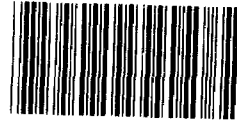


GAO

United States
General Accounting Office
Washington, D.C. 20548

Program Evaluation and
Methodology Division



149853

August 6, 1993

The Honorable John Glenn
Chairman, Committee on
Governmental Affairs
United States Senate

Dear Mr. Chairman:

In answer to your letter, I enclose GAO's responses to the written questions you submitted on behalf of yourself, Senator Dorgan, and Senator Cochran as follow-up to the hearing you chaired on June 10 concerning our "Evaluation of the U.S. Strategic Nuclear Triad."

I want to take this opportunity to express my sincere appreciation for your work in making the June 10 hearing possible and for the follow-up work you and your staff have performed in trying to draw the critical lessons from our eight reports.

I am also hopeful because of the constructive response the Department of Defense has adopted with regard to our study. As you know, Deputy Secretary Perry testified at the hearing that our findings will be "a very important input" to DOD's strategic planning. However, I will avoid getting too enthusiastic until I see some strong studies coming out of DOD that use valid and reliable data to back up assertions about weapon system performance and cost.

If you or the other Members of the Governmental Affairs Committee have any further questions, please call me on 202-512-2900.

Sincerely yours,

Eleanor Chelimsky
Assistant Comptroller General

Enclosure

Written Questions Submitted by Senator Glenn
and GAO Responses

Question 1: Uncertain Costs

- The cost of modernizing the triad has uncertainties. Which systems have the greatest (and the least) cost uncertainties? How uncertain?

GAO Response

Our assessments of cost uncertainty do not always agree with those of the Department of Defense (DOD). A major difference between DOD's and our cost assessments is that we assess costs for both the acquisition and deployment phases of the proposed strategic modernization programs, while DOD typically assesses only the acquisition phase.

In making the assessments for GAO's evaluation of the strategic nuclear triad, we analyzed four factors to estimate the cost uncertainty of a proposed weapon system: (1) the extent to which the system had already progressed through the DOD acquisition process and already demonstrated stability in DOD's own acquisition cost estimates; (2) whether it had completed its test and evaluation, either with overall success or with some problems, but with known costs to address them; (3) whether there was a history of operational deployment to empirically demonstrate operating and support costs, and (4) whether the system posed significant technological risk.

With regard to the cost uncertainties of the strategic programs that are currently deployed or being acquired, we made the following assessments:

- B-1B: The program has encountered numerous performance problems during both the acquisition and deployment phases and substantial cost growth has occurred; nevertheless, the costs to redress the deficiencies, although high, have been identified based on a substantial record of testing and deployment. Accordingly, we assessed cost uncertainty to be low; it is the cost growth for this system that has been high. In this latter regard, another GAO report, Strategic Bombers: Adding Conventional Capabilities Will Be Complex, Time-Consuming, and Costly (GAO/NSIAD-93-45), finds that the recent assignment of the B-1B to new conventional roles will add still more costs; but these also appear to have been reliably identified by DOD.

- B-2: During its acquisition phase, the program has experienced both performance problems and a high level of instability in DOD's own acquisition cost estimates. Moreover, there is no deployment history to demonstrate the accuracy of predicted operating and support costs, and the program poses a significant level of technological risk. Accordingly, we assessed cost uncertainty to be high.
- Ohio-class SSBNs with D-5 SLBMs: Although production of the last of the 18 SSBNs has not been completed, the design has been stable, as have DOD cost estimates. In addition, the system has been deployed for several years, thus establishing an operations and support track record. We assessed cost uncertainty to be low.

The analysis of our cost report, U.S. Strategic Triad: Costs and Uncertainties of Proposed Upgrades (GAO/C-PEMD-92-6), did not include an assessment of the cost uncertainty of the Minuteman III (MM III) upgrade and lifeservice extension programs. During the period in which we were performing our analysis, MM III was not a proposed modernization. However, based on the assessment factors outlined above, we would currently assess the cost uncertainty of the program to be low.

In summary, we found that the B-2 involves the greatest number of unknowns for any of the weapon systems we examined and thus presents the highest level of cost uncertainty.

Question 2: Minuteman III Modernization, Part I

- Please describe how GAO obtained the figure of \$23 billion for Minuteman III modernization, giving a break-out of the \$23 billion budget.

GAO Response

Our report, U.S. Strategic Triad: Final Report and Recommendations (GAO/C-PEMD-92-8), relied on data provided by the Air Force showing that the 30-year lifecycle cost for the MM III lifecycle extension program was \$16.5 billion. We subsequently found those data to be incorrect: the Air Force's Minuteman III Life Extension Report, which we received after our report's publication, made explicit that the \$16.5 billion figure was for a lifecycle cost out to the year 2010, not to the year 2020. To obtain a 30-year lifecycle cost, we extrapolated the operations and support costs of the MM III program 10 additional years.

Specifically, we used the Air Force's cost estimate for various acquisition programs necessary to maintain reliability and to extend the life of MM III to 2010 (\$4.6 billion) and the Air Force's cost estimate for annual operations and support to

the same year (\$11.9 billion at \$.631 billion per year); to this we added 10 additional years of operations and support costs at the same rate of \$.631 billion per year (\$6.3 billion). A breakout of the Air Force's cost estimates is provided on page 18 of its Minuteman III Life Extension Report, which we enclose herewith as appendix I.

Question 2: Minuteman III Modernization, Part II

- Why does GAO recommend examining the decision to modernize the Minuteman III? What are the advantages and disadvantages of modernizing the MM III in terms of capabilities, survivability and other factors?

GAO Response

We stated in our classified report, U.S. Strategic Triad: Final Report and Recommendations, and in our unclassified testimony, that we question the advisability of funding major life-service upgrades for the MM III force because the cost-effectiveness of such an effort is not obvious. There are three reasons for this: (1) its estimated cost through the year 2020 will be \$23 billion, based on Air Force figures; (2) the fact that a reduced nuclear threat environment exists, both now and in the foreseeable future; and (3) the likelihood that substantive modifications would require robust flight test programs that would quickly use up limited test assets.

A re-examination of the MM III life extension program, which we recommend, might consider the various advantages and disadvantages that emerged from our analysis. Two major advantages are that (1) the de-MIRVing of MM III will further reduce "destabilizing" elements in the triad, and (2) the lifeservice extension will likely maintain, if not improve, the relatively high reliability of the MM III force. Four major disadvantages are that (1) MM III has less military capability than the D-5 (Mark 5) SLBM in terms of hard target attack capability; (2) being based in immobile silos, the MM III force presents an array of easily located targets that an enemy can choose to attack; (3) confidence in the system's reliability and accuracy, especially out to the year 2020, will necessarily deteriorate without new test assets beyond those currently being contemplated for MM III flight testing; and (4) the MM III's \$23 billion cost, including significantly greater per warhead costs than those of other systems (see table 1 below), may make other alternatives relatively more attractive.

Question 3: MM III vs. Trident, Cost-to-Go, Part I

- What are the costs-to-go in the GAO report on a total cost basis for the de-MIRVed Minuteman III and the Trident?

GAO Response

Based on the Air Force's Life Extension Report numbers, we found the total costs-to-go for the de-MIRVed MM III force to be \$23 billion out to the year 2020. We found the total costs-to-go for the Ohio/D-5 force to be \$58 billion, assuming a 30-year lifecycle for each SSBN. However, because some Ohio class SSBNs were deployed in the 1980s and will be retired before 2020, we calculated the average lifecycle cost-to-go for the entire force of 18 Ohio SSBNs to be 25.6 years from the year 1992 forward. To take the difference in lifecycle assumptions for the two systems more fully into account, we calculated cost per warhead per year for the MM III and Ohio/D-5 systems. These calculations are shown in table 1.

Table 1: Costs-to-Go per Warhead per Year for Minuteman III and Ohio/D-5 (with 1 warhead per Minuteman III and 4 per D-5)

System	Assumed Life-cycle From 1992	Life-cycle Cost-to-Go	Number of Warheads	Dollars per Warhead	Dollars per Year per Warhead	MM III Compared to Ohio/D-5
MM III	18 years to the year 2010	\$16.5 billion	500	\$33 million	\$1.83 million	40% higher than Ohio/D-5
MM III	28 years to the year 2020	\$23 billion	500	\$46 million	\$1.64 million	25% higher than Ohio/D-5
Ohio/D-5	25.6 years on average for each SSBN	\$58 billion	1728	\$33.6 million	\$1.31 million	

Note that these estimates do not take into account various differences between the MM III and Ohio/D-5 systems, such as the essential invulnerability of the SSBNs at sea compared to the known (attackable) locations of ICBM silos, the greater accuracy of the D-5 SLBM, or different likely alert rates for ICBMs and SLBMs under a variety of different scenarios. The analyses that incorporate these factors are classified.

Question 3: MM III vs. Trident, Cost-to-Go, Part II

- Do these costs take into account (1) the retention of C-4s in the Pacific fleet, (2) the increase of MM III costs from \$16 billion to \$23 billion, (3) the lifetimes of the Trident SSBNs, and (4) the decommissioning costs of nuclear weapons and nuclear reactors?

GAO Response

The calculations given in table 1 above make the following assumptions:

- (1) The lifecycle costs estimated for all 18 Ohio SSBNs are based on an assumption that each would carry 24 D-5 missiles with 8 warheads each. (Retention of C-4 missiles, even including lifeservice extension for them, if necessary, would likely be less costly.) Estimates in table 1 for dollars per warhead, however, are based on 4 warheads per missile, to comply with the 1750 SLBM warhead ceiling of the START II treaty. Overall costs (or savings) to download the SLBM force from 8 to 4 warheads per missile are not included.
- (2) As shown, MM III lifeservice extension costs to the year 2010 (\$16.5 billion) and to the year 2020 (\$23 billion) are taken into account.
- (3) We used an average remaining lifeservice of 25.6 years from the year 1992 for the entire Ohio SSBN force. This calculation assumes a lifeservice of 30 years from deployment for each Ohio SSBN.
- (4) As we point out in our report, U.S. Strategic Triad: Costs and Uncertainties of Proposed Upgrades, nuclear warhead and/or power plant disposal costs for either MM III or the Ohio/D-5 force and the scrap costs (and value) of non-nuclear components of systems were not available from the Department of Defense and are not included.

Question 3: MM III vs. Trident, Cost-to-Go, Part III

- Which system is more capable, the MM III or the Trident II D-5 with W-88 warheads? Which one is capable of destroying "hard-targets?"

GAO Response

At the time we performed our analysis, the MM III was not a proposed upgrade for the land leg of the triad. Thus our comparison for the D-5 SLBM was not to Minuteman but to the then

proposed upgrade Peacekeeper ICBM. We performed this comparison using the following measures of effectiveness: (1) speed and reliability of communications to command authority; (2) time to target, especially for time urgent targets; (3) pre-launch survivability against pre-emptive attack; and (4) lethality to enemy targets, including accuracy, warhead yield, and reliability.

On the measures of speed and reliability of communications and on time to target, we found Peacekeeper and the Ohio/D-5 system with W-88 (Mark 5) warheads to be essentially equal in terms of actual operational effectiveness. For pre-launch survivability, we found that SLBMs on submerged SSBNs possess a clear advantage over ICBMs in easily locatable silos. And we found the D-5 Mark 5 SLBM to be equivalent to the Peacekeeper ICBM on the measure of capability to destroy hard targets.

In contrast, MM III is considerably less accurate than either the Peacekeeper or D-5/Mark 5, and hence would be much less lethal against hard targets. On other measures, such as communications speed and system reliability, MM III is essentially the equal of the two other systems, while sharing the same deficiency as Peacekeeper with regard to easy locatability, given its basing mode in fixed silos.

In sum, the D-5 with Mark 5 (W-88) warheads would be considerably more capable with regard to hard targets than the MM III.

Question 4: ICBM-Silo Vulnerability

-- Has your analysis on silo vulnerability taken into account the effects of (1) fratricide on second and subsequent warheads and (2) the lack of an ability to practice such an attack? Generally, how would these two effects change your estimates of silo kill probability?

GAO Response

Our report, U.S. Strategic Triad: ICBM Vulnerability (GAO/C-PEMD-92-2), found that the claimed increase in vulnerability of U.S. ICBMs in their silos due to improved Soviet missile accuracy had been greatly overstated. The specific calculations we employed in this study followed a methodology provided to us by the Department of Defense, using intelligence community data to incorporate the performance of the most lethal Soviet ICBMs.

As our study noted, the former Soviet Union would have faced a number of major uncertainties about their missiles' performance in planning any attack on the U.S. Many of these uncertainties could not have been confidently resolved short of actual nuclear

conflict. Since no computer model can adequately simulate all actual attack conditions--and since we were in part addressing the claim that U.S. ICBMs were highly vulnerable to massive Soviet attack--we chose to examine U.S. ICBM losses assuming Soviet systems of maximum effectiveness. This meant no Soviet losses of incoming warheads to fratricide. The number of incoming Soviet warheads in our analysis was reduced only by the system reliability factor estimated by the U.S. intelligence community for particular Soviet missiles. Soviet warheads were further assumed to detonate at the altitude that would cause the greatest damage to U.S. silos. And we assumed that no U.S. ICBMs were launched on warning or even under attack--both of which would reduce U.S. losses.

In effect, this analysis embodied the so-called "worst-case" scenario from the U.S. point of view. But even in this case, we calculated that more U.S. ICBMs would survive than had been claimed. Further, it is readily apparent that if fratricide and test unrealism were quantifiable in some reliable manner, the impact on our calculations would have been to increase the number of surviving U.S. silos.

The point here is that any model that could reliably predict U.S. ICBM survivability--by taking into account uncertainties for the attacker that are not currently measurable--would demonstrate less vulnerability than the "worst case" scenario. Further, accounting for fratricide and test unrealism, if that could have been done in some reasonably rigorous way, would have had the effect of augmenting the number of U.S. ICBM silos that could ride out a former Soviet ICBM attack, survive, and retaliate.

Question 5: Air Defense Estimates

-- Are the 1976 CIA Team B projections for Soviet air defenses consistent with those used by the DOD in the late 1970s and early 1980s?

GAO Response

We did not go back to any intelligence sources, such as the 1976 Team B projections, that pre-dated the Defense Department's justifications to Congress for acquiring both the B-1B and the B-2. One of the major baseline sources of our analysis of the size of Soviet strategic air defenses and of the accuracy of intelligence community projections that were made for them was the October 1981 Joint OSD/Air Force Bomber Alternatives Study. It was this study that presented the DoD justifications to Congress for the B-1B and the B-2, in very large part on the basis of claimed increases in the number and effectiveness of Soviet strategic air defenses. The study's estimates were based on the latest threat analysis from the U.S. intelligence community available at the time. The specific sources were

official intelligence community assessments, such as the Defense Intelligence Projections for Planning ("DIPPs") which are coordinated throughout the various agencies of the intelligence community.

Written Questions Submitted by Senator Dorgan
and GAO Responses

Question 1: The Air Force's proposed Minuteman Life Extension Program involves an acquisition cost of \$4.6B for modifications. Air Force cites a total cost-to-go of \$16B based on the \$4.6B of acquisition programs and \$11.9B of operations and support for the 1992-2010 timeframe. You have chosen the timeframe to the year 2020 as a basis for comparison. In your cost conversion, you appear to have extrapolated without first removing the acquisition cost. Will you please make the necessary correction?

GAO Response

No correction is required because we did not include acquisition costs in the 2010-2020 estimate, having already included them in the 1992-2010 estimate. The calculation I presented in my testimony--\$23 billion for the 30-year lifecycle cost for MM III--is not the same as the number (\$16.5 billion) given in our report, U.S. Strategic Triad: Final Report and Recommendations (GAO/C-PEMD-92-8). This report relied on data provided by the Air Force showing that the 30-year lifecycle cost for the MM III program was \$16.5 billion. We subsequently found those data to be incorrect: the Air Force's Minuteman III Life Extension Report, which we received subsequent to the publication of our series of reports, made clear that the \$16.5 billion figure was only for a lifecycle out to the year 2010, not to the year 2020. To obtain a 30-year lifecycle cost, we extrapolated the operations and support costs of the MM III program 10 additional years.

Specifically, we used the Air Force's cost estimate for various acquisition programs necessary to maintain reliability and to help extend the life of MM III to 2010 (\$4.6 billion). We also adopted the Air Force's cost estimate for annual operations and support to the same year (\$11.9 billion at \$.631 billion per year); these costs are needed in addition to the acquisition costs cited above for normal operations and maintenance and general facility support. To this \$11.9 billion for operations and support, we added 10 additional years of operations and support costs at the same rate of \$.631 billion per year (\$6.3 billion). (\$4.6 billion + \$11.9 billion + \$6.3 billion = \$22.8 billion; statistical rounding gives the figure of \$23 billion.)

Question 2: Your estimate of the life cycle cost-to-go for the Trident system is \$58B based on a timeframe out to the year 2020. How did you compute the annual operational and support (O&S) cost of a Trident boat? Did you include cost of operating shore bases such as Bangor and Kings Point? To be more specific, did you include, for each base, costs of maintaining roads, grounds and buildings; medical facilities; dining facilities; dormitories;

salaries of indirect support people; recreational activities? (In calculating ICBM costs, all of these elements are included.) Including all these elements, what is the annual O&S cost of a Trident submarine and its missiles?

GAO Response

As specified in our report, U.S. Strategic Triad: Costs and Uncertainties of Proposed Upgrades (GAO/C-PEMD-92-6, see pages 14-15, and 32-33), our Ohio/D-5 lifecycle cost analysis does include both the direct and indirect costs of operating the Trident system-related facilities at Bangor and Kings Point. Specifically, our analysis of the costs to operate and support the Ohio/D-5 system includes the following elements:

- (1) Military construction costs for the Trident missiles and submarines (\$1.2 billion);
- (2) General SSBN operating costs, including the costs to convert C-4 capable SSBNs to the D-5 missile, missile industrial facility maintenance, general support costs (such as base infrastructure costs like housing, chapels, and theaters), and ongoing investment costs (totaling \$40.7 billion);
- (3) Fleet ballistic missile support (\$.7 billion); and
- (4) Headquarters support (\$3.7 billion).

The total of these operations and support (O&S) costs is thus \$46.3 billion.

As our report states on page 14, our cost estimates do not include the disposal or scrap costs, and value, of materials at the end of the system lifecycle. DOD officials informed us that such cost estimates were not available, and for that reason we could not include them.

Based on the acquisition and operations and support costs yet to be expended as of the end of fiscal year 1990, we calculated the total costs-to-go for the Ohio SSBN/D-5 SLBM system to be \$58 billion. Of course, to calculate the system's cost-to-go on a more current basis--that is, as of the end of fiscal year 1992, which is the date of the Air Force's Life Extension study estimating costs to the year 2010--would require a downward adjustment of the \$58 billion figure.

Question 3: A certain number of Trident boats will age out before the year 2020. In your cost-to-go, did you include boat replacement costs? In cases where submarine nuclear reactors will require re-coring, did you include the relevant costs?

GAO Response

We did not calculate costs for any follow-on system to replace either Ohio class SSBNs or D-5 missiles. Our lifecycle cost analysis assumed a 30-year lifecycle for each Ohio class SSBN. Because a portion of the fleet was deployed in the 1980s and is scheduled for retirement before the year 2020, we have calculated the average lifecycle to go for the entire force of 18 Ohio SSBNs to be 25.6 years from the year 1992 forward, and we have calculated a cost per warhead per year for the Ohio/D-5 system. We have performed a similar calculation for the MM III lifeservice extension program, using both the Air Force's \$16 billion estimate for service to the year 2010 and our extrapolation of operation and support costs to the year 2020. The results of these calculations are shown in table 1. (This table, already presented earlier, is repeated here for the reader's convenience.)

Table 1: Costs-to-Go per Warhead per Year for Minuteman III and Ohio/D-5 (with 1 warhead per Minuteman III and 4 per D-5)

System	Assumed Life-cycle From 1992	Life-cycle Cost-to-Go	Number of Warheads	Dollars per Warhead	Dollars per Year per Warhead	MM III Compared to Ohio/D-5
MM III	18 years to the year 2010	\$16.5 billion	500	\$33 million	\$1.83 million	40% higher than Ohio/D-5
MM III	28 years to the year 2020	\$23 billion	500	\$46 million	\$1.64 million	25% higher than Ohio/D-5
Ohio/D-5	25.6 years on average for each SSBN	\$58 billion	1728	\$33.6 million	\$1.31 million	

Note that these estimates do not take into account various differences between the MM III and Ohio/D-5 systems, such as the invulnerability of the SSBNs at sea compared to the known (attackable) locations of ICBM silos, the greater accuracy of the

D-5 SLBM, or different likely alert rates for ICBMs and SLBMs under a variety of different scenarios.

The calculations above make the following assumptions:

- (1) The lifecycle costs estimated for all 18 Ohio SSBNs are based on an assumption that each would carry 24 D-5 missiles with 8 warheads each. (Retention of C-4 missiles, even including lifeservice extension for them, if necessary, would likely be less costly.) Estimates for dollars per warhead in table 1, however, are based on 4 warheads per missile, to comply with the 1750 SLBM warhead ceiling of the START II treaty. Overall costs (or savings) to download the SLBM force from 8 to 4 warheads per missile are not included.
- (2) As we point out in our report, U.S. Strategic Triad: Costs and Uncertainties of Proposed Upgrades, nuclear warhead and/or power plant disposal costs for either MM III or the Ohio/D-5 force and the scrap costs (and value) of non-nuclear components of systems were not available from the Department of Defense and are not included.
- (3) These data do not include a potential additional \$1.9 billion being considered by the Air Force to improve the inertial measurement unit of the MM III's guidance system for the purpose of improving accuracy.
- (4) Costs for the Ohio class SSBNs do include all of the Navy's estimates for operating and maintaining the system, such as any nuclear power plant re-coring scheduled before the year 2020. Only the costs of disposing of the used core, once replaced, were not available from the Navy and are not included.

Question 4: The C-4 missiles in the Pacific Ocean submarines will begin to age out before the year 2020. We understand that the Navy wants to backfit with D-5 missiles. Have you included the cost of backfitting, including the costs of the boat modifications needed to accommodate the backfit?

GAO Response

Our lifecycle cost estimates do include the costs of backfitting the C-4 Ohio class SSBNs with D-5 missiles, involving the costs of both the new missiles and the necessary modifications to the submarines themselves.

Written Questions Submitted by Senator Cochran
and GAO Responses

Panel 1: Eleanor Chelimsky, Assistant Comptroller General for
Program Evaluation and Methodology GAO

Ms. Chelimsky, I'd like to thank you for taking the time to appear before this committee to discuss a serious topic which so directly affects our nation's security. I'd also like to commend the General Accounting Office for studying the cost effectiveness of the various legs of the triad. Certainly, any serious discussion of how to structure and arm our nation's military must examine cost effectiveness--GAO's yardstick in this study--as one of the many components considered.

Question 1: I am, however, concerned that this study focuses so heavily on the question of which upgrades to the Triad are most cost effective. The cost of a program is something my colleagues and I take very seriously, but does this approach not limit the flexibility of a U.S. response?

GAO Response

Two points are relevant here: first, we did not perform one analysis of cost-effectiveness, we performed several; and second, we did not perform only cost-effectiveness analysis.

Concerning the first point, we measured cost in a variety of ways because we believe that no single measure provides a definitive picture even of the cost issue taken alone. Accordingly, we assessed: acquisition costs (the measure most frequently cited by DOD); total lifecycle costs (combining acquisition costs [RDT&E and procurement] with all available forms of operating and support costs); sunk lifecycle costs, and lifecycle costs yet to be expended ("costs-to-go"). Using these different cost measures, we then performed various cost effectiveness calculations on a cost per warhead basis. In this regard, we calculated costs per deployed warhead for each proposed modernization system, and we performed cost per arriving warhead calculations employing classified DOD assumptions concerning alert rates, reliability, and survivability. We performed these latter cost per arriving warhead calculations for two different scenarios: surprise Soviet attack, and attack under generated alert, that is, with strategic warning.

In addition to performing these cost analyses, we assessed the effectiveness of each proposed modernization plan and of several previously deployed systems using seven different

measures of effectiveness.¹ Thus, from a methodological viewpoint, our analysis of cost effectiveness issues was quite comprehensive.

Concerning my second point above, GAO never imagined that cost effectiveness could be the sole basis for comprehensively evaluating the strategic triad--although it is an important basis--because it fails to capture several critical concepts and elements. For precisely that reason, we did not limit either our conceptualization of the issues or our specific analyses to cost effectiveness. We examined many other aspects of the triad and specifically performed the following additional analyses, all of which can be found in the evaluation's final report (GAO/C-PEMD-92-8):

- The impact of both existing strategic systems and proposed modernizations on arms control considerations, and the impact of specific provisions of the START I and II treaties on the systems and their upgrades (pp. 200-201).
- The interactions of various systems within legs of the triad, such as whether the air-leg's combination of penetrating bombers and cruise missile carrying aircraft enhanced the ability of either system to achieve mission objectives (pp. 187 and 194).
- Interactions among the three legs of the triad, including whether and how dissimilar performance characteristics--both strengths and weaknesses--of the systems in the different legs were complementary or merely redundant. For example, we assessed the feasibility and likely effectiveness of attacks on each of the very different basing modes of the three legs of the triad (bomber bases, ICBM silos, and SSBNs at sea) employing different attack scenarios--either

¹The seven measures of effectiveness we employed were the following: (1) survivability against both offensive and defensive threat systems, for both platforms and weapons (for example, submarines and their ballistic missiles; bombers and their cruise missiles); (2) delivery system performance (that is, accuracy, range, and payload); (3) warhead yield and reliability (that is, the probability that the warhead will detonate as intended); (4) weapon system reliability (that is, the combined reliability of all the component processes from platform launch to warhead detonation); (5) flexibility across a number of dimensions, including retargeting and recall; (6) communications (for example, connectivity between command authority and platforms); and (7) responsiveness (that is, alert rate and time-to-target).

simultaneous launch of attack systems or simultaneous detonations of the warheads employed (pp. 190-191).

- The likely cumulative or synergistic impact of the three legs of the triad on Soviet nuclear force planning and strategy. Specifically, we first assessed whether, if deployed, each proposed U.S. strategic system would have: (1) provided the U.S. with a technological hedge against the capabilities of defensive or offensive Soviet systems; (2) complicated Soviet planning, (3) helped dilute Soviet material resources, and/or (4) had a positive or negative effect on the U.S. ability to respond flexibly to a range of Soviet attack scenarios (p. 199). Second, we examined whether existing U.S. systems and proposed upgrades, taken together, enhance or detract from U.S. deterrence of Soviet attack and whether the performance of new and currently deployed U.S. systems can be considered adequate to support an effective deterrence strategy. For example, while we found that adding mobility to ICBM systems would, indeed, increase their survivability, we found that a U.S. silo hardening program would have similarly increased silo-based ICBM survivability. However, based on other analyses--in this case, threat analysis--we found that neither program was necessary to preserve either the survivability of U.S. retaliatory capability--including that of ICBMs--or deterrence (pp. 195-196).

It is important to recall that my statement at the Committee's June 10th hearing presented only highlights of our evaluation and that our nearly thousand-page, 8-volume study considered many other aspects of the triad (as discussed above) that could not be covered in the time available.

Question 2: Do you believe cost effectiveness to be the paramount consideration in upgrading the legs of the Triad?

GAO Response

As already noted in my answer to your first question, we believe that cost-effectiveness analysis (such as cost-to-go per arriving warhead under strategic warning), based on valid and reliable data, is one of several forms of analysis that is needed to perform a comprehensive evaluation of a complex matrix of systems such as the strategic triad. In the particular case of the triad, however, such analysis takes on exceptional importance because it is more than 30 years since this kind of work has been performed. On balance, I would suggest that a thorough assessment--such as the one already conducted by GAO, or the Defense Department's current "bottom up" review--would be incomplete if it consisted only of a cost-effectiveness analysis,

but that it would also be incomplete--like so very many other assessments of the past--if it did not include analysis.

Question 3: In the past, we were dealing with the Soviet Union within the framework of deterrence. This framework posited that deterrence would "work" as long as both sides were risk averse, rational actors. DCI Jim Woolsey, in his confirmation hearing a few months back, stated "We have slain a large dragon, but we now live in a jungle filled with a bewildering variety of poisonous snakes, and in many ways the dragon was easier to keep track of." Is the GAO so sure of the future that you are willing to state that we need cost effective forces, which is where your report leads us, instead of flexible forces with a spectrum of capabilities?

GAO Response

As requested by the Congress, our review was of U.S. strategic systems in the context of the U.S. relationship with the former Soviet Union. During the course of our work, we found that the U.S. possession of flexible strategic nuclear forces, able to respond to a range of scenarios with a spectrum of capabilities, was an essential element of an ability to deter and if necessary respond to attack, even from the unitary "dragon" that Director Woolsey referred to in his confirmation hearing.

Specifically, we evaluated flexibility in two different ways. First, we analyzed the ability of each individual strategic system to operate in a flexible manner: that is, we assessed the extent to which, if at all, systems could be recalled, retargeted, or could attack a variety of target types under differing circumstances. Second, we assessed the extent to which the overall triad gave the President a variety of different retaliatory options: that is, whether the capabilities in the various legs of the triad were in fact complementary.

In effect, our reports analyze the triad systems across a number of dimensions that are directly relevant, not just to the Cold War, but also to evaluating the usefulness of these systems in the present and future. It is readily apparent that the recallability of bombers gives them a performance flexibility that is considerably greater than ballistic missiles, and that this could be useful in conventional post-Cold War crises. At the same time, it is clear that the focus of our work--as requested--was the capability of U.S. strategic systems vis-a-vis the then-existing principal threat, the Soviet Union. Analysis of the applicability of U.S. strategic forces to dealing with, say, third-world states possessing nuclear stockpiles of a dozen weapons or less, and exclusively medium-range missiles, was outside the scope of our study.

GAO's evaluation does not state that cost-effectiveness should take precedence over other dimensions or measures in deciding what strategic systems offer the most advantages. Indeed, our reports make clear that there are multiple important non-cost dimensions to these systems, such as flexibility or arms control. The analysis presented in the eight reports show the desirability for the United States to retain strategic forces that are flexible and that possess a spectrum of capabilities to cope with a variety of potentially unforeseen threat scenarios. However, it is also important that these systems be cost-effective, given that it makes little sense to spend money on new systems to obtain capabilities that already exist in our military inventory, or that are designed to meet non-existent or vastly overestimated threats.

The short answer to your question, then, is that we believe our report leads not to the conclusion that we need cost-effective forces, but that whatever forces we need should be subjected to cost-effectiveness (and other) analysis on a fairly regular basis.

Question 4: When the GAO began this study in 1990, Peacekeeper Rail Garrison and the Small ICBM were ongoing programs, and we were projecting a much larger B-2 buy than we are today. Given the demise of the first two programs, and the evisceration of the B-2 program, how valid does your study remain?

GAO Response

It is correct that we were asked to address certain systems that are no longer being developed or procured. However, our reports also address eight systems that are currently under development, being flight tested, or currently deployed--and that will remain viable for many years to come.²

While our studies produced numerous findings and recommendations, many of them classified, we believe three of these merit serious attention in the post-Soviet world. These are:

1. On balance, the evidence shows the sea-leg to be the strongest, most cost-effective component of the triad under a range of scenarios. We believe this conclusion has special importance as we enter a post-Soviet period of uncertainty and major domestic budgetary pressures. I would remind you that Deputy Secretary Perry agrees with us on this point: he commented at the Committee's June 10th hearing that in his view also, the Trident

²These systems include the B-52H, B-1B, B-2, ALCM, ACM, MM III, Ohio SSBN, and D-5 SLBM.

system is the "dominant leg of the triad" and that "we could get by very nicely with much smaller forces and [even] a single leg."

2. Because strategic bombers are flexible and stabilizing, they add a critically important character to the overall nuclear force. Again, we believe this finding has significant implications for our post-Soviet force structure.
3. Finally, the multiple flaws and failures we found in areas like threat forecasting, testing, and reporting are, if anything, more important for the future than the past. As you know, our data showed that Soviet threats--whether to our land, sea, or air leg weapon systems--were consistently inflated beyond what was actually the case; testing of the U.S. systems was frequently truncated or unrealistic or both; and reporting on a variety of subjects was frequently incomplete, pessimistic with regard to mature systems, and optimistic about the likely cost and performance of new ones. We also found a dearth of the comparative evaluations needed to show whether a proposed system is justified in terms of three things: the threat it faces, its performance capabilities vis-a-vis other systems, and its relative costs.

These flaws and omissions are not, as some have claimed, the characteristics of an acquisition strategy that is exercising prudence by preparing for a "worst case scenario." Indeed, it can never be prudent to have imprecise or distorted information, either about U.S. or enemy capabilities. On the contrary, we would argue that such a situation is inherently imprudent, because it allows unhappy surprises in time of war and costly consequences for the U.S. budget. Overall, the failures of information we found were serious, pervasive, and persistent over the past 10-15 years; one measure of the validity of our study will certainly be the degree to which it helps us avoid these failures in the future.

Totals Through 2010

The total cost of sustaining the Minuteman III ICBM force through FY 2010 is estimated to be \$16.5 billion. An additional \$1.9 billion is being considered to improve the inertial measurement unit of the Guidance and Control Unit.

These costs are summarized in Table 2.

Minuteman III Life Extension Costs Through FY 2010
(FY 1992 Constant Dollars in Millions)

	FY 1992-2010
Stage 1	\$657
Stage 2	\$639
Stage 3	\$432
PSRE	\$250
Guidance	\$1,406
Rivet MILE	\$265
Non-Missile Equipment	\$310
REACT	\$346
MEECN	\$113
Others	\$72
Operations & Support (\$631M per year)	(\$11,989)
Military Personnel	\$3,819
Depot Maintenance	\$931
Sustaining Investment	\$380
Sustaining Engineering	\$912
Other Direct Costs (SAC)	\$3,781
Indirect Costs	\$2,166
Total FY92-2010	\$16,479