U.S. STRATEGIC FORCE STRUCTURE
AND
EMPLOYMENT PLANNING: 1959-1979

by

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Submitted to the Department of Political Science on 11 May 1979 in partial fulfillment of the requirements for the degree of Master of Science

ABSTRACT

Since about 1963-64, U.S. strategic nuclear planning has broken down steadily. The thesis describes an important determinant of this deterioration, namely the divorce between force structure and employment planning. The history and dynamics underlying this disconnect are discussed, and the implications of the trend are considered.

Thesis Supervisor: William W. Kaufmann
Title: Professor of Political Science
<table>
<thead>
<tr>
<th>CHAPTER</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>CHAPTER I: INTRODUCTION</td>
<td>4</td>
</tr>
<tr>
<td>CHAPTER II: STRATEGIC FORCE SIZING</td>
<td>10</td>
</tr>
<tr>
<td>CHAPTER III: STRATEGIC EMPLOYMENT PLANNING</td>
<td>57</td>
</tr>
<tr>
<td>CHAPTER IV: CONCLUDING REMARKS</td>
<td>101</td>
</tr>
<tr>
<td>GLOSSARY AND NOTES</td>
<td>115</td>
</tr>
<tr>
<td>BIBLIOGRAPHY</td>
<td>129</td>
</tr>
</tbody>
</table>
CHAPTER I: INTRODUCTION

This thesis will examine the accelerating deterioration of U.S. strategic nuclear force planning from about 1962 to the present. I will focus on one crucial trend over this time—the divorce of employment and force structure planning to the point that:

- The two planning activities do not interact in a productive fashion by which the establishment of effective future forces, plans, doctrine, etc. is promoted,
- Force and employment capabilities are so divergent that extremely inappropriate situations may arise,
- Future changes in the nuclear forces will most likely be based on some pretty poor precedents, aggravating things even more.

By "divorce" of the two types of planning, I mean to suggest that neither of the two is providing effective input into the larger U.S. strategic planning arena.

According to a widely read monograph [28:3], U.S. strategic planning actually is a blend of employment, force structure, declaratory, and deployment planning. Of the four, the former two are by far the most important, since these alone contribute to the shaping (as opposed to the mere identification) of desirable strategic conditions. Put another way, we try to construct our strategic tomorrow with these twin tools. As a corollary, (and mainly because our major adversary also tries to shape and manipulate developments), we attempt to employ the same devices to rationalize and to render appropriate our "contemporary" posture as that will appear in the "strategic context" which is determined by both friendly and antagonistic agency, and by a host of unpredictables.
Briefly defined, force structure (or sizing) planning describes decision-making on force size, constitution and capabilities. A decision to withhold developmental funds for, say, improved POSEIDON accuracy in this sense is identical to a decision to buy Bomber A or Missile B. Employment (or contingency) planning is bound to use the forces available to plan nuclear operations to achieve goals as stipulated by national political authorities. The vehicle for strategic employment policy is the SIOP, a set of emergency war plan packages.

Some might argue that each matter is one of the two sides of the same coin. After all, someone who plans to buy a car will weigh equally and simultaneously the dual problems of 'employment' and 'force structure' in his or her decision. If a major mission of the planned vehicle is the economical transportation of large payloads (supplies, family, tools for the job, etc.), then a pool of candidate cars, vans and station wagons (as opposed to sport cars) presumably will be under consideration. Likewise, if the proposed acquisition is a second car mainly for leisure activities, a different "force structure" decision will be likely. From another point of view, a person who is inclined towards a given car probably has a good idea a priori of its likely employment. In this hypothetical case, the close linkage of the two factors is a prudent--and obvious--course of action.

Intuitively, the close coordination of force and employment plans is desirable, if not essential, in strategic planning. Suppose that U.S. political and military leaders place a very high priority on the successful attack of Soviet hard military targets. We would want an inventory of accurate, prompt weapons for this job. But say that the Soviets' symmetrical development of such plans (and the acquisition of the RVs needed to implement those plans) threatened our silo-based ICBMs to the extent that we could not be confident of their
availability. We could turn to accurate SLBMs or to alternative basing mode ICBMs. As everyone knows, we're currently in the middle of this exact problem. Regrettably we now find ourselves with a substantial gulf between the onset of the problem and the activation of a cure because we have deferred too long some key planning decisions. This is an important, but by no means unique, example of the divorce of force structure and employment planning.

Planning is not only intended to keep us out of jams. We can use planning to enforce disadvantageous cost-exchange ratios on the U.S.S.R., to compel the Soviets to follow our lead (if not to imitate us), and to preempt the development of unfavorable situations. We can plan so as to minimize future surprises and thereby avoid the kinds of expensive crash programs that are attendant upon precarious strategic relationships tending towards instability. U.S. and Soviet planning is not a zero-sum game, either. Both sides can use planning as a moderating force, a source of partial certainty, and as a counterweight to risky schemes promoted by parochial interests; in this sense, good planning is the best arms control. Not only is taking the long view the responsibility of civilian and service authorities alike--it is without doubt a useful tool for the painless preservation of the national security.

Now, there is no particular catastrophe which must befall us if our planning "fails," and in fact many anomalous circumstances may lead to good solutions which might not have otherwise been generated by even the best plans. If, say, a nation wishes to enhance its domestic well-being, or to shore up some non-nuclear security capability, a disruption in strategic nuclear planning is in order. Because the contingencies and forces we have prepared will only become operationally relevant in extremis we might even find ourselves able to take
an occasional "chance" by suspending the development or maintenance of some strategic capability or other.

However, things may have gone too far in this direction. As will be argued in Chapter II of this thesis, U.S. forces today essentially are those designed by SecDef McNamara in 1961-63. McNamara was required at the time to use a general index for force sizing (assured destruction) mainly to resist USAF initiatives to acquire extra forces under the flag of "counterforce." Since the Johnson Administration's ICBM "clean up" of 1964, SNDV levels have been driven by attrition in the bomber force. Since about 1966-68, even the artificial rule of assured destruction has been discarded and force levels have evolved by virtue of momentum alone. As I will also argue, one major post-1963 SOF "procurement" program--MIRV--did little to change U.S. strategic capabilities. Like other bomber and missile upgrades undertaken between 1964 and 1979, MIRV merely was a change of U.S. forces at the margin. A second highly publicized activity--improved ICBM accuracy--has, to the extent we have made commitments actually to buy advanced capabilities, been neutralized by Soviet accuracy improvements. It equally is a change at the margin.

In Chapter III, I will look at the evolution of employment planning. Although it is impossible to say for sure, targeting seems to have changed little over the last 20 years. Of the two key Soviet target arrays: Counterforce (hard target) and the Urban/Industrial (U/I) base, the former has been a driver, if not a crutch, for war planners. It is possible that target planners would "shoehorn" U.S. forces of any type into these types of attacks, no matter how matters of efficiency may impinge. Commitment "in full" to either or both targets constrains U.S. capabilities in other regards. Worse, the effectiveness of U.S. forces in the hard target mission has rapidly declined with increasing
MINUTEMAN vulnerability. As a result, it is very unlikely that we will be able to satisfy the "Damage Expectency" goals stipulated by guidance without engaging in wildly inefficient attacks.

In Chapter IV, I will discuss the specific actions we have taken to arrive at the current situation. I will nominate some "cures." Finally, I will pose a few important allied questions, the discussion of which would be a desirable complement to future planning.

Because talk is a lot cheaper than strategic nuclear hardware, we have invested Lynn Davis' third type of planning with inordinate importance. The turmoil surrounding our strategic debates may not address with fidelity the key issues. For example, if U.S. strategic employment planning has not changed too much over time, then what accounts for the seeming enormity of our doctrinal swings over the last two decades? And if planning has changed, then why haven't force developments kept pace?

U.S. strategic planning is not entirely shot through. A lot of good decisions which have made have been overturned or deflected for a number of reasons. Planners, both within and outside of the government have devoted impressive talent and attention to a plethora of seemingly insoluble problems. When measured in terms of output, however, the planning story is not always flattering to its participants. The net picture suggests the deliberations of auto company executives who must decide annually whether next year's strategic forces will have fins, simulated wood panelling, an extra-wide chrome grille, or what have you. Under bad circumstances, we may paint fierce teeth on our car to scare potential aggressors. But, no matter how valid the point might be that nuclear war is a dangerous and risky business, it is discouraging to hear threatened "Launch on Warning" or to have nuclear operational planning couched in a game-of-chance metaphor. Finally,
when a set of developments does cast into doubt the entire concept of a
"gas guzzler," we are apt to respond first by installing on the console
an elaborate mileage computer to enable us to update constantly some
"draw-down curve" of transport effectiveness.

It is apparent that repairs are in order. Probably the best
way of effecting useful change is to improve our understanding of mili-
tary planning in general. This thesis seeks to point out some of the
factors behind the formation of a single type of force for only part of
that force's existence. The exercise might be useful as an input into
an analytic effort of broader scope.

Before continuing, I would like to acknowledge the contri-
butions of several experienced defense planners with whom I spoke
during the preparation of this thesis. I am especially grateful to Pro-
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of this paper. I have benefitted greatly from Professor George Rath-
jens' excellent and lucid presentation of some of the vital operational
components of strategic posture and contingency planning. And for
her indispensible contribution to this effort I must thank Ms. Fran
Stefan, whose great kindness I hope to be able someday to repay.
CHAPTER II: U.S. STRATEGIC NUCLEAR OFFENSIVE FORCES SIZING

Many stories have described and many analyses have sought to explain the determinants and predicates of the evolving U.S. SOF structure. Regardless of the diversity of theories and methods employed in such studies, however, all have a common denominator. Each demonstrates that any given force structure decision is made in a complex, turbulent and unique environment. There is no doubt that generalization of the colorful dynamics of the "weapons acquisition process" is a risky occupation. Accordingly, no effort is made here to interpret any particular developments.

Rather this chapter will examine certain larger force structure trends. I will first trace briefly historical force structure developments, and note those key decisions which have shaped this evolution. I will display some SNDV and warhead data which I will use to analyze war plans and effectiveness of U.S. forces in Chapter III. In the aggregate, and according to strategic "rules of engagement", (employment plans), the force structure has remained more or less at a steady state, relative to those objectives defined by the national targeting guidance. As will be seen in Chapter III, some major force sizing disconnects--most notably the MIRVing of U.S. ballistic forces--essentially preserve, rather than increase or modify, U.S. offensive operational capabilities. The strategic force story more recalls the White Queen's advice to Alice ("it takes all the running you can do to stay in one place") than it suggests the more popular demonology of Molochian arms racing.

The conclusions of this chapter are these. First, U.S. forces have been modified at the margin to keep pace with the changing U.S./Soviet strategic context. Second, we may have reached the end of the
road in our practise of "fixing up" the forces bought in the early 1960s. Third, and in seeming opposition to the spirit of the Race to Oblivion metaphor, at no time during the last fifteen years was it likely that the U.S. would deploy new forces to change radically the complexion of our strategic capabilities, because we could not have afforded to do so.

**BRIEF HISTORY OF THE US SNFs**

Historically, U.S. SNFs have been sized according to a single rule: forces are procured so that a sufficient supply of warheads is available with which to cover some predetermined set(s) of targets under specified contingencies. As anyone familiar with strategic or tactical targeting knows well, however, a target inventory or bombing encyclopedia tends to generate more targets than can be attacked by a force of feasible size. In the interests of economy, therefore, the SecDef and others traditionally have been obliged to oppose the services and have sought to restrain the definition of "essential" target systems to lists of moderate size. This particular source of strife—together with occasional controversy surrounding the attribution of priorities to various classes of candidate targets—has been in fact at the root of all points addressed by the ongoing "strategic debate."

The evolution of the U.S. strategic nuclear force structure is thus linked to the pressures applied to the target list which has been suggested by the national guidance, with an upper bound imposed by (usually) civilian planners. The force structure planning process

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* See Ref [33] for a brief narrative history of U.S. SNF sizing milestones

** Chapter III is devoted to a detailed examination of targeting issues, and the relative effectiveness of U.S. SNFs in various missions. For the moment we review only the most essential targeting issues as they affect centrally force sizing.
might be described using the annual OSD/service budget process as an analogue. The joint target staff selects some unwieldy set of targets, together with pessimistic estimates of U.S. SOF reliability, thereby developing a case for a JSOP-style warhead inventory. OSD then submits guidance to the services restricting numbers of warheads, and the targeteers then "do the best they can" within those constraints.

In actuality, force sizing does differ from budget preparation in one crucial respect: unlike an annual budget request, a debate over the ability to cover targets (and, therefore, force size) occurs irregularly, and results from perturbations induced in forces caused by two types of enemy activity. First, if the U.S.S.R. can reduce the apparent effectiveness of U.S. forces by such measures as active defenses, by a threat of preemptive strike, or by hardening targets, one response which the U.S. might elect is the deployment of extra warheads to compensate for reduced force effectiveness. Second, if the set of designated "high priority" targets grows, more warheads must be added as a matter of course. Necessary warhead loadings show no tendency to drop off in number over time, because the Soviet target base has not decreased in size; nor has the U.S. revised its definition of "high priority targets." Consequently, the U.S. SNF structure is more or less an evolving accretion of "packages" oriented towards specific types of targets.

As will be argued in Chapter III, there is no straightforward way of determining exactly how many warheads are necessary to accomplish the objectives in the national guidance given changes in U.S. forces or Soviet targets. As a result, relatively arbitrary target selection (and, by association, force sizing) rules have been used in lieu of the determination of force sizing according to specific effectiveness criteria. Strategic force sizing is essentially a "seat of the pants"
business. With this in mind, let's examine the major events which have shaped U.S. force structure developments.

Before 1950, of course, the maximum size of the U.S. offensive arsenal was thought to be limited, even in the long run, by a shortage of fissile materials. Target planning was done carefully and in the style of 8th and 15th Air Force style of targeting of World War II. After an ample supply of Uranium was ensured (by doubling the commodity's market price), the USAF was able to increase greatly the size of its target roster. Targeting continued to be discriminating and precise, though, and it was focused on destroying particular economic capabilities as opposed to terrorizing central cities. With a growing supply of bombs available, the question remained to determine the appropriate number of Soviet targets to be destroyed and thereby compute the bomber forces necessary for this job.

Around 1950, using photographs made by the Germans, the USAF set about determining "what, cumulatively, was needed to destroy the Soviet Union." [24:141] The outcome of this and other efforts appears to have been the establishment of a canonical warhead delivery requirement for U.S. forces of something on the order of 1000 or so weapons on Soviet targets. One senior defense official is said to have reported that a SIOP based on the plans operational through the 1950s would deliver at the minimum about 1000 weapons, presumably on the Soviet Union. [4:186]. And, according to H. York,

"In the late forties and early fifties, before the invention of the H-bomb, it was determined that we needed one thousand delivery vehicles (then land-based and sea-based bombers) in our strategic forces. This was determined by several factors: professional judgments informed by World War II and the Korean experience; calculations (for high penetration reliability); and probably most important, purely fiscal considerations . . ."

[36:3]
If this "kilotarget" (or some similar) criterion was used as a planning device, then it would follow that about 2000 SNDVs--given worst-plausible-case assumptions about the effectiveness of enemy defenses and the damage which could be wrought in a sneak attack--would be required.

As this assumption is not unreasonable, I will proceed from this point. Assuming that USAF and USN either did not collaborate on targeting [5:171] or that they divided up responsibility for different types of targets [23], (and if TAC was configured for theater-oriented nuclear strikes--as appears to have been the case given the technical capabilities of then-deployed aircraft), then it seems that over the period 1956-59, SAC achieved a sort of equilibrium in its ability to cover targets, i.e. no particular stresses existed which would drive up requirements for weapons. As B-52s (with two weapons) replaced B-47s (with a single bomb) roughly on a 1:2 basis, it was also clear that, in the absence of major change in the strategic environment or in planning, SAC capability would remain remarkably constant for some time into the future. That a balance between forces and targets had been reached is evident in then-Colonel Glenn Kent's reported stubborn opposition to the McNamara targeting reforms of 1961 on the grounds that the move would threaten SAC's ability to cover its finely tuned target menu.

The forging of an apparent target:force linkage during the period 1950-1961 was made possible by a remarkable stability in the strategic employment planning environment during that time. This was due to several factors. For one thing, the constitution of the Soviet target base remained relatively constant over the entire time, and the fact of constancy was abetted by the relative lack of sophistication of contemporary U.S. reconnaissance and target data collection
resources. Second, the use of large (up to 24 Megaton) weapons against most targets then confronted meant that, since $P_k$ was nearly unity, lethality considerations were of minor importance in satisfying required OPKs. Lack of sophisticated reconaissance and geodetic data probably also figured in the (by today's standards) unrigorous selection of aim points, as did the inaccuracy associated with then-practised bomb release techniques (drogue and toss bombing). Pre-launch survivability (while a matter of some concern [91] was not as important an issue in the pre-1960 period as it has come to be with a powerful Soviet ballistic missile threat against CONUS forces, and airborne alert and dispersal could decrease part of the remaining threat posed by bomber, Cessna, or suitcase sneak attacks. U.S. plans did not incorporate "withhold options" either, and campaign planning was complicated by none of the uncertainties associated with recycling regrouping and controlling attrited forces. Most important, SAC devoted heroic efforts to ensuring the reliability of its bombers by deploying sophisticated defense suppression munitions, decoys, and aircraft.\footnote{When an aircraft carries its own defense suppression capability, or when defense suppression and confusion is to be performed by a bomber on airborne patrol or by a quick reacting unmanned system, there are none of the uncertainties which one encounters where survival of individual types of systems is not so certain.}

It is not surprising then that the quick-paced developments of the early-1960s--ballistic missile threats to bombers, appearance and proliferation of a new type of very important target (missiles), a U.S. decision to diversify its strategic forces into a TRIAD, and Air Force interest in buying several new manned bombing systems (B-70, and X-20--"DYNA SOAR"--among them)--combined to throw the delicate force structure-target balance--known as "optimum mix"--into
disequilibrium. McNamara's "no-cities" doctrine surely provided an additional source of "irritation" to the situation. Originally, for example, the proposed counterforce targeting reforms ordered by McNamara worried SAC/JSTPS. The plans would lead to great difficulties in covering the SIOP target list for two reasons.

- Options were seen as possibly eroding the big one-shot SIOP which JSTPS had carefully prepared as SAC's only contingency.
- The reformed SIOP was seen as a "threat" to planned USAF weapons systems. In particular, the requirement for withholding forces at graduated stages of central conflict biases force planning against bombers which are not as suitable for being withheld as are armored or mobile ICBMs and SLBMs.

Immediately on the commencement of revised employment planning, however, the Air Force's attitude was reversed. Ball describes the subsequent developments:

"While U.S. targeting plans were being revised, work was also underway redesigning the U.S. strategic posture to make it compatible with the new nuclear warfighting strategy. In the spring of 1961 the NESC was formally directed to 'determine the force levels necessary to accomplish the objectives of the NSTAP.' The NESC study (the Hickey study) concluded that the currently programmed strategic force was inadequate for that objective. It recommended a much expanded Minuteman force (2000-2150 missiles by 1971), the development of much improved CEPs and very high warhead yields (over 50 megatons for advanced Titan missiles), a variety of yield options for SLBM warheads (from kiloton to multimegaton range), and the procurement of a force of reconnaissance-strike bombers with 'fully reprogrammable' cruise missiles and 'very high Pk . . against any target.'"
In short, the Air Force used the McNamara "no cities" strategy as a basis for requesting new forces far in excess of those considered previously.

This is not to suggest that the new McNamara strategy unleashed an Air Force "bureaucracy" which had been straining at the bit for an excuse to promote new forces. On the contrary, the Hickey study "was by far the best available on the subject to that date. The study group developed a list of all strategic targets, and, using the best available intelligence and their own judgment, projected the growth of these target lists over the next ten years. They then estimated the performance characteristics of the planned weapon systems of all the Services and calculated how many would be needed to destroy 75 percent and 90 percent, respectively, of the projected targets in each of the next ten years. These calculations were summarized and forwarded along with force recommendations to the Secretary of Defense."

[5:172]

The Hickey study was a remarkable anomaly, because it marked the only attempt ever made in U.S. strategic planning history to build simultaneously war plans and forces. The fatal constraint behind the effort, of course, was the budget.

Enthoven and Smith argue that McNamara responded to the subsequent arresting requirements for new weapons and increased programs by asking "why 90 percent or 75 percent (of all targets) ?" [5:179] They claim that while attempting "to find better criteria (than mere across-the-boards target destruction percentages) . . . it was McNamara's judgement . . . that the ability to destroy in retaliation 20-25 percent of the Soviet population and 50 percent of its industrial capacity was sufficient." Systems Analysis developed a chart showing that 400 reliable EMT was sufficient to accomplish these damage levels. Enthoven and Smith claim that "this judgement was influenced strongly by the fact of strongly diminishing returns at levels beyond
Figure One

Percentage of Targets Destroyed vs. EMT on Targets (x 100)

Source [40:139]
these" [5:175]. This fact was portrayed in a well-known relationship, shown in Figure one.

Given the original declared requirement that each leg of the TRIAD should be able to accomplish this mission independently, the definition of Assured Destruction in this manner seems to be an elegant yet simple force structuring rule based on a practical U.S. strategic objective; the ability to inflict intolerable damage on the Soviet Union as retribution for serious aggression.

However, this hypothetical rule for force structuring is almost certainly not accurate. As I will show in Chapter Three, no decision was made to cease counter military (especially counterforce) targeting, nor is it apparent that any attack was ever prepared on the basis of an analytic rule used in computing A.D. criteria. On the contrary, it seems that assured destruction was set up as a force sizing rule by McNamara (arbitrarily) and was based on the capabilities of the forces which McNamara had already planned to procure! "A.D." merely was a simple "snapshot" description, albeit an ingenious one, of the capabilities of then available and programmed U.S. forces which was to serve as a ceiling on force size. Thus:

FIGURE 2
BACK OF THE ENVELOPE FORCE SIZING EXERCISE

41 POLARIS = 16 \times (1)^{2/3} \times 41 = 656 \times (.6 \text{ availability}) = \text{apprx 400 EMT}
450 MINUTEMAN = 450 \times (1)^{2/3} = 450 \times (.9 \text{ availability}) = \text{apprx 400 EMT}
300 B-52 = 300 \times 4 \times (1.5)^{2/3} = 1600 \times (.25 \text{ reliability}) = \text{apprx 400 EMT}

The reader may reject these numbers as circumstantial; however, McNamara's intention not to exceed these force levels (obviously there are the unintentional exception of the MINUTEMAN and the B-52s, but
these derived from external action) is clearly evident in his decision to turn off the strategic force increase budget after FY63 and FY64.

Within a given leg of the TRIAD's 400 EMT allotment, all of the strategic missions for that leg (whether or not they had to do with retaliatory attacks) were prepared. [4:181] Between the different components of the TRIAD, special roles also were assigned to prevent competition and to assist in optimal use of available forces in SIOP planning. It has been persuasively argued [8:99] that the Polaris fleet was more or less exclusively dedicated to the urban/industrial full-SIOP retaliatory role. Bombers and ICBMs concentrated more on the Soviet military target base, and the latter were vital to counter-ICBM operations, because only ICBMs could be on enemy missile targets (especially hardened missiles) with sufficient promptness to destroy those weapons before they could be used. Accordingly, an exception to the 400 EMT rule arose for ICBMs, even with the larger force of 1000 MINUTEMEN planned. As will be argued in Chapter III, enemy ICBM targets are one of, if not the highest priority target systems. This being the case, it is probable that planning is done according to relatively strict criteria, such as "one reliable warhead one target." Because one "reliable warhead" practically speaking is two a priori warheads, Air Force planners might have attempted to size their ICBM forces by the rule "two times expected enemy silo population."

According to figures published by Albert Wohlstetter, projected (and actual) Soviet ICBM deployments for selected years are:
FIGURE 3
A PRIORI ESTIMATES OF SOVIET ICBM STRENGTHS

<table>
<thead>
<tr>
<th>Date Projection Made</th>
<th>Date Projection For</th>
<th>Number SU ICBMs</th>
</tr>
</thead>
<tbody>
<tr>
<td>1962</td>
<td>1967</td>
<td>350-650</td>
</tr>
<tr>
<td>1963</td>
<td>1968</td>
<td>425-700</td>
</tr>
<tr>
<td>1964</td>
<td>1969</td>
<td>400-700</td>
</tr>
<tr>
<td>1965</td>
<td>1970</td>
<td>410-700</td>
</tr>
<tr>
<td>1966</td>
<td>1971</td>
<td>505-790</td>
</tr>
</tbody>
</table>

Interestingly, Air Force force procurement initiatives are remarkably congruent with these assessments. The 1964 Damage Limiting study assumed that 600 Soviet ICBMs would be deployed by 1969 [4:241]; simultaneously, Air Staff was proposing a force of 1200 MINUTEMAN. Similarly, the original Lickey Committee proposal for about 2000 MM* was based on a 1958-59 projected Soviet target base of about 1000-1200 Soviet ICBMs.  

The two-ICBM shots per silo rule was not to be, as McNamara turned off the MINUTEMAN program at the planned six wing deployment. Subsequently, force sizing is said by a senior defense official to have been defined by a rule of one "best possible" warhead per silo, plus Assured Destruction [4:102]. One of the major recommendations of the Damage Limiting study was that, once a good warhead/silo was available, it was better to proceed with qualitative improvements, rather than with larger deployments. Among other things, OSD commenced an ICBM clean-up in early 1964 [39] and phased out the ATLAS and TITAN I ICBMs during the CY. TITAN IIs were also slated for decom-

*The additional 100-150 MM were for Defense Suppression (in lieu of SKYBOLT) [5]
missioning as attrition "took its toll" [18:6]. (However the TITANs are still in place.) At any rate, it was decided to equip MM Wing VI with the MINUTEMAN II, and move for the earliest possible MINUTEMAN II retrofit into other wings (as opposed to deploying Wing VII).

The Damage Limiting study also cast some doubt on the utility of bombers [4:241]. As noted, bombers are not acceptable for prompt CF as are ICBMs, and there are major problems associated with withholding and recycling aircraft during a graduated war, to which SSBNs are not subject. Bombers run up large personnel and O&M tabs and also can "cost" a fair number of friendly RVs in virtual attrition for defense suppression. Nor are bombers necessarily flexible weapons. It has been contended that Senior U.S. Air Force and OSD officials felt that McNamara desired an end to a large bomber force and that he planned to let the force decay by attrition. [4:44, 156]

McNamara’s actions surely support this argument. McNamara cancelled the B-58 program in October 1962 after only 90 of a planned 290 aircraft had been delivered. More important, he terminated B-52 output at the planned figure of 744 aircraft, and vetoed a USAF proposal to buy some more airplanes. Both the B/RS-70 and X-20 programs were cancelled.

The B/RS combat mission was better done by ICBMs, argued OSD [5:244-47] and it was proposed that a wing of SR-71s be procured for the post-strike reconnaissance mission. DYNA-SOAR was replaced with MOL (Manned Orbital Laboratory). SKYBOLT was cancelled; HOUND DOG procurement stopped at about 630 missiles, and SRAM was initiated in 1964 to replace it. The B-47 phaseout, briefly delayed because of tensions over Cuba and Berlin, was completed by February, 1966. Although the FY65 Annual Report indicated that future bomber options included AMSA and FB-111, the FY66 Report cast of-
For all of these reasons, bomber strength fell off rapidly. However, not even McNamara could undercut JSTPS' war plans by reducing the number of weapons available for use in the then-anticipated SIOP (by lowering the number of warheads in the arsenal for certain missions). One solution was the fractionation of B-52 bomb payloads; USAF apparently equipped most planes with 4 small B-57/B-61 bombs instead of 2 of the higher yield B-28/B-53 bombs. Also, McNamara was able to trade off bombers for ICBM warheads, on account of MIRV. For example, in 1965, McNamara proposed a phaseout of about 345 B-52s (mods B/C/D/E/F) to leave a residual force of some 255 or 260 G/Hs. SAC was reported to have expressed concern that such a move would undercut SIOP coverage by reducing numbers of available warheads [4:183]. In exchange for the 345 airplane drawdown, the Air Force requested 490 FB-111s. McNamara compromised with 210 FB-111s and 350 3-MIRVd MMIII. In each case, the warhead count was identical. Here is an excellent example of force structure being driven by targets and war plans, subject to the top-line Assured Destruction constraints.

In fact, when the "Assured Destruction"-committed SSBN force is excluded from consideration, the consistency of weapons available for "military" use aboard U.S.A.F. ICBMs and bombers is remarkable.

* SEA employment affected B-52 levels.

** 490 FBs x 4 SRAM/bomb = 1960 warheads; 350 x 3 MINUTEMAN III + 210 x 4 FB warheads = 1890 warheads. 5.5 B-52 weapons (4 internal carriage plus average of 1.5 outboard SRAM) x 345 = 1898 warheads. The reader will recall that AMSA was also expected by USAF in the near future.
FIGURE FOUR
HISTORIC CONSTITUTION OF U.S. BOMBER FORCE

NUMBER OF AIRCRAFT (TN)


MID-YEAR

B-36
B-58
FB-111
B-47
B-52
Figure five reveals the trend in force loadings and milestone force structure decisions used to counteract inventory deterioration. The force sizing history described in Figure five is analogous to a thermostat which seeks a warhead comfort level of about 1750-1800 and which activates the furnace when levels fall below 1600 alert/reliable weapons.

As we shall see in the next section and in Chapter III, it is the requirement that U.S. forces be able to cover a baseline target list that has been the basis of key procurement and upgrade decisions since the late 1950s. When asked whether MIRV was developed as a response to Soviet ABM, J. Foster (DDRE) said in 1968

"Not entirely. The MIRV concept was originally generated to increase our targeting capability rather than to penetrate ABM defenses. In 1961-62 planning for targeting the Minuteman force, it was found that the total number of aim points exceeded the number of Minuteman missiles. (MIRV) allowed us to cover these targets with . . . fewer missiles."

[47:21]

The rationale for the M-X in fact has been given as the insurance of continued SIOP coverage by the ICBM leg of the TRIAD [see 41]. Evidently, the figure 200 x 10 weapons that the USAF has in mind for the M-X program are based on the one-for-one replacement of unreliable MINUTEMAN II and III warheads by M-X weapons. [92]

As a rule, then, force structure changes as (i) targets change; (ii) SOF performance changes. There is one kicker though. The extent to which force structure can satisfy the requirements for force structure response is subject to a top-line SOF procurement budget. As we will see, the limitation imposed by diminutive budgets has been profound.
FIGURE FIVE

TOTAL WARHEADS ON ICBMS AND BOMBERS

LESS: ICBM VULNERABILITY & RELIABILITY

LESS: BOMBERS NOT ON GROUND ALERT

GROUND ALERT CHANGED FROM 50-40%

GROUND ALERT CHANGED FROM 10-30%
CONCLUSIONS

This brief "history" suggests three very important force sizing axioms. First, the definition of A.D. appears to have been based on the capabilities of forces-in-being and programmed by 1962-63; "A.D." was the spigot by means of which McNamara was able to turn off the strategic buildup commenced by President Kennedy in 1961. This contradicts the widely held impression that forces were built on the basis of an a priori quantitative characterization of the utility of Assured Destruction as an adequate deterrent based on enemy capabilities and perceptions.

Second, strategic operations were planned within the nominal A.D. constraints according to traditional target selection and employment planning rules. Kugler cites an interview with a Senior-DoD official to this effect [4:235], and other evidence also supports this contention. Thus the 1200 net EMT of a canonical A.D./TRIAD structure did not exist primarily as a hedge against "failure of one leg" (and as insurance against the possibility that 400 EMT might not be deliverable onto U/I targets). The criterion was a force sizing rule of thumb, with no relationship to the size of target systems, the attributes required by U.S. forces, and the plans which would coordinate U.S. strategic employment in a war.

Alain Enthoven testified in 1968 that an excess of warheads generated by assured destruction permitted wide coverage of military targets, just as had been the case before the invention of A.D. The FY75 Annual Report suggests that U.S. planning's purpose "is not to provide an independent assured destruction capability in each element of the (TRIAD)" [75:49].

Third, and most important of all, the trend in force structure planning has been based on increasingly ambiguous principles. No
SecDef since McNamara has said what a U.S. "assured destruction" attack (much less other options) should seek to accomplish. Clark Clifford said that the effectiveness of the U.S. SNFs was gauged by "their ability, even after absorbing a well-coordinated surprise strike, to inflict unacceptable damage on the attacker" [69]; Melvin Laird said that deterrence hinged on "an adequate second strike capability" [71]; Donald Rumsfeld said that deterrence was based on "assured retaliation," which demanded the ability to wreak "irreparable damage" on Soviet targets [77]. The most useless statement of U.S. strategic force sizing requirements of them all was made at a time when strenuous initiatives were being made to discover rationales for new forces, and new capabilities for existing forces:

"There is an absolute point beyond which our forces must not be allowed to go. That is the level of sufficiency. Above or at that level, our defense forces protect national security adequately. Below that level is one vast undifferentiated area of no security at all. For it serves no purpose in conflicts between nations to have been almost strong enough."

[26:167]

Incredibly, this was the extent of the problem posed by the President to the Congress—which is responsible for approving force structure decisions.

Clearly, this "retreat from specificity" is based on the judgment and experience of successive SecDefs since McNamara that careful expression of strategic goals, either quantitatively [e.g. "200 cities"], or qualitatively [e.g. "destroy viability"] can only lead to demands for more forces. [Conversely, it is very difficult for even a "constraining" rule like A.D. to succeed, since manipulation of reliability and other data can synthetically increase force requirements. After 1966, for example, McNamara both had to dilute and deempha-
size Assured Destruction as a rule, despite his invocation of the "greater than expected threat" rule which sought to place a floor under reliability data.] This was the case with Counterforce in 1961-62; with Damage Limitation in 1964; with "flexible options" in 1973-74. It has also been apparent that a warhead demand was created by the NSDM-242 (April 1974) "anti-recovery" guidance which sought to obtain a reliable capability to "retard significantly the ability of the U.S.S.R. to recover from a nuclear exchange and regain the status of a 20th century military and industrial power more quickly than the U.S." [77] Lame-duck Rumsfeld left behind in the SecDef's office an albatross when he suggested that "8500" weapons would be needed to implement the anti-recovery scheme. But, according to Conover [19:18], "it has been recently reported that Harold Brown is moving away from the anti-recovery concept because it is too ambiguous and could be used to justify enormous increases in the nuclear forces." Brown also removed the only specific CV force index he had used, the 200 cities criterion, between his FY79 and FY80 Reports. Despite a brief attempt at RV conservation--Brown toured the U.S. during 1978 and delivered some excellent speeches on the fallacy of relying too heavily on the arbitrary numerology advanced to support proposals for force increases--he has returned to the inane force sizing rule of "Essential Equivalence" which in effect puts force sizing decisions in the hands of the enemy, and only ensures that we will at best mirror-image his mistakes in our own posture (if we do anything at all). Brown also has seemed to support some of the new targeting initiatives designed to cope with the genuinely distressing deve-

*Speeches given in San Francisco (23 June 78) and in New York (13 September 78) among others.
lopments in the Soviet target base to be noted in Chapter III; in this regard, the Secretary appears to see the ALCM as the solution to most if not all force structure problems. We will return to this point in Chapter IV, but I wish to note here that force sizing has seemed, since 1959, to have taken leave of the target base (and therefore become disconnected from war plans); after 1968, even the arbitrary structuring rules set by McNamara have been abandoned. Let me now turn to a review of the implications of this trend for force employment.

ANALYSIS

As the preceding account indicates, U.S. strategic force sizing since 1963 has been a matter of attempting to satisfy certain strategic criteria within the constraints imposed by OSD fiat at that time. By mid-1961 it is said that President Kennedy and SecDef McNamara had fixed ultimate force size (with the exception of an option on a seventh MINUTEMAN wing) [4], and by FY63 all projected strategic ballistic SNDVs were either in-hand, in serial production or programmed (with long lead items more or less completely funded.)12 And on 26 October 1962, SAC took delivery of the 744th B-52, marking the end of the production of strategic B-bombers which had proceeded without interruption since 1946 (and which has been dormant since that time). Thus, the net historical constitution of each leg of the TRIAD by SNDV type has been "frozen" for some time, as Figure six indicates.13

Although launcher levels have been consistent since FY64 (with some decrease, since FY67, in bomber TAI), there have been material changes within SNDV categories. The most prominent result of what is usually called "force modernization" has been a substantial jump in warhead loadings as shown in Figure 7 (on a page following).
FIGURE SIX
HISTORIC COMPOSITION OF U.S. SOFs

TOTAL SWDVs

BOMBERS

SLBMS

ICBMS

MID-YEAR
FIGURE SEVEN

U.S. BOMB & RV LOADINGS BY SNDV TYPE

BOMBER

SLBM

ICBM

(×1000 WARHEADS)


MID-YEAR
This is the result of SNDV "fractionation" accomplished over the last fifteen years. 550 MINUTEMAN have been converted to a MIRV capability of up to three RVs per ICBM, and 496 of the 656 POLARIS tubes have been reequipped with POSEIDON missiles each carrying an average of 10 RVs. Bombers have been "MIRV-ed" as well since 1961, as larger numbers of smaller gravity bombs were placed on aircraft, as were the HOUND DOG and SRAM ASMs (with deployment of each commencing in 1961 and 1971 respectively). By design, net U.S. force megatonnage has fallen radically, as has (to a lesser extent) equivalent megatonnage (due to the relatively small average size of the warheads in the current U.S. arsenal).

This section will examine the extent of the impact on U.S. SNFs of payload fractionation. It is frequently contended in this regard that the main purpose and leading consequence of warhead proliferation has been an expansion in the scope of the U.S.'s basic strategic mission objectives. The questions of improved command and control or greater planning flexibility aside, it is often argued that the addition of so-and-so many extra weapons increases the list of cities or other targets scheduled for attack in nuclear war. If this were to be the case, then the growth of the U.S. warhead arsenal would imply major changes in U.S. strategic operational planning, regardless of the consistency of the SNDV inventory. However the claim does not bear close examination. Extra RVs have at no time represented an opportunity for an overall "qualitative" breakout for U.S. employment options within the framework of U.S. SNF sizing rules which are based on the extent and nature of the targets these weapons must cover.

While an increase in our warhead "census" can facilitate flexibility in operations, I will argue here that the seeming fulmination of U.S. warhead loadings does not represent any appreciable change with respect
to our canonical force sizing practises and, further, that our capabilities in the aggregate have remained constant despite this increase in reentry vehicles and bombs.

This is for two reasons bearing on Assured Destruction and countersilo operations which derive from a frequently ignored but crucial technical feature of fractionation: namely the fact that for a given level of warhead design sophistication, the overall EMT which can be carried by a ballistic missile of fixed throwweight is constant. Further, because, MIRV made possible the execution of multiple "sorties" by a missile (a characteristic theretofore unique to bombers) MIRVed ballistic missiles can be used to cover an expanding target base without requiring more SNDVs. The nature of the targeting issues involved (and the effectiveness of these forces) is described in detail in Chapter III. For the moment we shall examine the evolution of U.S. SNF capabilities according to two arbitrary rules:

.U.S. ICBM RVs shall be used to cover the Soviet ICBM target base using either "one (or two) shots per silo" as an attack planning guideline. ICBM targets shall be attacked until all targets are covered or until all warheads are expended. We reserve the option of adding bomber warheads to insufficiently covered targets.

.We desire an SSBN force which is sized according to the 400 reliable EMT rule for urban/industrial attacks or an "assured destruction" strike.

First, consider the silo coverage problem. The evolution of this Soviet target base is shown in Figure eight. We ignore in this analysis related targets such as LCFs and reload bunkers (which we would be interested in attacking under actual circumstances). Omitting any consideration of reliability, availability, or prelaunch sur-
vivability, we can apply our historical ICBM force to all or parts of the Soviet target base as shown (for both one and two shots per silo) in Figure nine. If, in the case of a two shot per silo attack, we wished to cover the target base thoroughly we could expend bomber forces for this purpose. However, after 1968, using a bomber availability factor of .3 or .4, all alert and surviving bomber RVs must be committed to silo targets, and in each case, we still cannot cover all targets with a reliable two shots per silo. To do so with ICBMs would require the procurement of a large number of new ICBM warheads. Two options (which, again, do not include reliability, survivability, etc.) for achieving this capability are:

\[
\text{PAVE PEPPER:} \quad \frac{2 \times 1600}{7} = 458 \text{ SNDVs} \quad \text{M-X:} \quad \frac{2 \times 1600}{10} = 320 \text{ SNDVs}
\]

Sized-down versions of both options are now (or recently have been) under consideration as means for providing baseline Soviet silo coverage. It is amply clear in this case that an increase in U.S. ICBM RVs-on-station has failed to keep pace with the growth of their designated targets.

Let us turn now to the 400 EMT reliable SSBN force. The historical "capabilities" of this force are described in Figure ten. Note that only with the full 31 boat Poseidon retrofit has a full on-station complement of 400 EMT become available. * Only as C-4 and D-5 come on line will EMTage per SLBM exceed unity by any margin.

I now combine both of these factors to describe the net change in U.S. strategic capability measured by warheads. Suppose that we are willing to accept only as many shots per silo and as much EMT as

\* *missile reliability is excluded
### FIGURE EIGHT

**ESTIMATED HISTORICAL CONSTITUTION OF USSR ICBM FORCES**

<table>
<thead>
<tr>
<th>MID-YEAR (approx)</th>
<th>ICBM TYPE*</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>6</td>
</tr>
<tr>
<td>60</td>
<td></td>
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<td>61</td>
<td>9</td>
</tr>
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<td>64</td>
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<tr>
<td>65</td>
<td>215</td>
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</tr>
<tr>
<td>67</td>
<td>570</td>
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<td>68</td>
<td>855</td>
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<td>1030</td>
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<td>70</td>
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</tr>
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<td>78</td>
<td>1426</td>
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<tr>
<td>79 (est)</td>
<td>1508</td>
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<td>82 (est)</td>
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</tr>
<tr>
<td>83 (est)</td>
<td>1535</td>
</tr>
<tr>
<td>84 (est)</td>
<td>1569</td>
</tr>
</tbody>
</table>

(*: includes all mods SS-11.
N.B. SS-16 will probably be prohibited by SALT II, if ratified.)

**SOURCES:** [96]
## FIGURE NINE

### BASELINE U.S. CAPABILITIES

<table>
<thead>
<tr>
<th>MID-YEAR</th>
<th>SURPLUS(DEFICIT) IN IC RVs(2/silo)</th>
<th>SURPLUS(DEFICIT) IN IC RVs(1/silo)</th>
<th>DEFICIT IN ON-STN SSBNs(EMT)</th>
</tr>
</thead>
<tbody>
<tr>
<td>63</td>
<td>180</td>
<td>270</td>
<td>(333)</td>
</tr>
<tr>
<td>64</td>
<td>474</td>
<td>654</td>
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<tr>
<td>65</td>
<td>424</td>
<td>639</td>
<td>(147)</td>
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<tr>
<td>66</td>
<td>324</td>
<td>614</td>
<td>(187)</td>
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<tr>
<td>67</td>
<td>(86)</td>
<td>484</td>
<td>( 51)</td>
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<td>199</td>
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<td>69</td>
<td>(1006)</td>
<td>24</td>
<td>( 51)</td>
</tr>
<tr>
<td>70</td>
<td>(1706)</td>
<td>(316)</td>
<td>( 51)</td>
</tr>
<tr>
<td>71</td>
<td>(1972)</td>
<td>(359)</td>
<td>( 42)</td>
</tr>
<tr>
<td>72</td>
<td>(1884)</td>
<td>(215)</td>
<td>( 34)</td>
</tr>
<tr>
<td>73</td>
<td>(1594)</td>
<td>80</td>
<td>( 18)</td>
</tr>
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<td>74</td>
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<td>(870)</td>
<td>642</td>
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<td>(698)</td>
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<td>-0-</td>
</tr>
<tr>
<td>79</td>
<td>(862)</td>
<td>646</td>
<td>-0-</td>
</tr>
</tbody>
</table>
are available aboard unattributed, perfectly reliable ICBMs and on-station SLBMs, respectively. We assume therefore that no bombs or ASMs are committed to either silo targets or to the satisfaction of an adequate single 400-EMT capability. Figure eleven indicates that the U.S. supply of "discretionary" warheads, in this example all bomber weapons, has remained remarkably constant since forces were fixed in 1963. Were we to spend some bomber warheads against silos, against related LCF and related RVSN targets, or to "flesh out" the 400 EMT capability of the SSBN forces especially prior to 1967, there would be many fewer available bomber weapons. It is clear, within the bounds of these arbitrary force sizing "procedures" that the U.S. strategic nuclear force structure has changed little over time measured in warheads as well as in SNDVs.

**BUDGETS AND FORCES**

Only to a very limited extent do force structure decisions drive budget levels for military activities. On the other hand, the reverse causality--the centrality of the budget as a force sizing tool--describes well the history of SNF planning especially from about 1963 to the present. With the exception of a very few major procurement efforts, the U.S. SNF structure necessarily has resided in "impoverished" conditions, at least relative to the popular image of runaway strategic spending. What amounts to budget "redlining" has forced planners, among other things: to upgrade current forces rather than replace forces; to spend substantial sums to buy "continuously available options," (to be activated should a future radical deterioration in world order demand large new procurement, as opposed to buying useable, fieldable capabilities constantly over some planning horizon); and to accept many actual and even more potential inefficiencies as a penalty for deferring
FIGURE TEN

US FB M Capabilities Relevant to "A.D."
**FIGURE ELEVEN**

U.S. SNF "DISCRETIONARY" WEAPON AVAILABILITY

<table>
<thead>
<tr>
<th>FY</th>
<th>TOTAL US RVs</th>
<th>LESS: SSBN FORCE UP TO 400 EMT</th>
<th>LESS: US ICBM RVs TAKING UP TO 2 RV/silo</th>
<th>LEFT</th>
</tr>
</thead>
<tbody>
<tr>
<td>63</td>
<td>3120</td>
<td>144</td>
<td>180</td>
<td>2788</td>
</tr>
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<td>9878</td>
<td>5120</td>
<td>2154</td>
<td>2604</td>
</tr>
</tbody>
</table>
force structure decisions.

To date these tactics have been relatively effective as compensatory instruments. Constraints on SNF spending have helped to permit increased funding levels for other Federal programs, both civil and military. And none of our "options" became necessary as a consequence of explosive and dangerous external developments. As the slack for further marginal improvements to existing systems is stretched taut, however, we will need to consider a partial reverse of the strongest limitation on the U.S. SNFs: the Program 1 budget.

When J. F. Kennedy became President, the U.S. had spent for several years an average of about $30 billion a year in FY60 on a variety of strategic programs. Two centerpieces of our strategic programs up through 1960 led to especially high funding levels. These were:

- operation, maintenance, procurement, and improvement of both offensive and defensive aircraft and related systems;
- diverse and high risk R & D pursuits in a variety of areas

It is difficult to conceive of any activity that requires the inescapable high funding of aircraft operations. We may elect silo-based, rather than rail or air-mobile MINUTEMAN, but no such luxuries are generic to bombers and fighters. Aircraft are expensive to buy and operate. Costly improvements constantly must be made to keep bomber and interceptor squadrons ready to deal with a sophisticated threat. Adjuncts to aerospace operations such as radars, tankers, and the like are not cheap. Personnel involved with aircraft operations—pilots, crews, mechanics, controllers—need special, intensive and constant training, and command proportionately higher pay. R and D similarly consumes expensive resources, including the greatest "luxury" item of the U.S. defense budget: manpower. Unless aerospace operating
budgets keep vigorously in step with inflation—and they haven’t—operational expenses can bankrupt a military air force. As Table twelve shows strikingly, the impact of inflation on manpower and operations can be a powerful determinant of strategic force sizing.

**TABLE TWELVE**

**COST IN FY80 $ PER SQUADRON OF AIRCRAFT (BOMBER AND INTERCEPTOR) TO MAN AND OPERATE U.S. SOFs. (EST.)**

<table>
<thead>
<tr>
<th>Year</th>
<th>Cost</th>
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<tbody>
<tr>
<td>FY1964</td>
<td>$ 60M</td>
</tr>
<tr>
<td>FY1968</td>
<td>$ 76M</td>
</tr>
<tr>
<td>FY1972</td>
<td>$117M</td>
</tr>
<tr>
<td>FY1976</td>
<td>$139M</td>
</tr>
<tr>
<td>FY1980</td>
<td>$165M</td>
</tr>
</tbody>
</table>

Source [2]

After his election, President Kennedy and SecDef McNamara carefully reassessed U.S. forces and objectives with a view towards sufficient capability at reasonable cost. Despite the major strategic build-up ordered by the President, requested funding for SNFs actually dropped, mainly because systems with lower life-cycle costs (especially MINUTEMAN) were substituted for manpower/capital/O&M-intensive bomber and interceptor fleets. Further, during Secretary McNamara’s tenure, many programs proposed for development and procurement were cancelled, and prompt and substantial phaseouts of extant forces were accomplished.17

Yet demands for austerity could not end there. The President recognized that conventional and other defense programs were ignored only at U.S. peril, and more important, that the country would be more threatened by the economic problems linked with unchecked defense spending than by any foreign adversary. Because the DoD budget constitutes fully 75 per cent of the Federal government’s discre-
tionary authority, and because of other urgent pressures on Federal budgets, the DoD has decreased over time as a component of the Federal budget; moreover, DoD has "fooled" part of the bill due as a result of growth in other government activities and has grown much less quickly than the Federal budget in general.

FIGURE THIRTEEN
DEFENSE AS A SHARE OF (%):

<table>
<thead>
<tr>
<th>FY</th>
<th>GNP</th>
<th>FEDERAL OUTLAY</th>
<th>ALL PUBLIC OUTLAY</th>
</tr>
</thead>
<tbody>
<tr>
<td>64</td>
<td>8.3</td>
<td>41.8</td>
<td>28.1</td>
</tr>
<tr>
<td>68</td>
<td>9.4</td>
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<td>72</td>
<td>6.9</td>
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</tr>
<tr>
<td>76</td>
<td>5.7</td>
<td>24.4</td>
<td>16.4</td>
</tr>
<tr>
<td>80</td>
<td>4.9</td>
<td>23.1</td>
<td>14.9</td>
</tr>
</tbody>
</table>

Source [77][78][80]

Given the general trend in DoD real "growth," the current burden of inflation, and the Carter administration's plan for a balanced budget, I assume in this analysis that a major reorientation in national policy is a prerequisite for change in DoD TOA.

Within the 10 DoD programs, Program 1, the Strategic Nuclear Forces has with respect to DoD spending played a role similar to that of the DoD within Federal Budget as a whole. Thus, when other priorities arise, Program One (together with some other activities, especially Program 6, Research and Development) are used, in effect, as the discretionary portion of DoD's TOA. The decline of Program 1 TOA over time is shown in Figure 14. This reflects, among other things, the influence of the SEA priority on the Defense budget, but note that Program 1 has failed to "recover" even after the termination of the
Indochina war. From this trend, it is clear that Program 1 can only show a real increase if its contribution to net DoD TOA is increased by a rate appreciably above inflation.

Let's turn now to the Program one accounts themselves. We may distinguish between three missions: Strategic Offensive Forces, Strategic Defensive Forces, and Strategic C$^3$ and Intelligence. (I will group Strategic "Miscellaneous"—a line item appearing in the FY79 FAD—with SC$^3$I in this analysis.) As Table 15 reveals, Program one has not changed at all in terms of the major systems and capabilities it supports for some time. Over time, the relative share of Program One allocated to each activity has evolved as shown in Figure 16. The most obvious trend is the decrease in SDF TOA; first, by 1968, as a result of the large-scale phase out of ADC/ANG squadrons and ADC's BOMARC B and ARADCOM's Nike-Hercules and HAWK firing batteries; and after 1968 until it was cancelled, the SAFEGUARD program.

Using Figure Five and Historica, FYDP [2] data, it is possible to estimate the components of Program one for offensive forces (SOFs). The accounting categories: Military Personnel, Operations and Maintenance, Procurement, RDT & E, and Military Construction and Housing, are broken out in Figure 17. An interesting characteristic of these accounts is the constancy, in percentage terms of the ratio of combined (MilPers + O&M + MilCon/Hsg) to Total Prog 1 (Offense) TOA. Over FY62-77, the three average 48.7% of net Offensive TOA; since FY76 when the SDF drawdown bottomed out, their average contribution to Offensive TOA is 50.7%. Because these categories are extremely sensitive to CPI, fuel cost, and other fact-of-life price increases, it follows that, unless Program 1 (offense) keeps pace with current prices increase, a drawdown in operational units has probably occurred, as Program one (offense) is one of the few defense ac-
FIGURE FOURTEEN
PROGRAM ONE (SNF) BUDGET TRENDS

% of Total DoD TOA

Billions of FY80$


FY

-- X--X-- = $ (TOA) PROG 1

= % PROG 1

of DoD TOA

45
FIGURE FIFTEEN
RECENT COMPOSITION OF U.S. STRATEGIC NUCLEAR FORCES BY MISSION

<table>
<thead>
<tr>
<th></th>
<th>FY77</th>
<th>FY78</th>
<th>FY79</th>
<th>FY80</th>
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<tr>
<td>SOF</td>
<td></td>
<td></td>
<td></td>
<td></td>
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<tr>
<td>ICBM</td>
<td>1054</td>
<td>1054</td>
<td>1054</td>
<td>1054</td>
</tr>
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<td>SLBM</td>
<td>656</td>
<td>656</td>
<td>656</td>
<td>656</td>
</tr>
<tr>
<td>B-52</td>
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<td>316</td>
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<td>FB-111</td>
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<td>60</td>
<td>60</td>
<td>60</td>
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<td>KC-135</td>
<td>615</td>
<td>615</td>
<td>615</td>
<td>615</td>
</tr>
<tr>
<td>SSBNs</td>
<td>41</td>
<td>41</td>
<td>41</td>
<td>41</td>
</tr>
<tr>
<td>A/Ss</td>
<td>11</td>
<td>11</td>
<td>11</td>
<td>11</td>
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<table>
<thead>
<tr>
<th>SDF</th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>fighter/intcptr a/c</td>
<td>270</td>
<td>273</td>
<td>273</td>
<td>273</td>
</tr>
<tr>
<td>B57</td>
<td>18</td>
<td>18</td>
<td>18</td>
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</tr>
<tr>
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<td>10</td>
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<td>0</td>
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</table>

<table>
<thead>
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</thead>
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<td>11</td>
</tr>
<tr>
<td>EB57</td>
<td>18</td>
<td>15</td>
<td>15</td>
<td>0</td>
</tr>
<tr>
<td>E-4A</td>
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<td>-</td>
<td>1</td>
<td>n/a</td>
</tr>
<tr>
<td>SR-71</td>
<td>8</td>
<td>8</td>
<td>8</td>
<td>n/a</td>
</tr>
</tbody>
</table>
FIGURE SIXTEEN
BREAKOUT OF PROGRAM ONE BUDGET
BY MISSION CATEGORY

FIGURE SEVENTEEN
PROGRAM ONE BREAKOUT (BY ACCOUNT CATEGORY)
tivities where readiness cannot (or at least should not) be traded off for, say, procurement or for price increases. 18

With the exception of a slight MilCon contribution to the TRIDENT base construction at King's Bay GA and Mangor WA, none of the 50.7% attributable to the three accounts listed above is available for new procurement or for RDT & E. For all intents and purposes, a relatively constant 50% of our SOF TOA is "gated" and unavailable for modernizing old and buying new systems. This being the case, we can assess the ability of the Program 1 (Offense) TOA budget to sustain the kind of expenses associated with and generated by new and ongoing force modernization programs.

First, I wish to make a distinction between "upgrade" and "new" programs. Upgrade programs are programmed independently of new activities and include relatively routine force modernization, major subsystem procurement (e.g. SRAM, or MIRV, the purpose of which is to enhance the capabilities of existing SNVs), and also R & D programs with constant funding trends (such as ABRES). "New programs" are defined here specifically to refer to new, follow-on SNV development and procurement programs. The ability of Program 1 (Offense) to bear the burden of "new" programs is therefore equivalent to our ability to finance such major programs as TRIDENT, B-1, M-X, etc.

Upgrade TOAs, for four activities appearing in the DoD Annual Report's "Selected Major Programs" are listed for FY71-80 in Table 18.

It is important to note that upgrades are programmed independently of major new activities. For example, a comprehensive 1969 B-52 modification study laid the groundwork for a $1 billion upgrade of the B-52's ECM and penetration capabilities, for all SAC operational mods (D/G/H). Although this program seems competitive (in a
FIGURE EIGHTEEN

ACTUAL TOA FOR SELECTED UPGRADE PROGRAMS
[MILLIONS OF FY80 $]

<table>
<thead>
<tr>
<th></th>
<th>71</th>
<th>72</th>
<th>73</th>
<th>74</th>
<th>75</th>
<th>76</th>
<th>77</th>
<th>78</th>
<th>79**</th>
<th>80***</th>
</tr>
</thead>
<tbody>
<tr>
<td>tanker/B52 upgrades</td>
<td>481</td>
<td>437</td>
<td>413</td>
<td>267</td>
<td>(207)*</td>
<td>(147)*</td>
<td>87</td>
<td>74</td>
<td>157</td>
<td>144</td>
</tr>
<tr>
<td>SRAM and SCAD</td>
<td>1196</td>
<td>1520</td>
<td>1355</td>
<td>1123</td>
<td>1019</td>
<td>1053</td>
<td>570</td>
<td>130</td>
<td>131</td>
<td>107</td>
</tr>
<tr>
<td>MINUTEMAN upgrade</td>
<td>2075</td>
<td>1264</td>
<td>1159</td>
<td>504</td>
<td>251</td>
<td>119</td>
<td>54</td>
<td>31</td>
<td>17</td>
<td>17</td>
</tr>
<tr>
<td>POSEIDON-POLARIS upgrade</td>
<td>171</td>
<td>156</td>
<td>154</td>
<td>140</td>
<td>168</td>
<td>186</td>
<td>253</td>
<td>238</td>
<td>377</td>
<td>198</td>
</tr>
<tr>
<td>ABRES and Improved Accuracy</td>
<td>3923</td>
<td>3377</td>
<td>3081</td>
<td>2034</td>
<td>1645</td>
<td>1505</td>
<td>964</td>
<td>473</td>
<td>682</td>
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<tr>
<td>Total, these programs</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

* = estimate
** = planned TOA
*** = proposed TOA
budgetary sense) with B-1 procurement. Congress was told that the program would do and cost the same, regardless of the outcome of the B-1 decision:

"As far as B-52s are concerned, cancellation of the B-1 had absolutely no effect on our near-term ECM plans . . . The B-1 (cancellation) allowed, if not forced us to look again at the long-term B-52 ECM planning that we had not previously addressed . . ."

That is to say, the postponement of B-1 serial production merely accelerated the requirements for fielding B-52 ECM improvements [53: 18].

Also programmed upgrades are "reliable", that is, TOA "proposed for authorization," "proposed," and "planned" are relatively unchanged as they move in from outyear projections towards actual TOA. Hence, when an upgrade-type program is planned, there is a predictable impact on funding available for new programs. Since for the years under consideration, upgrades constitute from a fourth to virtually all of Program 1 (offense) procurement, it is immediately evident that upgrading comes at the expense of major follow-on and new programs, unless programmed follow-ons are matched by a real jump in Offensive TOA. And, in fact, "Selected Major Programs" entries suggest that such increases must be in the works, since outyear program costs are obviously too big for a relatively fixed $4 Billion for Offensive Procurement & RDT&E. That new programs, not upgrades, suffer the consequences of a procurement ceiling is evident in Figure 19.

In another format, Annual Reports for FY77, 78, and 80 feature projected Outyear Program One budgets: in the FY77 and 78 budgets outyear upswings principally represent a piggybacking of M-X, TRIDENT, and B-1. Other Program One funding history is superimposed. Note that, like Tantalus, outyear real Program One increases are al-
## Figure Nineteen

**Funding "Profiles" of Three Major Follow-On SNF Programs**

[TOA in Millions of FY1980$]

<table>
<thead>
<tr>
<th>FY</th>
<th>Actual Funded</th>
<th>Planned</th>
<th>Proposed</th>
<th>Prop'd for Auth'n</th>
</tr>
</thead>
<tbody>
<tr>
<td>73</td>
<td>1318</td>
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<td>-</td>
</tr>
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<td>74</td>
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<td>75</td>
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<td>2842</td>
<td>2860</td>
<td>-</td>
</tr>
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<td>76</td>
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</tr>
<tr>
<td>77</td>
<td>2643</td>
<td>3431</td>
<td>3578</td>
<td>4194</td>
</tr>
<tr>
<td>78</td>
<td>3809</td>
<td>3411</td>
<td>4134</td>
<td>3857</td>
</tr>
<tr>
<td>79</td>
<td>-</td>
<td>1849</td>
<td>2635</td>
<td>2489</td>
</tr>
<tr>
<td>80</td>
<td>-</td>
<td>-</td>
<td>2305</td>
<td>3253</td>
</tr>
<tr>
<td></td>
<td>73</td>
<td>739</td>
<td>739</td>
<td>-</td>
</tr>
<tr>
<td>74</td>
<td>700</td>
<td>700</td>
<td>739</td>
<td>-</td>
</tr>
<tr>
<td>75</td>
<td>623</td>
<td>623</td>
<td>699</td>
<td>-</td>
</tr>
<tr>
<td>76</td>
<td>866</td>
<td>866</td>
<td>981</td>
<td>-</td>
</tr>
<tr>
<td>77</td>
<td>589</td>
<td>1898</td>
<td>1869</td>
<td>2015</td>
</tr>
<tr>
<td>78</td>
<td>505</td>
<td>505</td>
<td>2465</td>
<td>2130</td>
</tr>
<tr>
<td>79</td>
<td>-</td>
<td>59</td>
<td>123</td>
<td>3120</td>
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<tr>
<td>80</td>
<td>-</td>
<td>-</td>
<td>55</td>
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<td>73</td>
<td>13</td>
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</tr>
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<td>450</td>
<td>168</td>
<td>1631</td>
</tr>
<tr>
<td>80</td>
<td>-</td>
<td>-</td>
<td>676</td>
<td>514</td>
</tr>
</tbody>
</table>

**Programs:**
- Trident & C-4
- B-1 Bomber
- M-X ICBM
ways just out of reach. Mr. Paul Warnke's expression "Apes on a Treadmill" is an excellent description of Program one planning: the lead ape is, of course, "intended" TOA, and it is being pursued by actual authority. (See Figure 20)

Finally, it is essential to note that the TOA figures for Procurement appearing in this chapter do not, for the most part, correspond to outlays as Figure 21 shows. Most of this disparity results from SCN (TRIDENT) problems, and some of it was caused by the anomalous impact of the B-1 cancellation. It is probable that some of the procurement-related TOA is reprogrammed into operational and manpower expenses as well.

With this in mind, we need ask what is the ability of the U.S. to support new programs over the period, say, FY81-FY90. Most people are optimistic. Mr. Paul Nitze recommends a strategic catch-up program consisting, among other things, of MARV, 10000 MPS shelters, M-X, B-1 and related projects. This, he avers, could be done at "costs that would increase the strategic arms budget marginally above present levels." [44.208] In a Congressional Budget Office paper, four options for U.S. counterforce capability are hypothesized. From 1979-2000 these would cost, in FY 80 $:

- Finite Deterrence = $126.8 = $6.0 Billion/year
- Slow Counterforce = $143.1 = $6.8 Billion/year
- Prompt CF = M - X = $155.5 = $7.4 Billion/year
- Prompt CF (Trident) = $159.5 = $7.6 Billion/year

The report adds that "costs shown do not include all the costs of maintaining the strategic forces. Not included are the costs of such functions as command, control, communications; surveillance; and strategic defense." [14:xvii]. And, on a somber note, Mr. Warnke has warned that the price of failure to sign SALT II will be an added defense
**FIGURE TWENTY-ONE**

Disparity Between Program One and Program One (Offense)

TOA and Outlays for Broken-Out Accounts

<table>
<thead>
<tr>
<th></th>
<th>MILPERS</th>
<th>O &amp; M</th>
<th>PROC</th>
<th>RDT &amp; E</th>
<th>MILCON/HSG</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>1977</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>TOA</td>
<td>1.8</td>
<td>2.7</td>
<td>4.4</td>
<td>2.3</td>
<td>0.3</td>
</tr>
<tr>
<td>OUTLAY</td>
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<td>1.9</td>
<td>4.3</td>
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<tr>
<td><strong>1978</strong></td>
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<td></td>
<td></td>
<td></td>
<td></td>
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<tr>
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<td>1.9</td>
<td>2.7</td>
<td>4.3</td>
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<tr>
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<td>1.5</td>
<td>1.9</td>
<td>4.0</td>
<td>2.0</td>
<td>0.2</td>
</tr>
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<td><strong>1979</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>TOA</td>
<td>2.1</td>
<td>3.0</td>
<td>3.0</td>
<td>2.7</td>
<td>0.2</td>
</tr>
<tr>
<td>OUTLAY</td>
<td>2.1</td>
<td>2.1</td>
<td>3.2</td>
<td>2.6</td>
<td>0.2</td>
</tr>
<tr>
<td><strong>1980</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
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<td>2.0</td>
<td>3.3</td>
<td>4.5</td>
<td>2.3</td>
<td>0.2</td>
</tr>
<tr>
<td>OUTLAY</td>
<td>1.4</td>
<td>1.8</td>
<td>2.3</td>
<td>1.8</td>
<td>0.1</td>
</tr>
</tbody>
</table>

**1977**

TOA    | 1.8     | 2.6   | 2.4  | 2.2     | 0.2        |
OUTLAY | 1.4     | 1.8   | 2.3  | 1.8     | 0.1        |

**1978**

TOA    | 1.8     | 2.7   | 3.2  | 2.4     | 0.2        |
OUTLAY | 1.4     | 1.8   | 3.0  | 1.9     | 0.2        |

**1979**

TOA    | 1.6     | 2.2   | 2.7  | 2.1     | 0.2        |
OUTLAY | 1.6     | 2.1   | 3.0  | 1.9     | 0.2        |

**1980**

TOA    | 1.5     | 2.4   | 4.0  | 1.7     | 0.1        |
OUTLAY | 1.5     | 2.3   | 2.8  | 1.8     | 0.1        |

*All Figures in Billions of FY1980 $

*: planned; **: proposed

Source [2]
burden to the United States of from 5 to 6 Billion a year for at least a decade for crash strategic program development. [55]

Whether the cost for such programs is "marginal" or admittedly major, the following facts are clear:

. Trends point to continued low funding levels for Program One Offense. Opportunities for one-time "cures" such as the fighter/SAM phase-out executed by McNamara have been by and large expended

. An increase in Program One funding sufficient to pay for even one major procurement effort would involve a real increase in funding materially above the rate of inflation

. Thus, it is likely that such increases in Program One procurement could only come as either (i) the result of a radical re-orientation of national priorities towards much improved defenses, or (ii) the spoils available from scavenging other DoD activities.

Pertinent to the subject of this thesis, the following facts are evident:

. At no time during the period FY63-present could we have afforded a major new program for the strategic forces

. That upgrading essential components of the TRIAD consumed nearly all available procurement and RDT & E moneys.

. That "immediately available options" is the best defense policy we could have employed under the circumstances.

Secretary Schlesinger described U.S. force structure planning best when he said that:

"Shifting sands seems to be the best way to characterize the strategic rationales of recent years. In 1961, the suicidal implications of massive retaliation were underscored: the United States would be faced with a choice between humiliation and holocaust. Interest then developed in damage-limiting and coercion. But there has been little willingness to invest money in either."

[17:113]
In Chapter III, we will turn to the question of force employment planning and we shall examine the implications of force structure for the U.S. ability to execute its desired nuclear war plans. In Chapter IV, we will ask the question: "Is the decay of U.S. force planning a serious matter?"
CHAPTER III: U.S. STRATEGIC EMPLOYMENT PLANNING

The basis for U.S. strategic nuclear employment planning is incorporated in a set of nuclear war execution programs which have been known, since 1960, as the SIOP [Single Integrated Operational Plan]. The SIOP is literally the gear between national "strategy" and the Strategic Offensive Forces. For this reason, every debate on "retargeting," "doctrine," and the like is in essence a discussion of the options which should be contained in SIOP and the way in which those options should be executed. Ironically, the SIOP is so tightly held that most of the participants in various controversies have no idea of how declared operational reforms will change the employment status quo ante (nor how reforms would be implemented) and those who are familiar with the plan have not volunteered substantive input to the public debate. With this caveat in mind, I shall speculate here on some likely aspects of SIOP's evolution and its relation to force planning.

SIOP is planned on the basis of a set of U.S. military objectives for nuclear war contingencies decided upon by the President and the SecDef. The capabilities deemed essential by the NCA are articulated in guidance which is issued to JCS. The guidance will include objectives which might be paraphrased colloquially as "we desire the ability to launch an attack against Soviet ICBMs with such-and-such an expectation of damage," "we want a plan which will black out the European Soviet Union," and "should worse come to worst, we should be able to unleash a sufficiently effective attack which will be capable of destroying the U.S.S.R. as a viable twentieth century entity."

The JCS then elaborates on the specific requirements of SIOP in order to render the national guidance compatible with other U.S.
war plans, especially plans for theater contingencies. A list of requirements is then issued to the commander of JSTPS, whose job it is to oversee the detailed translation of the guidance into practical war plans. The commander of JSTPS supervises the design of the SIOP and heads a "governing board" which makes decisions on specific problems encountered by the various technical staffs which work on the different components of the Plan, (such as a target staff, a mission planning staff, and so on). The resulting plans are simulated and the necessary revisions are made. After approval, the latest plan presumably is promulgated to operational units.

Practically speaking, the core of the SIOP design process is the categorization and "pigeon-holing" of certain types of targets. JSTPS maintains an up-to-date TDI which lists some 25,000 or more targets, together with vulnerability data and geodetic coordinates. The TDI probably is organized according to some principal target attribute, such as function. We would then be able to select out of the TDI all silos, all refineries, all railroad marshalling yards, or all police stations. Each target category is subcategorized according to various data and priorities. An entry for the Ufa refinery might show, for example, that it is the U.S.S.R.'s largest refinery, that it represents 6.5% of the U.S.S.R.'s entire refining capacity, that it is in the Bashkin A Oblast, near Kuybyshev, that it is colocated with a city of 750,000 people, that it is not near any military targets, but that it is colocated with some other industries. We would also desire some data of the relative importance of a particular target to other economic, military or administrative activities. We would want to know that the destruction of Ufa would not immediately influence a European battle, nor would this impact on Sino-Soviet operations, but that its destruction could have major implications for nearby shipbuilding in-
Finally, we'd like to know "how essential is the prompt destruction of this target?", and so on.

We would then select relevant targets to prepare the options required by the SecDef's guidance. Consider a plan to destroy 80% of the U.S.S.R.'s refining capability. We would extract the relevant entries from the TDI, develop force requirements and devise a laydown capable of producing the requisite damage with specified confidence. We might also develop a menu of attack plans, so that a different mix of SNDVs could be used should circumstances so demand. Within an option, we might also have suboptions. It might be desirable, for example, to trade off some attack effectiveness (by raising height of burst or moving to lower yield weapons) in order to produce as little collateral damage as possible. We might desire to conduct a particularly dirty attack. We might wish to restrict our attack on refineries to installations in particular geographic regions. We might wish to time the arrival of weapons to take advantage of some advantage or other, or to secure the negotiating advantage of "threatening death by a thousand cuts instead of by a single blow."

Because the SIOP is an integrated plan, we would have to examine each option with respect to its implications for executing subsequent attacks without degradation. It is necessary to plan fall-back and retargeting protocols for employment should a weapon (or group of weapons, such as a SSBN) dedicated to one or more LNOs be destroyed and to determine which options should be substituted for others if one particular package is unavailable or unsuitable.

According to this hypothetical method of SIOP preparation, historical evolution in employment doctrine could be gauged in terms of changing guidance; in terms of the relative priority accorded different target categories; by reviewing historical C^3-related preparations; by
comparing the degree to which less than full SIOP options are refined in terms of extent and quality of specified objectives. Since little information is available publicly, it is necessary to trace the SIOP's history in terms of declaratory U.S. policy. There is no guarantee, however, that declared strategic objectives reflect actual U.S. targeting plans.

HISTORICAL REVIEW

The first U.S. emergency war plan, HALFMOON, is said to have been approved by the JCS in 1948. [35:33] HALFMOON constituted A-bomb attacks on targets in 20 Soviet cities by D+60. U.S. plans became more ambitious with the increased availability of weapons, but increased force loadings merely expanded and did not change U.S. targeting. Apparently, after 1951 (when an adequate reserve of fissile materials was ensured), planners could not find much practical difference between different kinds of targets, because of a seeming limitation on weapons yields. [Thus, up until 1951, no research had been done on the problem of fallout, mainly because it was planned that all weapons would be burst at high altitudes to maximize the area covered by low levels of blast.]

The availability of Hydrogen bombs, together with a perceived growth in the Soviet strategic nuclear capabilities, led to a paradoxical development in U.S. war planning. On 30 October 1953 Admiral Radford presented NSC 162/2 to an NSC meeting outlining the New Look. On 12 January 1954, J. F. Dulles described the plan in his "massive retaliation" speech. Although massive retaliation tends to be associated with attacks seeking mainly or entirely to cause countervalue damage [see 9], the target list was in fact organized into three distinct classes: DELTA (Countervalue); BRAVO (Counterforce); and ROMEO (which were attacks designed to impede the advance of
Soviet forces into Western Europe—analagous to NOP.) Until the U.S. weapons stockpile began to grow at a brisk rate (1953-54), USAF doctrine emphasized relatively precise strikes on specific objectives in urban areas. In fact, the limited Soviet power generation system seemed an ideal target in the early 1950s; (it should be remembered that these targets were considered counterforce because of their contribution to military production). The availability of H-bombs permitted a slackening in the obligations for precise targeting. Whereas before it had been necessary to select aim points with care, a high-yield Hydrogen weapon (the lethal radius of which exceeded by a significant fraction the area of many targets even with the most pessimistic assumptions about delivery accuracy) made agonizing over specific targets unnecessary. Although USAF did not seek Soviet fatalities as an objective, to go after a particular military target in an urban area involved devastating the entire city. Regardless of one's choice of attack criteria, laydowns involving forces such as these did not require refined attack planning, and the situation might be described as "wild." However, 

"By 1954 it was apparent to some Rand corporation analysts that increased attention should be given to BRAVO targets—one prescient study argued, for example, that "with the steady expansion in our fissile material stockpile... we might be able to turn our attention to such worthy objects as counterforce targets, which become increasingly worthy as the Russian stockpile increases." And in the mid-1950s, as American stockpiles grew and "as Soviet airpower came to be recognized as the chief threat to NATO," the emphasis of American targeting policy shifted to counterforce [i.e. discriminate] targeting. In 1957, at a meeting at (HqSAC), Curtis E. LeMay requested the "development of a Modus Operandi (for) the defeat of communist air power."

[20:10]

In fact, the Optimum Mix targeting plan of the 1950s already did include a heavy loading of military aim-points; the "prescient" but un-
referenced Rand study may have been thinking about ICBMs, and Le-
May may have been thinking of SAMOS instead of some new targeting
scheme as his "Modus Operandi." [50] However, the point is well
taken here that increased precision in target planning was a necessary
corollary to an increased emphasis on high confidence destruction of
"communist" air power.

The fact remains that the U.S. policy of Massive Retaliation did
not place any particular burden on U.S. war planning staffs. Up until
1960, the Joint Chiefs of Staff's JSCP consisted of a single plan. Once
the Emergency War Order had been issued to alert U.S. forces by the
President, all aircraft and missiles would be launched promptly against
their targets with no possibility of recall. There were no planning pro-
blems such as are posed by limited attacks, by withholding forces, and
the like. At one point, Air Force and Navy plans did not even take into
account the nuclear weapons of the other service. 6 The massive U.S.
blow would devastate Communist military forces and would kill some-
think like 360-525 million Soviet, Chinese and Bloc citizens.

In late 1959, however, President Eisenhower directed the Net-
Evaluation Sub-Committee of the National Security Council to study
problems associated with less than all-out attacks on urban areas.
The NESC study group, chaired by General Hickey, produced a pro-
posal for prioritized coverage of enemy strategic and other military
targets, advocating attacks on urban areas to the extent that warheads
were available after allocation to military targets. Accordingly a
new guidance, known as NSTAP (National Strategic Targeting Attack
Policy and Guidance) was issued to the newly created Joint Strategic
Target Planning Staff, which contained for the first time, representa-
tives of both U.S. strategic services. JSTPS produced the first SIOP
by November 1960. 7 [20:17]
The New SIOP was given, according to Ball [20:12] five options, ranging along a spectrum of increasing "intensity;"

1) Counterforce targets
2) Area Air Defenses not located near cities
3) Air Defense in the vicinity of cities
4) Command and Control systems
5) All other (including U/I) targets

Also, "sub-options included such things as use of air/ground burst weapons; clean/dirty bombs; larger/smaller warheads; civil defense/evacuation." Moreover, Soviet targets were separated, at least for planning purposes from those of the Bloc and the PRC.

In addition, a number of committees and research organizations reported on such subjects as C³, more controllable MINUTEMAN forces, and the like. As a result of some of these projects, a tighter rein on MINUTEMAN launch, development of EC-135 LOOKING GLASS aircraft (first going airborne in 1961), procurement of an eight-entry dialable MMII target select option, initiation of a new more accurate Minuteman RV (the AVCO Mk-11), and the establishment of better integration of NCA with such new NORAD systems as BMEWS, were among improvements directed.

The history of subsequent developments has been described well elsewhere: I will limit further narrative observations to two key points.

First, despite the rhetoric surrounding "Assured Destruction," U.S. strategic employment planning has always placed a heavy emphasis on covering military targets. As McNamara said at Ann Arbor on 16 June 62:

* See references [4] [8] [19] [20]
"We are convinced that a general nuclear war target system is indivisible, and if, despite our efforts, nuclear war should occur, our best hope lies in conducting a centrally controlled campaign against all of the enemy's vital nuclear capabilities, while retaining reserve forces, all centrally controlled." [1:114-120]

Apparently the focus, in SIOP preparation, on military targets has changed little since 1962. Thus, during the Counterforce discussion of 1974, "Schlesinger made it clear that the U.S. SIOP had always included a heavy loading of military aim points on its various target lists." [6:12] In 1974, Schlesinger said that "only a small fraction of the more than 25,000 targets contained in the strategic targeting plan are cities. The majority of these targets include a wide range of military objectives such as Soviet bomber bases and some missile silos." [32:38] Ball quotes a former Assistant Secretary of Defense who said in 1971 that

"The SIOP has remained essentially unchanged since (1962) . . . the targeting philosophy, the options and the order of choice remain unchanged from the McNamara speech . . ." [20:16-17]

The account goes on to note that a "two-star Air Force planner was quite emphatic (in 1973) that the SIOP was 'never reworked under (President) Johnson. It is still basically the same as 1962.'" Ball also notes that "A recent study of Henry Kissinger actually castigates the National Security Adviser for failing to 'energize the bureaucracy to update the Joint Chiefs' War Plan (SIOP), a plan that has remained essentially unchanged since 1962.'"

The second feature of importance is the change in the degree of "articulation" of strategic options over time. Prior to the first SIOP, the Emergency Action Plans envisioned the simultaneous at-

*Even when speaking about C^3, it seems redundancy is necessary!"
tack of all types of targets immediately upon the initiation of conflict. But the NESC SIOP introduced the five graduated levels of strategic attack noted supra, and McNamara sought to inject even more agility into war plans: as McNamara said on 17 February 1962: "Our new policy gives us the flexibility to choose among several operational plans, but does not require that we make any advance commitment with respect to doctrine or targets." Apparently, a redoubled emphasis on purely military options with minimum collateral damage was part of the McNamara reforms: as the Assistant Secretary of Defense interviewed by Ball also said, that following the renegation of the no-cities strategy, "it has become more difficult to execute the pure counterforce option." [20:16] Lambeth notes that in the McNamara years special efforts were made to produce alternate laydowns for a variety of contingencies, and that the "SIOP has, since 1961, comprised more than a single big package." [6:9] While hardware and C³ capabilities permitted excursions from plans, noted Lambeth, these were improvisational not codified—until 1973-74. As Secretary Schlesinger himself said

"The first question you raised is whether we possess options at the present time or possessed options previously. The answer to that question is yes; we had a number of options that had been built into our war plans, but all of these options were at a very high level which would have caused major fatalities in the Soviet Union... However, if you ask the people who do the SIOP planning, they will tell you that we can always do selective strikes if that is what is wanted. But there had not been a sufficient examination of the details so that one could say definitively that we had practicable low-level options. So one had an array of several options at the upper end of the spectrum, each of which would have imposed major damage on the Soviet Union."

[31:37]

Schlesinger has also said that SIOP's options consisted of
"massive preplanned strikes in which one would be dumping literally thousands of weapons on the Soviet Union. Some of these strikes could to some extent be withheld from going directly against cities, but that was limited even then. With massive strikes of that sort, it would be impossible to ascertain whether the purpose of a strategic strike was limited or not. It was virtually indistinguishable from an attack on cities.

William Beecher disclosed in August 1972 that, although the SIOP was limited to a few massive retaliatory strikes, only one of these actually called for attacks on Soviet cities: "current war plans continue to list certain 'hard' targets . . . Several warheads are assigned to each target. There are hundreds of such targets on the list. The U.S. President actually has a wide choice of targets. He could go after cities in a second strike, or he could go after, and confidently know he would destroy, most remaining targets in Russia." [20:17]

As Schlesinger said, "what the change in targeting does is give the President . . . the option of limiting strikes down to a few weapons." [51] According to the Secretary, some of the options under development "envisage strike packages of 'three to five weapons . . . other Defense Department spokesmen have added that the overall targeting reorientation involves a wide-ranging development of responses 'up and down the spectrum from one weapon all the way up to massive use of weapons.'" [6:28] But, as Lambeth warns, "the key themes involved in the policy, however, are not so much 'limitation' and 'restraint' as they are 'flexibility,' 'selectivity,' and 'control.'"

We see that the requirements for target coverage have stayed the same (or grown), while the acquisition of flexibility and controllability of forces has become essential. It is necessary to ask whether the forces have kept pace with these demanding requirements. I turn now to a consideration of the forces' abilities in this regard, and will
illustrate the matter by measuring the ability of U.S. forces to accomplish the strategic missions which would be called for under the SIOP.

TARGETING: WHO GETS WHAT, WHEN, HOW

In the rest of this chapter, I will assess the ability of U.S. SNFs to accomplish a variety of generic missions which are certainly part of most U.S. SIOP variants. In general, U.S. capabilities have decayed, and because of recent force planning decisions, it is probable that these trends will continue. As a result we will be increasingly obliged either to accept large planning penalties due to inherent U.S. force inefficiencies, or else to sacrifice certain strategic missions and capabilities.

The effectiveness of U.S. strategic nuclear forces is measured according to their ability to survive a first strike and then to destroy certain fractions of a variety of Soviet target systems, including strategic and other military, energy-producing, transportation, industrial, etc. bases. In this analysis, I will allow deterrence "to fail," and then I will display (for different years when relevant) the results of a nuclear exchange in terms of Soviet targets destroyed by U.S. forces. Historically speaking, a priori net assessment of most military capabilities has been poor. There is little doubt in most people's minds that the uncertainties and ambiguities in many aspects of nuclear operational planning are sufficiently major that the results of "nuclear wars" of the type described here may be tenuous and arguable. Some people also may dispute my selection of data. However, I feel that these numbers reflect accurately the more important trends. Of course, if the reader does not like the assumptions here, he or she is free to substitute their own figures. Most important, whether the results ex-
pressed do or do not coincide with other studies, the cases described here do highlight the key sources of "perturbation" to which U.S. SNF sizing should be sensitive. And as U.S. strategic policy requires, we can also determine constantly, using calculations such as these, whether serious imbalances between U.S. and Soviet capabilities are developing.

The basic instrument for SIOP planning is DE--Damage Expectancy--computation. Simply, DE expresses the probability that a given weapon will inflict a preplanned level of damage on a particular target. The JCS in their instructions to JSTPS will express the national guidance in terms of a set of criteria which is readily translated into DE. DE is thus the quantitative expression of the goals of U.S. nuclear war plans.

DE combines two pieces of qualitative information on weapon's performance: the overall mission performance of a weapon, and the effect of the weapon on its designated target. Accordingly, for a certain "sortie" a strategic weapon has two ratings:

A RELIABILITY rating, describing the probability that a weapon will arrive "on target," that is within some reasonable miss distance, and explode. This is the product of the weapon's prelaunch and flyout survivability, the successful penetration of inflight defenses and the defeat of other enemy countermeasures, and the reliability of all components and subsystems required for proper weapons performance from launch to fuzing.

A LETHALITY rating, describing the effects of a successful detonation against relevant targets of interest. Many lethality indices and formulae exist which describe, to varying levels of sophistication and detail, the effects of a warhead with given accuracy (CEP), yield, and height-of-burst on a
target with parametrized vulnerabilities. Against a silo (P-type) target, a ground-burst weapon has a $P_k$ of about

$$\left[ \frac{6Y^{2/3}}{H^{2/3}(\text{cep})^2} \right]^{1/5}$$

The notion of lethality is not necessarily synonymous with $P_k$ as it is usually defined, because we are not always interested in killing a target in the sense of destroying it utterly. To be sure, against silos and similar targets, we probably will want to do severe damage, and so we will attempt to ensure the achievement of a counter-silo DE of close to unity. Against residential buildings and light industry, on the other hand, we may deem it sufficient to cause less than obliteration. In public discussion, however, problems of DEs much less than unity is resolved by recourse to certain canonical aggregative criteria such as "cookie cutters."\textsuperscript{11}

Using SOF ratings and target data, we can "build DEs" against targets and develop some war plans. Consider the problem of attacking a set of valuable but isolated point targets such as silos. We first compare the OPK of appropriate weapons with the highest $DE$ assigned to any silo; say they are 0.72 and 0.90 respectively. After committing this weapon to this target, we would still require $(0.90 - 0.72) = 0.18$ on that target to satisfy the $DE$ of 0.90. We then proceed down the target list to the next target, which, say, has a $DE$ of 0.88. Using another weapon of the sort used on the first target, we have a $DE$ debt of 0.16. We move down the list attacking subsequent targets; ultimately we will reach 0.18 and we could then plan to take a second shot against the first target. Using a weapon with a $DE$ of 0.18 or

\footnote{We use this formula instead of the more popular formula based on CMP, because it seems that the numbers which it yields are rather closer to the PVN calculations based on more detailed (but classified) information for the types of targets discussed here.}
better satisfies the DE prerequisite. If there is no such weapon available, we may either have to use more than one extra shot on the target, or else we might go on to other targets.

On most targets, we can blend DEs. Suppose we have a silo (DE=0.9) and an nearby reload bunker (DE=0.6). A weapon with 0.72 OPK on the silo reduces its remaining DE to 0.18, but say it has no effect on the bunker. It may then be possible to find an aimpoint between the silo and bunker which satisfies the remaining DEs for both (0.18 and 0.60 respectively). Such set of adjacent targets is called a "target island." If we are planning strikes on cities, it is clear that computing aimpoints will be a complicated job, since we must satisfy DEs on many nearby targets in an area while economizing on weapons against the island. 12

Targets all belong to specific categories, such as "Strategic Rocket Forces," "Tactical Aviation," and so on. Prior to the commencement of SIOP preparation, each category is prioritized with respect to all others. A minimum DE, corresponding in effect to the relative importance of each category is determined. Thus, when attacks on target set #1 have gone below a residual DE of 0.25, the target selection algorithm jumps to target category #2. There are other rules and procedures, of course. There may be limits on the numbers of weapons that can be spent on a particular target to prevent the squandering of ineffective RVs on relatively invulnerable targets or to take into account fratricide. Various attributes of weapons and operations--promptness of SNDVs, requirements for suppression of defenses to ensure reliable penetration, ontime coordination, etc.--obviously must figure also into plans.

A review of the components of reliability and lethality immediately suggests some types of changes in the strategic planning en-
vironment on which force structure and employment plans are ideally based. By comparing DEs and weapons capabilities over time, we have a longitudinal measure of U.S. force effectiveness against selected targets. Over time, as the number of targets increases, and reliability of weapons drops, or as required DEs are increased by U.S. policy decisions, U.S. planning must respond. Suppose that, all things being equal, Soviet silos become harder. Say the SSPK of the best available U.S. RV against a Soviet silo of x psi is 0.45, and that we require a DE on that silo of 0.90. The silo hardness is uprated to y psi, so that our SSPK for that type of RV falls to 0.3. Then, a third warhead of the same type is required. Likewise, suppose that a single weapon is currently aimed midway between two Soviet research installations, satisfying a DE on each of 0.47. But suppose that, because of an upward reassessment of the importance of each target, (or, because it is discovered that the targets have been sandbagged) the DE is increased (or the SSPK of the warhead falls). The two installations now each rate their own weapon or alternatively, a larger weapon might be programmed to the same aimpoint.

A list of major factors to which SIOP is sensitive appears in Table 22.

Let's now turn to an evaluation of the effectiveness of U.S. SNFs versus an evolving target base. In this analysis our operational repertoire consist of these required missions:

. Countersilo (CS)
. Other Counterforce Targets (OCF)
. NATO Nuclear Employment Targets (NOP)
. Counter-Other Military Targets (COMT)
. Secure Strategic Reserve (S/R)
. Defense Suppression (D/S)
TABLE TWENTY-TWO

REALISTIC SOURCES OF IMPORTANT PERTURBATIONS FACING OPERATIONAL PLANNING

ADVERSE:

- Increase in number of targets, especially appearance of new types of targets
- Increase in importance of targets relative to some constant target prioritization scheme (for, say, use in preparation of imbalancing attacks)
- Decrease in vulnerability of targets (e.g. by means of hardening)
- Decrease in reliability of friendly warheads

POSITIVE:

- Improved lethality of weapons (e.g. greater Y, improved CEP)
- Improved reliability and availability of warheads (e.g. silo upgrade, greater on-station rates for SSBNs, faster take-off and EMP hardening for bombers)
- More warheads by MIRVing, e.g. or by introduction of theater weapons in lieu of central systems
- Downgraded importance of some targets and missions (e.g. heavier reliance on ALCMs would free up some warheads currently assigned to suppress defenses in support of manned bomber attacks)
Low Collateral Damage-Industrial/Economic/Transportation (LCD-I/E/T)

Urban/Industrial "Assured Destruction" targets. (U/I)

COUNTERSILO (CS)

As was demonstrated in Section III-1 above, the counterforce mission has been a central determinant of employment planning since the 1950s. Of all Soviet target systems, the Soviet Strategic Rocket Forces (RVSN) target array has evolved so as to require constant qualitative and quantitative response. Quantitatively, the target list has expanded from tens of aimpoints by 1960 to something like 1600 targets today. In qualitative terms, most of these targets have been (or are being) hardened to the extent that excellent offensive performance is now a prerequisite for even modest OPKs.13 As I will show, the RVSN target base can be a major driver of U.S. SOF employment if the NCA opts for a severe DE for these targets.

The U.S.'s ability to attack silos has in particular been driven by changes on the part of both offense and targets. As Figure 23 indicates, U.S. prompt ICBM CS performance has increased while the Soviet target system has become more challenging from the point of view of U.S. planners. Each factor has a corresponding positive or adverse effect on U.S. requirements for covering silos with adequate DEs. The problem remains to compute the relative weight of each on U.S. countersilo performance over time.

The cumulative impact of these trends is shown in Figure 24. In the top line, the growth of ECMP14 of U.S. forces with respect to a fixed Soviet target set is shown. Thus, if U.S. forces for the years described were to attack the Soviet silo target base as it existed in 1967, their ability to destroy these targets in those years would increase dramatically as a result of the U.S. improvements dramatized
ILLUSTRATIVE FACTOR INCREASE

- LETHALITY OF BEST U.S. RV
- IMPROVED ACCURACY
- Y:W
- # OF RVs
- SILO UPGRADE

(M) OF U.S. ICBM FORCE'S CAPABILITIES

GROWTH IN NUMBER OF SILOS

HARDEN OF SIL

THREAT TO MINUTE

OF THE "DIFFICULTIES" INVOLVED IN ATTACKING SOVIET SILOS

(1967)
in Figure 3.1A. Note that there is no prelaunch attrition of U.S. ICBMs, and no operational reliability is taken into account. This line describes the improvement of U.S. prompt CS capability over time in the absence of any countervailing developments.

The other lines portray the impact of Soviet developments on U.S. counter-silo capability. In the second line, current U.S. forces are pitted against current Soviet targets. Again, we assume no prelaunch vulnerability and missile reliability in each case is 1.0. Thus, were a completely available and reliable U.S. force to be launched in a first strike against more and harder Soviet targets they would deliver on an average basis the ECMP shown against silos. By comparison, the ECMP required to generate DEs of .9 and .75 on the average then-year silo is shown. Only in the baseline year 1967 can U.S. ICBMs satisfy a .75 DE on Soviet ICBM targets. A U.S. first strike would today generate a DE on the average silo of 0.5. The third and fourth lines reveal the degradation in U.S. capabilities resulting from the introduction of reliability/availability factors. The third line includes only a machine reliability of 0.8; the fourth line adds a prelaunch survivability degradation which moves from .75 to .24 over the 1967-1983 period.* It is clear that the ability of U.S. ICBM forces to cover a canonical Soviet silo system with desirable DEs has been more than undermined by Soviet initiatives.

The reason for the ICBM DE shortage on Soviet targets is highlighted in Figure 25. For high DEs and relatively low OPKs, requirements for on-target RVs quickly diverge beyond feasible levels.

"ABILITY OF U.S. PROMPT HTK FORCE TO DEAL WITH CHANGES IN SOVIET COUNTERFORCE TARGET BASE"

U.S. CURRENT FORCES VS. SOVIET 1967 TARGETS

- U.S. CURRENT FORCES VS. SOVIET 1961 TARGETS INCLUDING 0.8 BEHAVIORITY OF U.S. FORCES FOR RECIP RELIABILITY

- U.S. CURRENT FORCES VS. SOVIET CURRENT TARGETS WITH RECIP RELIABILITY FACTOR PLUS PRE-LAUNCH SURVIVABILITY OF U.S. FORCES INCLUDED

[*: ECMP REQUIREMENTS BASED ON CURRENT SOVIET SILO TARGET PROFILE]
For example, if a DE of 0.9 is selected, then if OPKs from 0.7 to 0.9 are halved, the number of RVs required for that DE more than doubles. As a case in point, to cover the Soviet silo base in 1979 with .9 and .75 DE respectively would require 9048 and 6032 MMIII/NS-20/Mk-12A, using generous assumptions on prelaunch ICBM survivability.

Since, under ideal conditions there is only about 1 U.S. RV/silo, and since none of these RVs can produce a DE anywhere near 0.75-0.9, we have to look elsewhere to build DE.

Following the exhaustion of ICBM RVs against silos, any outstanding DE debts can be "paid off" by allocation of bomber weapons and SLBM RVs to remaining targets. Endorsement of either commitment rarely appears in public discussion. It is held that these are unwarranted attacks because (i) bomber weapons are not on target with sufficient speed to find anything except "empty holes," and (ii) our SLBM RVs are neither accurate nor explosive enough to contribute more than a trivial gain to hard-target DEs. In practise, substantial numbers of gravity bombs, ASMs, SLBM RVs, and, in the future, cruise missiles, may be launched against silos, for several reasons.

First, subsequent shots might be feasible for "technical" reasons. A moderately successful counter-ICBM laydown may damage many enemy rounds in addition to killing others outright. A one-MT burst: 1000-1200 meters from a 3000 psi silo will not destroy the silo but the missile in it will be subjected to a force of several thousand g's and, even if it is not destroyed, may not be operable for some time. 15 [38:71] Similarly, the same C^3 safety features which prevent unauthorized launch of ICBMs could produce launch delays under attack. One source notes that only two MM LCFs can launch a flight of missiles, but that launch time is extended to "several hours".
FIGURE TWENTY-FIVE

NUMBER OF U.S. REENTRY VEHICLES REQUIRED TO ACHIEVE GIVEN D.E. ON A TARGETS FOR VARIOUS OPK's.

D.E. REQUIRED

OPK
DISCLAIMER

Page has been ommitted due to a pagination error by the author.
(It takes a go vote all 10 flight LCFs, plus a vote from an LCF in another flight to launch MM immediately. [22:386]) Deliberate attacks on LCFs might have such a delaying effect. Buried ICBM field cabling and rf communications may be vulnerable to EMP and other nuclear effects and could lead to slower response. An advantage of "cold-launched" ICBMs (the SS-17 and 18 being fourth generation examples) is the fact that a silo can be "reloaded" with another missile. Even if a hardened reload bunker is exactly next to the silo, however, the process takes about twelve hours. Thus a bomber weapons on a silo can prevent the use of launch facilities for refiring ICBMs. 16 And, until about 1980 when the last SS-7 is decommissioned, a number of Soviet ICBMs will remain vulnerable to SLBM attack, since these older weapons are very soft and because some of the weapons are in effect "crew served." Finally, some ICBMs may not be ready to launch, either because of overhaul or for other reasons. 17 The reader can probably imagine some other circumstances under which bomber or submarine shots might add materially to OPKs against Hard Targets.

Second, for completeness of argument we must ask whether an enemy would launch all of his surviving forces as opposed to losing them to hostile action. Probably it is imprudent to wager on this, but a first salvo by ICBMs is a sufficiently serious act of war that commanders on the receiving end probably would react in a consistent way whether or not surviving defenses if any detected an incoming wave of bombers. Further, even if an enemy did anticipate the unleashing of his surviving forces on warning of bomber attack, disruption of C3 and the selective "breaking up" by ICBMs of an enemy's in-place force could lead to serious holes in the residual ICBM forces target coverage and thus a very inefficient launch-under-
bomber warning attack.

Third, and eclipsing these other reasons in practical consequence is the simple fact that bomber weapons or Poseidon Mk-3 weapons may be spent on silos, because targeting rules require it. To the general public, the launch of a Mk-12 and 3 Poseidon RVs against a 2000 psi silo may be squandering or throwing away the latter warheads, but to targeteers, this may be necessary to build an adequate DE.

Some sample hybrid silo packages of two hardnesses are shown in Figure 26.

In short, we are losing quickly our ability to cover CF targets to even modest DEs. By the mid-late 1980s, the OPKs of MMIII RVs will be, including reliability, indistinguishable from those of current (i.e. POSEIDON) submarine-based RVs for the hard target role. This being the case, we must select one or more of the following courses of action:

1. we can do nothing and suffer the increasing inefficiencies in CF attacks,
2. we can get out of the silo-busting business altogether,
3. we can move to LOW which will still not generate good DEs against an increasingly hard CS target base,
4. we can eliminate part or all of the requirement for prompt HTK and go to ALCMs as a delayed counterforce weapon,
5. we can procure a new system (either M-X or Trident II or both) to reverse ICBM reliability and inadequate SLBM lethality.

OTHER COUNTERFORCE (OCF)

The following targets are related counterforce objectives:
FIGURE TWENTY-SIX

o OPTION ONE: ADD SLBMS (ONLY) TO IC SHOT*

<table>
<thead>
<tr>
<th></th>
<th>v. 1000 psi</th>
<th>v. 2000 psi</th>
</tr>
</thead>
<tbody>
<tr>
<td>MMIII/NS20/12A</td>
<td>.870/.209</td>
<td>.730/.175</td>
</tr>
<tr>
<td>Add TRIDENT C4</td>
<td>1.000/.320</td>
<td>.810/.256</td>
</tr>
<tr>
<td>Add do</td>
<td>- /.431</td>
<td>.883/.328</td>
</tr>
<tr>
<td>Add do</td>
<td>- /.542</td>
<td>.960/.405</td>
</tr>
<tr>
<td>Add do</td>
<td>- /.653</td>
<td>- /.481</td>
</tr>
<tr>
<td>Add do</td>
<td>- / 764</td>
<td>- /.558</td>
</tr>
</tbody>
</table>

... ... ...

o OPTION TWO: ADD ALCMs (ONLY) TO IC SHOT*

<table>
<thead>
<tr>
<th></th>
<th>v. 1000 psi</th>
<th>v. 2000 psi</th>
</tr>
</thead>
<tbody>
<tr>
<td>MMIII/NS20/12A</td>
<td>.870/.209</td>
<td>.730/.175</td>
</tr>
<tr>
<td>Add ALCM</td>
<td>1.000/.906</td>
<td>1.000/.854</td>
</tr>
<tr>
<td></td>
<td></td>
<td>- /1.00</td>
</tr>
</tbody>
</table>

o OPTION THREE: ADD SLBM and ALCM SHOTS AFTER IC SHOT*

<table>
<thead>
<tr>
<th></th>
<th>v. 1000 psi</th>
<th>v. 2000 psi</th>
</tr>
</thead>
<tbody>
<tr>
<td>MMIII/NS20/12A</td>
<td>.870/.209</td>
<td>.730/.175</td>
</tr>
<tr>
<td>Add C4</td>
<td>1.000/.320</td>
<td>.810/.256</td>
</tr>
<tr>
<td>Add ALCM</td>
<td>- /1.00</td>
<td>1.000/.935</td>
</tr>
</tbody>
</table>

/*/ NOTATION: each entry describes net DE built on target after shots indicated. Entry is in format a/b where a is the DE accomplished without reliability or prelaunch survivability considerations and b is the DE when these degradations are introduced.
.500 IR/MRBMs
.10 Operational ICBM test sites (Plesetsk, Star City, Kapustin Yar, Baikonur Cosmodrome at Tyuratam)
.150 LCFs (based on U.S. ratio of LCFs: launchers)
.50 Miscellaneous targets (reload bunkers, nuclear weapons depots, etc.)
.50 LRA bases (primary and staging)
.5 SSBN ports
I allot one warhead of any type available to each target.

**COMT**

I assume that substantial numbers of strategic weapons are assigned to some of the Soviet theater military objectives not covered by NOP. The COMT package is in effect a central strategic capability for theaters other than NATO. A hypothetical target system is

.60 Western Military District Divisions
.30 Central U.S.S.R. Divisions
.45 Far East Divisions
.10 Fleet bases
.50 Frontal Aviation Main Operating Bases.
I allow one warhead of any type available for each target.

**NOP (NUCLEAR OPERATIONAL PLAN)**

NATO theater nuclear planning has been integrated with U.S. central strategic planning since the early 1950s, when ROMEO targets would be attacked by both strategic systems and by newly emplaced tactical nuclear forces (TNFs). TNFs were defined conceptually by Project VISTA at CalTech in 1948. TNW received a major boost in 1949 when Chairman of the JCS General Bradley endorsed the idea of using TNW as a counterweight to Soviet conventional su-
periority. In October, 1953, President Eisenhower authorized the JCS to include tactical and strategic nuclear weapons in NATO defense plans. [45: Chap 3]

Between 1953 and about 1973, NATO nuclear employment plans were necessarily linked to a full SIOP execution. According to MC 14/2, in force during the 1950s, a Warsaw Pact breach of the NATO tripwire would unleash a massive theater nuclear retaliatory blow. The NATO GSP (General Strike Program) would be executed as part of an ensuing massive central strike. The great importance of the GSP to U.S. defense planners can be gauged by the great priority invested in nuclear-oriented tactical strike aircraft both land and carrier based.

NATO's conversion to the MC 14/3 "flexible response" doctrine in the late-1960s apparently did not change TN planning. It is said that NATO then "had a choice of options linked to the SIOP or nothing," (except for a few weapon demonstration package) [15:20], and that as a result, NOP attacks remained massive.

In 1973, Secretary Schlesinger attempted to shift U.S./NATO TNW policy to an emphasis on graduated response options. Among other things, this included the development of the appropriate C³ apparatus to permit control over nuclear forces after the first exchange [15:21]. Schlesinger also recommended the deployment of GLCM as a useful tool for rationalizing TNF structure (by reducing vulnerability of QRA a/c and improving performance of NATO TNFs) [42] as well as approving production of the "ERW." [48:46]

Most important, Schlesinger ordered development of new theater nuclear war plans other than the GSP. According to Schlesinger, theater LNOs developed ranged from packages of 3-5 weapons
on up the scale to massive salvoes involving thousands of weapons.
As well, in 1974, Schlesinger said that all U.S. central strategic
forces would be given a theater nuclear capability.

Currently, the NOP has three generic components. The PSP
[Priority Strike Plan] are attack plans using loaded and "cocked"
QRA forces. PSP targets are those of primary interest to SACEUR;
it seems that the PSP is an analogue of the Counterforce portions of
the U.S. SIOP. TSPs [Tactical Strike Programs] are large packages
which can consist of attacks on targets which arise during theater con-
tingencies as well as attacks on preplanned targets. There are also
SEPs [Selective Employment Plans] which are theater LNOs.

All in all, there would probably be 750-850 long-range tar-
gets in a full NOP. Of these from 200-500 would probably be struck
by execution of a PSP. The creation of SEPs has greatly refined
NATO's TN posture, by allowing meaningful theater nuclear response
at a less than massive level.

However, the NOP remains locked to the SIOP. If the full
SIOP is ordered, residual NOP forces will be fired in their entirety
against targets not previously destroyed by SEPs or by a TSP.
SACEUR prepares plans and nominates a NOP target list to JSTPS,
who advise SACEUR of any redundancy between NOP coverage and
other planned coverage. Within this framework, SACEUR is free to
use his warheads as he deems most appropriate.

The NOP commands:
. all U.S. TNFs in Europe, especially QRA aircraft, \(^{18}\) and
  including at least the two CV task forces committed to the
  Mediterranean
. the 4 U.K. POLARIS-armed SSBNs [6:26]
. Five U.S. POSEIDON SSBNs. \(^{19}\)
Of these only the Poseidons represent an a priori commitment of U.S. strategic systems and would count against U.S. SNF SNDV and RV levels. Because they are targeted in coordination with SIOP, they are counted against net U.S. capabilities and are assumed not to assist in the completion of central strategic objectives.

DEFENSE SUPPRESSION (D/S)

As I suggested in Chapter II, Defense Suppression for bombers is a crucial and increasingly complex problem. Proponents of various bomber systems have always argued that bombers are more "flexible" than ballistic systems. This is most likely not congruent with the practical view held of aircraft at JSTPS. Bomber trajectories must be rigidly controlled and mission milestones carefully timed to ensure coordination of bomber times-on-targets or HCL trespass, with other sorties (especially suppression, but also to prevent "fratricide of bombers" caused by friendly attack.) For crew and aircraft safety and to ensure maximum SIOP effectiveness, precise release, yield select, fusing, attack/egress/recovery and other procedures must be followed exactly. (And for political reasons, you do not want armed aircraft flying "armed recce", i.e. looking around for nuclear targets of opportunity). From a targeteers perspective, a bomber is but a "manned missile." 21

Suppression of enemy air defenses will therefore remain an important strategic mission so long as manned bomber forces are a major part of the TRIAD. Because the destruction of a single manned bomber could result in a failure to cover several targets, then

---

*HCL = H-hour line of control, the point at which bombers are acquired by Soviet air defenses.*
increasing the reliability of surviving, launched gravity bombs and ASMs is desirable for the sake of "smooth" SIOP execution. Suppression for ALCMs is much less important, as attrition can to a large degree be compensated for simply by sending more rounds. As W. Perry has frequently noted, USAF's proposed cruise missile operational "tactic" is to overwhelm Soviet defenses by strength of numbers. An attractive feature of a switch to a homogeneous ALCM/standoff bomber force is that much of the D/S requirement would presumably disappear and some warheads would become available for other missions.

PVO Strany is large and has become appreciably more competent over time. As U.S. bomber penetration probability are said to have remained a constant .85 for many years, it follows either that many warheads are used to soften up a wide range of Soviet air defenses or else that SAC concentrates or opening up very thoroughly a few penetration corridors using fewer weapons. In times of warhead deficit, the latter probably describes JSTPS practise: this tactic is also consonant with the theoretical advantage accorded any preferential offense.

In order to destroy interceptor or mobile SAM/surveillance forces before they can be "flushed" from airbases or garrison, it is useful to attack them promptly, that is, to use IC/SLBMs against relevant targets. (But even if this advantage is not gained, destruction of bases, O&M, relief crews, and POL can complicate substantially the Soviet's ability to recycle its units and may restrict some of PVO to a single air defense sortie.) It is reported that a program to harden PVO hangarettes is being undertaken to foil such suppression opportunities [54:42]. Assuming that aircraft can fly out of and be recovered within a radiation/EMP environment, the goal then be-
comes cratering or cracking runways, a mission for which POSEIDONs are probably inadequate; yet because MINUTEMAN RVs will be scarce, I assign C-3 RVs to this role. (Attacks on GCI, the linchpin of PVO will continue to be effective.)

It is impossible to say just how many warheads might be launched in D/S strikes. Aspin assumes that about 400-500 surviving SRAMs (after a Soviet attack on a day-to-day U.S. force) are used for D/S [16:10]. Quanbeck and Wood suggest that from 200 to 400 warheads are adequate to open up penetration corridors. [25:67] I will use 320 in this analysis, of which half are SRAM and half Poseidon.

As Soviet continental defenses become more mobile and capable, it may happen that PVO Strany will acquire the ability to reconstitute severely damaged defenses in bomber penetration corridors within a relatively short time. If the possibility exists of penetration corridors becoming quickly clogged, then D/S would probably be linked only to relatively large bomber raids, as it would not then be worthwhile to destroy many defenses for the sake of permitting a few aircraft to penetrate. Under these circumstances, D/S attacks would be used in attacks ranging from regional LNOs to full-scale SIOP attacks.

SECURE RESERVE (S/R)

Even in the most savage arsenal exchange models, a last-strike secure reserve force is withheld. The purpose of the S/R is generally given as the maintenance of something bordering on "essential equivalence" even after an all-out U/I attack. More recently,

* No weapons are dedicated to the Moscow ABM system.
a S/R force has been described as valuable by virtue of its ability to coerce recovery contributions from non-devastated nations after a U.S./U.S.S.R. general war. [30]

"Secure Reserve forces are mainly a byproduct of the 1961 McNamara SIOP reforms. In accordance with the new graduated response doctrine, and its emphasis on "intrawar deterrence" a reserve was to be held. As McNamara noted at Ann Arbor, our conduct of strategic operations would be done "while retaining reserve forces, all centrally controlled." [1]

This clearly was part of the basis of the important decision to move to solid propellant missiles and to armor ICBMs against attack. Likewise, the POLARIS had the advantage of being witholdable.

How large would a S/R be? In the ACDA Soviet Civil Defense study, the U.S. is said to withhold some 10-15% of its warheads. [13:6] The IIM Soviet Civil Defense analysis uses 20% [3]. A Boeing Company rebuttal to the ACDA study termed ACDA's S/R allocation "too low." [37] Thus, I assume that the U.S. withholds at least 15% of its warheads. Some insiders have complained that the utility of the S/R is minimized by the assignment of the least effective and relevant U.S. weapons to that mission. On the basis of this evidence, I assume here that all A-3, 592 C-3, and 480 gravity bomb weapons constitute our Secure Reserve force.

ASSURED DESTRUCTION ATTACKS AND VARIANTS

The most conspicuous and least likely nuclear operational contingency for which the United States prepares is the execution of an all-out, "Assured Destruction"-style attack. Under this concept, should worse come to worst, the U.S. must be able at any time to commit a significant fraction of its forces against enemy Urban Industrial (U/I) targets with the objective of satisfying the national guidance's required for a full-SIOP level blow against Soviet Union.
In the mid-1960's McNamara often described publicly the mission of such an attack as "the destruction of the Soviet Union as a viable twentieth century nation." Subsequently, the guidance has apparently evolved away from destroying viability and has tended to speak of delaying the recovery of the Soviet Union from the damage inflicted in a U.S. SIOP-level attack. In fact, a PRM on the subject is now in progress to consider a whole-scale revision of the U.S.'s targeting policies in this regard. It has been implied that the switch in targeting results from a recognition that the destruction of Soviet viability might not be a feasible task, although in practice the actual outcomes of different attacks (some designed to destroy viability and some to impede recovery) probably do not vary by more than a few percent in terms of their effects (measured by fraction of target type destroyed, ability to convert/use surviving resources, etc.).

In the early 1960s, OSD/SA formally devised the "assured destruction" principle. Estimates of U.S. forces surviving Soviet attack under a variety of scenarios were made, and these weapons were allocated to Soviet U/I targets in the following manner. First, an arbitrary damage rule, such as the "cookie cutter" was set. Then weapons were overlayed on maps of Soviet urban areas so that most of the productive economic assets in a city would reside inside a cookie cutter radius. Proceeding from the largest city on down the list (until warheads are all accounted for) U/I damage is computed by summing the fraction of IFS within all cookie cutters. In this way, SA discovered that U.S. SOF's would be able to destroy an impressive fraction of Soviet IFS (about 50-70%), and would kill 20-25% of the Soviet population (which is colocated with industry). (The damage levels were computed by attacking reliably the largest 200 Soviet cities, and using the generally accepted index
index of normalized blast effect, EMT.) In strategic rhetoric, it is argued that this damage is unacceptable to the Soviet leadership, but it is unlikely if anyone knows this for sure. Rather, Assured Destruction merely describes U.S. force capabilities as they stood at the time the A.D. computations were made, i.e. in 1964.

According to the 400 EMT rule, the aggregate U.S.S.R. U/I target base has not changed appreciably over time. Claims of industrial and population dispersal to the contrary, Soviet countervalue assets have in fact become more concentrated over the last decade. Because only about 2% of the Soviet population own private cars (and for some other reasons), the result of increasing concentration is greater urban density with relatively little outward creep of cities into suburban belts, as has been the U.S. experience. Thus the data presented in Figure 27 below are indicative of a somewhat more "lucrative" target system; the Soviets have unwittingly made a contribution towards more efficient U.S. Assured Destruction targeting.

**FIGURE 27**

**INCREASING CONCENTRATION OF SOVIET URBAN/INDUSTRIAL BASE**

<table>
<thead>
<tr>
<th># Cities</th>
<th>1966</th>
<th>1975</th>
<th>1966</th>
<th>1975</th>
</tr>
</thead>
<tbody>
<tr>
<td>10</td>
<td>8.0</td>
<td>8.7</td>
<td>18.4</td>
<td>17.1</td>
</tr>
<tr>
<td>50</td>
<td>17.2</td>
<td>19.6</td>
<td>40.0</td>
<td>38.4</td>
</tr>
<tr>
<td>100</td>
<td>22.5</td>
<td>26.0</td>
<td>52.4</td>
<td>51.9</td>
</tr>
<tr>
<td>200</td>
<td>28.1</td>
<td>32.9</td>
<td>64.5</td>
<td>65.3</td>
</tr>
<tr>
<td>300</td>
<td>31.4</td>
<td>36.6</td>
<td>70.9</td>
<td>72.5</td>
</tr>
</tbody>
</table>

Source [80:70]

Even had the Soviets succeeded in making the effort to proliferate economic, administrative and other assets to remote areas, the overall cost to the U.S. of placing reliable extra warheads on
"new" targets is so trivial relative to the cost of the new installations that such a Soviet tactic can be dismissed as a likely source of perturbation to U.S. strategic operational plans. At any rate, all evidence indicates that Soviet interest in economies of scale has prevailed over dispersion as a tenet of Central plan siting.\(^29\)

Yet qualitatively and from the perspective of target planning staffs, the Soviet U/I target system has changed in such a way that U.S. offensive planning must make great compensation. More important, recent and "new" U.S. targeting practices (those currently being debated and likely to appear in a new SIOP revision) may require some radical changes in operational planning. The net impact on U.S. SOFs will probably be a pressure to many more warheads with superior performance. As things now stand, new forces will be required for these missions, since currently deployed weapons are increasingly unsatisfactory for U/I sorts, at least as the trends are moving.

These changes are due to initiatives to increase the "articulation" in U.S. U/I war planning rules. As data bases have improved, and as economic damage and recovery models have been refined and some analysts have proposed the attribution of specific DEs to many of the components of the Soviet economy. Some target selection algorithms will now seek to set very high OPKs against certain installations in a city and will not use cookie cutters and IFS/MVA in planning laydowns (except to computer collateral damage).

Because under many circumstances, individual targets cannot be linked, a given target island will constitute more aimpoints than before if equal (or greater) damage levels are to be achieved on separated installations in the island. Against segregated point targets (some of which may be hardened), small POSEIDON-type warheads
encounter substantial problems. Suppose a target of importance is hard by coincidence or design, or, more likely, that it is determined that the equipment in the plant will require a high psi P-effect. To produce, say, 200 psi over the plant, though, requires resetting HOB (from that which would be chosen to maximize psi over an area) with the result that the area covered by a 10 psi or better blast drops by about 50%. In this example, fuzing reliability and CEP are much more important than they would be with the 10 psi coverage maximization case because of the small window above a target within which a weapon must be exploded to take advantage of overpressure reflection.

Another result contributing to a requirement for a greater number of warheads is the impact of offset aiming on OPKs for targets near aimpoints. Consider Table 28:

<table>
<thead>
<tr>
<th>OFFSET</th>
<th>Pk</th>
<th>1000 feet</th>
<th>2000 feet</th>
<th>4000 feet</th>
</tr>
</thead>
<tbody>
<tr>
<td>10 psi</td>
<td>.96</td>
<td>.93</td>
<td>.66</td>
<td></td>
</tr>
<tr>
<td>25 psi</td>
<td>.59</td>
<td>.48</td>
<td>.14</td>
<td></td>
</tr>
<tr>
<td>50 psi</td>
<td>.31</td>
<td>.23</td>
<td>.05</td>
<td></td>
</tr>
</tbody>
</table>

OPT HOB; CEP = 2000 Ft

When low HOBs are chosen to maximize high local blast, the situation is even worse. It is easy to imagine, after reviewing these data and others, a requirement to assign a nonintuitively large number of RVs to a given cluster of high value targets.

The requirements for increasingly precise and thorough U/I targeting mainly derive from changing assessments of the damage required to accomplish the goals stated in the guidance for a full-
SIOP attack. The empirical data produced by USSBS and the theoretical analyses of viability and recovery times done with such tools as Input/Output modeling support the notion that a successful attack relies on the complete destruction of specified economic, administrative, and related sectors with resultant "imbalancing" of social activities and failure to reestablish viability.

Yet the question of what activities are essential and which require reliable attack is not easy to solve. J. Leavitt produced a long list of industrial activities which were considered essential in 12 major studies of U.S. recovery [12]. This list can surely be expanded. Moreover, auxiliary activities such as transportation and management are not integrable into the I/O models. Finally, targeting schemes designed to exploit Soviet national cultural differences, to destroy local Soviet party, administration and international security apparati, or to exploit other weaknesses are difficult to translate into practical targeting rules. Given planning conservatism (especially redundant coverage for vital targets), it is clear that an apparent "diminution" in target coverage could arise. Thus, between the FY66 and FY69 Annual Reports, McNamara's criteria for assured destruction dropped:

**FIGURE 29**

PERCENT OF EACH TYPE OF TARGET DESTROYED REQUIRED FOR ASSURED DESTRUCTION

<table>
<thead>
<tr>
<th>Annual Report</th>
<th>Population</th>
<th>Industry</th>
</tr>
</thead>
<tbody>
<tr>
<td>FY66</td>
<td>25-33</td>
<td>67</td>
</tr>
<tr>
<td>FY68</td>
<td>20-25</td>
<td>50-67</td>
</tr>
<tr>
<td>FY69</td>
<td>20-25</td>
<td>50</td>
</tr>
</tbody>
</table>

Source: [66] [67] [69]

Eventually, the objective of destroying viability was apparently drop-
aped as a SIOP mission description in favor of the objective of "delaying recovery for the longest time possible." Maximally delayed recovery is, in analytic terms, less demand than the destruction of viability. The move from one to the other almost certainly represents a conclusion by planners that it was impossible to destroy Soviet viability either because the appropriate Soviet target base was too large to be adequately struck or, conversely, because the necessary RVs for this mission had (i) been programmed out of the A/D package into other missions, or (ii) become somehow less effective against a portion of the necessary targets.

At the same time, a decision was made to deploy the Mk-3 RV rather than either the Mk-12 or Mk-17 (or a mix) aboard the Poseidon missile [8:71]. Although the choice of the Mk-3 POSEIDON has often been attributed to the bureaucratic interest of SPO [8:99], it may be the case that the (average of) 10 RV configuration represents a perceived A/D warhead shortfall for the full-SIOP mission, with a corresponding requirement for more broad target coverage. The counter-recovery pressures on our ability to do a full A/D attack since then have continued.

The greatest of these strains has been the Soviet Civil Defense Program. Debate on SUCD tends to ignore the crucial fact that Soviet recovery is apparently dependent first and foremost on the survival of political, military, and economic managers and that a U.S. attack should seek to amputate the "head" rather than the "limbs" of the Soviet Union. Because of the construction of shelters (together with tighter requirements on DEs for key installations), the Soviet economic/administrative target base might resemble increasingly the military target base over time. This trend is described in Figure 30.
Figure Thirty

[Graph showing the number of targets from 1965 to 1985 for different categories: ECON Targets, HARD ECON, SOFT MILITARY, and HARD MILITARY. Source: [7:10-11].

[Targets shown not in additive format]
As even stronger requirement for A/D warheads emerge, the technical requirements for U/I weapons may be asymptotic to those of top-of-the-line HTK-oriented RVs. Cruise missiles are an apparently ideal answer to this dilemma.

Putting aside these various points, we will use in this analysis the historical requirement for a reliable 400 EMT attack on 200 cities. We will also require some weapons for attack of targets located outside the Soviet urban/industrial target base (other than this 400 EMT). But I note in passing that while a strong warhead requirement such as is apparently developing does not by itself mitigate appreciably the awesome damage done in any nuclear war, the fact does remain that a seeming shortfall of warheads may lead either to changes in the national guidance or requirements for new forces the results of which may not be optimal from an American point-of-view.

LOW COLLATERAL DAMAGE INDUSTRIAL/ECONOMIC/TRANSPORTATION (LCD-I/E/T)

A substantial number of targets such as:
- power generation
- gas and oil extraction, and mining
- transportation bottlenecks—bridges, rail, locks and canal system interdiction nodes
- agricultural production and storage
- industry located away from urban areas (such as Aluminum—and therefore aerospace—which uses large amounts of power generated by hydroelectric power facilities)

will be attacked in addition to the U/I target base discussed above. No public data describes well the size of such a target system. Therefore, using the U.S. economy as an analogue, I will require the delivery of 550 weapons on these Soviet targets (since about 20%
of the U.S. MVA is located outside of urban areas, a proportional force for these targets is (400 EMT/80%/20% =100 EMT.) As EMT is an irrelevant index, since we are interested in coverage of the most points and not geographic area, I allocate 400 POSEIDON RVs and 150 SRAMs to these targets.

U.S. FORCE LOADINGS: SURFEIT OR AUSTERITY?

In order to gauge the sufficiency of U.S. SOF's to cover their appointed targets, I will simulate two nuclear wars. In OPTION ONE, U.S. commanders withhold the forces necessary to execute full and undergraded U/I and LCD-I/E/T attacks. In OPTION TWO, the U.S. begins its campaign with a two-on-one attack on Soviet CS targets.*

As Figure thirty-one shows, there is little room to maneuver in either case. After allotting RVs for obligated target systems (NOP, D/s, S/R, COMT), we see that

- OPTION ONE permits only about 1 shot on the average against CS targets
- OPTION TWO "overdraws weapons" and we would be obliged to dip into S/R to satisfy a 400 EMT attack.

Note that these numbers do not include enemy action, and do not reflect the effectiveness of forces.

One fact is clear. It is evident that the U.S. is unable to generate the forces required to attack adequately part or all of the Soviet Hard Target base. Even if more weapons were available, however, U.S. OPKs vs. Hard Targets are fast approaching unacceptable levels. The same trend may one day also trouble U/I attack plans. In order to analyze U/I effectiveness, though, we in-

* or, alternatively, four shots on each of half of the CS targets, etc.
## FIGURE THIRTY-TWO

### WARHEAD EMPLOYMENT OPTIONS

(No attrition)

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<tr>
<th></th>
<th>MM3</th>
<th>MM2</th>
<th>TII</th>
<th>A3</th>
<th>C3</th>
<th>Grav Bomb</th>
<th>SRAM</th>
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<tr>
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<td>1650</td>
<td>450</td>
<td>54</td>
<td>160</td>
<td>4960</td>
<td>1264</td>
<td>1500</td>
</tr>
<tr>
<td>Fully Gen'd Alert</td>
<td>1568</td>
<td>428</td>
<td>51</td>
<td>128</td>
<td>3968</td>
<td>1011</td>
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<tr>
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<td>2373</td>
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<td>1973</td>
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--- 185 Reliable EMT remains for A/D mission ---

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<tr>
<th></th>
<th>MM3</th>
<th>MM2</th>
<th>TII</th>
<th>A3</th>
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creasingly will be required to resort to more sophisticated analysis than the "cookie-cutter" and P/I-95 rules used heretofore in the official planning community and still active in public studies. Since this is not a feasible task, we'll focus in Chapter IV on the implications of the force sizing and employment planning trends discussed supra, by using the Soviet Hard Military Target system as a case-in-point.
CHAPTER IV: CONCLUDING REMARKS

In Chapters II and III I have described some trends in force structure and employment planning for the strategic nuclear forces. My results are summarized here.

STRATEGIC FORCE STRUCTURE PLANNING

U.S. strategic nuclear forces as they are now are those chosen by McNamara between 1961 and 1963; forces have been limited by assured destruction and other rules to prevent acquisition ambitious of the military services.

Since 1966-68, even the "arbitrary" A.D. rule used by McNamara has been cast aside.

In terms of SNDV levels, forces have been shaped since 1964 by aircraft attrition; in terms of RVs, forces have grown, but the ability of forces to do certain missions has not changed one way or the other.

Of changes in the strategic target base, growth in number of Soviet hard military targets has been the key trend.

Of all changes instituted to deal with an evolving target base and strategic context, most changes have been made "at the margin."

STRATEGIC EMPLOYMENT PLANNING

Hard-targets drive SIOP preparation.

War planning is done independent of force planning.

Employment planning has stayed roughly the same over time, and does not appear to be influenced by "external" (i.e. outside of JSTPS) developments.

Clearly each type of planning has gone its own way. The forces we would require to build adequate DEs on Soviet silos have
been available for assignment by force planners. Conversely, employment planners probably will design "inefficient" attacks (putting POSEIDONs on silos, e.g.) regardless of the evolving capabilities of the force structure. Although this appears in a variety of frameworks, let's view the most arresting example of this phenomenon, namely the "hard-target kill" case.

There is no doubt that U.S. war plans place a heavy emphasis on attacking Soviet silos. While an official associated with SIOP preparation noted in 1977 that

"There is no plan for a disarming first strike; there is no national policy requirement, nor do we field the capability for such a strike." [81:44]

this does not mean that silo attacks are not envisaged. In the FY77 Annual Report, Secretary Rumsfeld said,

"This degree of flexibility . . . necessarily includes the option and the capability to strike accurately at military targets including some hardened sites. But it does not permit, and our programs do not aim to acquire, a disarming first strike capability against the U.S.S.R." [77]

The reason for less than total coverage is probably the shortage of appropriate warheads more than any other factor. There are two reasons why this has been the case. First, the number of reliable weapons suitable for counterforce constantly has been undermined by Soviet activities. Second, the lethality of U.S. RVs has lost a race with Soviet hardening.

In the case of reliability, improving Soviet CEPs increasingly have threatened MINUTEMAN.

In response to this threat, the U.S. has deferred or cancelled repair programs. The M-X, for instance, has been in engineering development since 1973, and that system's progress will undoubtedly languish as the result of major political debate (affiliated with SALT
II) before a go-ahead decision is given. TRIDENT II has suffered an identical history. More important than delays in developments has been a requirement that M-X be available for prompt launch, which inherently renders the system vulnerable to an attack of certain scale. (M-X merely increases the number of weapons that the Soviets must expend to decimate U.S. forces). Most M-X basing modes have been described as warhead "sponges."

Unlike Soviet forces, U.S. SNFs are kept at a very high degree of "readiness" [82:77] [83:14]. In fact, U.S. forces have been designed expressly for this capability.

It was reported that MM could be launched in 35 seconds [63]. This more than size or storability considerations probably drove the U.S. to solid fueled ICBMs. H. York reports that the original MM rationale was LOW! [46:186] This is corroborated by the fact that the earliest MM could be auto destructed. (It turned out that solid fuels were also very suitable for armoring.)

But a collateral to prompt launch is vulnerability. Thus

"If we can eliminate the vulnerability of our strategic arms to surprise attack, we will have broken the vicious circle: that they must be ready for prompt launch because they are vulnerable, and that they are vulnerable because they must be ready." [10:16]

Moreover, prompt launch enhances the risk of accident. Yet while some thought has been given to a variety of inert (survivable but delayed) launched ICBMs no one involved in force or employment planning views the option seriously. All current options are techniques to spread rather than alleviate U.S. force vulnerability. There is not much hope for planning alternatives as opposed to extensions of the U.S.'s counterforce posture.

Similarly, U.S. SNF lethality has not kept pace with the requirements of the Hard-Target Mission. MINUTEMAN III has been
upgraded, but President Carter has failed either to increase the number of MM III or to upgrade MM II [84]. The survivable SLBM forces also have not been equipped to bear part or all of the prompt counterforce mission. Between 1967 and 1973, for example, Congress acted repeatedly to prevent the development of accurate POSEIDON. First a proposed mix of POSEIDON's including Mk-12 and Mk-17 hard-target killer RVs and the STINGS guidance (as well as the Mk-3) was vetoed. A 1969 DoD initiative to repair some POSEIDON accuracy problems was defeated by Congress; a 1970 DoD budget request was cut by Congress "to prevent future hard-target kill capability," and budget requests for improved accuracy were likewise excised for FY71 and FY72. [10] It is even possible that the yield of the POSEIDON RVs was intentionally downgraded during this time. 

To support his counterforce requirements, then SecDef Schlesinger appears to have chosen the reasonable course of concealing HTK development programs. Command Data Buffer in particular is known only for its retargeting capability, but CDB permits an improvement in MM accuracy independent of its "retargeting" capabilities. 

In short, the legislative body responsible for approving force structure decisions has consistently undercut JSTPS' counterforce packages. On the other hand, JSTPS probably continues to use any and all forces available for CF attacks. I am saying nothing here in favor of or against CF. But it stands to reason that (no CF-targeting- plus-no CF-forces) and (CF-targeting-plus-CF-forces) are reasonable postures whereas "using POSEIDONs on silos" really is the worst of all worlds.

It is not surprising then that Harold Brown has spoken with concern of this breakdown in planning. In the FY79 Report, Brown
noted that force structure and employment planning would no longer be "decoupled," and this theme was even more emphatically put in the FY80 Report.

But it seems that the initiatives now underway are destined to perpetuate the historical disconnect. The three leading "threats" to reformed planning are SALT, Essential Equivalence, and ALCM. Whether by coincidence or not these are also the three endeavors which SecDef Brown most strongly supports.

Thus, SALT boxes in U.S. force options, and makes force planning easier by relieving the U.S. of the requirement for difficult decisions. Essential Equivalence similarly defers the initiative for force sizing to the U.S.S.R. The cruise missile is the ideal "immediately available option." It can be deployed in arbitrarily large quantities to cover a growing target base. Grimly, it is ideal for NATO deployment. It is accurate enough for all missions. Sacrificed only is prompt response.

Two purposes of planning are (i) the coordination of future events and minimization of surprise and (ii) the manipulation of the future to our advantage. The future of U.S. forces seems to be in disarray, and there is evidence to suggest that we are not exploiting the second use of planning.

As Donald Rumsfeld said in his FY78 Report:

"If the life of fixed, hard ICBMs cannot be extended . . . the U.S. should not accept a strategic relationship in which we must bear the heavier costs of alternate basing while the Soviets are allowed the luxury of retaining their fixed ICBMs."

But, by failing to deploy a more lethal force earlier, this privilege is in fact accorded the U.S.S.R. *

* had the U.S. acted more positively with POSEIDON in 1969, would the Soviets have deployed the same ICBM-heavy force which now causes so many problems?
Moreover, by stretching out decisions, we may put expensive systems on-line past their period of greatest utility. C. Gray observes that, because of IOC slippage in M-X, that missile will not be available during the period 1982-87 when it will be most needed, but that, deployed in the late-1980's it may face unforeseeable problems with new types of ABM. [29]

Likewise if ASW were to advance 20 years overnight, we might cancel our Ohio-class SSBN program in favor of boats with 6 to 10 tubes. In twenty years, of course, TRIDENT boats will be among the mainstays of our SNFs, and it is possible that we might then have an ASW gap. The fault will lie not in Soviet advance however but with the decisions of the late 1970s.

I will conclude this thesis with a few "final comments."

FINAL COMMENTS

The constituents of our planning DYAD--force structure and employment planners--may be likened to the technical assistants who support senior decision-makers in large corporations. Force structure planners manage inventory by projection depletion of U.S. capabilities, by determining threshold criteria for inventory shortfall and by introducing lead time considerations into replenishment schedules. Employment planning is analogous to, say, air route scheduling with its requirement for sequentially programmed activities, coordination of aircraft with client "demand" and timing.

But in the corporate world, neither is able to resolve the basic decisions on which profit and other measures of success hinge. In business, senior officials will merge the assessments of all supporting staffs according to some set of criteria which collectively we might call an "objective function." The objective function provides a means for translating proposed strategies into payoffs to
the firm. The payoff is not profit alone, nor sales, nor the elimination of competitors, since the best outcome for each player in such a market economy tends to reside within (as opposed to being at the edge of) a bounded set of feasible outcomes for all players [85]. To the extent their abilities and experience permit, corporate commanders can steer the "best" course through uncertain waters. Here, success is more than the evasion of shipwreck--it is the achievement of preset, well defined goals which are congruent with the broader aims of the leaders and the organizations they represent.

This analogy describes well the strategic nuclear planning environment. However, there is no objective function in planning which we might use. Rather the sole criterion by which we gauge our progress is the avoidance of war: as M. Dunham has noted, it is a peculiar trait of American strategic thinking that we set up nuclear warfare as a mutual foe of the U.S. and U.S.S.R., as an "imaginary player," (in the terminology of n-person game theory), against whom the two superpowers must collude [86] [87]. Implicit in the assumption are two axioms. First, there is a general feeling that nuclear war is not war in any useful sense: as Harold Brown has said, nuclear weapons cannot capture territory, they can just blow things up. In fact, nuclear weapons cause destruction so efficiently that limitation of damage for useful goals is not feasible. Likewise, "superiority," "advantage," etc. have no meaning. As E. Rabinowich wrote at the dawn of the atomic age that:

"if both sides in a conflict have enough atomic bombs to wipe out the others' cities, they are in approximately equal position even if one has three times more bombs than the other." [88]

As a result, there are no criteria for the success of nuclear planning save "no nuclear wars."
Unfortunately this tends to obscure the fact that neither force structure nor employment planning (nor both combined) are "substitutes" for a priori policy determinations; each should be an important aid in the implementation of policies which are tuned to support net U.S. national security goals. I do not think it is too optimistic to assume that if we decided just exactly what we wished to do with SNFs, and if we could build a convincing set of operational "rules," we could build simultaneously forces and plans "downwards" from national security objectives. Under the circumstances, our strategic posture would be useful in emergency, and most important it would be robust in the face of external perturbations and uncertainty.

Consider for a moment the implications of Mr. Paul Warnke's testimony to Senator Proxmire's committee that a failure of SALT would necessitate a $30-40 Billion U.S. crash spending program. It is hard to think of a more serious indictment of our planning that Mr. Warnke has served here. Mr. Warnke is stating that the U.S. must be protected against some threats by SALT and not by its military forces. To design forces to such an extent that a relatively small international development can blast them off balance to the tune of $40 billion hardly seems a good sign.

Now, not even in Erewhon will our planning work out all the time. It is debatable whether any posited national objective could or should be integrated clearly with the possible use of nuclear weapons. Indeed a major theme of declaratory U.S. policy is the ambiguity and uncertainty of nuclear warfare ("Cosmic throw of the dice"). This view is predicated strongly on what is the inappropriateness of nuclear weapons for nearly every contingency. More substantively, the tenacious U.S. belief in the inevitable escalation of any type of war to holocaust underscores what is close to being a religious belief
in the unsuitability of nuclear forces for application to situations
where some military activity is a possibility [9]. Nuclear weapons
are a "trick deck" we reserve for introduction when our luck starts
to fade in the big card game.

This kind of thinking is exemplified most clearly in the
Counterforce/LNO/Collateral Damage debate begun in about 1973
and continuing through this date. Thus a pivot of the case argued by
foes of counterforce is, to cite a widely read article,

"Strikes causing relatively few casualties would be
militarily insignificant; strike inflicting appreciable
damage on U.S. strategic forces would cause very
large civilian casualties." [89:145]

"Military effectiveness" is defined here as the nearly total elimina-
tion of the U.S. ICBM force, and massive collateral damage (in the
case of the worst Soviet attack) could be in the neighborhood of 13
Million fatalities. But Bruce Bennett [7] has demonstrated that the
U.S.S.R. could clean up its attack by a variety of simple measures.
Under these circumstances, maximum collateral fatality levels fall
to about 3 million, with a two million median: these figures are about
an order of magnitude less than those caused by the basic silo-buster
baseline attack, and the "cost" to the Soviets to reduce U.S. fatalities
is the survival of an extra 4-10% of U.S. SNFs.

Even though Bennett's attack challenges the central contention
of counterforce critics (i.e. that a CF attack is not necessarily tan-
tamount--in fatalities--to an attack on several American cities), most
people ignore the possibility of a Soviet clean-up. Avoiding Whiteman
drives down collateral fatalities, but most people consider it irrational
for the Soviet attack to attempt to do its worst against anything less

* Avoiding Whiteman AFB, and 8 SAC bases, airbursting, and using
550KT instead of 3 MT shots on silos.
than the entire U.S. central strategic target system! At one point it was widely held (indeed many still cling to the notion) that a Soviet sneak attack would lay waste to American cities as early as possible, maybe even avoiding military targets in the process. Today, we doubt the reasonableness of this scenario, while at the same time we cannot bring ourselves to conceive of a Soviet attack which would try to cut out the basis for a U.S. retaliatory attack on Soviet cities which might be justified at the time. Then-SecDef Schlesinger was denounced as he argued that "the likelihood of limited nuclear attacks cannot be challenged on the assumption that massive civilian fatalities and injuries would result." [31] Perhaps Soviet planners would not be so quick to execrate Dr. Schlesinger's contention after viewing the details of the clean attack.

Other evidence suggests that we do not view nuclear war as a real problem. A non-provocative form of civil defense might include stricter regulations to prevent the siting of nuclear power plants and earth-filled dams upwind or upstream from urban areas. A review of a variety of U.S. warehousing and land-management practises indicates that concern about nuclear war is not a practical problem. We view nuclear war as a scientific curiosity, and most of the literature on nuclear war effects focuses on esoteric phenomena such as ozone. But, as Hal Hollister has aptly said, "when you've lost 80% of your industry and half your population, then to be able to worry about an increase in sunburn and skin cancer is a real luxury." [60]

Second, and following from this, is the dismissal of the Soviet Union as a would-be aggressor in the nuclear realm. To be sure, if no good at all can come from nuclear employment, aggression is tantamount to madness. Putting aside the excellent arguments advanced by Ikle and others that this is a contingency as
worthy of our attention as others [10], the fact of the matter is that, should the Soviets feel differently about the use of nuclear forces as genuine goals of conflict, the consequences of a U.S./Soviet confrontation could be disaster.

What adds special relevance to this question is the seeming determination—the apparent existence of some prime mover—driving Soviet strategic force developments. The basis for the expensive and qualitatively dramatic Soviet initiatives naturally is a subject for debate and discussion. Among the explanations favoring the view of an essentially benign Soviet Union are (1) the build-up as a symptom of traditional Soviet paranoia and overcompensation for perceived external threats, (2) constant dynamic force innovations as a result of internal Soviet bureaucratic politics (3) overdoing things to hedge against chronic Soviet shortcomings in technical capabilities (especially missile reliability), and (4) the Soviets are just catching up with what we did in the 1960s. Interestingly, none of these explanations impute any specific operational objectives to the Soviet objectives, that is, Soviet force developments are the result of factors which have nothing to do with any goals which might be termed "military". In this respect, perceptions of the Soviet planning world mirror-image our own situation.

Complementing these views are interpretations of the Soviet occupation as being guided by some "rational" agency, in the sense that Soviet planners decide on some course of action and then implement it straightaway in their fielded forces. Regrettably, most discussion of this possibility quickly descends to Clausewitz/Sokolovskii-style sloganeering, and so debate is quickly enmired in the morass of strategic "doctrine" and "mind sets." Because proponents of the rational view usually also prejudice their cases by proposing unbe-
lievable levels of Soviet efficiency, sophistication, and cunning, the rational view is equivalent to the "malignant" or "alarmist" view.*

Still, out of the vast body of literature, some excellent analysis persuasively argues that Soviet activities do reflect a genuine linkage of force and employment planning. ** It is this possibility—the existence of some set of objectives and, within realistic margins, the translation of "strategy" into forces and plans—that is the source of current American anxiety and consternation over Soviet activities. In one view, we recall the image of "if the kids are quiet, they're up to no good," and in another view we will modify the extent of the badness possible with care are sober assessment. But in either case, most people would think that the U.S.S.R. has embraced far more tightly the basic doctrine of U.S. strategic philosophy which is that "you do not only need forces, but you need a plan."

I will provide a single example of the issues at stake. According to one source [44:216],

"it seems highly likely (during the Cuban missile crisis) that the Soviet leaders . . . did something that U.S. leaders, as I know from my own experience, did only in more general terms—that is, ask their military just how a nuclear exchange would come out."

*The civil defense debate is a most recent and excellent case-in-point. Wild allegations and poor analyses have clouded debate. But the fact remains, that even if Soviet C.D. is lousy, it does represent some official recognition of Soviet value especially of (i) continuity of government, and (ii) the value of population in recovery.

**[61] is an informative review of the more important trends in Soviet strategy and some possible underlying motivations, and [90] provides an interesting and credible explanation of Soviet planning with respect to some defined military goals.
And, another U.S. participant in the Cuban deliberations has recalled that, when he proposed that the U.S. consider some possible "demonstrative" nuclear actions (should the Soviets not stand down), the idea was rejected summarily by all the other participants present, including some of the "coolest and most rationale" nuclear game theorists of the day.

Now the U.S. is no more a rudderless ship than the Soviet Union is a careening juggernaut, but in point of fact, there seems to be highlighted a growing disparity in planning, to go with a growing disparity in forces and capabilities. As a prerequisite for "recovery" and for future proper strategic planning, the creation of an objective function for strategic planning is essential. Only in this way can the U.S. deal with unforeseen contingencies, (if necessary, as Lambeth has said, by making the least bad decision at a time when there are no good ways out [6:23]. It seems to me that the core of any such objective function must be based on the solution of the question: is nuclear war war? Writing in 1962, the eminent British military historian Michael Howard observed

"that the command of POLARIS or MINUTEMAN had become a less-than-military affair" [102:151]

Nominated as representatives of the opposing "warfighting" school are many analysts whose proposed employment repertoire (often) consists of first, surgical, and selective strikes, tricky laydowns, kinky timing, and the like. But few of these proposals are even remotely connected with strategic warfighting objectives as these pertain to central or theater nuclear war. A consequence of the type of thinking springing from "drawdown curves," and worse representations of reality is a disconnect between national political purpose and the ability of nuclear forces to do a limited number of things. I personally do not see how the elimination of the Soviet capability for refining oil or im-
prisoning dissidents fits in with any such objectives.

(I should note that I have excluded a new force, with its own methods and missions from this analysis. Arms control rapidly is changing the DYAD into a TRIAD. Already it appears that arms control will add new complexity to the problem.)

In this thesis I have discussed some of the implications of the force sizing/employment break. The glue to render fit the pieces should be the selection of national aims and effective application of nuclear capabilities to these aims, wherever desirable and feasible.
NOTES FOR CHAPTER II

1. SAC has traditionally invested great effort in ensuring the penetrability of strategic aircraft. Bomber operations might be called "mode-linked," i.e. the failure of a single aircraft on penetration can result in many targets going uncovered; compensation for this involves inefficient and redundant targeting. Accordingly, it is better to act to ensure penetration survivability. See [33]. Among the specialized systems that have been oriented towards defense suppression have been the B-58 bomber, the SNARK (and the cancelled NAVAJO), SKYBOLT, and, possibly the first ICBMs. The technical prerequisites of a Defense Suppression system are its ability to (i) arrive before the aircraft, (ii) destroy a target which may be to some extent hard and spread out over a large area, (iii) arrive reliably. Reliability for each bomber can be enhanced by having the aircraft carry its own suppressive munitions: RASCAL, HOUND DOG, SCAD, SRAM, and ALCM head up this list.

2. Originally, SAC was maintained at a low state of readiness, with the potential to go to sustained alert conditions. Subsequently, bomber alerts became more "intense" for lesser numbers of aircraft during peacetime conditions, so that these planes could flyout under warning of enemy missile attack. In an extreme crisis, it is possible to disperse bombers to civil airfields (and even operate off the interstate, e.g.) to avoid the destructive preemption a missile-armed enemy could inflict. However, to maintain bombers at a high state of alert for a long time is a difficult matter. Fresh crews must be provided as alert crews become fatigued, the plane must be maintained, fueled and armed, the nuclear weapons aboard the plane must be carefully guarded, communications must be intact between dispersed and airborne aircraft and the NCA. It is possible to maintain forces at very high alerts in this way for a short time. The same goes for withholding aircraft during a graduated war, except that there is an even greater requirement for planes to stay on the move.

3. Equivalent Megatonnage is commonly defined as the yield of a weapon in megatons raised to the $2/3$ power. It is thus a better index of the destructive blast effects produced by the weapon. Lately, though, there has been a dispute over the exponent [105]. An I- or P-95 is a targeting device namely a circle containing a certain amount of Industrial capability or population; the center of an I/P-95 can be used as an aimpoint for a weapon of a given size. Contrary to the numbers appearing in this text citation, McNamara's original criteria were $1/4$-$1/3$ population destroyed and $2/3$ industry destroyed.

4. According to Halberstam [97:91], McNamara wanted only 450 MINUTEMEN at first. (The third wing was to be in New Hampshire). When asked by JFK why he did not ask Congress for 450 missiles, McNamara reported that a force of at least 1000 MINUTEMAN was the least he could take to the Hill without being "murdered." McNamara's intention to lower the bomber force is described in Chapter II of the thesis.
5. Ref [20] and interviews

6. Possibly the best reason for retaining the TITAN IIs is their de facto "early warning" capability. Most TII silos are appreciably south of MM farms, and Soviet warheads launched through normal threat trajectories from the same latitude would (so long as they flew similar trajectories) arrive on TII targets several tens of seconds before they arrived at the most Southerly MM silos at Whiteman AFB. A phased attack on the whole of U.S. ICBM forces -- starting with TITAN and walking south to North with ground bursts to avoid fratricide effects would ensure a material interval during which a LUA option could be implemented, at least for the most Northern wings. If an attack avoided TITANS in favor of coordinated nearly simultaneous shots on MM wings, the TITANs could be fired under attack as a made-to-order LNO for use against any number of useful Soviet target arrays. A criticism of Soviet IC farm locations is in order, mainly because of their latitudinal organization.

7. W. Mooz [103] has detailed the attrition rates for combat aircraft including bombers.

8. The B-58 was a dog. It originally was designed as an ALBM carrier [39], and the aircraft/missile combination was almost certainly configured with the defense suppression mission in mind ([50] indicates that what became AGENA upper stage was the ALBM designed with the B-58 in mind. General LeMay represented SAC opinion when he said that even in the unlikely case that the B-58 could be made to fulfill its operational requirements, SAC still did not want it.

9. The HOUND DOG is a jet powered cruise missile which carries a nuclear warhead of yield .65 or 3.5 MT depending on source. The missile is no longer operational, and it was phased out largely because it added serious drag to the B-52 (mainly through its pylons -- even the SRAM pylons add 10-12% drag at altitude). The HOUND DOG was at one point to be equipped with Goodyear Aerospace ATRAN terrain matching guidance but this was never implemented. Thus, the HOUND DOG was relatively inaccurate.

10. As SecDef McNamara himself observed in one instance (concerning the Walküre cancellation),
      In fact, the whole debate on the B-70 tended toward terms which had very little to do with the facts of the situation. There was a lot of talk about missiles versus bombers. I have no feeling about missiles versus bombers as such. If bombers serve our national interest, then we should be interested in bombers; if missiles, then we should be interested in them...[95:92]

11. The B-28 and B-43 were early nuclear bombs, probably with yields greater than 5 Megatons. One of these was probably a weapon with about 24 MT yield. [98]. The B-53 was a bomb for the B-52; since the W-53 was the TITAN IIs warhead (with yield 9 MT) I assume that the B-53 has the same yield. Sub-
sequently, new bombs were developed. Lately nuclear warheads for gravity bombs are said to have a set of low dialable yields ranging from about 1.2 MT (maximum) to fairly low yields, possibly on the order of 440 KT. [16] & [104]

12. Although ultimate force levels were set more-or-less firmly by late-1961 [1:Chapter II], deliveries of some forces (especially SSBNs) continued into CY67. (All long-lead funding for SSBNs had been included in budgets through FY64). Submarine construction is relatively lengthy and a boat is typically not deployed operationally for up to a year after it is launched (for shake-down and sea trials). The THRESHER accident was one factor which led to a delay in SSBN commissioning because of tighter inspection criteria.

13. In addition to these strategic force levels (SNDVs and RVs), U.S. and Soviet forces include a large number of theater nuclear warheads. Although some U.S. TNFs have had an unambiguous ability to strike the Soviet Zi -- including THOR, JUPITER, MACE (esp. the B mod), REGULUS, and the like -- the only "theater forces" capable of reaching Soviet targets on a two-way mission today are the F-111s (two wings of which are based in the U.K.) (F-4s could do this mission, but would have trouble recovering). TNFs are excluded from this analysis. The reader is invited to inspect [15], [45], and [48].

14. See Foster [11]. This is because of a certain minimal "buy-in" weight for any weapon, for reentry shielding, HE trigger, arming, fusing, safety, and other gadgetry. Because the yield of a weapon increases faster than linearly with respect to the weight of an RV, the relationship Weight raised to the 1.5 power is sometimes cited as a very rough rule of thumb. If EMT is defined as yield to the 2/3 power, then net EMT is roughly constant regardless of fractionation. However, Y also depends on Y:W ratio, design, composition of the bomb, adjustments for tailored nuclear weapons effects, and so on. Further, the EMT scaling exponent of 2/3 is the subject of constant and hot debate. Downwards revision of the exponent to a new value of as low as 0.3 have been proposed [105], so this "rule" must be considered as a very crude heuristic. I am indebted to Professors G. Rathjens, and J. Ruina, for their views on this.

15. Peter Gold, of the Office of Senator Gary Hart (D-Colo) has expressed the view widely held by many analysts (including nearly all Minimum Deterrence theoreticians) in his observation that "a single POSEIDON submarine could destroy 160 Soviet cities." However, there are a several factors which render this comment inaccurate: they include problems with missile reliability, range, warhead yield (and criteria for target destruction), and MIRV "footprint" limitations. Thus, in the OTA study on the Effects of Nuclear War [06], the U.S. in its attack on Soviet energy production and distribution targets is unable to cover the entire target system with its allotted 10 SNDVs -- this is because of MIRV footprint restriction (the footprint of an SLBM is, relatively
speaking, much smaller than those of ICBMs, and the footprints of ICBMs with small throwweights are smaller than those with larger throwweights per RV). As General Russ Dougherty, former CinCSAC is said to have put the footprint issue, "Show me a man who can kill twenty ducks with one shotgun shell and I want him on JSTPS."

16. Nor should they. While specific force structure matters must play a role in setting relative priorities for allocation, internal factors as well as external considerations can be counted on (rightly) to dominate strict analytical requirements as determinants of force sizing decisions. Among the most potent internal factors are uncertainty of the present and future (including capabilities, adversarial intentions, abilities, and technology), the sensitivity of decisions to the dictates of marginal utility of expenditures directed towards the same goal, and the possibilities for substitution of alternate forces and concepts (including "denial", negotiated and non-military solutions as options). An array of external factors -- which include institutional, economic, management, and political issues -- may be stronger even than all internal inputs. Thus, we are constrained by an OMB "top line," and resources must be equitably shared between many enterprises. We cannot ignore management issues -- we can't start up and shut down programs as we please, etc. Most persuasive is the fact that "analytic determinism" is in violation of the democratic process which Defense -- like any other public activity -- is constituted annually to serve.

17. Among the systems which McNamara phased out, cancelled, or procured in less-than-originally programmed quantities were: (Strategic systems along listed) ABM, advanced ICBM, AMSA, B/RS-70, B-58, DYNA-SOAR, MOL, F-12, about 300 B-52s, many ADC/ANG squadrons, ARADCOM and ADC NIKE, HAWK, and BOMARC batteries, SKYBOLT, most of SAGE/BUIc, ANP, SLAM, TITAN I, ATLAS, the SR-71, JUPITER/THOR, MACE A/B, MATADOR, SNARK, REGULUS, HOUND DOG, the 7th MINUTEMAN WING, and four extra POLARIS SSBNS.

18. Even so, alert rates have fallen with time, from 50% to 40% in the late 1960s, to 30% in about 1974. Airborne alert was cancelled with (i) the hardening of ICBMs, and (ii) the costs -- in terms of operations and accidents -- of airborne alert. Closing strategic bases, it might be observed, is as hard as closing any other base, and the resistance encountered here is another deterrent to trimming forces at the edges.
NOTES FOR CHAPTER III

1. An example of a "cute" LNO is an attack on the refining capability of the USSR. I say "cute," because it is not immediately apparent how such an attack would help U.S. interests in a larger military contest. However, Schlesinger has spoken of such an attack as a sample LNO [20:46], and the O.T.A., in its recent study, the Effects of Nuclear War includes a hypothetical exchange of 10 SNDVs aimed at the petroleum refineries of the other side.

2. See Collier's magazine, 27 October 1951, for a fictional "I was there," news account of a nuclear war bearing a strong resemblance to HALFWON. The highlight of World War III there is an airborne suicide assault on a Soviet nuclear weapons plant in the Urals.

3. Apparently, in the late 1940's and early 1950's, U.S. planners felt that the largest bomb which might someday be in the U.S. arsenal would have a yield of something like 100 Kilotons. This sentiment was prevalent at a time when the successful manufacture of an H-bomb was not certain. It was thought that preinitiation of fission would prevent the fabrication of larger weapons than 100 KT. However, the expert weapons designer, Ted Taylor, built a special Uranium bomb, (The "S.O.B.", for Super Oeralloy Bomb), which had a yield in the "megaton range." [24:140ff].

4. Through the early 1950s there were no such things as hard or point targets in the Soviet Union. To maximize the area covered by a modest amount of blast (as was done at Hiroshima, e.g.), the Air Force considered only relatively high altitude airburst weapons. The USAF had not considered the notion of surface bursts, and, to study the fallout activity of an airburst bomb which accidentally fell to the ground before detonating (as well as analyzing some ground burst applications), the JANGLE series of surface and subsurface tests was organized. [27:40-41].

5. The issues at stake are highlighted in the B-36 dispute. [10:32]. The original USAF orientation towards countervalue (in the Douhetian style), and U.S.N.'s interest in Mahanian-type counterforce attacks have slowly reversed over time. I am indebted to Jack Nunn and LTC Bob Clewell, USA, for some interesting pointers on the subject of the U.S.'s offensive tradition. The interested reader is encouraged to see [93].

6. As carrier and TAC pilots assigned to nuclear delivery missions against peripheral targets in the 1940s/1950s will tell you, there was no coordination between SAC and the other concerned services in the areas of mission and sortie coordination. All of the pilots who I have spoken with have outlined the key issue (in their eyes) having to do with coordination, namely the fear that tactical aircraft would be threatened by the larger yield nuclear weapons dropped by SAC aircraft operating at much higher altitudes. [5] also notes that USAF and USN planned their forces as if the "other side did not exist."
7. See also[93]

8. See page 103 of this paper.

9. Reference to "lay down" options and problems in some respects seems to be a giveaway of planning interest in the problems associated (usually with avoiding) collateral damage from nuclear bursts.

10. A priori estimates of military capabilities, especially those hinging on technical factors have been terrible throughout history. Most notably there is the matter of the estimated casualties caused by the delivery of bombs prior to World War II. Because of some isolated incidents of World War I "strategic bombing," e.g. a Gotha raid scored an accidental direct hit on a school in Poplar, London, causing many casualties and precipitating a local riot -- it was felt that (by analogue) the delivery of 1 ton of bombs in World War II would cause 50 casualties. Of course the figure over-estimated the actual damage done by a very large margin. [107]. Another example of technical assessment is found in R. Wohlstetter's Pearl Harbor.[109]. Prior to 7 December, U.S. intelligence officials did not think that the Japanese had solved the technical problems associated with launching torpedoes from aircraft into shallow water. Of course, the Japanese had indeed solved this problem. This machine gun is another case in point.

11. The "cookie cutter" describes a circle around the ground zero [GZ] of a weapon within which every type of a given target of interest is considered destroyed with no damage occurring outside the perimeter of the cookie cutter. [See 100]. Based on AEC theoretical and empirical data, a cookie cutter for fatalities and U/I damage corresponds to about the 5 psi overpressure contour for weapons of relatively low yield. More recently, a more sophisticated log-normal index has been devised which has a non "abrupt" cut-off for the edge of the cutter, to take into account the gradual (not quantum) fall off in lethality with increasing distance from GZ. The new non-zero-sigma rules lower Pk values slightly within a certain distance of GZ.

12. The SIOP is accordingly a very complex document which is continually updated as new targets appear and as prioritization decisions are changed; in short the SIOP is very easily perturbed by any number of phenomena. Imagine a package of weapons for an assured destruction attack on a certain city. Suppose a new target is found which is not covered by adequate blast from previously programmed weapons. The entire package must be reworked, since all weapons are linked in the laydown and the movement of one weapon can only be done by rewriting the entire package.

13. In the early 1970s, the Soviets apparently decided to superharden their silos. Beginning with their most modern launchers, it is reported that all silos will be hardened to 3000 psi. [Air Force magazine, March 1977 page 37. The net program cost is said to be $20Billion;
at U.S. prices, this describes a hardening program for all Soviet launchers. 3000 psi may be a trifle high, since this is the ultimate compressive strength of cement. See AW&ST, 18 April 1977 p 18. The U.S. is said to have spent about $10 million per silo in its upgrade program. [108].

Silo response to translational accelerations and to dynamic (Q) drag on headworks is not well understood, and is subject to sufficiently many externalities and influences that the simple popular rules of Pk based on such-and-such a psi may be wildly inaccurate under some circumstances. Moreover, interactive phenomena, such as reflected overpressure and unreliability in fuzing (as well as the well-known CEP variable) further compound difficulties. Data on the individual vulnerability of U.S. silos is available in classified sources, but even so, unpredictable factors, such as the height of the water table, will figure prominently in actual circumstances. Consequently I do not vouch for the accuracy of these silo hardness numbers; they are used only to illustrate a trend:

<table>
<thead>
<tr>
<th>YEAR</th>
<th>AVERAGE SILO HARDNESS</th>
<th>NUMBER OF TARGETS</th>
</tr>
</thead>
<tbody>
<tr>
<td>1967</td>
<td>200 psi</td>
<td>570</td>
</tr>
<tr>
<td>1971</td>
<td>325 psi</td>
<td>1513</td>
</tr>
<tr>
<td>1975</td>
<td>490 psi</td>
<td>1603</td>
</tr>
<tr>
<td>1979</td>
<td>1350 psi</td>
<td>1508</td>
</tr>
<tr>
<td>1983</td>
<td>1650 psi</td>
<td>(1550)</td>
</tr>
</tbody>
</table>

Note on Fratricide: To be sure, the fratricide constraint is a salient matter, but the experience of 35 years suggests that few engineering problems defy solution for long. If there is even a small probability that fratricide will not destroy incoming shots (say, if a second airburst disperses the debris in the stem of a first ground burst shot), then the subsequent shots can improved materially OPK versus silos -- if warheads are available. Also if RVs do not fuze or explode to South of silos, nth shots can arrive with impunity. Fratricide, first widely reported in "Why ICBMs can survive a nuclear war," [Air Force magazine, 1975], has all the beauty of a McNamara force structure limiter.

Given historical U.S. interest in Counterforce attacks, I assume that something like 0.9 is used as a DE for RVSN targets. [AWST reports 0.87 as a HTK DE, 11 July 1970, p 15].

14. "CMP" -- CounterMilitary Potential -- is an index of HTK capability also known as "K". However CMP is an inaccurate index at low CEPs, since CMP increases even after the target comes within the cookie cutter of the weapon. Tom Brown has observed that a single weapon with nearly perfect accuracy would have a CMP sufficient to destroy many targets (when divided between them). This is of course impossible. J. Foster [11], and Foster and Bruce Bennett (in an unpublished Rand Working Note) have advanced the ECMP formulation which includes this fact and also takes into account the properties of individual targets.
15. This is especially the case for iron-wheel (gimballed) gyros. Strapdown and similar INS technologies might render ICBM guidance packages less vulnerable to ground shock.

16. Weapons that are cold-launched -- i.e. thrown clear from a silo or launch tube before the missile's engine is ignited -- can be reloaded, since such weapons do not destroy a silo as utterly as do missiles which are "hot launched", i.e. ignited in the silo. Two of the Soviet fourth generation ICBMs -- the SS-17 and SS-18 -- are cold-launched and can be refired (by loading an extra missile into a launcher). Because the Soviet Union is building many more such missiles than are required to fill holes and to conduct a test program, and because there is evidence that the Soviets are (i) storing reloads in bunkers near silos and (ii) practicing reloading, the reload problem might be a justification for hitting "empty holes." Cold launching has other advantages: the volume of a silo or other launcher can be more completely filled with ICBM, since the silo need not contain channels for venting the hot exhaust gases of hot launched missiles. Also, if the missile is a dud -- and 90% of missile failures occur during primary engine ignition -- the dud round is thrown clear of the silo or launch tube, permitting a reload and also minimizing the risk of the defective missile to the launcher (especially valuable in the case of SLBMs).

17. Command Data Buffer simulates ICBM trajectories using local gravitational gradiometric data when the targets for missiles are changed. Thus, when a MINUTEMAN III is in the process of being retargeted it may be down during trajectory recomputation and unavailable for prompt launching.

18. At the highest state of alert, up to 25% of NATO's nuclear capable aircraft may be standing QRA. Needless to say, this puts a bite in NATO's air-to-ground conventional capabilities at the time they are most needed [esp. all-WX capability, i.e. the F-111]. USAFE has therefore opposed the continuation of this practise and has sought to prevent the nuclear-hardwiring of the F-15 and F-16 (they lost on the latter).

19. Metzger and Doty [56] indicate the equivalent of 3 SSBNs assigned to NATO, but it is unclear in this account whether this number refers to on-station forces or total NATO-committed forces. From many indications -- especially the fact that the U.S. original SSBN "donation" to NATO (at the 1962 Athens summit) was five boats, I reckon that their "480" RV figure is on-station force. At a generated DEFCON, and given SSBN availability, a fourth boat could probably be turned around or sped to patrol areas which, incidentally, need not be very far from CONUS. Using the U.S.'s perennial 2-CV commitment as a model, it is doubtful that the number of U.S. SSBNs could decrease without a NATO ministerial "firestorm."

20. [Deleted]

21. Another factor contributing to the rigidity of bomber operations is the need for working around training and practice doctrine for nuclear delivery.

22. Wm. Perry has used the metaphor of "pellets from a shotgun" in describing
the U.S.'s cruise missile penetration concept.

23. A preferential offense is based on the following concept: a defender is obliged to defend all targets from all sorts of threats, while an attacker can select a single attack tactic and time and coordinate his attacks to friendly advantage. Thus, Soviet air defenses must anticipate an all-azimuth U.S. bomber or cruise missile attack, while SAC can pick small corridors through which all forces will travel, overwhelming local defenses. The relative cost to the U.S. of maintaining a threat which requires a given level of Soviet defensive outlays is spoken of under the rubric of "cost exchange ratios."


25. Although they are used frequently as vernacular expressions, both "recovery" and "viability" are technically defined for the purposes of target planners. Viability, first discussed in detail in S. G. Winter, Jr.'s seminal work [110] is the prerequisite for recovery after U/I warfare. An economy is said to be viable iff

(i) its output is sufficient to provide workers and their families with a level of consumption high enough to encourage general contribution to productive recovery activities and socially acceptable behavior
(ii) output is adequate to meet fixed claims on the economy (such as a requirement to care for nonproductive citizens, to meet further military and internal security demands, to dispose of corpses and conduct the necessary demolition and public health functions, etc.)
(iii) it is possible to maintain the stock of real capital (including inventories) required to accomplish (i) and (ii) supra.

If an economy is not viable, then there will be tremendous pressures on the productive citizenry to avoid recovery work in favor of individual incentives, such as feeding their families. Workers will leave recovery activities to "trek" and forage for supplies, and, as shortages take their tolls, remaining workers will be even less productive, etc. A vicious downward spiral ensues. Accordingly, it is thought to be necessary to maintain viability (or restore it immediately), and targeteers might put the destruction of viability as their primary goal. In this paradigm, recovery is a classic race the survivors must run to ensure viability of the U.S. economy prior to the exhaustion of inventories. However, as Sobin and Bull ["Measurement of critical production capacities for models of post-attack recovery," RAC-TP-387, February 1970] conclude: "it is not easy to conclude (from a survey of literature) that any particular kinds of capacities are the critical ones in the sense of providing absolute limits (to recovering viability)." The answer to this dilemma is undoubtedly expressed officially in most excessive statements of objective targeting requirements.

26. McNamara's original index for U/I damage -- IFS, or "Industrial Floor Space," -- was chosen because it is very easy to compute. IFS is simply the area occupied by plants involved in different (or nondifferentiated)
economic activities. However, IFS is not a clear and very useful index of U/I damage because it does not give any measure of losses in such areas as services and agriculture. MVA (Manufacturing Value Added), describes the amount of value added to raw materials in manufacturing processes. It is a more refined index of industrial production, but it too does not include Services. Other indices of economic damage are GNP (Gross National Product), GVO (Gross Value of Output), and K (for Capital). With GNP it is theoretically possible to compute the loss to an economy in terms of "services destroyed"—but because an exact determination depends on knowing who was killed and who was not, GNP calculations are not very useful from an analytic point-of-view. GVO double counts the value of inputs, and K does not include services.

27. A useful expression of population colocation with industrial activities is as follows:

<table>
<thead>
<tr>
<th>Population within</th>
<th>US</th>
<th>USSR</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.0 nmi of industry</td>
<td>9</td>
<td>16</td>
</tr>
<tr>
<td>1.5 nmi &quot;</td>
<td>22</td>
<td>31</td>
</tr>
<tr>
<td>2.5 nmi &quot;</td>
<td>45</td>
<td>44</td>
</tr>
<tr>
<td>5.0 nmi &quot;</td>
<td>65</td>
<td>62</td>
</tr>
</tbody>
</table>

Source: Armed Forces J. International, May 1979, p 26

28. By other indices (floor space, including floor space calculations normalized for multi-story dwellings), the USSR is far more concentrated than is the United States. See DCPA Attack Environment Manual.

29. Soviet planning indeed tends towards "gigantism" in plant sizing. The immense Kama River, Atommash, and Pavladar plants each account for a substantial fraction of Soviet output in motor vehicle, atomic reactor, and Aluminum production. For sample industries, the Soviets are 50-100% more concentrated than the U.S. [100]. Such large installations are examples of a truly pervasive eggs-in-one-basket philosophy which has few parallels in the U.S. civilian sector.

30. Individual target blast vulnerabilities may greatly exceed overpressures dictated by general area coverage rules. Industrial and residential structures may collapse at 5 psi, but thorough destruction of dies, presses, tooling, etc. may require 20-50 or more psi. Lightweight industrial structures may even add to the survival prospects of fixtures by acting as "spaced armor" (absorbing energy of the shock front and carrying it away from targets below as the roof of the structure decomposes.) The Boeing company, in conjunction with DNA, has shown that the resistance of individual industrial equipments to blast effects can be enhanced greatly by hasty measures [Boeing Aerospace Company, "Industrial Survival and Recovery after Nuclear Attack," Seattle, 1976]. In some experiments, calculators and motorcycles were packed in woodchips or sandbags and were able to survive overpressures exceeding 100 psi. As analyses of recovery of individual industrial processes after World War II indicate, survival of tools and equipment was much more important than the survival of buildings per se as a determinant of recovery.
31. In an authoritative report, R. U. Ayers has pointed out the following faults of I/O modelling [111]

- I/O models are 'snapshots' of the economy and do not reveal evolutionary trends and effects of trends
- Dynamic features of production, esp. lead times are ignored
- Allowance for substitution is a function of the number of sectors in the model
- Inter-industry coefficients are fixed and therefore unrealistic
- Lack of geographic specificity does not provide for the adverse consequences of transpo disruption
- Demand is typically a function only of supply and does not relate to policy decisions

Among these, the key problems concern substitution and the detail of available data. For example, within a given sector, there is the provision for infinite substitutibility ... in sector "Tools" hammers are as good as saws for every activity requiring tools. But there is no chance for substituting between sectors, although the ingenuity of production controllers has been demonstrated repeatedly; (this is especially the case when labor can be substituted for a lost input of another type). "Imbalancing" (i.e. bottlenecking) attacks are an intuitive consequence of I/O economic modelling, because the erasure of an industrial sector leads to general economic collapse (since all sectors relying on the input of another activity neutralized by the imbalancing attack collapse, etc.). But the fallacy of this type of analysis is evident in the case of the imbalancing attack on the Soviet paint industry proposed a few years back. Because (i) virtually every economic activity in the USSR requires paint as an input, (ii) there are very few paint plants in the USSR and little inventory, (iii) it takes years to rebuild a paint plant, it "follows" that the Soviet economy should grind to a halt after a counter-paint LNO!

32. Some hard-core target planners with whom I spoke claim that the issuance of NSDM 242 (anti-recovery guidance) to supercede previous viability-killing was mainly based on the acknowledgment by Defense Planners that it was impossible, within the constraint on the number of warheads allowed for U/I attacks, to destroy the viability of the USSR. Counter-recovery targeting is said to be a "step down" from anti-viability targeting. From an unclassified vantage point, there is little that can be said about the ramifications of the changed guidance. It might be noted, from an intuitive perspective, however, that nuclear weapons of any yield do damage so efficiently (and the damage tends to be interactive), that it is hard to imagine how a small change in targeting protocol would produce radically different results of a full-SIOP attack. I would bet that the results of various targeting philosophies in force over the years have not changed much over time (at most by only a couple of percent) in terms of numbers of key targets destroyed.
NOTES FOR CHAPTER IV

1. According to Greenwood [8], and other sources, the original design specified yield of the weapons inside of the Mk-3 (POSEIDON) RV was as high as 70 kilotons. So far as I am aware, the nuclear weapon was not redesigned after this performance requirement had been issued. As there were no impediments to the test program (unlimited 70 KT testing is permitted under the tighter 150 KT test-ban threshold set after the relevant period), I cannot think of any reason that it would be impossible to reach the specified yield of 70 KT. Of course, the Mk-3 yield is now reputed to be 40 KT. Thus, unless the warhead configuration was changed in design stage, it is possible that some change in the weapon "at the margin" was made to reduce yield by nearly 50%. The most obvious (but not the only) candidate for suspicion would be the removal of a warhead "booster," a vial of light isotopic fuels (which has come into notoriety in connection with W. Pincus' reporting of the "ERW" or "neutron bomb" controversy.) (A liability of a Tritium booster is the fact that the SSBN must take off time to have the warheads "recycled," insofar as the half-life of Tritium is something like 12 years). Unless the warhead design was changed, then, or unless the engineers charged with developing the system failed to satisfy the 70 KT requirement, then it is possible that some intentional steps were taken to downgrade the yield of the POSEIDON weapons.

2. According to some articles in Aviation Week, the Command Data Buffer [CDB] permits an improvement in ICBM accuracy independent of other improvements in RV performance. [Interview, Mike Callaham, MIT Program for Science and Technology in International Security]. What the CDB does is simulate ICBM trajectories against new targets, taking into account anomalous gravitational forces in the North American continent over which the ICBMs will be flying. An improved gradiometric system will use the floated, neutral buoyancy AIRS sphere to accomplish on-board gravitational gradiometry (to improve geoid models which do not incorporate mapped anomalies due to iron deposits, mountain ranges, etc.). See the March 1977 Astronautics and Aeronautics, article entitled "Gravity Gradiometry."
<table>
<thead>
<tr>
<th>Acronym</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>A.D.</td>
<td>Assured Destruction</td>
</tr>
<tr>
<td>ABRES</td>
<td>Advanced Ballistic Reentry Systems</td>
</tr>
<tr>
<td>ADC</td>
<td>Air Defense Command</td>
</tr>
<tr>
<td>ANG</td>
<td>Air National Guard</td>
</tr>
<tr>
<td>ARADCOM</td>
<td>Army Air Defense Command</td>
</tr>
<tr>
<td>ASM</td>
<td>Air-to-Surface Missile</td>
</tr>
<tr>
<td>C3</td>
<td>(&quot;C-cubed&quot;) Command, Control, Communications</td>
</tr>
<tr>
<td>CEP</td>
<td>Circular Error Probable</td>
</tr>
<tr>
<td>CF</td>
<td>Counterforce</td>
</tr>
<tr>
<td>CONUS</td>
<td>Continental United States</td>
</tr>
<tr>
<td>CPI</td>
<td>Consumer Price Index</td>
</tr>
<tr>
<td>DDRE</td>
<td>Department (or Director) of Defense Research &amp; Engineering</td>
</tr>
<tr>
<td>DE</td>
<td>Damage Expectancy</td>
</tr>
<tr>
<td>DGZ</td>
<td>Designated Ground Zero</td>
</tr>
<tr>
<td>EMT</td>
<td>Equivalent Megaton</td>
</tr>
<tr>
<td>FYDP</td>
<td>Five Year Defense Plan</td>
</tr>
<tr>
<td>GSP</td>
<td>General Strike Program</td>
</tr>
<tr>
<td>HCL</td>
<td>H-hour Line of Control</td>
</tr>
<tr>
<td>HTK</td>
<td>Hard Target Kill</td>
</tr>
<tr>
<td>IFS</td>
<td>Industrial Floor Space</td>
</tr>
<tr>
<td>JSCP</td>
<td>Joint Strategic Capabilities Plan</td>
</tr>
<tr>
<td>JSOP</td>
<td>Joint Strategic Operations Plan</td>
</tr>
<tr>
<td>JSTPS</td>
<td>Joint Strategic Target Planning Staff</td>
</tr>
<tr>
<td>&quot;K&quot;</td>
<td>(a.k.a. CMP, for Counter Military Potential), Lethality Index</td>
</tr>
<tr>
<td>LCF</td>
<td>Launch Control Facility</td>
</tr>
<tr>
<td>LNO</td>
<td>Limited Nuclear Option (sometimes SNO)</td>
</tr>
<tr>
<td>LOW</td>
<td>Launch-on-Warning</td>
</tr>
<tr>
<td>MVA</td>
<td>Manufacturing Value Added</td>
</tr>
<tr>
<td>NCA</td>
<td>National Command Authority</td>
</tr>
<tr>
<td>NESC</td>
<td>Net Evaluation Subcommittee</td>
</tr>
<tr>
<td>NOP</td>
<td>Nuclear Operational Plan</td>
</tr>
<tr>
<td>NSTAP</td>
<td>National Strategic Target and Planning Guidance</td>
</tr>
<tr>
<td>OPK</td>
<td>Overall Probability of Kill</td>
</tr>
<tr>
<td>OSD</td>
<td>Office of the Secretary of Defense</td>
</tr>
<tr>
<td>PAL</td>
<td>Permissive Action Link</td>
</tr>
<tr>
<td>PLS</td>
<td>Prelaunch Survivability</td>
</tr>
<tr>
<td>PSP</td>
<td>Priority Strike Plan</td>
</tr>
<tr>
<td>QRA</td>
<td>Quick Reaction Alert</td>
</tr>
<tr>
<td>RV</td>
<td>Reentry Vehicle</td>
</tr>
<tr>
<td>RVSN</td>
<td>Soviet Strategic Rocket Forces</td>
</tr>
<tr>
<td>SDF</td>
<td>Strategic Defense Forces</td>
</tr>
<tr>
<td>SEP</td>
<td>Selective Employment Plan</td>
</tr>
<tr>
<td>SIOP</td>
<td>Single Integrated Operational Plan</td>
</tr>
<tr>
<td>SNDV</td>
<td>Strategic Nuclear Delivery Vehicle</td>
</tr>
<tr>
<td>SNF</td>
<td>Strategic Nuclear Forces</td>
</tr>
<tr>
<td>SOF</td>
<td>Strategic Offensive Forces</td>
</tr>
<tr>
<td>TAI</td>
<td>Total Authorized Inventory</td>
</tr>
<tr>
<td>TDI</td>
<td>Target Data Inventory</td>
</tr>
<tr>
<td>TN</td>
<td>Tactical Nuclear (or theater nuclear)</td>
</tr>
<tr>
<td>TOA</td>
<td>Total Obligational Authority</td>
</tr>
<tr>
<td>U/I</td>
<td>Urban/Industrial</td>
</tr>
<tr>
<td>ZI</td>
<td>Zone of the Interior</td>
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</table>
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