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Impact of a Reduced Nuclear Weapons Stockpile on Strategic Stability

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Introduction

I was asked to talk about the impact of a reduced nuclear weapons stockpile on strategic stability and would like to start my presentation with a brief discussion of a methodology that has been used to study strategic stability issues. There has been sort of a cottage industry in the analyses of these issues using what are basically strategic-force exchange models. These models are used to simulate (in a very crude sense) a massive nuclear exchange in which one side attacks and the other side retaliates. There has been a resurgence of interest in these models with the onset of the Strategic Defense Initiative (SDI) program. Researchers have been looking at issues concerning the stability of the transition period, during which some defenses have been deployed and during which deterrence and war-fighting capability rely partly on defense and partly on offense. Also, more recently, with interest in the Strategic Arms Reduction Treaty (START) and force reductions beyond START, the same calculation engines have been used to examine the impact of reduced forces on strategic stability. For both the SDI and the START reduction cases, I must caution that exchange models are able to address only a rather narrow class of strategic stability issues. There are many broader stability questions that are unrelated to nuclear weapons or that relate to nuclear weapons but are not addressed by the calculational tools I will discuss here.

Strategic Stability Analyses: Two Views

Strategic stability has been examined from two viewpoints that are not totally independent: first-strike stability and sufficiency of retaliatory forces. Studies of first-strike stability focus on the difference between outcomes of an exchange, depending on which side strikes first. If there is a large difference between the two cases, there is an incentive for one side or the other to strike first in a crisis situation: the greater the difference, the greater the instability. The most prominent example of this approach is the work of Glenn Kent.[1] Many others also have worked in this area, including Dean Wilkening[2] and some of us at Lawrence Livermore National Laboratory.[3] The detailed results from working through these types of calculations are not as important as the principle (and, as it turns out, the self-evident) lesson learned, which is the importance of the survivable basing of strategic forces in order to achieve first-strike stability.

The issue of the sufficiency of the nuclear forces that remain after an opponent's first-strike (i.e., second-strike retaliatory capability) form the basis of the second strategic stability analysis viewpoint. The most notable example in the open literature of this type of analysis is the work of Michael May, George Bing, and John Steinbruner.[4] The lesson learned by most people who have conducted these kinds of analyses is that the retaliatory capability of our strategic forces under the proposed START reductions seems to be sufficient. However, it must be noted that,

in examining second-strike sufficiency (or first-strike stability), we must make numerous assumptions with regard to: the alert rate of forces, whether intercontinental ballistic missiles (ICBMs) will be launched promptly after an attack, and what target coverage requirements must be met for deterrence. My own view is that the utility of these studies is not in the conclusions obtained—whether a certain proposed force structure is sufficient or not—but is in the illumination of issues about targets that must be held at risk for deterrence (both their number and required damage) and of plausible scenarios (in terms of alert rates and the survivability of forces to be used in retaliation).

Relevance of Strategic Force Exchange Models to Post-Cold War Analyses

A timely question is: Where does one go from here in these kinds of strategic stability analyses as the world enters the post-Cold War situation? This is a rather difficult question, and I really do not have a good answer for it. I have been trying to think of other analytic approaches to illuminate issues and have come up short. As a consequence, the framework I will be using for this discussion is, unfortunately, approximately the same as the framework used for Cold War analyses, which is a massive nuclear first-strike followed by retaliation.

This framework is broad enough to incorporate some of the dissuasion strategies that have been discussed at this Workshop. The type of stability studies done during the Cold War are applicable if there is a future resurgence of tension and have relevance in the analysis of a dissuasion strategy in which one is trying to reduce the possibility of the resurgence of tensions. My point of reference is a future where the Soviet Union continues to invest in strategic forces. I think this is rather probable, simply because the possession of a very capable nuclear force may be the Soviets' only leverage to being considered a great superpower in view of their troubled economy. To the extent that they can afford to invest in military forces over the next decade, I suspect that their investment will be in strategic forces.

An open question is whether there are other useful approaches and tools to address strategic stability issues in the post-Cold War era. However, it is unclear whether any alternative approach would lead to considering issues other than those that have been the focus of these strategic exchange analyses. These issues center around three basic questions:

- *What is the survivability of strategic forces, and what are the controlling command, control, and communication (C^3) elements?*
- *What are the size, composition, and coverage requirements for the target bases that must be held at risk for deterrence?*
- *What is the future role of and possibility for defenses?*

To the extent that force exchange modeling provides insights into these kinds of questions, perhaps it is relevant to post-Cold War strategic strategic stability issues.

Strategic Stability Issues

I have avoided any attempt to define the term *strategic stability* , but I have discussed aspects of strategic stability that can be quantified through the use of exchange models. I still will not offer a precise definition but would like to muse about some contradictions in and tensions with strategic stability.

One issue that has been a subject of discussion in this Workshop is the tension between first-strike stability and the goal of limiting damage. I will not say too much more about this subject. Obviously, to limit damage somewhat, one would like to have the capability to severely damage an opponent's residual nuclear capability after his first-strike. However, too much of that sort of capability can lead to first-strike instabilities.

A second area of tension relates to measure versus countermeasure competition. I would argue that some competition is good because, in the

absence of competition, the United States may be unable to sustain healthy modernization programs. Short of actual deployment, activities could consist of research and development to support future decisions to modernize forces, in the spirit of the "long shadows" model that Richard Wagner discussed at this Workshop. In any case, we need some competition (or spirit of competition) to pursue the research and development necessary to avoid technical surprise and maximize the effectiveness of the forces in being. At the other extreme, a rapid evolution of measures versus countermeasures can be costly and can lead to what might be considered a dangerous arms race.

A third point of tension is the issue of force reduction versus the surety that the remaining strategic forces are sufficient for deterrence. This point was most vividly shown in some of the studies I conducted looking at START reductions.[5] The basic conclusion, similar to that reached by May, Bing, and Steinbruner,[4] was that U.S. retaliatory capability seemed to be quite sufficient with the reductions under START. However, what is lost is some of the redundancy in the U.S. strategic Triad that provides insurance against unexpected threats or surprises in the performance of strategic forces. With reductions, there is less ability to "hedge" all sorts of uncertainties. Not that it is very probable, but if there are START reductions and the strategic submarine force were to become ineffective—either because of a breakthrough in Soviet anti-submarine warfare (ASW) capability or some fleet-wide technical problem—we would be much closer to the edge of what some people deem to be an insufficient strategic force level. This kind of tension will become even greater if reductions beyond START are negotiated.

As for the prospects for the next ten years, I echo the remarks that Albert Carnesale made at this Workshop to the effect that, regardless of what transpires in the way of START or START-II reductions, U.S. strategic forces will consist of the types of unit equipment that we have either deployed or are about ready to deploy. Only a few decisions remain that will affect the range of options for the year 2000. I suspect that the U.S. will proceed with the D-5 backfit program, modernize silo-based ICBMs [likely to include a reduction in number of reentry vehicles (RVs) per Minuteman missile], and procure some B-2s, although it is an open question as to how many. I believe it is much less likely that mobile ICBMs will be deployed by the year 2000 or that any substantial ballistic missile defense system will be fielded by then.

It is important that over the next several years we make the research and development investments that will allow us to reconfigure our twenty-first century forces in a way that is more optimal, taking into consideration that the size of strategic forces may be legislated by treaty. In defining what strategic-weapon-system unit equipment is needed, we must consider the possibility of force reductions significantly below START, either by the end of the decade or early in the next decade. An example of an area of concern is the next-generation strategic submarine: we can expect heightened concerns about "too many eggs and too few baskets" with Trident submarines if we reduce the total strategic weapons to only several thousand.

Target Levels, Second-Strike Force Sufficiency, and Classic First-Strike Instabilities

In this section, I will discuss target bases, then address issues about second-strike force sufficiency, and conclude with concerns that pertain to classic first-strike instabilities.

May, Bing, and Steinbruner,[4] using open literature sources, assembled a list of Soviet installations that might be targeted. Holding at risk these installations would be consistent with stated National strategy. Table 1 shows, in round numbers estimated from reading their graphs, the number of targets May, Bing, and Steinbruner used in their study. The total is something in excess

Table 1. Approximate number of targets identified by May, Bing, and Steinbruner (Ref. 4).

ICBM silos and LCFs[a]	1500
Other strategic targets	400
Other military targets	1600
Government and C^{3}I[b]	1100
Military manufacturing	1000
Energy	500

[a] LCF is launch control facilities.

[b] C^{3}I is command, control, communications, and intelligence.

of 6000 installations. Any conclusion pertaining to sufficiency of forces to deter and retaliate if deterrence fails depends on judgements about the number of these installations that must be damaged and the required level of damage. Later, I will return to the this issue and attempt to take into account the fact that some of these facilities are more critical than others.

The studies we conducted, while examining START reductions, focused on the case of second-strike retaliation under what might be described as a worst-case scenario (U.S. forces are not generated, and ICBMs are unable to execute a prompt response). Even under these conditions, it appears that the response could consist of about 2500 reliable, penetrating weapons (e.g., weapons on target). This number discounts weapons that are not reliable or do not reach the target area because of air and ballistic missile defenses. Any forces intended to be held in strategic reserve must be discounted from this total.

This estimate of about 2500 reliable, penetrating weapons in retaliation was based on a build of 132 B-2 bombers, but it is becoming increasingly clear that we are not going have a B-2 force of that size by the end of the decade, so this estimate may be too large. On the other hand, for less pessimistic planning scenarios, with generated forces and/or prompt launch of ICBMs, U.S. retaliation capability can be considerably larger.

How might these numbers be reconciled for START and START-II? First, let me introduce the notion of *target value* in recognition of the fact that some of the targets that comprise Table 1 are more important than others. What I am about to present has pedagogical value, but it does not represent the way in which those responsible for war plans actually go about their business. Suppose a (relative) point value were assigned to each target, these targets were then ranked in order of decreasing value, and a plot were constructed of cumulative value versus target number. The result might look like Fig. 1, which has the feature of diminishing return (decreasing slope) as the curve climbs. What I have plotted is a parabola, using the total number of targets shown in Table 1. In a some of our studies, we have found that a parabola is a fairly good fit to target bases in cases where we have been able to assign target values. It is also roughly the shape of the curves that Glenn Kent used in a number of his studies.[1]

A parabola does not have a well-defined inflection point (a "knee of the curve"), so I simply note that 50% of the value resides in the most valuable 1500 of the 6000 installations. And, it was previously noted that (in what might be characterized as a worst-case scenario) the U.S. would have at least 2500 reliable, penetrating weapons in retaliation to a Soviet attack. One can appreciate the consistency of these data and the judgement that the U.S. would have sufficient forces under a START agreement.

If there are reductions beyond START—to a START-II that constrains forces to 3000 to 5000 weapons—reconciliation of force levels and necessary damage to targets is more problematic.

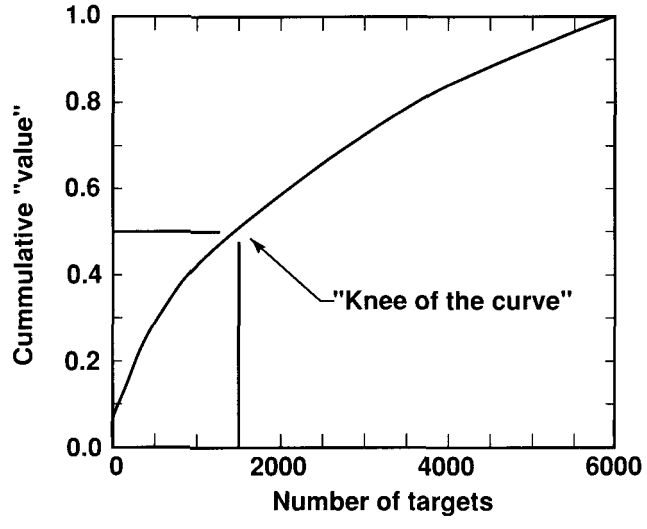

Figure 1. Notional representation of target value.

First of all, although there are practical limits for both bombers and sea-launched ballistic missiles, it is possible that forces could operate at somewhat higher alert rates, particularly if there were strategic warning. Also, ICBM first-strike survivability could be improved in the future, so the reduction in the number of reliable, penetrating weapons in retaliation in an unfavorable scenario may be less than the factor of 2 reduction in overall force size.

In addition, one can expect changes in the Soviet target set by the year 2000. The roughly 1600 other military targets in Table 1 will decrease in number as the Soviets make significant reductions in their conventional forces—how much is uncertain. Table 1 also includes about 1500 ICBM silos and launch-control facilities. Under START, many estimates show that the Soviet Union will have only 200 to 250 ICBM silos. Even with double coverage of Soviet silos that have weapons, counterforce targeting is going to be a much smaller drain on our inventory of second-strike weapons. Even so, there may be a need to accept lower damage requirements against some types of targets and/or to reduce the number of targets that have to be covered. In making these changes, the U.S. would shift to a more minimal deterrence posture, although it does not approach the minimal deterrence that Herbert York discussed at this Workshop.

Force Management Improvements

Improvements in force management can help compensate for reductions in forces. One possibility is the use of intelligence, sensors, and other sources of information to try to better understand the value of the targets at the time of the conflict. There are types of targets that may have very little or considerable value depending on the presence or lack of forces at that particular target or installation. Examples include airfields, weapon storage areas, and the peacetime locations of troops. With near-real-time information and the ability to retarget, there is room for considerable improvement in our capability to use our weapons effectively.

A second possibility for improved force management is to use a mechanism to monitor and report missile system reliability in the boost-phase (during which many of the reliability failures occur). If the monitored reliability failures could be backed up with additional weapons held in reserve, rather than by relying on double-coverage to achieve damage expectancy goals, the number of weapons required to achieve targeting objectives could be reduced. As a simple example, consider the goal of achieving 50% damage against the target set depicted in Fig. 1. If the weapons were 100% reliable, only 1500 weapons would be needed. If the weapons were 80% reliable and with optimal targeting, something in excess of 2200 weapons would be needed to achieve 50% damage. If coverage of launch failure were possible, that number could be reduced by about 300 weapons. Now, 300 weapons may not sound like a lot, but consider the investment required for a survivable ICBM system such as the Small ICBM or the difficulty that Leon Sloss had (in his presentation at this Workshop) in finding the weapons to constitute a sufficiently sized secure reserve force when the stockpile is only 3000 to 5000 weapons.

These two (of many possible) ideas for making force management improvements to help compensate for force reductions may have associated technical difficulties and, in any event, would require new investments to enable the near-real-time flexibility in execution of forces. This sort of flexibility would be a key ingredient in *neoexistential deterrence*, which is a tongue-in-cheek descriptor that I will use as a possible future basis of deterrence, which may not be realizable for decades. The term *neoexistential* is used since *existential* deterrence has another interpretation. The idea is that the nuclear forces provide deterrence by virtue of their existence and by the complete flexibility to use these forces against those targets that are deemed important in the particular crisis that arises. The weapons and their flexible use provide the basis of *neoexistential deterrence*, without specific reference to any predefined set of targets, crisis scenario, or potential adversary. In effect, this is taking some of the ideas Leon Sloss suggested in his presentation to the extreme. The size of the stockpile would be fixed by political agreement with the Soviets and would be justified by a bounding scenario of weapon usage or by the sizes of nuclear weapon stockpiles of other countries.

Practical limits to *neoexistential deterrence* merit some qualifications and comments. One qualification is that even with limitless flexibility in managing the forces and the best affordable set of sensors, it is unlikely that much damage limitation would be possible if the Soviets invest in survivable basing for their nuclear forces. We will not know the location of every strategic submarine and land-based mobile missile. A more appropriate mission and targeting strategy is one along the lines that Leon Sloss suggested: use against power projection forces. This strategy of emphasizing force management is quite consistent with the anticipated requirements of the United States' non-nuclear forces over the next decade. It is a direction in which we are generally heading: better intelligence, more flexibility, and improved ability to manage our forces. If you push in this direction too far, though, the survivability of these force management, intelligence gathering, and data fusion assets must be assured if they become critical components of the retaliatory force. If the capability of the retaliatory force is greatly enhanced by a few critical targets, a first-strike instability of a new sort could arise. There will be a tension between improving intelligence and the capability to manage forces to leverage the weapons that remain in the stockpile and avoiding reliance on these assets to the extent that it invites a first-strike.

The Strategic Triad

I wish to make some remarks about stability issues for each of the legs of the strategic Triad and for strategic defense, starting with ICBMs. My viewpoint over the years has been that ensuring the survivability of strategic forces (particularly ICBMs) is the responsibility of the owner of the weapons. That is to say, it seems irrational to me to argue that the accuracy improvement of U.S. ballistic missiles should not be pursued because this would put at risk Soviet silos and would foster a first-strike strategic instability. I view ensuring Soviet ICBM survivability as their responsibility and, similarly, it is our responsibility to pursue survivable basing options for U.S. ICBM systems. Furthermore, it is the responsibility of the U.S. research and development community to seek means for negating Soviet mobile missile systems and strategic submarines. From a strategic stability point of view, we might be better off if no "magic" solution for locating mobile missiles is found. Nevertheless, the research should be done together with development and deployment of affordable detection equipment. It is the responsibility of the Soviets to devise concealment and countermeasure schemes to try to defeat whatever capabilities the U.S. fields.

A frequently-voiced argument is that ICBMs in silos with one or two RVs (and possibly three RVs) provide a reasonable amount of first-strike stability. They would not be very lucrative targets. One- or two-RV ICBMs in silos could be targeted as part of a first-strike, but it is dubious whether any great strategic advantage is gained by using one or two RVs to destroy these ICBMs. A possible far-in-the-future strategic force posture would be 1000 RVs on each side in 1000 ICBMs in silos. The problem with this sort of force posture is that it is not resilient to treaty breakout, to the possibility of reloads for silos, and/or to treaty noncompliance. Hence, deMIRVing (off-loading RVs from) Minuteman missiles contributes to strategic stability but does not merit being a long-term solution to survivable basing of ICBMs. Research should continue to develop a better ICBM basing option for a future with significantly reduced strategic forces.

Comparatively, the most serious first-strike stability issue over the next decade pertains to the Soviet SS-18s and SS-24s, many of which will probably remain in silos. (I use the word comparatively because there are not any serious first-strike instability issues.) If the Soviets end the decade with a number on the order of 200 to 250 MIRVed ICBMs in silos, then 2000 to 2500 RVs, which is a substantial portion of their force, will reside in a very small number of targets. The Soviets might choose to use those weapons preemptively in a crisis because of their vulnerability. This instability is not as great as it might seem at first because even the loss of the Soviet silo-based ICBM force would not result in much damage limitation to the United States. There is little reason for the Soviets to fear a U.S. attack on these silos. In any case, crisis stability would be enhanced if the Soviets were encouraged to reduce their reliance on highly-MIRVed silo-based ICBMs.

As for the sea-based leg of the Triad, there is a general recognition of the need for a vigorous strategic submarine security program. I suspect the U.S. Navy will work this issue diligently, if for no other reason than the fact that it has legitimate interests on both sides of ASW effectiveness. Obviously, the Navy wants to ensure strategic submarine security and, on the other hand, it wants to vigorously pursue ASW against Soviet submarines that threaten U.S. surface action groups. My one concern is whether we will make the proper investment over the next decade to build a submarine fleet early in the twenty-first century that is more suited to a strategic force level of 3000 to 5000 weapons.

It has been argued that strategic air-carried systems are intrinsically much more stable systems than ballistic missiles, largely because of their much longer time of flight to the target area. I would like to raise a couple of concerns about this viewpoint. The source of my concern is bomber survivability. First of all, some first-strike stability issues arise because of the possibility of the depressed trajectory of a sea-launched ballistic missile threat to the bomber force. This threat could become more real if too much reliance is placed on air-carried systems for retaliation against a first-strike. Second, there could also be a significant asymmetry in alert rates in a surprise attack situation. Although such circumstances may be very unlikely, a scenario in which one side rapidly disperses its bombers and then immediately executes a first-strike, which damages all ungenerated bombers on the other side, is of concern.

The U.S. faces a dilemma about the future of its strategic bomber force. In the negotiated START treaty language, we made penetrating bombers a very attractive option because of the counting rule for bombs and short-range attack missiles. A rationale for discounting the number of weapons on penetrating bombers is the presence of Soviet air defenses. There are reasons for anticipating that the Soviets will continue to invest in air defenses in spite of their economic woes: they have potentially unfriendly neighbors both to the south and in other directions. To take advantage of the START bomber counting rule, we have to either maintain B-52s and B-1Bs as penetrating bombers for years to come, or we have to procure B-2 bombers during a time of decreasing defense budgets. If we do not make the investment in effective penetrating bombers, the U.S. will not have as many weapons under START as were contemplated in the late 1980s.

Finally, there is the issue of the future of ballistic missile defenses. I will not discuss any technical feasibility issues and will confine my remarks to strategic stability and defenses. First consider the case in which ballistic missile defenses are limited. By *limited*, I do not (necessarily) mean *treaty-limited*; I can imagine circumstances in which modifications are made to the Anti-Ballistic Missile Treaty and defenses are still constrained. One dilemma is: how limited should *limited* be? One of the purposes of the defense might be accidental launch protection, so there will be a trade-off between the size of the defense and the level of protection. The force must be limited to a size that will avoid evoking countermeasures by the other side. Perhaps the limited defense will be designed to handle countermeasures but that raises the cost and technical difficulty. Also, we have to consider the impact of Soviet ballistic missile defenses (consistent with the negotiated level) on the British and French forces. My point is that there is a tension between the level of defense needed to provide confidence in accidental launch protection and that which evokes countermeasures by the other side, complicates limited-strike options for the U.S. and for our allies, and/or raises concerns that defenses might undercut the retaliatory capability of strategic forces by limiting damage.

One other concern with regard to limited ballistic missile defense deployments is the possibility that these systems are likely to have or be perceived to have inherent antisatellite capability. They could be used against the sensors deployed to better manage forces. In this case, some potential first-strike stability issues could arise.

If the defense deployments are substantial, many of the researchers who have examined deployment scenarios recognize that there are first-strike stability issues, but they probably can be managed. However, significant questions do remain unanswered:

- How, in very general terms, do we intend to manage the competition?
- In the long term, can the offense versus defense competition be won by the defense?
- What will be the end-point?
- Will the end-point defenses succeed in limiting damage?

- For any other end-point (and while defenses are being deployed), what is the theory of deterrence during the transition period?
- What is the basis of deterrence when the objective is to preserve some targets in the U.S. and damage some in the Soviet Union (and vise versa, if the Soviets deploy a defense)?

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