

June 1995

# NAVY TORPEDO PROGRAMS

## MK-48 ADCAP Upgrades Not Adequately Justified







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

National Security and  
International Affairs Division

B-260154

June 12, 1995

The Honorable William J. Perry  
The Secretary of Defense

Dear Mr. Secretary:

As part of our ongoing work on Navy torpedo programs, we reviewed the Navy's plans to upgrade both the propulsion and the guidance and control systems of the MK-48 Advanced Capability (ADCAP) torpedo. Because the program manager is requesting approval to begin low-rate initial production, we are reporting on (1) the need for the propulsion system upgrade and (2) the appropriateness of approving low-rate initial production of the guidance and control system.

## Results in Brief

The proposed \$249 million upgrade to the ADCAP propulsion system is not needed. The Navy justifies this upgrade as improving the ADCAP's performance against diesel submarines operating in littoral or shallow water by reducing the range at which an adversary is alerted to an attack and the time available for that adversary to counterfire, thereby reducing the launching submarine's vulnerability. However, because of the short ranges at which diesel submarines are likely to be detected in littoral or shallow water, the technological improvement to be contributed by the propulsion upgrade—that is, torpedo quieting—will neither improve the performance of the ADCAP nor reduce the vulnerability of the launching submarine to enemy attack. Moreover, the Commander, Operational Test and Evaluation Force (OPTEVFOR), already considers the current ADCAP operationally suitable and effective in shallow water, and the Navy did not establish a requirement to improve the ADCAP's propulsion system for use in open ocean, deep water in its operational requirements document for the upgrade.

Approval for low-rate initial production for the guidance and control upgrade would be ill-advised at this time. The Navy's proposed acquisition schedule was developed to "piggyback" on the installation of the propulsion upgrade. Installing the new guidance and control unit will do nothing more to counter the existing threat than the current units until the new software is developed and installed. Since the software necessary to take advantage of the upgraded guidance and control hardware will not be ready until mid-1998, upgrade acquisition would be better scheduled to coincide with the software development schedule. As currently planned,

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the Navy could buy as many as 529 units at a cost of \$177 million before the new software will be available.

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## Background

In 1975, the MK-48 Advanced Development Torpedo program was established to develop, procure, and deliver to the fleet an advanced heavyweight torpedo system to counter faster, deeper diving, quieter submarines that could threaten U.S. ships. The ADCAP reached full production in fiscal year 1989 and is expected to serve as the Navy's primary submarine-launched antisubmarine warfare weapon through the year 2026. The Navy had planned to buy ADCAP torpedoes beyond the year 2000. However, in 1992, in response to the end of the Cold War and to budgetary pressures, the Secretary of the Navy canceled further ADCAP production. All production contracts for the ADCAP are scheduled to be completed by 1996.

In fiscal year 1989, the Navy began an effort to increase the processing capabilities of the ADCAP's guidance and control unit. The new unit was designed to process more data at a faster rate by using a new processor and converting its current software to the ADA computer language. The Navy had planned to use the new guidance and control system on torpedoes purchased in fiscal year 1995 and beyond. But since ADCAP production will end in 1996 and because the Navy believes the new guidance and control system and the use of ADA will enhance ADCAP operation, the Navy has decided to upgrade ADCAPs in its inventory with the new guidance and control units. Beginning in January 1997 and until ADA software is completed, currently scheduled for mid-1998, these units are expected to use a version of the current software modified for ADA.

In 1992, the Navy initiated the ADCAP torpedo propulsion upgrade program to reduce noise emissions, making the torpedo harder to detect. A July 7, 1992, operational requirements document described the initial improvement expected from the propulsion unit. In November 1993, the document was rewritten to provide operational requirements for the upgrade in littoral waters, including shallow water.

In January 1993, the Assistant Secretary of the Navy for Research, Development, and Acquisition approved a plan to combine the guidance and control and the propulsion upgrades into a single modification program. That decision and the decision to begin engineering and manufacturing development were based, in part, on a cost and operational effectiveness analysis (COEA) completed in 1992. The purpose of a COEA is

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to evaluate the costs and benefits of alternatives to the proposed changes, including maintaining the status quo.

The Navy program manager is currently requesting approval for low-rate initial production for the upgrade program. If approved, the Navy would upgrade its entire inventory of ADCAP torpedoes over the next 7 years at a total cost of about \$821 million—\$249 million for the propulsion upgrade, \$462 million for the guidance and control upgrade, and \$110 million for the torpedo's new software.

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## Propulsion Upgrade Does Not Improve Littoral- or Shallow-Water Operations

The most pressing threat to Navy submarines, according to Navy documents, is the diesel electric submarine. The Navy's Forward . . . From The Sea strategy places emphasis on defeating this type of threat. The Operational Requirements Document for the propulsion upgrade justifies the upgrade on the basis of improving the ADCAP's ability to defeat this type of threat in littoral- and shallow-water operations where diesel submarines are expected to be detected at very short ranges. The littoral- and shallow-water environments present difficult acoustic and geographic constraints that limit distances at which targets can be detected. The Navy's justification indicates that by quieting the torpedo, the propulsion upgrade would reduce the range at which an adversary could determine that it is under attack. This would put U.S. submarines in a better position to evade counterfire, yet maintain the same probability of destroying the target.

However, we found evidence that the upgrade would not improve the performance of the ADCAP by reducing the range and time a target is alerted or the vulnerability of the launching ship to counterfire by a diesel submarine operating in shallow or littoral water. For example, a June 1994 report by the Commander, OPTEVFOR, concluded that a diesel submarine operating in shallow water would have a very short period of time to react to an ADCAP launch at high speeds and would not be able to take effective evasive or counterfire actions. In addition, the report and other Navy documents show that the littoral- and shallow-water diesel submarine threat will likely be detected by Navy forces at ranges that are too close for quieting to yield any operational benefit. Although a diesel submarine alerted by the noise of a high-speed ADCAP launch could in some cases take evasive action, the report considered the increased probability of the diesel submarine taking effective action as insignificant. The Commander, OPTEVFOR, certified that the ADCAP torpedo without the propulsion upgrade was both operationally suitable and effective for shallow-water operations.

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In commenting on a draft of this report, the Department of Defense (DOD) said that the tests that showed that the propulsion upgrade would not improve shallow- and littoral-water operations were limited to a single threat in a single environment. DOD stated that testing in dissimilar environments might lead to different results. We agree that testing in an open-ocean, deep-water environment against a different threat could produce different results, but that was not the purpose of the upgrade. The Navy justified the upgrade on the basis of improving the ADCAP's performance against diesel submarines operating in littoral or shallow water and the threat used for the testing we cite was a simulated diesel submarine and the environment was shallow water.

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## The Proposed Propulsion Upgrade Does Not Address Open-Ocean, Deep-Water Requirements

As we have previously reported,<sup>1</sup> the proposed propulsion upgrade does not meet quieting goals that, until 1992 were considered necessary to counter a nuclear submarine threat operating in an open-ocean, deep-water environment.

In fiscal year 1986, the Navy initiated the Closed-Cycle ADCAP Propulsion System (CCAPS) program to replace the existing system and reduce its detection or delay its classification as a weapon by a threat submarine. But, as a result of technical problems, schedule delays, and high estimated costs, the Navy canceled the CCAPS requirement in July 1992 and decided to proceed instead with this propulsion upgrade program, which did not meet the CCAPS requirements.

In establishing the operational requirements for the upgrade in 1992, the Navy used open-ocean, deep-water based performance measures. However, in the 1993 revision, it eliminated open-ocean, deep-water operational performance requirements for the proposed upgrade. Thus, the upgrade is not in response to a specific open-ocean, deep-water performance requirement.

In commenting on a draft of this report, DOD stated that the Operational Requirement Document specifies that the ADCAP shall be operationally effective in all expected ocean environments. We agree that the Operational Requirements Document specifies that the ADCAP shall be effective in all ocean environments. However, OPTEVFOR has already approved the fleet introduction and certified the operational effectiveness

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<sup>1</sup>Navy Torpedo Program: MK-48 ADCAP Propulsion System Upgrade Not Needed (GAO/NSIAD-92-191, Sept. 10, 1992).

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and suitability of the ADCAP without the upgrade for use in all ocean environments.

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## COEA for Propulsion Upgrade Did Not Adequately Address Significant Issues

No new COEA has been prepared to support the proposal to proceed to low-rate initial production because, according to Navy program officials, an updated COEA is not required for a low-rate initial production decision.

The 1992 COEA did not address significant items that bear on the decision to approve production. Specifically, it did not evaluate:

- The proposed upgrade's effectiveness in shallow water. At the time of the COEA, a shallow-water model had yet to be validated against shallow-water results. This model is currently underdevelopment.
- Alternate ways to reduce the noise of the torpedo. The only comparisons made were of the proposed propulsion upgrade and the existing ADCAP.

Further, the effectiveness of the proposed upgrade and the existing ADCAP were compared in the COEA using different speeds. DOD maintains that this allowed a comparison of systems, each operating at its optimum efficiency. The comparisons of the two systems used a modified ADCAP running 63 percent slower than the existing ADCAP. However, slower torpedoes generate less noise and are therefore less detectable by an adversary. The COEA did not identify how much of the difference between projected propulsion upgrade performance and existing ADCAP performance was due to the difference in speed and how much may have been due to system improvements.

In addition, the December 1992 COEA assumed that the propulsion upgrade would achieve its noise goals. But in 1993, the allowable noise levels were increased by about as much as 30 percent over the COEA noise goals to accommodate differences in the torpedo's technical performance. Therefore, the projected quieting benefits of the upgrade may have been overstated.

In commenting on a draft of this report, DOD stated that alternative ways to reduce torpedo noise were addressed in a Special Initiatives Assessment (SIA) in 1991, which identified the propulsion upgrade as the most cost-effective alternative for torpedo quieting. However, the proposed upgrade did not exist at the time of the SIA.

A Navy briefing on the SIA and discussions with the Technical Program Manager at the Naval Undersea Warfare Center indicate that the purpose of the SIA was to evaluate alternative technologies to attain the CCAPS noise quieting levels considered necessary to counter the Soviet nuclear submarine operating in the open ocean. As noted above, CCAPS experienced technical development problems that generated the Navy's seeking alternatives to this development effort. Alternatives considered included electrical and stored chemical energy and major internal and external modifications to the current ADCAP. The study suggested that the only way to quiet the current ADCAP was to modify the existing open-cycle engine.

According to a Navy official, contractors were asked to come up with ways to make the current engine quieter. While some of the concepts from the SIA were considered, such as sound damping or adding a muffler, the proposed propulsion upgrade design bears very little resemblance to the designs considered during the SIA.

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## Acquisition of the Guidance and Control Upgrade Is Premature

The Navy has not established an independent need for low-rate initial production of the guidance and control upgrade. Navy officials told us that the Navy decided instead to acquire the upgraded guidance and control system beginning in 1995 because they anticipated cost savings from installing the propulsion and guidance and control upgrades at the same time. These projected savings shown in the 1992 COEA were based on buying enough of each upgrade per year to complete the program in 5 years. However, due to budget pressures, the quantities of the upgrades to be bought each year have been reduced and the program has been extended. According to program officials, this program extension would probably reduce the potential cost savings shown in the 1992 COEA, but at the time of our review a new cost analysis had not been conducted to determine the extent of the reduction in the projected savings.

Subsequently, DOD provided updated cost data. However, the new data prepared to support the low-rate initial production decision does not show the impact on potential cost savings if the propulsion upgrade portion of the modification program was canceled.

In commenting on a draft of this report, DOD stated that (1) the upgraded guidance and control hardware will provide the increase in processing power needed to allow the torpedo to discern the target in the complex, noisy, shallow-water environment and (2) this hardware is required to support software development and testing scheduled for fiscal year 1997.

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Our analysis shows that the new guidance and control unit will do nothing more to counter the existing threat than the existing unit does until new software is installed. ADA software that makes the new guidance and control system more effective in shallow water is not scheduled to be available until mid-1998, by which time the Navy, under the current plans, may have bought as many as 529 units at a cost of about \$177 million (in then-year dollars) through fiscal year 1998.

In November 1994, we reported<sup>2</sup> that the practice of prematurely approving low-rate initial production for weapon systems had resulted in large inventories of unsatisfactory weapons that have subsequently required costly modifications. We also noted that once low-rate initial production starts, options available to DOD and the Congress when the system is deficient are greatly limited.

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## Recommendations

We recommend that the Secretary of Defense direct the Secretary of the Navy to

- terminate the proposed propulsion system upgrade program and reduce program funding accordingly and
- delay any production decision for the guidance and control system until an acquisition schedule that coincides with the software development schedule and avoids premature commitment to production can be developed.

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## Agency Comments and Our Evaluation

DOD's written comments on a draft of this report are presented in appendix I. DOD disagreed with our two recommendations and stated that reductions in torpedo radiated noise are essential to enhancing the survivability of the launching vessel and that the upgraded guidance and control hardware is required to support fiscal year 1997 testing.

As indicated throughout the report, DOD's comments provide no new information or further rationale for the proposed upgrade. Therefore, we continue to believe that the propulsion upgrade should be terminated because it does not improve the performance of the ADCAP or increase the survivability of the launching submarine in littoral or shallow waters. We also continue to believe that the guidance and control upgrade should be scheduled to support the current software development schedule.

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<sup>2</sup>Weapons System Acquisition: Low-Rate Initial Production Used to Buy Weapons Systems Prematurely (GAO/NSIAD-95-18, Nov. 21, 1994).

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Although some upgraded guidance and control units may be needed for testing, the Navy cannot reasonably justify the production of over 500 units, which is its current acquisition schedule, before the software that makes the units more effective is scheduled to be available.

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## Scope and Methodology

We analyzed and discussed data and test plans at the Naval Undersea Warfare Center, Newport, Rhode Island. We reviewed data and discussed emerging issues with the Commander, OPTEVFOR, Norfolk, Virginia. In addition, we visited the National Maritime Intelligence Center, Suitland, Maryland, and the Commander, Submarine Development Squadron 12, Groton, Connecticut, to clarify threat capabilities and operational issues. We reviewed the cost, schedule, and technical performance issues and the results of our analysis with program officials in Washington, D.C., and with technical experts from the Naval Undersea Warfare Center, Newport, Rhode Island.

We conducted our review between September 1994 and April 1995 in accordance with generally accepted government auditing standards.

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As you know, 31 U.S.C. 720 requires the head of a federal agency to submit a written statement on actions taken on our recommendations to the Senate Committee Governmental Affairs and the House Committee on Government Reform and Oversight not later than 60 days after the date of the report. A written statement must also be submitted to the Senate and House Committees on Appropriations with an agency's first request for appropriations made more than 60 days after the date of the report.

We are sending copies of this report to the Secretary of the Navy; the Assistant Secretary of the Navy for Research, Development, and Acquisition; and appropriate congressional committees. Upon request, we will make copies available to other interested parties.

Please contact me on (202) 512-4841 if you or your staff have any questions concerning this report. Major contributors to this report are listed in appendix II.

Sincerely yours,

A handwritten signature in black ink that reads "Brad Hathaway". The signature is written in a cursive style with a long horizontal flourish extending to the left of the first letter.

Brad Hathaway  
Associate Director, Systems Development  
and Production Issues

# Comments From the Department of Defense

Note: GAO comments supplementing those in the report text appear at the end of this appendix.



ACQUISITION AND TECHNOLOGY

## OFFICE OF THE UNDER SECRETARY OF DEFENSE

3000 DEFENSE PENTAGON  
WASHINGTON DC 20301-3000



22 MAR 1995

Mr. Henry L. Hinton, JR  
Assistant Comptroller General  
National Security and International Affairs Division  
U.S. General Accounting Office  
Washington, D. C. 20548

Dear Mr. Hinton:

This is the Department of Defense (DoD) response to the General Accounting Office (GAO) draft Report, "NAVY TORPEDO PROGRAM: MK-48 ADCAP Upgrades Should Not Be Approved," (GAO Code 707083/OSD Case 9878), dated March 7, 1995. The DoD nonconcurs with the report.

See comment 1.

The draft report makes frequent reference to a June 1994 report by the Commander, Operational Test and Evaluation Force (COMOPTEVFOR). It is the DoD position that statements from the COMOPTEVFOR report are taken out of context or misinterpreted, leading to the erroneous conclusion that the Torpedo Propulsion Upgrade would not improve torpedo shallow water operations. The test addressed by the June 1994 report was not structured to evaluate or draw conclusions on the military utility of torpedo quieting. At DoD request, COMOPTEVFOR issued a letter on March 16, 1995, clarifying its comments regarding the results of that testing.

See comment 3.

The GAO assertion that the Torpedo Propulsion Upgrade (TPU) Operational Requirements Document (ORD) does not address the deep water requirement is not correct. In fact, the revised ORD Critical System Characteristics specifies that the ADCAP Torpedo shall be effective in all expected ocean environments (e.g. shallow water, Arctic, etc.) and specifies a performance threshold that the Torpedo Propulsion Upgrade must meet in three deep water environments.

See comment 6.

The GAO report incorrectly stated that the DoD failed to conduct an updated cost analysis following budgetary changes that extended the program procurement profile. The DoD did update its analysis of costs in evaluating the decision to proceed to Low Rate Initial Production (LRIP). The updated analysis, which supports the conclusions of the original Cost and Operational Effectiveness Analysis (COEA), was not available to the GAO at the time of the preparation of the draft report, but has subsequently been provided to the GAO. Contrary to the GAO assertion that the ADCAP Mods COEA did not adequately address alternate ways to reduce torpedo noise, the alternatives were previously evaluated in the *Special Initiatives Assessment (SIA)*, a more thorough technical/cost evaluation than a traditional COEA. The SIA identified the TPU as the most cost effective alternative.

See comment 6.

The DoD notes that the program costs identified by GAO do not represent the savings that could be derived by cancellation of the individual program segments. Since the modifications were planned as a single program, efficiencies derived from parallel production and development would be lost if individual program segments were cancelled or substantially modified.

**Appendix I**  
**Comments From the Department of Defense**

The DoD nonconcurrs with the GAO recommendation to terminate the Torpedo Propulsion Upgrade. Reductions in torpedo radiated noise are essential to enhancing the survivability of the launching vessel. Preliminary results of submarine versus submarine testing conducted in February 1995 show that the Torpedo Propulsion Upgrade remains covert even at ranges of half the anticipated detection range--providing encouraging results as to the military value of the Torpedo Propulsion Upgrade.

The DoD also nonconcurrs with the GAO recommendation to delay the production decision for the Guidance and Control (G&C) Upgrades. The upgraded G&C hardware provides the increase in processing power needed to allow the torpedo to discern the target in the complex, noisy, shallow water environment. This hardware is required to support software development and testing scheduled for FY 1997 to achieve shallow water performance goals, and will provide the growth potential necessary for orderly algorithm development.

In summary, the DoD considers the MK-48 ADCAP Modifications Program essential to address known operational requirements to improve torpedo performance and launch vessel survivability, particularly in the shallow water environment. Upgrading torpedo shallow water performance is critical to ensuring tactical control in Anti-Submarine Warfare. This was among the highest priorities identified by a joint technology review conducted by the Commanders of both the Atlantic and Pacific Submarine Fleets in July 1994.

Detailed DoD Comments on the GAO report findings and recommendations are provided in the enclosure. The DoD appreciates the opportunity to comment on the GAO draft report.



George R. Schneiter  
Director  
Strategic and Tactical Systems

Enclosure

Appendix I  
Comments From the Department of Defense

GAO DRAFT REPORT GAO/NSIAD-95-104 - March 7, 1995  
(GAO CODE 707083) OSD CASE 9878

"NAVY TORPEDO PROGRAM: MK48 ADCAP UPGRADES  
SHOULD NOT BE APPROVED"

DEPARTMENT OF DEFENSE COMMENTS

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FINDINGS

**Finding A: Propulsion Upgrade Does Not Improve Shallow Water Operations.** The GAO reported that the Operational Requirements Document for the propulsion upgrade justified the upgrade on the basis of improving the Advanced Capability (ADCAP) ability in littoral and shallow water operations where diesel submarines are expected to be detected at very short ranges. The GAO noted that the justification indicated that by quieting the torpedo, the (1) propulsion upgrade would reduce the range at which an adversary could determine that it is under attack and (2) would put U.S. submarines in a better position to evade counterfire, yet maintain the same probability of destroying the target.

The GAO concluded that the upgrade would not improve the performance of the ADCAP by reducing the range and time a target is alerted or the vulnerability of the launching ship to counterfire by a diesel submarine operating in shallow or littoral water. The GAO pointed out that a June 1994 report by Commander, Operational Test and Evaluation Force (OPTEVFOR), concluded that a diesel submarine operating in shallow water would have a very short period of time to react to an ADCAP launch at high speeds and would not be able to take effective evasive or counterfire actions. The GAO noted that the report and other Navy documents indicated that the littoral and shallow water diesel submarine threat will likely be detected by Navy forces at ranges that are too close for quieting to yield any operational benefit. The GAO added that the Commander, OPTEVFOR, certified that the ADCAP torpedo without the propulsion upgrade was both operationally suitable and effective for shallow water operations. (pp. 4-5/GAO Draft Report)

**DoD RESPONSE: Nonconcur.** Contrary to the GAO statement, the OPTEVFOR report does not conclude that a diesel submarine operating in shallow water "would not be able to take effective evasive or counter fire actions" or that "the increased probability of the diesel submarine taking effective action [as a

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Now on pp. 3-4.

See comment 1.

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result of being alerted by torpedo noise] is insignificant." The specific conclusions of the OPTEVFOR report regarding the successful detection and evasion of the torpedo are classified and are included in the classified version of the DoD response. It can be stated here only that the target successfully evaded the torpedo in some of the runs. The fact that more successful evasions did not occur was attributed to the short reaction time available as a result of short engagement ranges. More effective evasion tactics are known but were not employed in this test of a near term upgrade.

Tactics, in accordance with Naval Warfare Publication 70 series guidance, employed in the test resulted in short firing ranges to maximize Probability of Hit, due to the small concern for counterfire from the simulated threat. With regard to the test, the Commander, OPTEVFOR letter of 16 Mar 1995 (Ser 434/C13) states:

*"...testing was conducted on only one threat and environment. ... A test in dissimilar environments, against a more sophisticated projected threat, may result in conclusions that differ from [the referenced OPTEVFOR report]." Specific changes in tactics would be required for other threat scenarios [details available in the classified version of this response]. "In these cases, a quieter ADCAP would increase weapon effectiveness, lower target counterfire effectiveness and thereby increase launch ship survivability. Such a test is scheduled for late FY95."*

Current fleet sonar systems and tactics are able to engage diesel submarines at greater ranges than those in the cited test; at those greater ranges the benefits of torpedo quieting will be realized. [Examples are provided in the classified version of this response.]

Against a sophisticated threat capable of counterfire and effective evasion tactics, a greater firing range is required for the survivability of the firing ship. In cases where existing sonar systems produce short range detections, tactical guidance provides methods to open range to a safer, covert firing position prior to attack. This tactic reduces vulnerability caused by the acoustic detectability of the current weapon. At the preferred firing ranges, the Torpedo Propulsion Upgrade reduces detectability of the torpedo by the threat submarine--thereby reducing probability of successful evasion or counterfire.

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See comment 2.

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Comments From the Department of Defense

**Finding B: Proposed Propulsion Upgrade Does Not Address Deep-Water Requirements.** The GAO reported that in FY 1986, The Navy initiated the Closed Cycle ADCAP Propulsion System (CCAPS) program to replace the existing system and reduce its detection or delay its classification as a weapon by a threat submarine. The GAO observed that as a result of technical problems, schedule delays, and high estimated costs, the Navy canceled the CCAPS requirement in July 1992, and decided to proceed instead with this propulsion upgrade program which did not meet the CCAPS requirements. The GAO indicated that in 1993, the Navy rewrote the operational requirements for the ADCAP and eliminated open-ocean, deep water operational performance requirements for the proposed upgrade. (pp. 5-6/GAO Draft Report)

Now on pp. 4-5.

**DoD RESPONSE: Nonconcur.** It is the DoD position that the Torpedo Propulsion Upgrade does address deep water requirements. The Operational Requirements Document for the Torpedo Propulsion Upgrade expands, rather than eliminates, requirements on torpedo performance. In fact, the Operational Requirements Document specifically states that the performance parameters have been "expanded to address the diesel-electric submarine in a littoral environment." There was no change to the baseline ADCAP system technical performance requirements. The Operational Requirements Document specifies Torpedo Propulsion Upgrade effectiveness in three deep-water littoral environments. The Operational Requirements Document also states that the torpedo shall be effective in all expected ocean environments. Furthermore, the Test and Evaluation Master Plan (TEMP 371 Rev 5) for Torpedo MK48/ADCAP Program specifies a deep water environment for operational testing of the Torpedo Propulsion Upgrade.

See comment 3.

The Navy initiated the CCAPS to eliminate a target alertment deficiency (caused by torpedo noise) identified during operational testing and to address the projected threat of a new class of quieted Soviet submarines. The CCAPS program encountered severe technical problems and was projecting significant cost and schedule overruns. In order to resolve the outstanding ADCAP torpedo alertment deficiency, a study entitled the *Special Initiatives Assessment* (SIA) was undertaken to evaluate the cost and effectiveness of propulsion system alternatives for the torpedo. The SIA study concluded that tactical benefit offered by CCAPS and other technologically advanced alternatives was not sufficient to justify the additional development and production costs relative to the selected Torpedo Propulsion Upgrade.

See comment 4.

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Appendix I  
Comments From the Department of Defense

**Finding C: COEA for Propulsion Upgrade Did Not Adequately Address Significant Issues.**

The GAO reported that no new cost and operational effectiveness analysis (COEA) has been prepared to support the proposal to proceed to Low Rate Initial Production because, according to Navy program officials, an updated COEA is not required for a Low Rate Initial Production decision. The GAO asserted that the 1992 COEA did not address significant items that bear on the decision to approve production. The GAO noted that specifically, the COEA did not evaluate (1) the proposed upgrades effectiveness in shallow water and (2) alternate ways to reduce the noise of the torpedo.

The GAO found that the effectiveness of the proposed upgrade and the existing ADCAP was compared in the COEA using different operational tactics. The GAO contended that the comparisons of the two systems used a modified ADCAP running 63 percent slower than the existing ADCAP. The GAO explained that the slower torpedoes generate less noise and are therefore less detectable by an adversary. The GAO pointed out that the COEA did not identify how much of the difference between projected propulsion upgrade performance and existing ADCAP performance was due to the difference in speed and how much may have been due to system improvements. The GAO also pointed out that the December 1992 COEA assumed that the propulsion upgrade would achieve its noise goals, but in 1993, the allowable noise levels were increased by as much as 30 percent over the COEA noise goals. The GAO concluded that the projected quieting benefits of the upgrade may have been overstated. (pp. 6-7/GAO Draft Report)

**DoD RESPONSE: Nonconcur.** The COEA addressed shallow water performance by comparing shallow water acoustic propagation losses to the acoustics in deep water. That evaluation concluded that the upgrade was the best possible alternative for existing state-of-the-art shallow water models.

The GAO assertion that alternative ways to quiet the torpedo were not addressed in the COEA is misleading. Alternative quieting methods were addressed in the SIA. Based on the analysis of the SIA, the Service Acquisition Executive elected to start the program at Milestone IV/II; consequently, the COEA was not required to address multiple technical alternatives, since these alternatives had already been evaluated and downselected.

The GAO incorrectly stated that the DoD failed to conduct an updated cost analysis following budgetary changes which extended the program procurement profile. The DoD updated its analysis of costs in evaluating the decision to proceed to Low Rate Initial

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Now on pp. 5-6.

See comment 5.

See comment 4.

See comment 6.

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Production (LRIP). That analysis confirmed the conclusions of the original COEA.

The operational tactics employed in the COEA were different for ADCAP and Torpedo Propulsion Upgrade ADCAP to allow the performance of each weapon to be optimized. In simulation test runs, optimum performance for the Torpedo Propulsion Upgrade was achieved at a low runout speed, while optimum performance for the baseline ADCAP was achieved at high runout speed. The reason for the difference was that the baseline ADCAP was sufficiently noisy to be detectable by the threat even at low speed, and the tonal structure was easily identifiable (classifiable); consequently, the baseline ADCAP torpedo performed best when operated at high speed, to minimize the reaction time of the target.

The GAO stated that the COEA analysis was based on a lower radiated noise profile from the torpedo than that specified for the Torpedo Propulsion Upgrade. While it is true that the COEA baseline radiated noise profile was lower than the Operational Requirements Document objective, the COEA clearly evaluated the Operational Requirements Document radiated noise objective against the COEA baseline case and showed that the difference was not operationally significant. Analysis has shown that the current radiated noise of the Torpedo Propulsion Upgrade fully satisfies the Operational Requirements Document.

The Department of Defense Directive 5000.2 states that at Milestone III, Full Production Approval, a COEA analysis is necessary only if there have been major cost or performance changes during Engineering and Manufacturing Development (EMD). Pre-milestone planning with the Assistant Secretary of the Navy for Research, Development, and Acquisition in mid-FY 1994 identified that no COEA update was required for a Low Rate Initial Production decision.

**Finding D: Acquisition Of the Guidance and Control Upgrade is premature.** The GAO reported that the Navy has not established an independent need for the Low Rate Initial Production of the Guidance and Control Upgrade. The GAO added that according to Navy officials, the Navy decided to acquire the upgraded guidance and control system beginning in 1995 because of anticipated cost savings from installing the propulsion and guidance and control upgrades at the same time. The GAO explained that the projected savings shown in the 1992 COEA were based on buying enough of each upgrade per year to complete the program in 5 years, however, due to budget pressures, the quantities of the upgrades to be bought each year have been reduced and the program has been extended. The GAO noted that according to program officials, the

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See comment 7.

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program extension would probably reduce the potential cost savings shown in the 1992 COEA, but a new cost analysis was not completed to determine the extent of the reduction in the projected savings.

The GAO concluded that the new guidance and control unit will do nothing more to counter the existing threat than the existing unit does until new software is installed. The GAO noted that the ADA software which makes the new guidance and control system more effective in shallow water is not scheduled to be available until mid-1998, by which time the Navy may have bought as many as 529 units at a cost of about \$177 million (in then year dollars). (pp. 7-8/GAO Draft Report)

**DoD RESPONSE: Partially Concur.** The advanced software required to achieve adequate performance of the G&C Upgrade System against the advanced threats in shallow water is scheduled for fleet introduction in FY 1998. To support this schedule, hardware must be available for FY 1996 developmental testing. The planned LRIP buy is only 88 units instead of the 529 units referenced in the GAO report. Under LRIP, in FY 1995, the DoD plans to acquire 37 units of the G&C Upgrade System for FY 1996 developmental testing and 51 units in FY 1996 for FY 1997 operational testing. In addition to directly supporting the test schedule for advanced software, the FY 1995 start of LRIP avoids a break in production between all-up torpedo production and MODs production thus avoiding production start up costs for MODs and prevents the loss of contractor torpedo specific expertise and knowledge.

The GAO draft report states that the DoD failed to update the COEA to reflect budgetary changes to the procurement profile that was used for the COEA cost analysis. DoD has conducted an update to the Life Cycle Cost Estimate for the program to reflect the cited program changes in support of the Low Rate Initial Production decision. This Life Cycle Cost estimate was independently reviewed and endorsed by the Center for Naval Cost Analyses. The COEA conducted at Milestone IV did assess sensitivities of cost savings associated with the program to varying procurement profiles, and though the cited procurement profile extension does reduce cost savings, it does not invalidate the conclusion that savings will be derived from the program. The revised cost estimate in support of the Low Rate Initial Production decision, when compared to the original procurement profile, would not invalidate the original COEA conclusion that the ADCAP MODs program is more cost effective than maintaining the current system.

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Now on pp. 6-7.

See comment 6.

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**GAO RECOMMENDATIONS**

**RECOMMENDATION 1.** The GAO recommended that the Secretary of the Navy instruct the Assistant Secretary of the Navy for Research, Development, and Acquisition to terminate the proposed propulsion system upgrade program and reduce program funding accordingly. (p. 8/GAO Draft Report)

Now on p. 7.

**DoD RESPONSE: Nonconcur.** It is the DoD position that the Torpedo Propulsion Upgrade is required to reduce target alertment by reducing the detectability of the torpedo by the target. An alerted target may evade the torpedo attack and may have the opportunity to counterfire, causing risk to our own submarines. Target alertment is a concern when prosecuting advanced diesel and nuclear submarines in both deep and shallow water. Submarine versus submarine testing conducted to date with Torpedo Propulsion Upgrade ADCAP torpedoes has provided encouraging results as to its military worth; preliminary test results of indicate that the Torpedo Propulsion Upgrade remains covert even at ranges of half the anticipated detection range. The Torpedo Propulsion Upgrade which is defined in the Operational Requirement Document (ORD #310-02-92 Revision A of November 1993) identified the need for the Torpedo Propulsion Upgrade. Furthermore, ensuring tactical control against quiet diesel and nuclear submarines in the littoral was identified as one of highest priorities by the Commanders of both the Atlantic and Pacific Submarine Fleets in July 1994.

When attacking advanced diesel submarines in shallow water, tactics call for attack ranges greater than those used in the operational tests cited by GAO in order to preclude the likelihood of successful counterdetection and attack by the threat submarine. Quieting of the propulsion system is necessary to reduce alertment and maximize the probability of threat kill when conducting attacks against diesel submarines at such ranges.

The June 1994 report by Commander, OPTEVFOR made no assessment regarding a threat SSN alertment to an incoming torpedo in this phase of testing which was determined to be unsatisfactory during previous operational testing. That deficiency has not been resolved, however, the Torpedo Propulsion Upgrade will address this issue.

**RECOMMENDATION 2:** The GAO recommended that the Secretary of the Navy instruct the Assistant Secretary of the Navy for Research, Development, and Acquisition to delay any production decision for the guidance and control system until an acquisition schedule

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that coincides with the software development schedule and avoids premature commitment to production can be developed. (p. 8/GAO Draft Report)

Now on p. 7.

**DoD RESPONSE: Nonconcur.** As stated in the DoD response to Finding D, Low Rate Initial Production for the Guidance & Control Upgrade must commence in FY 1995 in order to support the schedule for developmental and operational testing of the advanced software. The software, required to achieve adequate performance against advanced diesel and nuclear submarine threats in shallow water, is scheduled for fleet introduction in FY 1998.

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## GAO Comments

The following are GAO's comments on the unclassified Department of Defense (DOD) letter.

1. Page 5 of the June 1994 report states that the probability of effective counter fire, based on best known projected capabilities and tactics of the threat submarine, was low and the adverse effect on survivability of the launching platform was not significant. The June 1994 report also shows that in the vast majority of cases the threat submarine when alerted by the noise of the Mk-48 Advanced Capability (ADCAP) torpedo did not have time to effectively evade the ADCAP or to effectively fire on the launching platform. The report shows that the ADCAP performance was well above the threshold stated in the 1993 Operational Requirements Document.

The tactical memorandum on which the tactics used in the test were based clearly states that short detection and firing ranges are a result of the harsh acoustical environments found in littoral and shallow waters. Further, Navy tactics as regards most encounters during regional conflicts will require quick reactions because of the short-detection ranges. Rules of engagement will likely preclude the attacking U.S. submarine from increasing the range to better protect itself. Moving to a safer covert firing range could cause the nuclear attack submarine to lose contact with the adversary and put U.S. surface forces at risk.

2. DOD provided us a bar graph as documentation that fleet sonar systems could engage diesel submarines at greater ranges than were used in the cited test. Navy personnel with whom we discussed the graph were not able to explain when and how the numbers used in the graph were derived. We asked for further documentation but were not provided anything. As a result, we are not able to accept the graph as a rebuttal to our position.

3. We agree that the Operational Requirements Document specifies that the ADCAP torpedo, with or without the propulsion upgrade, will be effective in all ocean environments. In fact, the Commander, Operational Test and Evaluation Force, has approved the ADCAP for fleet introduction and certified the operational effectiveness and suitability of the torpedo for use in all ocean environments without the propulsion upgrade. The three deep-water environments cited in the Operational Requirements Document are littoral, not open ocean.

4. The propulsion upgrade was not evaluated in or during the Special Initiatives Assessment (SIA). The purpose of the SIA was to evaluate

alternative propulsion system technologies to attain the Closed-Cycle ADCAP Propulsion System (CCAPS) noise quieting goals considered necessary to counter Soviet nuclear submarines operating in the open ocean. The study concluded that the noise goals were not attainable within the immediate future and suggested that the only way to quiet the ADCAP was to modify the existing open-cycle engine. Contractors were asked to come up with ways for quieting the engine. While some of the concepts from the SIA were considered, the proposed propulsion upgrade design bears little resemblance to the designs considered during the SIA.

5. According to the Technical Director of the cost and operational effectiveness analysis (COEA), the study cannot be used in any way to conclude that the propulsion upgrade will or will not be effective in shallow water.

6. DOD provided a one page update to the cost evaluation when we met to discuss their comments on the draft report. The updated data does not identify the cost of independently proceeding with either proposed upgrade.

7. The COEA noise level compared against the ADCAP base line was based on the 1992 Operational Requirements Document. Our report states that the 1993 Operational Requirements Document increased the radiated noise levels by as much as 30 percent.

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