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by Joseph M. Grieco

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Cornell University

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I. INTRODUCTION

The following is a critical analysis of Paul H. Nitze's "Assuring Strategic Stability in an Era of Detente."[1] While Jan Lodal's "Assuring Strategic Stability: An Alternative View," points to many problems in Nitze's analysis, it does not address the central assertion made by Nitze.[2] That is, Nitze argues that the trend in Soviet-American relative strategic forces is such that,

> ...the United States is moving toward a posture of minimum deterrence in which we would be conceding to the Soviet Union the potential for a military and political victory if deterrence failed.[3]

It is this provocative component of his analysis that is the focus of critical attention in this paper, for on the basis of it Nitze urges deployment of a partially mobile ICBM force.

Concerning Nitze's strategic analysis, three lines of criticism are pursued. One relates to the inappropriateness of Nitze's use of strategic throw-weight as the central measure of Soviet-American relative capabilities. Another line of criticism disputes Nitze's view regarding the ease with which a counterforce strike can be executed. Third, Nitze's use of strategic throw-weight and his assumptions concerning counterforce strikes combine to yield an unrealistic account of the probable course and outcome of a Soviet-American counterforce

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exchange. In sum, it will be shown that the future of the Soviet-American strategic relationship is much more favorable to the United States than described by Nitze, and therefore his policy proposal is unnecessary and possibly destabilizing.

II. NITZE AND THE SOVIET THROW-WEIGHT ISSUE

Nitze's argument concerning the future potential Soviet war-winning capability rests on two premises. First, a Soviet-initiated exchange would be purely counterforce, and the objective of both the Soviet Union and the United States in such an exchange would be to destroy as much as possible of the opponent's strategic throw-weight.[4] Second, the appropriate overall measure of post-attack residual capabilities would be strategic throw-weight.[5]

Clearly the concept of throw-weight is central to Nitze's analysis, and it is this concept, usually defined as the weight of strategic weapons and associated instrumentation which may be carried by various delivery vehicles, which deserves critical attention. First, it is doubtful that throw-weight is an important factor as accuracy during a counterforce exchange. As Lodal notes,

> Unless accuracies are better than about 0.2 nautical miles (CEP), <u>no</u> reasonable MIRV system can have much of a counterforce capability; once accuracies are better than 0.1 nautical miles, essentially <u>any</u> size missile, even those of relatively low throw-weight, can destroy silos. (emphasis in original)[6]

Thus if the USSR attempts to compensate for accuracy problems by building larger missiles, it will at best only catch-up or keep-up with US capabilities if the latter emphasizes accuracy improvements. On the other hand, if the USSR greatly improves its missile accuracies, then that component of its forces, not throw-weight, should be the focus of US attention.

Later discussion shows that Nitze is not oblivious to accuracy, but before turning to that, another point on throw-weight may be appropriate. As noted above, Nitze places great emphasis on throw-weight as the appropriate measure of post-counterforce residual capabilities. As he states,

> It is the situation _after_ attack (counterforce), of course, that is most important. And here, since the targets remaining after the exchange would almost all be soft ones, missile accuracy and other refinements in the original postures no longer have the same significance. Surviving throw-weight thus becomes an appropriate _total_ measure of residual capabilities on both sides. (emphasis in original)[7]

Not only does Nitze consider throw-weight appropriate, it is the only measure used in his analysis. Of course, he is correct insofar as he notes the lessened importance of accuracy when soft targets are attacked, but this does not, as shall be shown, justify the conclusion he draws, i.e., throw-weight is therefore appropriate as a measure of relative capabilities.

Assume that both sides engaged in counterforce attacks, and only soft targets remained. What then is more effective: a small number of large weapons, or a large number of small weapons? While it is perhaps counterintuitive, the latter is the answer. That is, much of the destructive energy of large weapons cannot extend itself beyond a certain distance from detonation. Analysts have observed that the effective yields of strategic weapons are their nominal yield to the two-third power; thus larger weapons have much of their destructive potential essentially "wasted."[8] Further, many soft targets need only a small amount of destructive energy applied, and the vast destructive energy of large weapons merely overkills such targets.

Thus it is more efficient, in terms of countervalue attacks, to have available a large number of small weapons. It is irrelevant that the USSR may have greater throw-weight than the US after counterforce exchanges, unless such throw-weight disparities are translated into larger numbers of warheads. Rather than throw-weight, numbers of warheads appear to be more appropriate as a measure of relative capabilities. As Enthoven and Smith observe,

> If a single index is needed, the number of separately targetable warheads is the least unsatisfactory one, because the number of targets destroyed increases almost in direct proportion to increases in the number of warheads.[9]

Former Secretary of Defense Robert McNamara makes a similar argument:

> ...the most meaningful and realistic measurement of nuclear capability is the number of separate warheads that can be delivered accurately on high-priority targets with sufficient power to destroy them.[10]

As explicated below, after any conceivable counterforce attack on it by the USSR, the US will have the greater number of nuclear warheads. In fact, counterforce exchanges, even if initiated by the USSR, worsen the position of the USSR in this regard. If this is so, and if the number of warheads is the appropriate measure of capabilities, then it is hard to share Nitze's concern that the USSR might consider a counterforce attack.

III. NITZE AND SOVIET COUNTERFORCE CAPABILITIES

The above discussion argues that throw-weight may not be as important as accuracy during a counterforce attack, and not as important as sheer numbers of warheads after an exchange. As regards throw-weight and accuracy, the former is significant only within a fairly narrow range of values of the latter. Interestingly enough, Nitze assumes an accuracy within the band described by Lodal, but does not at all emphasize his accuracy factor. Perhaps doing so would reveal a weakness in his analysis, for the accuracy he postulates for the new generation of Soviet ICBMs is exactly two times better than has been estimated recently by US intelligence officials.[11] This official estimate of 0.25 nm CEP is also quite inadequate in terms of the band of accuracies described by Lodal as necessary for counterforce attacks.

In any event, Nitze argues that with the deployment of SS-18s (which carry 8 one megaton weapons), and SS-19s (which carry 6 one-half megaton weapons), and assuming these new missiles have accuracies of 0.125 nm CEP, then with only 2000 one megaton warheads carried by 250 SS-18s, the USSR could threaten 92% of the American land-based ICBM force.[12] At least in theory, Nitze's scenario is both possible and disturbing. Given his assumptions, his calculations are essentially correct, and to the extent that his assumptions obtain, a relatively small portion of the Soviet ICBM force could indeed threaten the bulk of the American ICBM force. This scenario, if realistic, could create a perceived strategic relationship in which Soviet leaders might seem to have advantages over American leaders in a crisis situation, and from the American viewpoint this is obviously unacceptable.

However, evidence suggests that Nitze's assumptions, concerning the ease of a counterforce attack, need serious alteration, both in terms of achieved as opposed to expected accuracy, and the relationship of one attacking warhead to other warheads in the attack. First consider accuracy. When Nitze assumes an accuracy for Soviet missiles, he can only do so in terms of what the Soviets might expect as a result of test-firings of missiles. This raises some rather interesting observations made by (then) Secretary of Defense James Schlesinger in testimony before Congress in 1974. He noted that, for the US, regardless of accuracies estimated via test-firings, "We can never know what kinds of degrees of accuracy would be achieved in the real world." He noted that, "The parameters of the flights from western test ranges are not really very helpful in determining those accuracies to the Soviet Union." Finally, he noted that, "...there will always be a degradation in accuracy as one shifts from R&D testing... to operational silos."[13]

If the US is faced with real uncertainty regarding translation of test-flight accuracies into operational accuracies, then is it not fair to assume that the USSR experiences similar perceptions of uncertainty? Also, although Schlesinger did not explicite his understanding of the accuracy degradation problem, one might speculate that several factors contribute to it, and that these factors similarly confront Soviet planners. For example, the specific influences on accuracy of the gravitational pull of the sun and the moon, and the earth's magnetism as missiles go from the USSR to the US (or the reverse), might be difficult to forsee and accomodate to the extent needed for very small CEPs. Other factors might be the interference of static electronic fields, and local wind conditions. While advanced devices, such as terminal guidance systems, may be deployed with the purpose of minimizing such uncertainties, their very sensitivity might cause uncertainties concerning accuracy.[14]

While it is not publicly known what impact accuracy degradation has on counterforce capabilities, one can report that Schlesinger felt compelled to add 0.1 nm to Soviet and American CEP estimates solely on the basis of uncertainties he attributed to accuracy degradation.[15] If indeed it is more realistic to include such a degradation factor in counterforce calculations, then those suggested by Nitze, which fail to do so, should be viewed with a certain skepticism. To illustrate the implications of the degradation factor, the two silo-destruction functions indicated in Table I (see p. 8) are derived from the same assumptions used by Nitze with the sole exception of accuracy assumed for one of the functions. While the function, Threat A, (representing Nitze's calculations), assumes a 0.125 nm CEP, the function, Threat B, assumes a 0.225 nm CEP, reflecting Schlesinger's suggestion concerning the impact of accuracy degradation.

Table I: Soviet Counterforce Capabilities[16]

Threat A

Assumptions

Yield: 1 Megaton
CEP: .125 nm
SSKP: .89 (air), .85 (ground)
OAR: .83
TKP: .74 (air), .71 (ground)
Silo Hardness: 1500 psi
Operative Kill Probability: the average of air and ground burst detonations needed to destroy 92% of the US ICBMs.

Calculations

$Pk_1(\text{air})=1-(1-.74)^1=$ .74
$Pk_1(\text{ground})=1-(1-.71)^1=$.71
$Pk_2(\text{air})=1-(1-.74)^2=$ .93
$Pk_2(\text{ground})=1-(1-.71)^2=$.92
Pk_2(average 2 air & 2 ground burst RVs) =.925

The Attack

If 2 RVs/silo targeted, and 1000 silos attacked, then

1000 silos x .925 = 925 silos destroyed, or a little over 92% of the US ICBM force.

Number of RVs used in the attack: 1000 silos x 2 RVs/silo=2000 RVs.

Threat B

Assumptions

Yield: 1 Megaton
CEP: .225 nm
SSKP: .54 (air), .5 (ground)
OAR: .83
TKP: .48 (air), .415 (ground)
Silo Hardness: 1500 psi
Operative Kill Probability: the average of air and ground burst detonations needed to destroy 92% of the US ICBMs.

Calculations

$Pk_1(\text{air})=1-(1-.48)^1=$ .48
$Pk_1(\text{ground})=1-(1-.415)^1=$.415
$Pk_4(\text{air})=1-(1-.48)^4=$ .95
$Pk_4(\text{ground})=1-(1-.415)^4=$.889
Pk_4(average of 2 air & 2 ground burst RVs) =.92

The Attack

If 4 RVs/silo targeted, and 1000 silos attacked, then

1000 silos x .92 = 920 silos destroyed, or exactly 92% of the US ICBM force.

Number of RVs used in the attack: 1000 silos x 4 RVs/silo=4000 RVs.

Note that to threaten between 92% and 93% of the US ICBM under Threat A only about 2000 Soviet RVs are required, but that under Threat B some 4000 RVs are required for the same attack performance. Two observations become apparent on the basis of these crude calculations. First, without doubt accuracy degradation levels approaching those suggested by Schlesinger drastically affect the efficiency of counterforce strategies. While Threat A required relatively few RVs to attack many silos successfully, degradation of 0.1 nm or 80% requires an increase of 2000 RVs, or 100%, in order to attain the same destruction level. Second, enormous uncertainty enters into counterforce scenarios once accuracy degradation is taken into account. If the USSR uses only 2000 RVs, but finds that 4000 were needed, there may not be enough time to attack with the additional RVs before the US releases its ICBMs which survived the first attack.

There are also problems with Nitze's assumptions regarding the interaction of warheads as they attack a single target such as a missile silo. Nitze's assumptions are reflected by the calculations in Table I, i.e., warheads are assumed to complement each other's performance in such a fashion as to treat the overall probability of a silo kill as being the probalistic function of the number of warheads targeted against the silo. However, a recent article by McGlinchey and Seelig makes the opposite case, that warheads will in fact interfere with each other's performance.

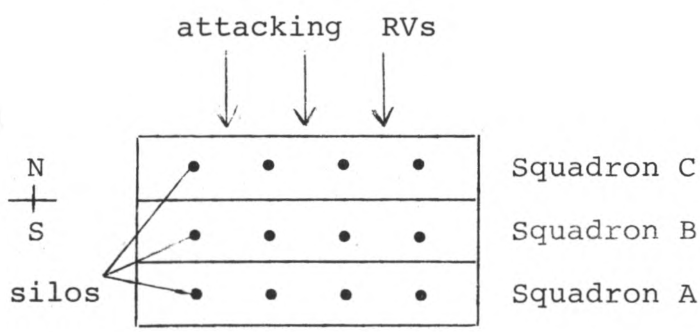
For example, they describe the problem of "neutron flux." The explosion of the first warhead may generate such a great amount of neutron atoms that succeeding warheads "...can be so affected that either the material will fail to initiate the nuclear reaction, or the reaction will occur with a reduced yield."[17] The high radiation and shock wave created by the first explosion also might negatively affect warheads following it. The radiation may render radar and inertial fuses inoperative, compelling the use of contact fuses, which according to the authors degrades warhead accuracy.[18] The shock wave has two negative affects. First, if an RV is close behind an exploding warhead, the latter's shock wave may create a "...deceleration load that will exceed the reentry vehicle's structural strength," thereby destroying the second vehicle.[19] Alternatively, if the second RV is placed further behind the warhead about to detonate, the former's trajectory "...may be deflected by the shock front, but, more importantly, it will traverse regions behind the front where air density and winds are very different from those predicted for normal reentry."[20]

This of course confirms the concept of accuracy degradation resulting from real world conditions rather than test-flights of strategic systems. Finally, there is the problem of the "mushroom clouds" caused by either air or ground burst detonations. While the problem is very acute for the latter detonation form, a Defense Department study of nuclear blasts found that the phenomena occurs with both forms, and is particularly sensitive to increases in yield, which of course means the problem is associated especially with the large Soviet warheads.[21] With the first warhead's detonation, there would develop rapidly an upward moving air stream which would pull up dust and debris into what would appear as a mushroom cloud. McGlinchey and

Seelig observe that, "Reentry vehicles can be disabled if they pass through the high density stem ... or if they are struck by debris."[22]

Strategic analysts are still in the process of learning how to include the fratricide phenomenon into counterforce calculations. One interpretation is that it constrains severely the number of warheads targeted against each silo, limits the detonation form employed by the attacker, and, finally, creates time problems for the attacker.[23] Consider for example the following hypothetical ICBM system:

Illustration I



One possible strategy for an attacker might be to lay down a barrage of one warhead per silo, and have all of the warheads land simultaneously. However, after completion of the attack, no further RVs could attack the more southern squadrons (B and A), in that the dust and debris raised by detonations over Squadron C would endanger RVs passing overhead on their way to B and A. Thus for an hour or so, fratricide problems would "mask" or "shield" Squadrons B and A from further attacks.

Therefore, unless an attacker is extremely confident about the performance of one attacking RV per silo, serious fratricide-related problems complicate targeting plans. Further, it should be noted that an attacker using more than one RV per silo would most likely want to take advantage of both air and ground burst detonations. The former is particularly adept at cracking the shields of attacked silos, and the latter offers the advantage of cratering which tilts a silo in such a fashion as to render its missile inoperable. However, ground bursts are particularly prone to displacing dust and debris, and therefore an attacker wishing to capitalize on the advantages of ground bursts must reckon with especially acute fratricide problems.

Thus, if an attacker employs two RVs per silo, then the attack must consist of first using air burst detonated RVs against the southernmost silos (in the above, Squadron A), wait until the fireball subsides in order to avoid radiation problems (a matter of perhaps 30 seconds), and then attack with RVs detonated in the ground burst mode. As the second wave of RVs detonate in Squadron A, silos in Squadron B may be attacked with air burst detonated RVs. Note, however, that Squadron C may not be attacked until all detonations are completed in Squadron A and the second wave of RVs enters into Squadron B. A Department of Defense official reported to this student that the above process of "walking up" an attack against US ICBMs would require an hour. After it is completed, no additional RVs could be committed until after the dust and debris settle in the northern silo fields. This would require a lull in the attack of one hour. Thus the total time to launch two salvos of two RVs per US silo would be, according to a Defense Department official, around three hours.

An alternative attack mode might be to target three RVs per silo, e.g., two air and one ground burst detonations. In this case an attacker would place one set of air burst detonated RVs in Squadron A, wait, send another salvo, again wait, and then send a final salvo of RVs detonated in the ground burst mode. Only as this last salvo enters into Squadron A may the attack begin against Squadron B, and so on from South to North. This strategy is reported by the official to require three to four hours of execution. Obviously if there are doubts about accuracy it would be more rational to attack with two salvos of two RVs per silo, for more RVs may be used in this attack mode than can be used in the three RV per silo mode, but both require the same amount of time for execution.

Interestingly enough, after either attack mode is completed, a large amount of dust and debris would remain in the atmosphere even after a substantial amount of time had elapsed. Thus an attacker would have difficulties with and therefore little confidence in satellite reconnaissance in determining which silos had been destroyed in the first salvo. As a result, an attacker contemplating two salvos of RVs may need to target all silos in the second salvo, even though many silos would be destroyed in the first salvo. The time urgency of an attack might compel such a costly targeting decision. After the hour elapses between attacks, use of satellite reconnaissance would require additional time to make observations, report them to attack authorities, and make appropriate targeting choices. Moreover, while an hour is needed before the second attack may begin, more time might be required for clearing of the air space above the silos such that satellites can be used with high confidence. In sum, a cautious attack planner may have little confidence in "shoot-look-shoot" strategies; rather, an attacker may feel compelled to take the safer path of targeting all silos in the second salvo, even though this is very costly in terms of warheads committed to the attack.

Thus accuracy degradation and strategic fratricide combine to complicate severely a potential attacker's counterforce strategy. On the one hand, degradation in accuracy makes unlikely that an attacker can rely upon the performance of only one RV per silo. On the other hand, fratricide makes the effectiveness of more than one RV per silo very uncertain, for the attacker is constrained in terms of the number and detonation forms of the RVs used in the attack. Most seriously, fratricide compels an attacker to leave unmolested large numbers of enemy missiles for relatively long periods of time (relative that is, to the time necessary to release missiles not yet under attack). Nitze fails completely to acknowledge, address, or include in his analysis these problems for an attacker, and therefore his discussion of possible Soviet counterforce capabilities must be considered greatly flawed.

IV. NITZE AND AMERICAN COUNTERFORCE CAPABILITIES

When the total Soviet and American strategic arsenals are introduced into counterforce scenarios, and if it is agreed that the most appropriate post-counterforce exchange measure of relative capabilities is the number of warheads remaining in strategic arsenals (rather than throw-weight), then a Soviet first-strike becomes much more unattractive than described by Nitze. As sketched in Table II, one might assume a maximum Soviet MIRVed ICBM program, a partially MRVed SLBM force, and one hundred bombers. A plausible American posture (say, by 1990), might have a total of strategic launchers below the proposed SALT II ceiling, but having as alterations to the present posture large numbers of B-1 bombers, B-52s fitted with SRAMS (Short Range Attack Missiles), Trident SSBNs, and all of the Poseidon SSBNs retrofitted with Trident I missiles.

Thus for the Soviets a vast program is assumed; they are just beginning to deploy their new ICBMs (some components are still being tested), and they have just tested a MRVed SLBM. On the American side, the B-1 is a new but already announced and fairly assured addition, and the number of Tridents deployed is assumed to remain as currently planned. Also, note that many of the B-52s currently in the US arsenal are assumed to be phased out as the B-1 is procured; if fewer B-1s are eventually procured that presently assumed, but more B-52s are retained, then US bomber capabilities would remain fairly constant. Thus the only major innovation made in the analysis is the retrofitting of the entire 31 Poseidon SSBN fleet with Trident I missiles, rather than the currently planned retrofitting of only 10 Poseidons.

Table II: The Strategic Balance[24]

Launcher System	Number Deployed	Warheads/Launcher	Warheads
(a) The USSR			
SS-19	1012	6	6072
SS-18	308	8	2464
other ICBM	180	1	180
SS-N-6-M3	544	3 (MRVs)	1632
other SLBMs	256	1	256
Bombers (Bear)	100	1 (kangaroo missile)	100
		Total Soviet Warheads:	10,704
(b) The US			
Minuteman III	550	3	1650
Minuteman II	450	1	450
Trident I	760	8	6080
B-1 Bomber	240	24 (SRAMs)	5760
B-52 G/H	295	24 (20 SRAMs, 4 bombs)	6120
		Total American Warheads:	20,060

In sum, prior to any sort of exchange, the USSR would have about 10,704 warheads, or about 50% of the US arsenal of 20,060 warheads. Even under the best conceivable circumstances, i.e., Nitze's scenario, the USSR would need to invest 2000 warheads or 18% of its strategic arsenal to destroy 1940 US warheads or less than 10% of the latter's arsenal. After such an attack, and prior to an American response, the Soviet position would actually deteriorate slightly: rather than having 50% of the US arsenal, after the attack postulated by Nitze the USSR would have 48% of the US arsenal in terms of warheads. Thus it is difficult to observe any massive Soviet strategic advantage gained by striking first, at least in terms of warheads; at best, the USSR remained about where it started, even if a near perfect strike is executed.

Consider, however, two scenarios in which the US responds in kind to the Soviet counterforce strike. (The calculations for the scenarios can be found in Appendix I). At one extreme is what one might call the Soviet best case: Soviet missiles have a 0.125 nm CEP (the accuracy used in the Nitze analysis), and American missiles, while they have the same test-flight CEP, encounter accuracy degradation problems such that the Schlesinger-suggested 0.1 nm degradation factor is added to the American accuracy. Thus American missiles have an accuracy of 0.225 nm CEP. At the other extreme accuracy assumptions are reversed: Soviet missiles have a 0.225 nm CEP, while American missiles have a 0.125 nm CEP accuracy. This scenario may be thought of as the Soviet worst case.

Note also that after the USSR completes its attack against the US ICBM system, there would probably be few hard targets remaining in the US, and attacks by the USSR on US soft targets would very probably provoke an American response in kind. Therefore, the USSR may not be able to attack new American targets so long as the US response to the initial Soviet attack remains directed against Soviet ICBMs. Thus the USSR cannot release its missiles during the US counterforce response, for effectively it has already attacked all permissible targets. Thus the US would have the time necessary to execute a counterforce attack taking into account fratricide problems.

In the USSR best case, only 250 SS-18s destroy 920 Minuteman silos, leaving 1250 Soviet ICBMs as targets for the US. If the US responds with 5000 Trident I warheads (leaving 1080 as a reserve), the Soviet surviving force consists of about 35 SS-18s, 549 SS-19s, 180 unMIRVed ICBMs, and their entire bomber and SSBN forces, yielding about 5742 warheads or about 49% of the pre-exchange Soviet arsenal. The US, losing most of its ICBM force, and expending 5000 Trident I warheads in its counterforce response, would have remaining its bomber force, 1080 sea-based warheads, and some land-based warheads, yielding 13,100 warheads, or 65% of its pre-exchange arsenal. The US proportion of its pre-exchange arsenal is greater than that of the USSR <u>after a perfect</u> Soviet attack. Also, in terms of warheads the USSR would have 43% of the US arsenal after the exchange, compared to 50% before the exchange, a net decrease of 14% for the USSR in relative capabilities.

Now consider the Soviet worst case. In this scenario the USSR would use its entire force of 308 SS-18s, as well as 256 SS-19s, leaving as targets 756 SS-19s, and 180 unMIRVed ICBMs. If the US commits a total of 5 Trident I warheads per silo (done in such a fashion as to account for fratricide problems), the USSR surviving arsenal would contain 114 SS-19s, 47 unMIRVed ICBMs, and its SSBN and bomber forces, totaling 2719 warheads. For the US, there would remain its bomber force, 100 ICBMs, and a Trident reserve of 1400 warheads, totaling 13,480 warheads. While the US has almost two-thirds of its arsenal remaining, the USSR has only one-fourth of its pre-exchange arsenal in terms of warheads. Also, Soviet relative capabilities vastly deteriorate in this scenario: from the 50% pre-exchange ratio, the USSR after a counterforce exchange with the US would have only about 20% of the US force in terms of warheads, a decrease in USSR strength relative to the US approaching 60%.

The above analysis yields at least three observations. First, under the best of circumstances, the USSR would stay only at about the same level of relative strength as the US via a first strike. Second, regardless of circumstances, with a US response to the USSR attack, the USSR strategic position would deteriorate as a result of the exchange it initiated.

Third, after an exchange the US unquestionably would have the forces needed to threaten the existence of Soviet society, thus denying the USSR any possibility of escaping unacceptable damage as a result of its attack. In sum, the USSR would suffer severely if it were to execute a first strike, and in fact a Soviet first strike would enhance American strategic superiority in terms of warheads. This obviously contradicts Nitze's claim that the US might soon concede to the USSR "the potential for a military and political victory if deterrence failed" (see above, p. 1).

The above analysis must confront several criticisms. For example, it assumes that warhead totals should be the measure of capabilities, and that small warheads can be compared on an equal basis with large weapons. In response: as noted above, it is the greater number of warheads which is the most efficient means against soft targets, (and only soft targets would remain after a counterforce exchange), and small weapons approach equality with large weapons against soft targets. Thus in this crucial category the USSR would suffer by striking first, and therefore US deterrence can be said to be strong. Thus Nitze's fear, that deterrence might fail, rests on a very weak foundation.

Also, it might be argued that US warhead superiority is based on its bomber force, and therefore its lead is illusory, for bombers have a doubtful survival and penetration capability compared to ICBMs and SLBMs. Two responses can be made to this point. First, the US could hedge against these problems by maintaining an SLBM reserve, as is assumed in the above discussion. Second, while the US may have doubts about its bomber penetration capability, the USSR might have doubts about its bomber interdiction capability. In considering a first strike, the USSR must take into account the problem of interdicting some 500 American bombers capable of delivering up to 12,000 strategic weapons (each with a minimum yield of 200 kilotons), and only a few of these bombers would need to reach and attack high-value targets in order to destroy Soviet society.[25] Surely, no rational Soviet leader would consider this a problem easily dismissed. Obviously this uncertainty on the part of the USSR concerning the US bomber threat would serve as a deterrent against a Soviet first strike, and again the future US-USSR strategic balance is more stable than suggested by Nitze.

Additionally, the Soviets themselves would be faced with vulnerability and penetration problems, even if they consider using their forces first. It is quite likely that 100 rather aged Soviet bombers are at least as vulnerable when trying to penetrate American air space as 500 vastly more advanced American bombers attempting to penetrate Soviet air space, even though there are more extensive Soviet air defenses. Also, Soviet SSBNs do not have the same operating and evasion capabilities as enjoyed by the American fleet, and therefore the USSR would probably have more to fear from anti-submarine warfare.[26] This too serves to deter possible Soviet expectations that advantages can be derived from a first strike.

A third criticism might be that the above analysis overstates US bomber and SLBM forces because many of these non-alert forces would be destroyed in a first-strike. While admittedly a serious criticism, one may reply that it would be most difficult for the USSR to launch an attack which caught the US very much by surprise, and US forces caught on the ground or in pens would be small. In contemplating a strike, the USSR would want to deploy its own forces to the maximum, thus giving warning to the US. Also, the USSR cannot expect to reduce US forces via a mixed ICBM/SLBM, for as noted by James Schlesinger in the 1975 Posture Statement, it would be extremely difficult for the USSR to coordinate a mixed attack which would not give adequate warning to either the US ICBM or bomber forces.[27]

Finally, Nitze and thus far this analysis assume that a Soviet counterforce attack is responded to in kind by the US, i.e., with US counterforce strikes. There is actually no reason why the USSR could be assured of such a response, and the US might even have cause to respond to a Soviet counterforce attack with a limited countervalue strike. Official estimates suggest that between 3 and 16 million Americans would die immediately during a "purely counterforce" Soviet strike.[28] If the US decided to go directly to countervalue strikes, it would have many more warheads in its arsenal, for it would not use the bulk of its SLBM force against Soviet ICBMs. US countervalue capabilities would therefore increase relative to those of the USSR, for the increase in US SLBM forces by withholding from a counterforce strike would be greater than the USSR forces that would have been destroyed by an American attack. Of course, it is debatable whether the US would retaliate in such a manner, but at the same time the USSR cannot be sure that the US would not so respond to a Soviet counterforce attack that killed so many Americans. This too serves as a deterrent to a Soviet first-strike, and, again, strategic stability is greater than suggested by Nitze.

V. CONCLUSION: NITZE AND THE MX MISSILE

Thus while Nitze considers throw-weight the appropriate measure of strategic forces, a strong argument exists that the number of warheads is a more useful measure. While Nitze considers a successful Soviet first-strike rather easily achieved, the above argues that such an attack would be extremely difficult. While Nitze fears that if the USSR strikes first it would be in a position superior to the US, and might threaten to or actually strike during a crisis, the present analysis suggests that such a course of action would be gravely dangerous for the USSR, and therefore deterrence is much more assured in the future than argued by Nitze. Thus a final issue is raised: Nitze's proposal for deployment of up to 10,000 partially hardened shelters to which US ICBMs would be dispersed if they were threatened. In light of the forces required to target all shelters, the USSR would consider a first-strike futile, and stability is thereby assured.[29]

Nitze's proposal attracts several criticisms. If future stability is already likely, as argued in this paper, then Nitze's plan is unnecessary. Further, there is the problem of the enormous cost of such a plan; estimates run between $12 and $50 billion.[30] There are also vast political problems with his proposal. As noted by Michael Nacht, a shelter system would be 'the ultimate shell game,' and would gravely impair strategic arms agreements.[31] With verification of forces made extremely difficult, the USSR might consider a US shelter system a cover for covert ICBM deployments, and might therefore respond with increased Soviet deployments. The result of Nitze's proposal could very well be an accelerated arms race. Additionally, if the SALT process were aborted, the resulting mutual recriminations as to the responsibility for such a turn of events would strain greatly Soviet-American relations. Finally, less destabilizing alternatives may be available to protect American ICBMs.[32]

Unfortunately, the US Government appears to be going in the direction opposite that suggested by the above analysis. The thrust of the new ICBM program, the MX missile, appears to be towards a shelter system. While $41 million was spent in

FY 1976 to study all basing modes, $35.1 million was requested for FY 1977 just for study of basing modes "employing multiple deceptive aimpoints,"[33] i.e., the Nitze plan. In fact, the MX program, using a multiple launch-point basing mode, appears to be accelerating. It was reported recently that the Air Force will request $400 million in FY 1978 for a "project validation phase" of the MX missile. It was also reported that the Air Force plan is to "move directly to a mobile basing mode" if a decision is made to procure the MX.[34] Yet, if the above discussion is correct, then for the forseeable future there is no real strategic need for a shelter system.

This is not to say that the US may be complacent about the future of the Soviet-American strategic relationship. In the distant future it is quite possible that both sides will acquire capabilities such that each might theoretically threaten the other's ICBMs with high confidence. While new US forces and deployment modes might then be a rational response, the arms control route should also be studied as a solution to the ICBM vulnerability problem. Of course, the arms control route probably would require a rather long time period for successful completion (this, in any event, has been our experience thus far), but as noted, we need not worry for the forseeable future about ICBM vulnerability. Thus, after (and assuming) a SALT II accord is finalized, the US will have ample time to pursue additional arms control arrangements whose aim can be to assure long-term stability. The crucial point with respect to Nitze is that his proposal might very well jeopardize those future arms control efforts. It is therefore suggested that his plan not be adopted, and that instead the US Government pursue a long-term policy heavily emphasizing arms control as the solution to the future ICBM vulnerability problem. Thus the stability sought by Nitze can be achieved without embarking on the problematic course he advocates, and the net impact might be greater security for the Nation.

Appendix I

1. Introduction

Employing some of the data found in Tables I and II, it is possible to construct very rough models of possible Soviet-American counterforce exchanges. In contrast to the use by Nitze of throw-weight as the key measure of the outcome of such an exchange, this analysis uses the resulting number of warheads remaining on each side after an exchange as the central measure of relative residual capabilities. Hopefully it will be shown that regardless of circumstances the USSR cannot achieve a strategic advantage via a first-strike. This thesis is of course the opposite of that proposed by Nitze.

2. Case I: The Soviet Best Case

(A) Assumptions for USSR

CEP:		0.125 nm
OAR:		0.83
Yield(SS-18):		1 Megaton
SSKP	(SS-18):	.85(ground)
	" :	.89(air)
TKP	" :	.71(ground)
	" :	.74(air)
$Pk_{(2)}$	" :	.92(ground)
$Pk_{(2)}$	" :	.93(air)
Assume $Pk_{(2)}$:		.93

(A') Assumptions for US

CEP:		0.225 nm
OAR:		0.83
Yield(TridentI):		100 kt
SSKP	" :	.14(ground)
	" :	.16(air)
TKP	" :	.12(ground)
	" :	.13(air)
$Pk_{(2)}$	" :	.23(ground)
$Pk_{(2)}$	" :	.24(air)
Assume $Pk_{(2)}$	:	.235

(B) The Exchange

The USSR attacks with 250 SS-18s, or 2000 1MT RVs, against the entire Minuteman force of 1000 launchers. Achieved is a 93% destruction rate. After the attack, there are 1250 Soviet ICBMs in reserve, 1070 of which are MIRVed. The US is assumed to have deployed its Bomber force to secure bases. The US attacks with its SLBM force. Keeping 1080 Trident I warheads as a reserve, the US may use 5000 RVs in its response, or 5 RVs/silo if only the MIRVed forces are attacked. Because the bulk of the US ICBM force is already destroyed, it is assumed that the US would have a relatively great amount of time to respond, for the Soviets no longer would have hard targets to attack. Attacks on soft targets might lead to escalation to countervalue attacks, and both sides probably would wish to avoid such a development. Thus if the US response is two waves of two RVs per silo, followed by a third wave of 1 RV per silo, the time of attack would be 1 hour for the first wave + 1 hour wait + 1 hour for the second wave + 1 hour wait + .5 hour for the third wave = 4.5 hours. (This compares with 1 hour for the Soviet attack). The US attack would be as follows:

Appendix I (cont.)

1000 targets
.235 Pk (average of Pk of 2 air and 2 ground burst detonations)

235

765 targets which survived the first wave
.235 Pk (2)

179 targets destroyed in the second wave

586 targets which survived the second wave
.13 Pk (1 airburst)

73 targets destroyed in the third wave

Total targets destroyed: 487 (or .487 overall kill probability)
Total targets survived : 513

Remaining are:

(1) For the USSR:

	launcher	RVs/launcher	Warheads
68 SS-18s - (.487)(68) =	35 SS-18s	8	280
932 SS-19s - (.487)(932)=	479 SS-19s	6	2874
Untargeted SS-19s =	70 SS-19s	6	420
UnMIRVed ICBMs (untargeted)	180	1	180
800 SLBM with warheads totaling...			1888
100 Bombers		1	100
Total Surviving Soviet Warheads			5742

(2) For the US:
70 ICBMs, of which,

	35 are Minuteman III	3	105
	35 are Minuteman II	1	35
SLBM reserve	= 135 Trident Is	8	1080
Bomber force	495	24	11880
Total Surviving American Warheads			13100

Appendix I (cont.)

(C) Results

1. Pre-exchange ratio : SU_1/US_1 = 10704/20060 = .50
2. Post-exchange ratio : SU_2/SU_1 = 5742/10704 = .49
3. Post-exchange ratio : US_2/US_1 = 13100/20060 = .65
4. Post-exchange ratio : SU_2/US_2 = 5742/13100 = .43
5. Change: .43-.50/.50 x 100 = -.14%

Thus after a mutual counterforce exchange using the above assumptions, the Soviet position in terms of warheads deteriorates by 14%.

3. Case II: The Soviet Worst Case

(A) Assumptions for USSR

CEP: 0.225 nm
OAR: 0.83
Yield: SS-18: 1 Megaton
SS-19: .5 Megaton
SSKP: SS-18: .5 (ground)
" : .54 (air)
SS-19: .35 (ground)
" : .39 (air)
TKP: SS-18: .415 (ground)
" : .48 (air)
SS-19: .29 (ground)
" : .32 (air)
$Pk_{(2)}$: SS-18: .65 (ground)
" : .73 (air)
SS-19: .50 (ground)
" : .54 (air)
$Pk_{\text{(average of 2 air and 2 ground)}}$:
SS-18: .70
SS-19: .52

(A') Assumptions for US

CEP: 0.125 nm
OAR: 0.83
Yield: (Trident I): 100 kt
SSKP: " : .38 (ground)
" : .42 (air)
TKP: " : .31 (ground)
" : .35 (air)
Pk_2: " : .52 (ground)
" : .58 (air)
$Pk_{\text{(average of 2 air and 2 ground)}}$: .55

(B) The Exchange

With the above assumptions, the USSR cannot achieve the same silo destruction level as in Case I using only one salvo of RVs. On the other hand, fratricide problems prevent the USSR from adding RVs to a single salvo; thus the USSR must use a strategy much more costly in time. This of course makes an attack much more risky. But, assuming that the USSR has three hours, it could send two salvos of RVs. The attack is as follows:

2464 SS-18s, or 1232 1 Megaton RV pairs, thus

1000 Minuteman targets
.70 $Pk_{(2)}$
700 Minuteman silos destroyed in first wave;

Appendix I (cont.)

300 targets survive, of which in the second wave,

232 targeted with SS-18s	68 targeted with SS-19s
.70 $Pk_{(2)}$	.52 $Pk_{(2\ SS\text{-}19\ RVs)}$
162 targets destroyed	35 targets destroyed
70 survive second wave	33 survive second wave;

Total silos destroyed: 897 or about 90%.
Total Silos survive : 103.

Note that in both waves all Minuteman silos are targeted, even though many are destroyed in the first wave; this reflects the time urgency of the attack and problems with surveillance. Thus 2464 SS-18 RVs and 1536 SS-19 RVs in the attack, or

2464 SS-18 RVs or 308 SS-18 missiles
1536 SS-19 RVs or 256 SS-19 missiles

4000 RVs and 564 missiles used in the attack.

Remaining would be 756 SS-19s and 180 unMIRVed Soviet ICBMs as targets for the American counterforce response. Using the same targeting strategy as in Case I, with 4970 Trident I warheads the US would still have a reserve of 1400. The attack would be as follows:

936
.55 $Pk_{(2)}$

514 targets destroyed in first wave,

422 targets survived first wave
.55 $Pk_{(2)}$

231 targets destroyed in second wave

191 targets
.31 $Pk_{(1\ airburst)}$

59 targets destroyed in third wave.

Total silos destroyed: 804 (or .86 overall kill ratio)
Total silos survived : 132

e

Appendix I (cont.)

Remaining are:

(1) For the USSR:

	launchers	RVs/launcher	Warheads
756 SS-19s - (.86) (756) =	114	6	684
180 unMIRVed ICBMs-(.86)(180)=47		1	47
	800 SLBMs with total of		1888
	100 Bombers	1	180
Total Surviving Soviet Warheads			2719

(2) For the US:

100 ICBMs, of which,			
	50 Minuteman III	3	150
	50 Minuteman II	1	50
SLBM Reserve	175 Trident I	8	1400
Bomber force	495 B-1s and B-52s	24	11880
Total Surviving American Warheads			13480

(C) Results

1. Pre-exchange ratio : SU_1/US_1 = 10704/20060 = .50
2. Post-exchange ratio : SU_2/AU_1 = 2719/10704 = .25
3. Post-exchange ratio : US_2/US_1 = 13480/20060 = .66
4. Post-exchange ratio : SU_2/US_2 = 2719/13480 = .21
5. Change: .21 - .50/.50 x 100 = -58%

<u>Thus after a mutual counterforce exchange using the above assumptions, the Soviet position in terms of warheads deteriorates by 58%</u>.

Footnotes

1. Paul H. Nitze, "Assuring Strategic Stability in an Era of Detence," Foreign Affairs, Vol. 54, No. 2, (January 1976), pp. 207-32.

2. Jan M. Lodal, "Assuring Strategic Stability: An Alternative View," Foreign Affairs, Vol. 54, No. 3, (April 1976), pp. 462-81.

3. Nitze, p. 227.

4. Nitze, pp. 224-25.

5. Nitze, p. 225.

6. Lodal, p. 465.

7. Nitze, p. 225.

8. See Albert Wohlstetter, "Is There a Strategic Arms Race: Part II," Foreign Policy, No. 16, (Fall 1974), p. 58. See also Alain C. Enthoven and K. Wayne Smith, How Much Is Enough? Shaping the Defense Program, 1961-1969, (New York: Harper and Row, 1971), pp. 179-83. See also Edward Luttwak, The U.S.-U.S.S.R. Nuclear Weapons Balance, (Beverly Hills: Sage, 1974), p. 4.

9. Enthoven and Smith, p. 183.

10. Robert S. McNamara, The Essence of Security: Reflections in Office, (New York: Harper and Row, 1968), p. 56.

11. Reported by Drew Niddleton, "Soviet Edge Seen in Nuclear Arms," New York Times, (April 19, 1976), p. 7.

12. Nitze, p. 231, footnote 10.

13. U.S. Congress, Senate. Subcommittee on Arms Control, International Law and Organization, Committee on Foreign Relations, U.S.-U.S.S.R. Strategic Policies, (March 4, 1974), released (April 1974), p. 15. Hereafter known as Schlesinger Hearing.

14. For a discussion on accuracy instrumentation, see Kosta Tsipis, "The Accuracy of Strategic Missiles," Scientific American, Vol. 233, No. 1, (July 1975), especially p. 19.

15. Schlesinger Hearing, p. 16-17.

16. In footnote 10 of his article, Nitze indicates that his calculations assume a .85 probability that a single megaton-range warhead can destroy a silo hardened to 1500 psi. With reference to the Rand Damage Probability Computer (1974), it is found that he may be referring to the SSKP of one warhead

with the yield of one megaton. He further notes that two such warheads have a .92 probability of a silo kill. Davis and Schlesinger note that the formula for the probability of a silo kill is:

$$Pk_{(n\ warheads)} = 1 - (1-TKP)^{n}$$

$$\text{Thus } Pk_{(2\ warheads)} = .92 = (1-(1-TKP)^{2}$$

$$.71 = TKP.$$

Further, Davis and Schilling note that the overall reliability of a warhead is related to the TKP as

TKP= (OAR) (SSKP)
Thus OAR= (TKP) (SSKP)
OAR= (.71) (.85)
OAR= .83

Therefore, Nitze provides the following assumptions which are included in the present analysis:

Silo Hardness:	1500 psi
Weapon Yield:	1 Megaton
SSKP:	.85 (ground burst)
Pk(2):	.92 (both ground burst)

And from his discussion one is able to determine the following:

OAR:	.83
TKP:	.71 (ground burst)

Sources: (1) For the Nitze assumptions, see his footnote 10, p. 231.

(2) Lynn Etheridge Davis and Warren R. Schilling, "All You Ever Wanted to Know About MIRV and ICBM Calculations But Were Note Cleared to Ask," Journal of Conflict Resolution, Vol. 17, No. 2, (June 1973), especially p. 217.

(3) For the SSKP figures, see the Damage Probability Computer for Point Targets with P and Q Vulnerability Numbers, (Rand R-1380-PR), (February 1974).

17. Lt. Col. Joseph J. McGlinchey (USAF) and Dr. Jacob W. Seelig, "Why ICBMs Can Survive a Nuclear Attack," Air Force Magazine, (September 1974), p. 83.

18. McGlinchey and Seelig, pp. 83-84.

19. McGlinchey and Seelig, p. 83.

20. McGlinchey and Seelig, p. 84.

21. Samuel Glasstone (ed.), The Effects of Nuclear Weapons, (Department of Defense, 1962), pp. 33-38.

22. McGlinchey and Seelig, p. 84.

23. The author wishes to acknowledge the assistance of a Defense Department official in his formulation of the relationship between strategic fratricide and targeting strategy. Unfortunately, the official has requested that direct recognition of his contribution not be made, but the credit due to him is great and the author deeply appreciates his assistance.

24. Assumptions:
   (1) SALT II accord reached; therefore
   (2) Each side may have no more than 2400 launchers,
   (3) Each side may have no more than 1320 MIRVed launchers,
   (4) The USSR is limited to the number of Modern Large Ballistic Missiles agreed to under SALT I (as is projected in the SALT II accord,
   (5) The USSR therefore may not deploy more than 308 SS-18s,
   (6) While Nitze assumes some of the other USSR ICBMs will be SS-17s, this student assumes that all will be SS-19s, which are not MLBMs but carry more RVs than the SS-17s.
   (7) The USSR presently does not have a MRVed or MIRVed SLBM capability; however, the SS-N-6-M3 has been tested with a MRV system, and therefore it is assumed that all 544 will be MRVed in the future.

Sources: (1) The USSR

For the force loadings of Soviet ICBMs and SLBMs, see General George S. Brown, United States Military Posture for FY 1977, (January 1976), pp. 32-38. On the number of SS-N-6-M3s, see The Military Balance: 1975-1976, (IISS, 1975), p. 71. The number of SS-18s permitted under SALT is found in Nitze, footnote 11, p. 219. For the weapon loading of Tu-95s (Bear Bomber), see Edward Luttwak, The U.S.-U.S.S.R. Nuclear Weapons Balance, The Washington Papers #13, (Beverly Hills: Sage, 1974) p. 24, and this figure is confirmed in Janes's All The World's Aircraft: 1975-1976, pp. 512-513. While the USSR currently has 135 long-range Bombers, in order to have a maximum ICBM and SLBM force and still remain under the SALT II ceiling, it is thought that they will phase out their older bombers, the Bisons. For the yield of SS-18 and SS-19 RVs, see Thomas A. Brown, "Missile Accuracy and Strategic Lethality," Survival, Vol. 18, No. 2, (March-April 1976), p. 55.

(2) The US

For the warhead loadings of US ICBMs, see The Military Balance, p. 71. The number of Trident SSBNs is found in Drew Middleton, "Navy Lays Keel on a Trident Sub," New York Times, (April 11, 1976), Section II, p. 30. Lodal says that 100 kt is the yield "projected" for the Trident I missile; see Lodal, p. 465, footnote 5. The B-1 figure is taken from John W. Finney, "House Approves Funds for Production of $21 billion B-1 Bomber," New York Times, (April 9, 1976), p. 12. On the number of SRAMs a B-1 can carry, see U.S. Congress, Senate, Research and Development Subcommittee, Committee on Armed Services, FY 1975 Authorization for Military Procurement, (April 25, 1974), p. 3876. On the number of B-52s Gs and Hs (which are the more modern B-52s, see Luttwak, p. 25, footnote 22, and on their weapons loads, see Luttwak, p. 22. Of course, it should be noted that not all SRAMs would be used against high value targets; many would be used to suppress air defenses. On the other hand, only a few are needed to do vast damage, and damage due to collocation of air defense sites with high value targets would probably also be very great.

25. Luttwak (p. 4) observes that the destructive energy of a warhead may be comparatively measured by taking it to the two/thirds power. Thus a SRAM warhead of 200 kt to the 2/3 power = .333 one-megaton-equivalent (o.m.e.). Enthoven and Smith (p. 207), and Luttwak (p. 13) observe that 200 o.m.e. would cause an unacceptable level of damage to Soviet society; 200 o.m.e. would destroy 21% of the Soviet population (killed: 52 million people), and 72% of the Soviet industrial capabilities. Thus in order to cause such an unacceptable level of damage, only 600 SRAMs would need to reach high value targets; this would be the force loadings of only 25 US Bombers, or 5% of the US Bomber arsenal.

26. Luttwak (pp. 10, 22) observes that US SSBNs are more quiet, and US ASW capabilities are more effective. He rates bomber penetration capabilities are about equal.

27. Luttwak (p. 15) observes that about one-half of the Soviet SSBN fleet is in port at any given time: these forces would need to be deployed prior to an attack or face certain destruction in their pens. For a discussion of the coordination problem, see James H. Schlesinger, Secretary of Defense, FY 1976 and FY 197T Authorization Request (Department of Defense, February 1975), p. I-13-18.

28. U.S., Congress, Senate. Subcommittee on Arms Control, International Organization and Security Agreements, Committee on Foreign Relations, Analysis of Effects of Limited Nuclear War, (1974), pp. 20-21.

29. Nitze, pp. 229-231.

30. The low figure is Nitze's, p. 229, and the high figure is Lodal's, p. 475.

31. Michael Nacht, "The Vladivostok Accord and American Technological Options," Survival, Vol. 17, No. 3, (May-June 1975), p. 112.

32. For example, Lodal, (p. 475, footnote 13), reports that Richard Garwin testified before Congress that the US could deploy steel rods and radar fuse jamming devices around Minuteman silos in order to incapacitate, respectively, ground and air burst detonated RVs. Another idea suggested by Garwin is to deploy pellet-shooting devices whose purpose would be to destroy attacking RVs. Of course, great care would need to be taken not to violate the ABM Treaty.

33. For the 1976 figure, see the FY 1976-197T Posture Statement, p. II-29. For the 1977 figure, see the Department of Defense Program for RDT&E, delivered by Dr. Malcolm R. Currie, (February 1976), p. III-19.

34. John W. Finney, "Air Force Developing ICBM That May Cost $30 Billion," New York Times, (October 10, 1976), pp. 1, 65.

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Peace Studies Program
Cornell University
170 Uris Hall
Ithaca, New York 14853

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