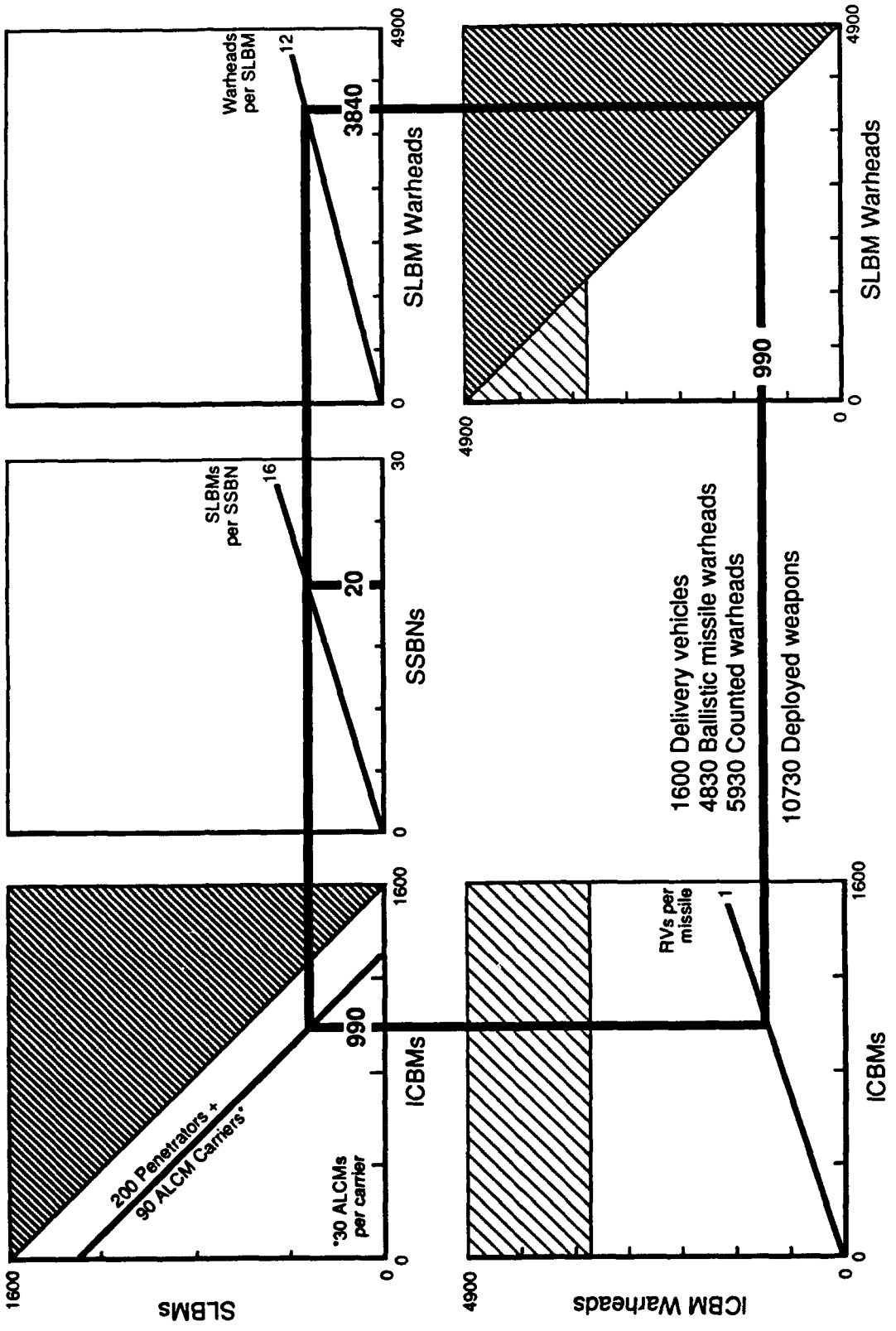

Fig. 7—Far-term U.S. forces—U.S. START position

structure would include some boats with 12 warheads per missile and others with eight warheads per missile. Verification could be made feasible by, for example, deploying some boats (current Trident boats) with 24 tubes and eight warheads per missile and other boats (new) with 16 tubes and 12 warheads per missile.

Near-Term U.S. Forces

If the far-term structure above is a desirable goal, it is important in the near term to not do anything to foreclose the possibility of achieving that goal. Specifically, it is important to maintain as many silos as possible. Once silos are eliminated, it could be politically very difficult to build new ones.

The near-term force posture, shown in Table 1, demonstrates how silos could be preserved. It is identical in sea forces and air forces to the low-cost structure. For ICBMs, to retain 990 silos, all that is needed is to replace the existing 200 Minuteman III/Mark 12 missiles with a single-warhead variant and eliminate ten Minuteman III/Mark 12A missiles. All 1000 silos could be maintained by replacing 15 Minuteman III/Mark 12As with single-warhead variants (as well as replacing the 200 Minuteman III/Mark 12s with a single-warhead variant).

Balanced U.S. Forces

These forces, also shown in Table 1, represent the view in this analysis of a plausible, affordable, effective U.S. force structure under the U.S. START position. It attempts to balance various competing interests, including low-cost versus modernized forces and Navy versus Air Force systems.

For ICBMs, the existing 50 Peacekeepers remain. These are new and highly effective missiles. Furthermore, since the ratio of the launcher limit to the ballistic missile sublimit will probably force keeping some MIRVed ICBMs, it might as well be these. All other ICBMs are single-warhead Minuteman IIIs (Mark 12s).

For sea forces, this force structure contains 18 unmodified Trident boats with eight D-5H warheads per missile. It seems wasteful to fill tubes on Trident boats to gain another few boats and of questionable political viability.

For air forces, the 95 B-52Hs are maintained as ALCM carriers and the 97 B-1Bs as penetrating bombers. In addition, 100 B-2s are deployed. The largest cost of this force structure is due to these B-2s. In spite of the high cost of the B-2, the United States is unlikely to be able to long avoid the implications of the agreed counting rule for them.

Table 1

ALTERNATIVE U.S. FORCES, U.S. START POSITION

	Low Cost		Near Term		Far Term		Balanced	
	Platforms	Weapons	Platforms	Weapons	Platforms	Weapons	Platforms	Weapons
MMII	450	450	450	450	0	0	0	0
MMIII-12	56	168	0	0	0	0	0	0
MM-12A	300	900	290	870	0	0	0	0
Mx-silo	50	500	50	500	0	0	50	500
MMIV	0	0	200	200	990	990	826	826
Trident C4	8	1536	8	1536	0	0	0	0
Trident D5H	7	1344	7	1344	0	0	18	3456
New (16 x 12)	0	0	0	0	20	3840	0	0
B-52H	95	1900	95	1900	0	0	95	1900
B-1B	97	1552	97	1552	97	1552	97	1552
B-2	0	0	0	0	103	1648	100	1600
New ALCM carrier (30)	0	0	0	0	90	2700	0	0
Deployed weapons		8350		8352		10730		9834
Launchers		1408		1542		1600		1600
Ballistic missile warheads		4898		4900		4830		4782
Counted weapons		5945		5947		5930		5929

In fact, failure to proceed with the B-2 program could fatally undermine necessary military support for START.

Deployed weapons total 9834 with this force structure, only 896 fewer weapons than for the far-term structure. This difference can be attributed to the increased carrying capacity of ALCM carriers assumed in the far-term structure. As B-52Hs age and are ultimately replaced by new ALCM carriers, the logic of the U.S. position dictates that as many ALCMs are deployed per carrier as possible. The ultimate effect could be a deployment that exceeds even current forces.

In terms of competing Air Force and Navy perspectives, the Navy would have to accept only 18 boats rather than 20, but they could start working on the next generation SSBN with fewer missiles per boat. Also, if SSNBs in overhaul do not count, this force structure would (just) meet the congressional desire for a minimum of 20 boats. The Air Force would have to accept only 100 B-2s, rather than the 132 they have planned for. As the debate on B-2 procurement progresses, this quantity may become a satisfactory compromise. Finally, the Air Force would have to accept only 1326 ICBM warheads out of 2450 deployed today, but they would get to preserve 876 out of 1000 silos.

IV. THE SOVIET START POSITION

DELIVERY VEHICLE LIMIT

The Soviet position of delivery vehicles differs from that of the United States in that the Soviets want strategic conventional bombers to count one each against the delivery vehicle limit of 1600. This difference would be of little consequence if the United States were satisfied with high warhead levels per ICBM, as with current systems, since the ballistic missile warhead sublimit of 4900 is reached before the delivery vehicle limit. However, the Soviet position would have serious consequences if the United States wants large numbers of single-warhead ICBMs. As discussed in Sec. II, the result could be to increase the warhead level per SLBM so that more single-warhead ICBMs could be deployed.

Compromises between the U.S. and Soviet positions on this issue are not difficult to imagine. For example, the United States could accept the Soviet position that conventional bombers count against the delivery vehicle limit but simultaneously either increase the delivery vehicle limit or lower the ballistic missile warhead limit. After all, it is not the limits themselves but rather the ratio of allowed launchers to ballistic missile warheads that is the source of the problem.

Alternatively, the United States could simply accept the Soviet position, deploying fewer ICBMs to compensate for deployed conventional bombers. If only 60 or so such bombers are involved, this would have only a minor influence on the U.S. strategic (nuclear) force structure. If two or three times as many such bombers are involved, the effect would become more drastic.

MOBILE ICBMS

The Soviet position on mobile ICBMs is that they be permitted up to the levels of 800 delivery vehicles and 1600 reentry vehicles.[1] These limits would accommodate both

[1] If the Soviets deploy up to these levels and keep 154 SS-18s, they would have 3140 deployed ICBM reentry vehicles, below the U.S. proposed sublimit of 3000 to 3300 ICBM reentry vehicles. So this sublimit may be unconstraining as the Soviets have been claiming. Of course, they could deploy additional nonmobile ICBMs. The second calculation these limits suggest is to determine the number of SS-24s with ten warheads each and SS-25s with one warhead each that would simultaneously reach both limits. These numbers are 89 SS-24s and 710 SS-25s.

100 rail-based Peacekeepers and 600 road-mobile SICBMs, more than the United States plans to deploy in the absence of START.

In addition to the advantages in survivability that mobile missiles could provide, deploying multiple warhead mobile ICBMs would relieve pressure on the delivery vehicle limit. This argues for a two-warhead SICBM if they are the only mobile missile deployed. It also argues against the United States trying to ban Soviet rail-based SS-24s indirectly by banning multiple-warhead mobile missiles.

A possible compromise would be to allow approximately 800 mobile ICBM reentry vehicles, half the level of the Soviet position, just the number needed for the Air Force's suggestion of deploying 50 rail-based Peacekeepers and 300 SICBMs.

ALCM COUNTING RULE

The Soviet position on counting ALCMs is that bombers count according to the maximum number of ALCMs they are equipped to carry.

The primary effect of the Soviet position is that many fewer ALCMs could be deployed than under the U.S. proposal. Just how many fewer depends on the extent the United States would exceed the nominal count of ten with the actual load. In theory, there is no reason the United States could not carry many scores of ALCMs per carrier.

A secondary effect is that the United States would probably prefer either shoot-and-penetrate bombers or a reduced carriage capacity (on the order of ten ALCMs) per ALCM carrier lest ALCMs be concentrated on too few bombers.

Finally, the Soviet position has the disadvantage that negotiations would be required as new bombers are introduced.

A possible compromise, skewed toward the U.S. position, is that each ALCM carrier counts 12, regardless of actual load. Although this would probably cause the United States to deploy in excess of 1100 air weapons, at least in the near term, the excess would not be substantial. Another possible compromise is that each carrier count 10 to 12 with a maximum carriage on the order of 20. This would probably limit U.S. deployments to no more than about 100 ALCM carriers carrying 2000 ALCMs.

ICBM SUBLIMITS

The United States has proposed ICBM warhead sublimits of 3000 to 3300. The Soviets prefer no sublimits on ICBM warheads but claim they are willing to accept them provided SLBMs are limited as well.

The U.S.-proposed ICBM sublimit would have no effect whatsoever on U.S. force structures nor would it probably have any effect on Soviet force structures. There is no compelling evidence that the Soviets would want to deploy more than 3300 ICBM warheads and fewer than 1600 SLBM warheads. Even if they choose to do so, the excess could not be very much.

The Soviet counterproposal could constrain U.S. SLBM forces even if the level were also set to 3300. Therefore, the United States would be better off dropping the ICBM sublimit than accepting the Soviet counterproposal.

One possible compromise would be to set sublimits for both ICBMs and SLBMs at 3600. This would have essentially the same effect as dropping both sublimits.

AIR WEAPON SUBLIMIT

The Soviets have proposed an explicit sublimit on counted air weapons—penetrating bombers and ALCMs—of 1100. As discussed earlier, the United States would prefer not to exceed this level unless ALCMs had high assurances of penetrating Soviet air defenses and they were heavily discounted, such as counting two ALCMs as one. Therefore, this sublimit should not have much effect on U.S. force structures. The real issue is just how are ALCMs to be counted?

A possible compromise would be not to include this sublimit but limit the number of penetrating bombers instead. This would make sense from the Soviet standpoint if their main motivation is to constrain the U.S. air weapon threat. It would also make sense from the U.S. standpoint because it does not make sense to allow deployments it is not prepared to make but that the Soviets might.

Another possible compromise is to eliminate ICBM, SLBM, and air weapon sublimits altogether.

U.S. FORCES UNDER THE SOVIET START POSITION

The following U.S. force structures have been developed to be consistent with the Soviet START position in each of the five areas of dispute analyzed above. Force structures are presented with rail-based Peacekeepers and road-mobile SICBMs, and a compromise structure that includes both.

Rail-Garrison Peacekeeper and SICBM U.S. Forces

These two force structures, illustrated in Fig. 8, are identical in air weapons and sea-based forces but differ in ICBM forces. Air weapons consist of 90 ALCM carriers, loaded with 10 ALCMs each, and 200 penetrating bombers. Counted air weapons total 1100, while actual deployed air weapons number 4100. There are also 110 conventional bombers counted against the delivery vehicle limit.

Sea-based forces consist of 20 Trident boats modified to carry only 20 missiles carrying Trident II missiles with eight warheads each. Thus the sea-based forces do not require major modification from currently planned forces. The total number of SLBM warheads is 3200.

Both force structures start with the existing 50 Peacekeepers. For the Rail-Garrison Peacekeeper force structure, these and an additional 50 Peacekeepers are deployed in rail-basing mode. In addition, 700 single-warhead silo-based ICBMs are deployed, resulting in a total of 800 ICBM delivery vehicles and 1700 warheads.

For the SICBM force structure, no additional Peacekeepers are deployed. Rather, 500 SICBMs in road-basing mode are deployed. In addition, 225 Minuteman III/Mark 12As and 25 Minuteman IIs are retained in silos. As with the Rail-Garrison Peacekeeper force structure, this results in a total of 800 ICBM delivery vehicles and 1700 warheads.

Both force structures have 9000 deployed weapons and are constrained simultaneously by the delivery vehicle limit, the warhead limit, and the ballistic missile reentry vehicle sublimit.

Compromise U.S. Forces

In late 1989, the Air Force offered a possible compromise ICBM modernization plan that put the existing 50 silo-based Peacekeepers in rail-basing mode and deployed only 300 SICBMs in road-basing mode. The compromise U.S. force structure shown in Table 2 represents START forces with these mobile ICBMs. It also represents my judgment of an effective, affordable U.S. START force structure consistent with the Soviet START position.

In addition to the mobile ICBMs discussed above, there are 113 Minuteman III/Mark 12As and 305 Minuteman IIs, for a total of 1444 ICBM warheads. Sea-based forces consist of 18 unmodified Trident boats with eight-warhead Trident II missiles.

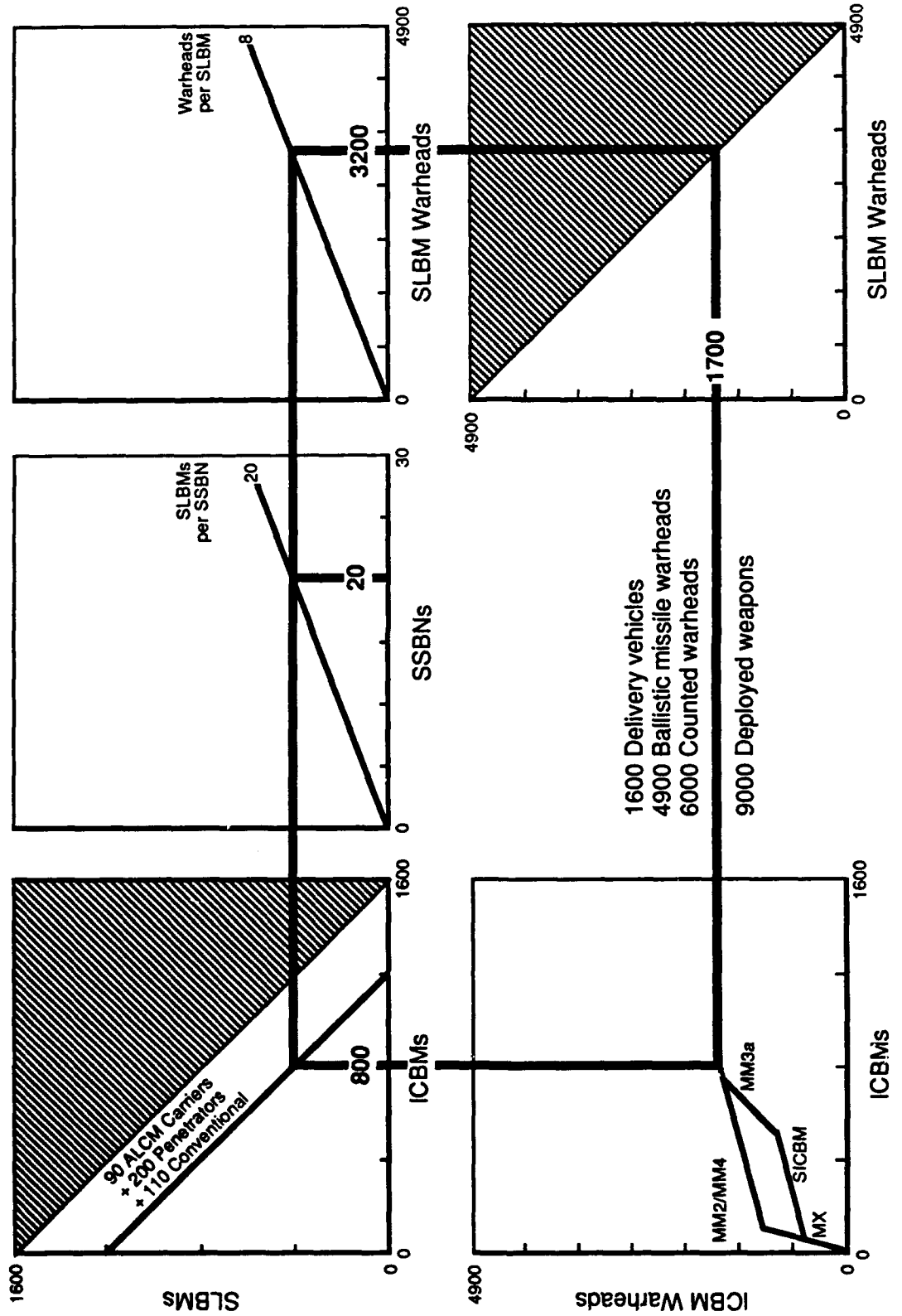

Fig. 8—Rail-Garrison peacekeeper and SICBM U.S. forces—Soviet START position

Table 2

ALTERNATIVE U.S. FORCES, SOVIET START POSITION

	MX-Rail		SICBM		Compromise	
	Platforms	Weapons	Platforms	Weapons	Platforms	Weapons
MMIII-12A	0	0	225	675	113	339
MX-rail	100	1000	50	500	50	500
MMII/MMIV	700	700	25	25	305	305
SICBM	0	0	500	500	300	300
Trident D5H	0	0	0	0	18	3456
New (20 X 8)	20	3200	20	3200	0	0
B-1B	97	1552	97	1552	97	1552
B-2	103	1648	103	1648	103	1648
New ALCM carrier	90	900	90	900	90	900
Deployed weapons		9000		9000		9000
Launchers		1490		1490		1490
Ballistic missile warheads		4900		4900		4900
Counted weapons		6000		6000		6000

SLBM warheads total 3456. Air weapons consist of the same forces as for Rail-Garrison Peacekeeper and SICBM force structure.

The total number of deployed weapons is (again) 9000, and the force structure is (again) constrained simultaneously by all three (sub)limits.

V. EVALUATIONS OF EFFECTIVENESS

This section develops various measures of U.S. national security strategy and applies them to compare the force structures developed in Secs. III and IV. Of course, these measures do not attempt to cover all aspects of national security strategy; they are intended to capture only the contributions that force structure makes. Even within this limited scope, the measures developed capture only part of what is relevant about the contribution of nuclear weapons to national security strategy, enough to provide a useful first cut at force structure comparison.

Figure 9 shows levels of U.S. weapons in various conditions—deployed, available, alert, surviving, and arriving. Strategic forces in 1989 provide a concrete example. Deployed weapons number slightly in excess of 12,000. Available weapons decrease this because of SSBNs in overhaul and aircraft in the maintenance pipeline. Alert weapons take into account alert rates for two scenarios—generated and day-to-day alert. Surviving weapons take into account prelaunch survivability also for two scenarios—prompt and delayed launch. Arriving weapons take into account weapon system reliability and probability to penetrate Soviet defenses.

There are very large differences in the number of weapons, depending on condition. This analysis strictly uses arriving weapons to calculate the measures. Measures of central deterrence, stability (sensitivity to generation and sensitivity to prompt launch), and coercive potential are shown in Fig. 9 and explained in the following sections. Figure 10 provides an overview of arriving weapons in each of the four scenarios for each force structure.

DETERRENCE

U.S. national security relies on deterrence of nuclear warfare as its central strategy.[1] The Soviets are viewed as deterred from initiating unrestrained nuclear warfare against the United States by the (certain) prospect of unacceptable damage in

[1]Force structures are not compared in this analysis on their ability to support *extended* deterrence because no measures of force structure that adequately relate to extended deterrence have been identified. However, it is doubtful that the force structures differ substantially in their abilities in this regard.

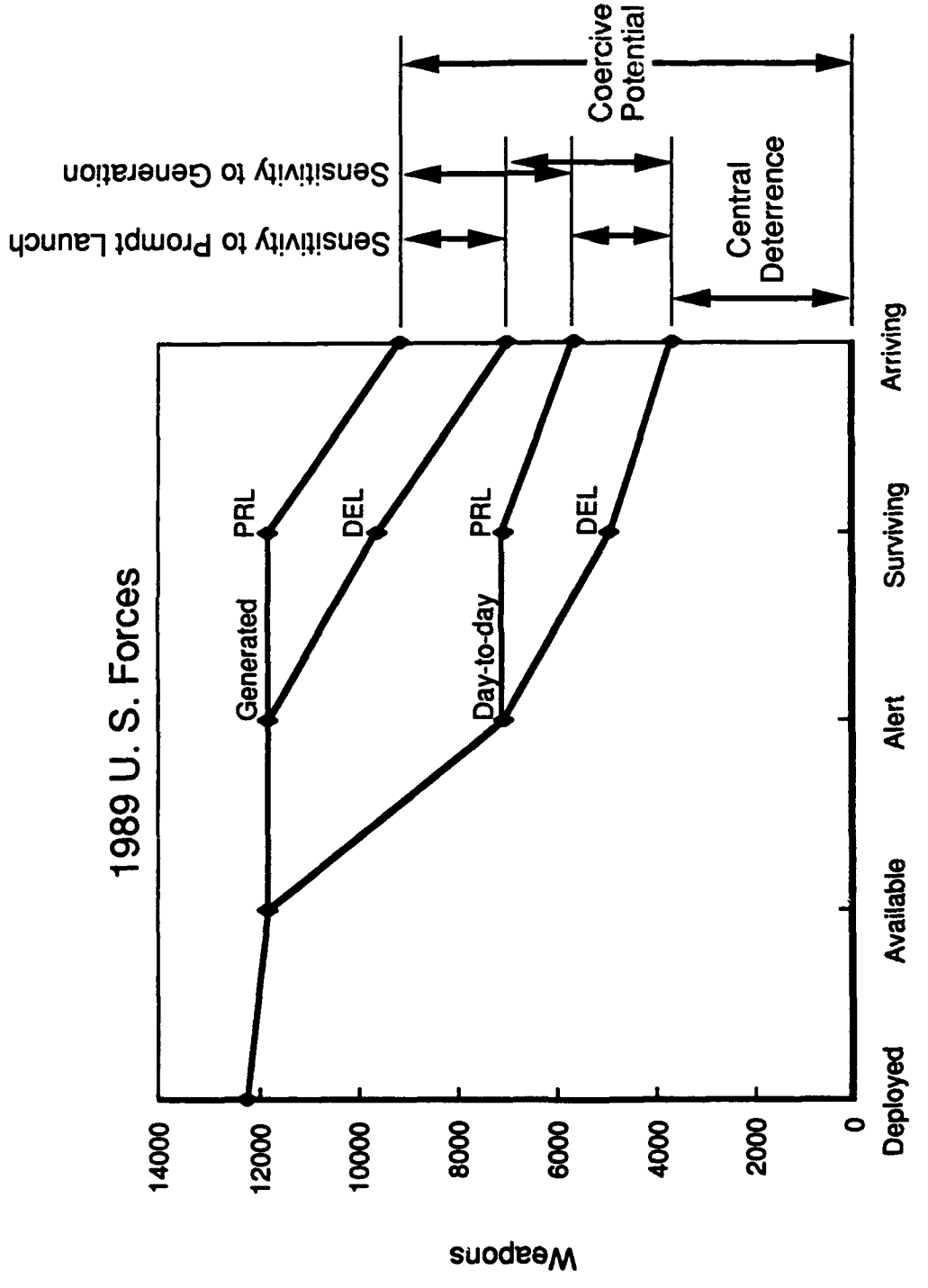

Fig. 9—Measures of effectiveness

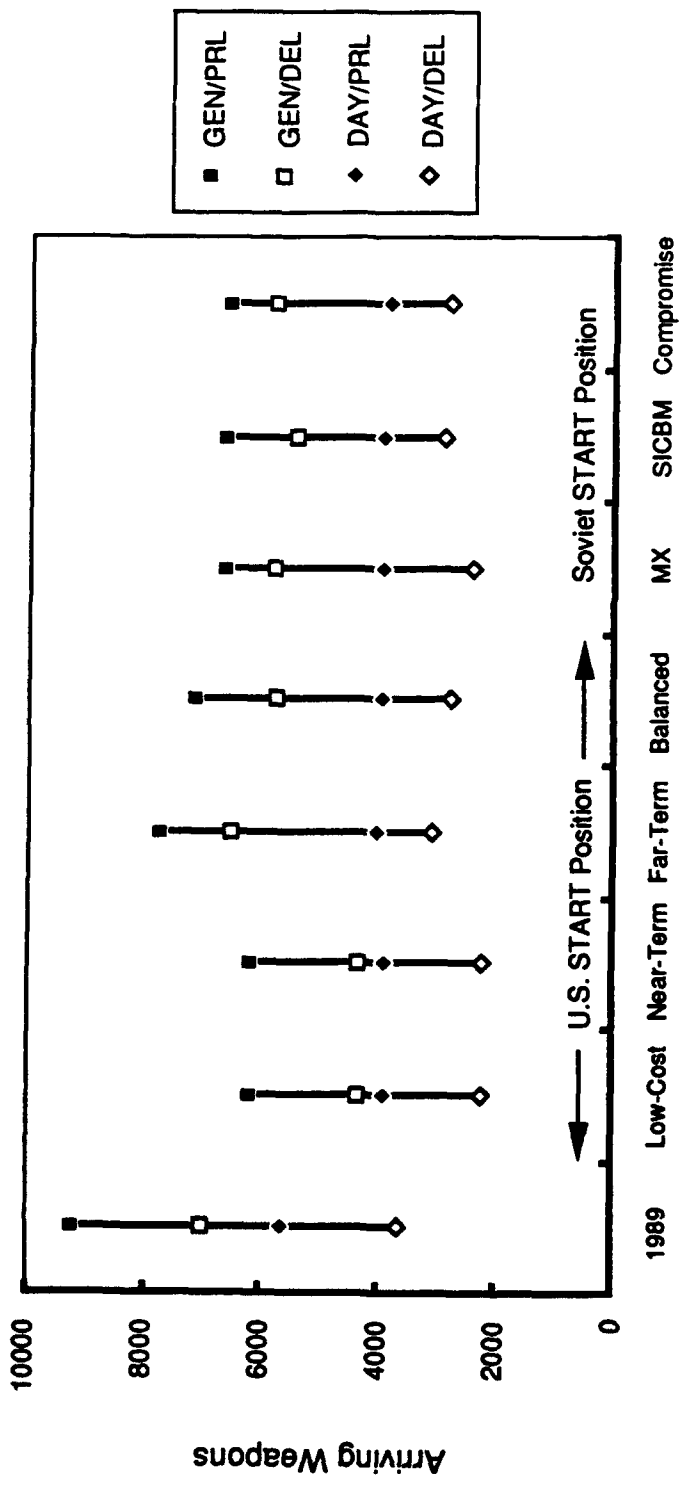

Fig. 10—Force effectiveness comparison

retaliation.[2] The measure of deterrence taken here is the number of arriving U.S. weapons in the worst plausible scenario—in which the United States is on day-to-day alert status and fails to promptly launch ICBMs.

This scenario is plausible on both counts. The U.S. alert rate is under the control of the Soviets; if the Soviets initiate the war, they can choose to do so when the United States is on day-to-day alert. The attack need not be viewed as a "bolt out of the blue," but could be, for example, a premeditated attack in the aftermath of a crisis after the United States (or both sides) returned to a day-to-day alert state.

That the United States may launch its ICBMs promptly (under attack) may be of concern to the Soviets, but the United States cannot depend on the Soviets believing we both can and will do it. Short times of flight of ICBMs make it uncertain that the United States *can* actually do it, and the circumstances in which the attack occurs could cause the Soviets to doubt the United States *would* do it even if it could.

Worse scenarios can be imagined. For example, the United States could fail to receive tactical warning, or to respond to it. In this case, alert bombers would have very low survival probability.

Figure 11 shows the number of arriving weapons in the day-to-day alert, delayed launch scenario, the measure of central deterrence. This measure is shown for each force structure, including 1989 forces, broken out according to Triad leg.

All START force structures do worse by this measure than 1989 forces. However, far-term forces come quite close, with only about 500 fewer arriving weapons. Had ALCM carriers been loaded with about 50 rather than 30 ALCMs each, far-term forces would have exceeded 1989 forces. Thus, the U.S. START position can provide deterring forces if we choose to deploy them.

Some postures—low-cost and near-term in particular—provide many fewer arriving weapons than 1989 forces. Whether the Soviets would in all circumstances view a retaliation with slightly over 2000 arriving weapons as not unacceptable, no one knows. However, it would be prudent to deploy forces at least up to the level of the balanced forces.

As for the Soviet START posture, with which the last three force structures are compatible, they can provide forces as good as, or better than, all other postures except

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[2]This measure can also be related to deterrence of less than massive strikes against the United States because the Soviets cannot be confident that the war will be terminated short of a massive retaliation.

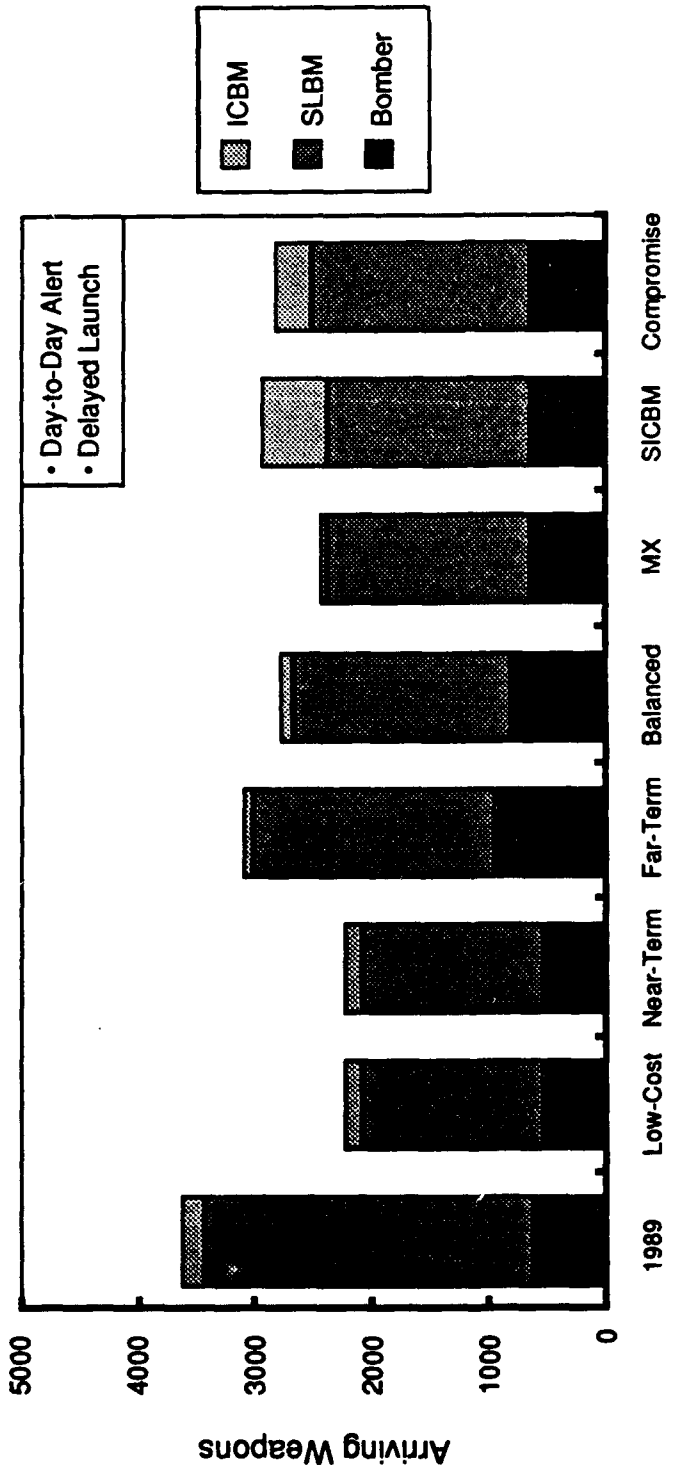

Fig. 11—Central deterrence

for the far-term posture. U.S. forces under the Soviet START position can exploit the favorable counting rule for penetrating bombers, but ALCMs are not discounted as with the U.S. position under which far-term forces were developed.

Again, some force structures do better than others, although the swing is not as great as with the U.S. START posture. The superior force postures are the ones that include SICBMs, since, unlike the rail-based Peacekeeper, they do not depend on prompt launch to survive a Soviet first strike in a day-to-day alert scenario. This also provides for the most balanced (among Triad elements) arriving retaliatory forces.

CRISIS STABILITY

The logic of deterrence applies to rational decisionmakers in control of events and with correct information about the other side's intentions and capabilities. However, in an international crisis, these assumptions very well might not apply in full. It is important to structure forces that will not excessively contribute to events getting out of control or to misperceptions.

The traditional view of crisis instability is more properly termed "first-strike instability." The scenario generally envisioned has both sides on generated alert, fearing that the other side will strike first and trying to decide whether to preemptively attack or to wait. Presumably, but often not reflected in the calculus of first-strike instability,[3] both sides would also be prepared to promptly launch vulnerable ICBMs.

This analysis takes a different perspective. To measure characteristics of force structures that might contribute to getting to such a state in the first place, an attempt has been made to capture the incentive to generate strategic forces and the incentive to implement a prompt launch strategy. As Fig. 11 indicates, these are measured by the increase in arriving U.S. weapons if the United States generates *and* promptly launches, respectively. These measures are termed "sensitivity to generation" and "sensitivity to prompt launch." The lower these numbers, the better.

Figure 12 compares the force structures using these measures. The top two graphs show the absolute increase in arriving weapons, while the bottom two graphs show the ratio of arriving weapons. For 1989 forces, in the case where the United States rides out

[3]This case is often excluded from calculations of first-strike instability; if vulnerable ICBMs are launched under attack, there is no incentive to launch first. Both sides inflict the same damage and suffer the same destruction whether they strike first or second.

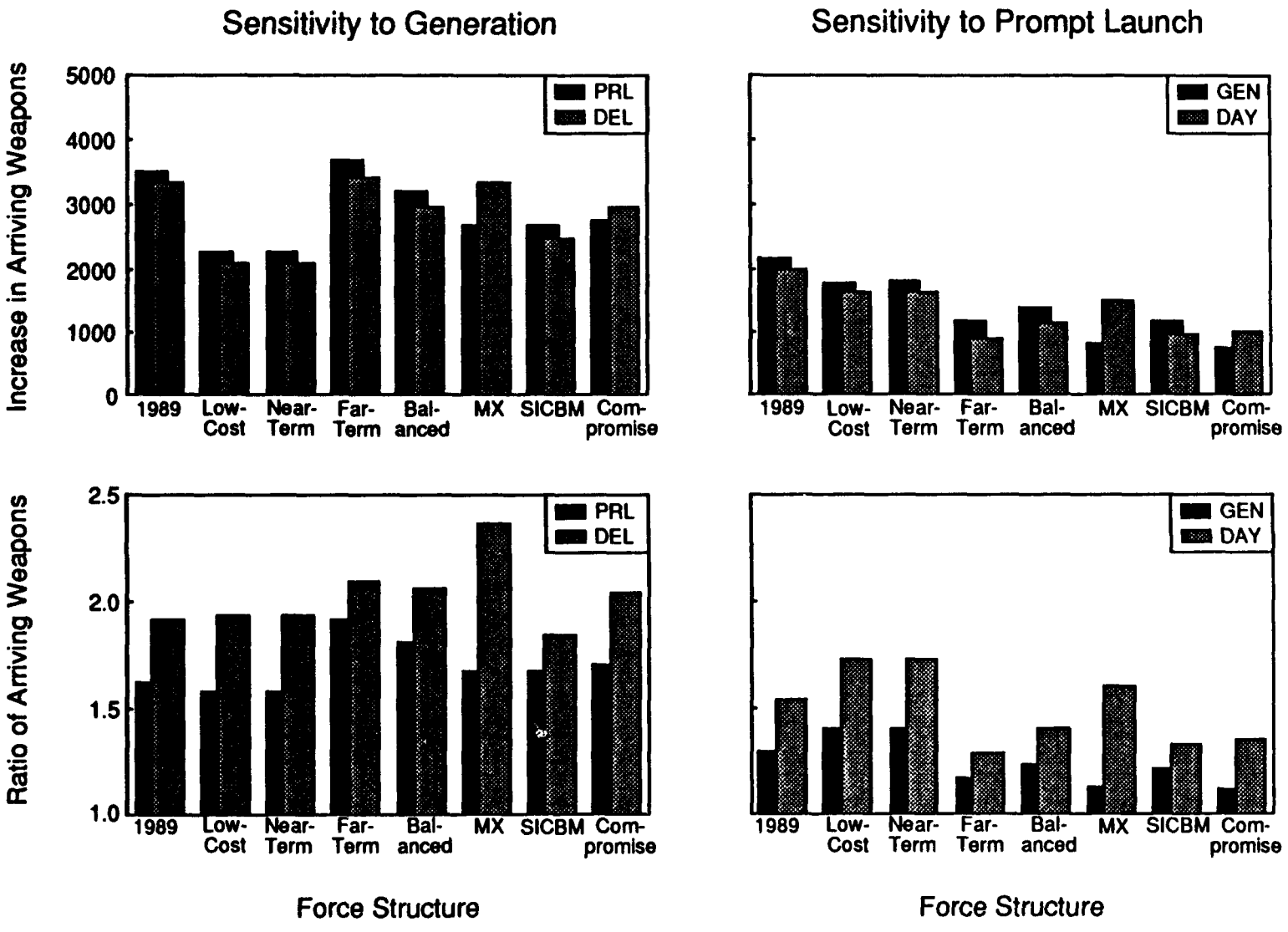

Fig. 12—Crisis stability

the attack before retaliating, the United States would be able to retaliate with over 3000 additional arriving weapons were it to generate its forces. This represents approximately 1.9 times the arriving weapons for the day-to-day alert case. For sensitivity to prompt launch, in the day-to-day alert case, if the United States promptly launches ICBMs, it would have approximately 2000 additional arriving weapons, representing 1.6 times the number if it did not.

No force structures are clearly superior by both measures. The force structures that most exploit the air-weapon counting rules tend to be the ones most sensitive to generation because of the low day-to-day alert rates for bombers. These could be alleviated (while also contributing to the measure of central deterrence) by increasing these rates. The force structures that include large numbers of silo-based ICBMs tend to be the ones most sensitive to prompt launch.

Force structures consistent with the Soviet START position have average sensitivities to generation and average to low sensitivities to prompt launch, with the notable exception of the Rail-Garrison Peacekeeper force structure in the delayed launch case. Rail-Garrison Peacekeeper is not survivable in its day-to-day posture, but it is highly survivable in its generated posture. If the United States planned not to promptly launch ICBMs, it would be highly sensitive to generation of these forces. This sensitivity disappears for the prompt launch case, which is possible in either alert state. Of course, this means the United States would be more dependent on prompt launch under day-to-day than under generated alert.

COERCIVE POTENTIAL

This measure of central deterrence is based on what is termed here the "worst plausible" scenario. However, in a crisis where the United States has generated forces, the Soviets must consider the possibilities that the United States might strike first or launch promptly if the Soviets strike first. In that case, the number of U.S. weapons arriving is based on the "best plausible" scenario—generated alert and prompt launch.

The number of weapons in Fig. 11 is taken here to be principally a measure of the coercive potential of nuclear weapons. It could also be taken as a measure of U.S. capability to achieve war-fighting aims by "covering" targets or inflicting damage.

Figure 13 presents force structures evaluated according to this measure, broken out by Triad leg. As for central deterrence, all START force structures are inferior to

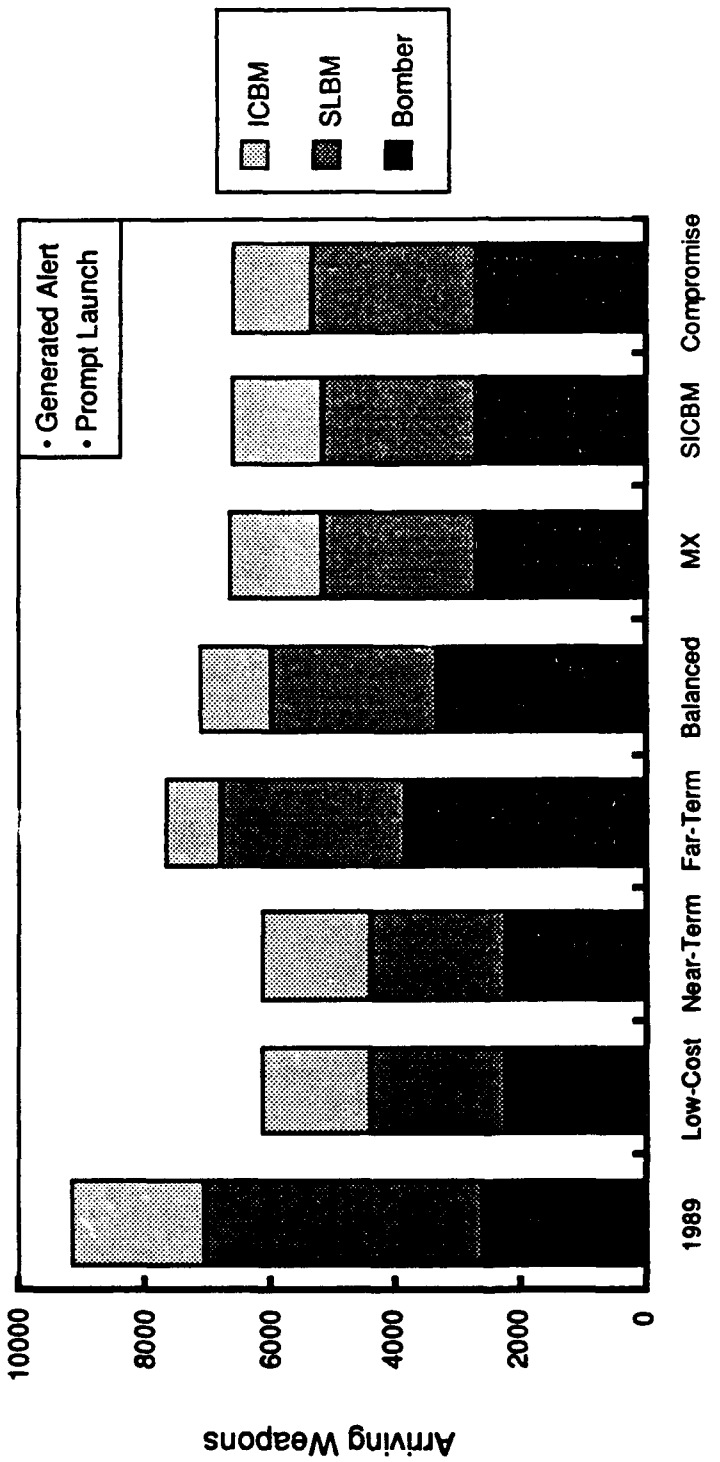

Fig. 13—Coercive potential

1989 forces, but far-term forces come close. None of the other structures seems considerably worse than the others. Thus, in addition to its inherent lesser importance than deterrence and crisis stability, this measure does not afford a basis by which to prefer one structure over another.

VI. OBSERVATIONS AND RECOMMENDATIONS

This analysis has only indirectly considered weapon system cost. Implicit consideration of cost affected force structure development principally by limiting the number of new U.S. penetrating bombers (B-2s) to approximately 100, even though under the counting rules for such bombers, it would be advantageous to deploy more.

This analysis has not analyzed the potential effect of START on Soviet forces. Thus, some recommendations are phrased with the verb "consider." These recommendations might or might not hold were a more comprehensive analysis undertaken. Note also that recommendations on START provisions are given without regard to the likelihood of success in negotiating them.

Finally, these measures of comparison are necessarily imperfect reflections of what they claim to measure individually and as a set are incomplete. In particular, measures related to ability to execute selective attacks, extended deterrence, or war termination are not included. These are critical components of national security strategy, yet no satisfactory measures of force structure have been found that relate to them.

START PROVISIONS

Observation: Although agreed START provisions *could* result in U.S. force structures with up to 4000 fewer deployed weapons than in 1989, they do *permit* the deployment of forces that may not be deficient in ability to support U.S. national security strategy in the areas of central deterrence, stability, and coercion.

Nevertheless, one can imagine revisions of, or modifications to, existing provisions that would better serve U.S. national security strategy, and these may be worth trying to (re)negotiate.

Recommendation: Consider renegotiating the delivery vehicle limit.

An increase of several hundred in the delivery vehicle limit would allow for more single-warhead ICBMs without having to increase the number of warheads per SLBM.

Recommendation: Consider negotiating a stipulation that a limited number of SSBNs in overhaul not count against either delivery vehicle or warhead limits.

This would help to alleviate potential competition between Navy and Air Force systems and ease the problem of satisfying the congressional desire for a minimum of 20 SSBNs.

Recommendation: Consider negotiating a limit on the number of allowed penetrating bombers.

The agreed counting rule for penetrating bombers, coupled with no explicit limit on their number (other than the limit of 6000 warheads), could result in a substantial increase in the number of warheads ultimately deployed under START. If the United States is not prepared to exploit this loophole, and does not want to see the Soviets do so, a limit of perhaps 300 to 400 or so on penetrating bombers would seem prudent.

Recommendation: Consider renegotiating the number of allowed SS-18s.

The 1540 allowed hard-target-kill-capable Soviet SS-18 reentry vehicles will enable them to attack U.S. silos with no more than one SS-18 reentry vehicle for many silos *if* the United States makes a concerted effort to preserve as many silos as possible. It would provide a great disincentive for the Soviets to launch a counterforce attack if they could not cover all silos with even one capable ICBM reentry vehicle. To gain this state, the number of SS-18 reentry vehicles will have to be reduced to below 1000, perhaps below 800. Of course, banning the SS-18 would be best of all.

Observation: For the United States, outstanding force structure issues should not present a critical impediment to an agreement.

On all outstanding issues examined, plausible compromise positions exist that would have minor effects on U.S. force structures. In fact, the United States could agree to all Soviet positions on outstanding issues without major effect on its ability to implement its national security strategy. The largest effect would come from accepting the Soviet ALCM counting rule, under which the United States would probably deploy on the order of 1000 fewer ALCMs than the 1900 currently planned. However, because the day-to-day alert rate for bombers is only about 30 percent, this would only result in 300 fewer alert ALCMs in that scenario and an even smaller discrepancy in arriving ALCMs.

As stated earlier, that the United States *could* agree to the Soviet START position on all outstanding force structure issues examined does not imply that it *should*. Some START provisions and force structures are more advantageous to U.S. national security strategy than others.

Recommendation: Do not try to eliminate mobile Soviet SS-24s by banning all MIRVed mobile ICBMs.

The United States is concerned about verifying the number of SS-24s the Soviets deploy under START. However, there are advantages under the currently agreed delivery vehicle limit to deploying mobile ICBMs with more than one warhead (such as a two-warhead SICBM). Since mobile ICBMs are survivable (in certain scenarios), it is better that they, rather than silo-based ICBMs, be MIRVed. Thus, if verification of rail-based missiles becomes an insurmountable problem, it would be better, and also more to the point, to ban rail-basing rather than MIRVed mobile ICBMs.

Recommendation: Try to negotiate procedures for distinguishing eight and 12 warhead versions of the Trident II missile.

This is desirable so that some SLBMs could carry 12 warheads (again, increasing the number of single-warhead ICBMs deployable) while not requiring all missiles to be counted as having this many. One approach could be to fill tubes on some, but not all, boats. Boats with some filled tubes could carry the 12-warhead Trident II, and those with the full 24 tubes could carry the eight-warhead missile.

Recommendation: Protect the flexibility to fill tubes on Trident boats and download Minuteman III missiles.

Filling tubes on Trident boats increases the number of boats deployable (although at a substantially greater cost per deployed missile). It could be ultimately necessary to fill as many as eight tubes per boat, leaving 16 deployed missiles per boat. Also, to deploy single-warhead silo-based missiles beyond the 450 Minuteman IIs, the least costly approach will be to remove warheads from current Minuteman III missiles. This will increase the price to destroy each ICBM reentry vehicle and decrease the sensitivity to force generation, thereby contributing to crisis stability.

Observation: To wisely structure forces under START, the United States needs to determine priorities, measures, and criteria for national security objectives and strategies toward which strategic forces contribute.

National security objectives and strategies are not clearly articulated or prioritized. Many important components of national security strategy have no generally accepted objective measures. Few, if any, measures have objective criteria for sufficiency (how much is enough?). Thus force structure decisions are driven in large part by considerations of cost, politics, and intuition.

Recommendation: Undertake to develop a comprehensive policy framework for evaluating the contribution of strategic forces to U.S. national security goals.

U.S. STRATEGIC FORCES

START will take some time to complete. Progress on outstanding force structure issues is excruciatingly slow. Nor are these the only, or by any means the most intractable, differences. Major stumbling blocks exist with regard to verification, SLCM limits, and linkage with the ABM Treaty and the Space and Defense Talks. Therefore, the United States must consider what strategic force programs to pursue in the interim.

Recommendation: Continue development and deployment of the B-2.

Completely independent from other reasons in favor of deploying the B-2 bomber, it provides a means of exploiting the counting rule that non-ALCM-carrying bombers count as only one weapon, regardless of actual load.

Recommendation: Maintain the B-1 as a penetrating bomber.

The B-1 contributes substantially more arriving weapons per counter weapon than it would as an ALCM carrier, even if its probability of penetrating Soviet air defenses is modest. Also, if the B-1 is converted to an ALCM carrier, the B-52H would need to be retired (or else ballistic missile warheads would need to be reduced well below the 4900 limit), resulting in no net increase in ALCM carriers but a substantial reduction in the number of penetrating bombers.

Recommendation: Postpone new Trident boat authorizations.

As construction begins on each additional Trident boat, the United States diminishes its flexibility to structure ICBM forces acceptable to the Air Force without modifying the Trident boats by filling tubes or modifying the Trident missile. Rather than building submarines with 24 tubes and planning to fill them in if necessary, the Navy should consider its options for a submarine with fewer launch tubes.

Recommendation: Continue the 12-warhead Trident II program; address distinguishability with the eight-warhead missile.

Higher numbers of warheads per SLBM will allow lower numbers of warheads per ICBM. This in turn will allow deployment of a greater number of single-warhead

ICBMs, the only plausible nonmobile deployment of ICBMs that costs the Soviets more (in reentry vehicles used) to attack than they destroy.[1]

Recommendation: Maintain the option to deploy a two-warhead mobile SICBM.

Unless the Air Force is prepared for a drastic reduction in the number of ICBM warheads, some ICBMs will have to be MIRVed. We are better off MIRVing mobile ICBMs, which are survivable, than silo-based ICBMs, which are not.[2]

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[1]This recommendation is crafted to alleviate problems caused by the limit of 1600 SNDVs. Were this limit to be raised, as recommended above, this step might become unnecessary.

[2]See note 1 above.

Appendix

U.S. WEAPON SYSTEM DATA

This appendix provides the data used in calculations underlying all figures and tables presented in this Note. Table A.1 provides average delivery system loadings and quantities of deployed delivery vehicle for each force structure developed in this study.[1] Data for 1989 are based on an interpolation between FY 1988 and FY 1989 data; it is assumed that all nuclear B-52Gs and no B-52Hs have been converted to a pure standoff role and no purely penetrating B-52Hs remain.

Table A.2 provides weapon system planning factors used for all weapon systems considered in this study. In general, they are one-significant-digit[2] estimates based on plausibility considerations.

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[1]Congressional Budget Office, *Modernizing U.S. Strategic Offensive Forces: Costs, Effects, and Alternatives*, November 1987.

[2]Exceptions include (1) probability of penetration, where the estimate for the generated alert, prompt launch scenario has been degraded by a factor of 0.9 for either day-to-day alert or delayed launch and the factor $(0.9)^2$ for the day-to-day alert, delayed launch scenario; and (2) availability, which is based on CBO data on number of deployed and available systems.

Table A.1

DELIVERY SYSTEM LOADINGS AND DEPLOYED QUANTITIES

Delivery System Name	Loadings			Deployed Delivery Vehicles								
					U.S. START Position				Soviet START Position			
				1989	Low-Cost	Near-Term	Far-Term	Balanced	MX-rail	SICBM	Compromise	
	Warheads											
MM-II	1			450	450	450				25		
MM-III	3			200	56							
MM-IIIa	3			300	300	290				225	113	
MM-IV	1							826	700		305	
MM-V	2											
MX-rail	10								100		50	
MX-silo	10			50	50	50		50		50		
SICBM-road	1									500	300	
SICBM-silo	1					200	990					
	Missiles	Warheads/ missile										
C3	16	10		16								
C4-P	16	8		12								
C4-T	24	8		8	8	8						
D5-H	24	8			7	7		18			18	
D5-L	24	12										
New 16/12	16	12					20					
New 20/8	20	8							20	20		
	Bombs	SRAMs	ALCMs									
B-52G so			12	98								
B-52H s/p	4	4.22	7	95								
B-52H so			20		95	95		95				
B-1B pen	8	8		97	97	97	97	97	97	97	97	
B-1B s/p	6	5.67	12									
B-1B so			22									
B-2 pen	8	8					103	100	103	103	103	
New-10 so			10						90	90	90	
New-30 so			30				90					

Table A.2

WEAPON SYSTEM PLANNING FACTORS

Delivery System Name	Pre-Launch Survivability							Weapon Name	Reliability			Probability of Penetrating			
	Avail-ability	On Alert		Prompt Launch		Delayed Launch			Launch	Flight	Warhead	Prompt Launch		Delayed Launch	
		Generated	Day-to-Day	Generated	Day-to-Day	Generated	Day-to-Day					Generated	Day-to-Day	Generated	Day-to-Day
MM-II	1.00	1.00	1.00	1.00	1.00	0.10	0.10	MM-II	0.95	1.00	0.95	1.00	1.00	1.00	1.00
MM-III	1.00	1.00	1.00	1.00	1.00	0.10	0.10	MM-III	0.95	0.95	0.95	1.00	1.00	1.00	1.00
MM-IIIa	1.00	1.00	1.00	1.00	1.00	0.10	0.10	MM-IIIa	0.95	0.95	0.95	1.00	1.00	1.00	1.00
MM-IV	1.00	1.00	1.00	1.00	1.00	0.10	0.10	MM-IV	0.95	1.00	0.95	1.00	1.00	1.00	1.00
MM-V	1.00	1.00	1.00	1.00	1.00	0.10	0.10	MM-V	0.95	0.95	0.95	1.00	1.00	1.00	1.00
MX-rail	1.00	1.00	1.00	1.00	1.00	1.00	0.00	MX-rail	0.95	0.95	0.95	1.00	1.00	1.00	1.00
MX-silo	1.00	1.00	1.00	1.00	1.00	0.10	0.10	MX-silo	0.95	0.95	0.95	1.00	1.00	1.00	1.00
SICBM-road	1.00	1.00	1.00	1.00	1.00	1.00	1.00	SICBM-road	0.95	1.00	0.95	1.00	1.00	1.00	1.00
SICBM-silo	1.00	1.00	1.00	1.00	1.00	0.10	0.10	SICBM-silo	0.95	1.00	0.95	1.00	1.00	1.00	1.00
C3	~0.9	1.00	0.60	1.00	1.00	1.00	1.00	C3	0.90	0.95	0.95	1.00	1.00	1.00	1.00
C4-P	~0.9	1.00	0.60	1.00	1.00	1.00	1.00	C4-P	0.90	0.95	0.95	1.00	1.00	1.00	1.00
C4-T	~0.9	1.00	0.70	1.00	1.00	1.00	1.00	C4-T	0.90	0.95	0.95	1.00	1.00	1.00	1.00
D5-H	~0.9	1.00	0.70	1.00	1.00	1.00	1.00	D5-H	0.90	0.95	0.95	1.00	1.00	1.00	1.00
D5-L	~0.9	1.00	0.70	1.00	1.00	1.00	1.00	D5-L	0.90	0.95	0.95	1.00	1.00	1.00	1.00
New 16/12	~0.9	1.00	0.70	1.00	1.00	1.00	1.00	New 16/12	0.90	0.95	0.95	1.00	1.00	1.00	1.00
New 20/8	~0.9	1.00	0.70	1.00	1.00	1.00	1.00	New 20/8	0.90	0.95	0.95	1.00	1.00	1.00	1.00
B-52G so	0.92	1.00	0.30	1.00	1.00	1.00	1.00	B-52G alcm	0.90	0.90	0.95	0.90	0.81	0.81	0.73
B-52H s/p	0.95	1.00	0.30	1.00	1.00	1.00	1.00	B-52H grav	0.90	1.00	0.95	0.70	0.63	0.63	0.57
B-52H so	0.95	1.00	0.30	1.00	1.00	1.00	1.00	B-52H sram	0.90	0.95	0.95	0.70	0.63	0.63	0.57
								B-52H alcm	0.90	0.90	0.95	0.90	0.81	0.81	0.73
B-1B pen	0.93	1.00	0.30	1.00	1.00	1.00	1.00	B-1B grav	0.90	1.00	0.95	0.80	0.72	0.72	0.65
B-1B s/p	0.93	1.00	0.30	1.00	1.00	1.00	1.00	B-1B sram	0.90	0.95	0.95	0.80	0.72	0.72	0.65
B-1B so	0.93	1.00	0.30	1.00	1.00	1.00	1.00	B-1B alcm	0.90	0.90	0.95	0.90	0.81	0.81	0.73
B-2 pen	0.91	1.00	0.30	1.00	1.00	1.00	1.00	B-2 grav	0.90	1.00	0.95	0.90	0.81	0.81	0.73
								B-2 sram	0.90	0.95	0.95	0.90	0.81	0.81	0.73
New-10 so	0.93	1.00	0.30	1.00	1.00	1.00	1.00	New-10 alcm	0.90	0.90	0.95	0.90	0.81	0.81	0.73
New-30 so	0.93	1.00	0.30	1.00	1.00	1.00	1.00	New-30 alcm	0.90	0.90	0.95	0.90	0.81	0.81	0.73