

March 2003

DEFENSE
ACQUISITIONS

Advanced SEAL
Delivery System
Program Needs
Increased Oversight




GAO
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Highlights

Highlights of [GAO-03-442](#), a report to the Committee on Armed Services, U.S. Senate

Why GAO Did This Study

The Advanced SEAL Delivery System (ASDS) is a mini-submarine that is one of the U.S. Special Operations Command's largest investments. The program is approaching the end of a difficult development and must undergo key testing before decisions are made to proceed beyond the first boat. Over the past several years, the Congress has raised concerns about technical difficulties, schedule delays, cost growth, and management oversight. The Senate Armed Services Committee requested that GAO review the status and problems facing the program. Specifically, this report examines the ASDS program's (1) progress towards meeting requirements and technical challenges, (2) ability to meet schedule and cost projections, and (3) underlying factors contributing to program problems.

What GAO Recommends

GAO is recommending that, before the operational evaluation is held, DOD ensure that the overall ASDS test and evaluation master plan and the specific test plan for the operational evaluation are both sufficient in scope and approved. GAO is also recommending that DOD elevate the level of management attention and hold a formal milestone review before buying additional boats. DOD concurred with most of GAO's recommendations.

www.gao.gov/cgi-bin/getrpt?GAO-03-442.

To view the full report, including the scope and methodology, click on the link above. For more information, contact Paul Francis at (202) 512-4841 or francispl@gao.gov.

DEFENSE ACQUISITIONS

Advanced SEAL Delivery System Program Needs Increased Oversight

What GAO Found

While progress has been made in addressing technical difficulties with the first boat, some problems must yet be solved and other capabilities demonstrated before the ASDS can meet all of its key performance requirements. For example, the Navy has not yet been able to develop an adequate propulsion battery. In addition, the ASDS' final design will remain uncertain until technical problems are solved and testing is completed. The degree of uncertainty will be important as the U.S. Special Operations Command could decide that the ASDS is ready to conduct missions and commit to buying more boats after the operational evaluation scheduled for April 2003.

The ability of the ASDS to meet cost and schedule projections is problematic. The program has experienced major schedule delays and cost increases. The program is 6 years behind its original schedule, and, by GAO's estimates, costs have more than tripled. Cost and schedule estimates were being formally revised at the time of this report, but even their accuracy will be uncertain because of unresolved, known problems; the potential for discovering new problems in upcoming testing; and the difficulty of estimating costs for future boats based on the first boat's aging data.

Several underlying factors have contributed to the ASDS' difficult development. In retrospect, the capabilities required of the boat outstripped the developer's resources in terms of technical knowledge, time, and money. Key problems, such as the battery and the propeller, were discovered late—in testing on the first boat—rather than in component or subsystem level testing. Finally, the program suffered from insufficient management attention on the part of both the government and the contractor, which led to missed opportunities for righting the program as it proceeded. Moreover, the management attention that was exercised has been hampered by outdated information.

ASDS Mated to USS *Greeneville* (SSN 772) Off the Coast of Hawaii, September 2002



Source: U.S. Navy.

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G A O

Accountability * Integrity * Reliability

United States General Accounting Office
Washington, DC 20548

March 31, 2003

The Honorable John Warner
Chairman
The Honorable Carl Levin
Ranking Minority Member
Committee on Armed Services
United States Senate

Key decisions lie ahead for the Advanced SEAL Delivery System (ASDS), a mini-submarine that is one of the U.S. Special Operations Command's largest investments. The Department of Defense (DOD) is increasingly relying on special operations forces to accomplish its missions, especially in the current national security environment of the fight against terrorism. The ASDS, with a potential cost on the order of \$2 billion, is a major development effort to enhance the capabilities of the U.S. Special Operations Command's naval special forces. The mini-submarine is designed for clandestine delivery and extraction of Navy SEAL teams and equipment performing operational missions in high-threat environments. The program, which is being managed by the Navy, is approaching the end of a difficult development and the first boat must undergo key testing before a decision is made to proceed with additional boats.

During the past several years, the Congress has raised concerns about the technical difficulties, schedule delays, cost growth, and management oversight of the ASDS program. Senate Report 107-62, which accompanied the National Defense Authorization Act for Fiscal Year 2002, called for us to review the status and problems facing the program. We briefed the defense committees in April and May 2002 on the results of our review. At that time, you asked us to continue reviewing the program's progress. Accordingly, this report examines the ASDS program's (1) progress towards meeting requirements and technical challenges, (2) ability to meet schedule and cost projections, and (3) underlying factors that have contributed to program problems.

Results in Brief

While progress has been made in addressing technical difficulties with the first boat, some problems must yet be solved and other capabilities demonstrated before the ASDS can meet all of its key performance requirements. For example, the Navy has not yet been able to develop an adequate propulsion battery and the first boat is not quiet enough to meet

acoustic stealth requirements. In addition to solving known technical problems, the potential for discovering new ones is significant because the first boat is slated to begin operational evaluation in April 2003. The ASDS's final design will remain uncertain until technical problems are solved and testing is completed. The degree of uncertainty will be important because the U.S. Special Operations Command could, following the operational evaluation, decide that the ASDS is ready to conduct missions and commit to buying more boats.

The ability of the ASDS to meet schedule and cost projections is problematic. The program has experienced major schedule and cost increases since it was started, and these increases have continued since our April 2002 briefing. The program is 6 years behind its original schedule, and, by our estimates, costs have more than tripled. Current schedule and cost estimates have not been updated since 1999. These estimates were being formally revised at the time of this report, but they will be subject to change because of unresolved, known problems; the potential for discovering new problems in upcoming testing; and the difficulty of estimating costs for future boats based on the first boat's aging data.

Several underlying factors have contributed to the ASDS's difficult development. In retrospect, the capabilities required of the boat outstripped the developer's resources in terms of technical knowledge, time, and money. Key technical problems, such as the battery and the propeller, were discovered late—during testing on the first boat—rather than in component or subsystem level testing. Finally, the program suffered from insufficient management attention on the part of both the government and the contractor, which led to missed opportunities for righting the program as it proceeded. Moreover, the management attention that was given has been hampered by outdated information.

We are making recommendations aimed at improving the quality of information available and enhancing DOD's oversight of the ASDS program. In its comments on a draft of this report, DOD concurred with two of our recommendations and partially concurred with our recommendation to elevate the level of management attention. Specifically, DOD concurred with all but a part of one of the particulars of this recommendation concerning the development of an independent cost estimate.

Background

The ASDS is a battery-powered mini-submarine about 65 feet long and 8 feet in diameter with a dry interior. It is operated by a two-person crew and can carry equipment and SEAL personnel. The vehicle has a hyperbaric recompression chamber with a lower hatch that can be opened and closed underwater to allow divers to exit and reenter the vehicle (referred to as lock in/lock out) at various depths.¹ The ASDS is expected to have increased range, speed, and capacity over the current underwater SEAL delivery vehicle, which is an open, wet submersible that transports SEALs wearing scuba gear and thus exposes them to ocean water temperatures. The ASDS's main advantage over existing SEAL delivery systems is its ability to transport forces in a dry environment, which reduces the SEALs' exposure to cold-water as well as their physical and mental fatigue. Use of the ASDS is not limited to delivery of Navy SEALs. It can be used for intelligence collection, surveillance and reconnaissance, combat search and rescue, sabotage and diversionary attacks, forward observation for fire direction, underwater ship attack, and offensive mine operations.

Several organizations are involved with the ASDS program. The U.S. Special Operations Command is funding the program, and its Naval Special Warfare Command set the requirements and will be the user of the system. The Assistant Secretary of the Navy for Research, Development, and Acquisition is responsible for approving each phase of the ASDS acquisition process. The Naval Sea Systems Command is the acquisition program manager and is responsible for overseeing the prime contractor, Northrop Grumman.

The program's last official baseline—from 1999—calls for building six boats and two facilities. The plans also include the ability to transport the ASDS boat using a variety of methods, including undersea (“piggy-back” on a 688-class attack submarine), by air (aboard C-5 aircraft), and by road (on a large flat-bed trailer). The Naval Sea Systems Command awarded a contract to Northrop Grumman for detailed design and manufacturing development in September 1994.² In August 2001, the Navy program office took what it calls “conditional” preliminary acceptance of the first boat from Northrop Grumman under an agreement that all contractual

¹ A chamber used to treat divers suffering from decompression sickness, which can be caused by descending below sea level.

² The contract was originally awarded to Westinghouse Electric Corporation, which was subsequently bought by Northrop Grumman in 1996.

requirements needed for final government acceptance would be completed within 1 year. However, Navy officials told us that the contractor has not satisfactorily completed the contract requirements within this period, and the first boat is still not ready for final government acceptance.

The first ASDS boat is scheduled to undergo an operational evaluation in April 2003. An operational evaluation is a field test conducted by the war fighter under realistic conditions for the purpose of determining the effectiveness and suitability of the boat for use in combat. The operational evaluation will be a major factor in deciding whether or not to declare an initial operating capability—the point at which the first boat can be used to conduct missions.

Progress Made in Meeting System Requirements and Resolving Technical Problems, but Difficulties Remain

During the past year, the ASDS program has made considerable progress in addressing technical difficulties. However, the first boat has not yet demonstrated that it can meet all key requirements. Several technical challenges still need to be addressed, and further technical and operational testing is required before all key performance requirements can be demonstrated and the first boat can be considered fully operational.

The ASDS Has Not Met All Requirements

The first boat produced has not demonstrated the ability to meet all of the program's key performance parameters. Key performance parameters represent those critical performance parameters so significant that a failure to meet a minimum value of performance can call into question a system's ability to perform missions. Each key performance parameter is made up of individual subordinate requirements that must be met to demonstrate the parameter.³ At the time of our review, Naval Sea Systems Command officials judged that 11 of the first boat's 16 key performance parameters had been met, 4 were still in process, and 1 required action. However, the status of the subordinate requirements, as shown in table 1, makes the assessment of the key performance parameters less clear.

³ These subordinate individual requirements are specified in the contract and the user's Operational Requirements Document.

Table 1: Status of the ASDS Key Performance Parameters, Boat 1

Key performance parameter number	Key performance parameter	Status			
		Demonstrated, all subordinate requirements met	Demonstrated, some subordinate requirements not met	In process	Action required
1	Maximum combat range		✓		
2	Maximum cruise speed		✓		
3	Transport depth (submarine host)		✓		
4	Transport speed (submarine host)		✓		
5	Concurrent lock in/lock out		✓		
6	Operating temperature			✓	
7	Storage temperature	✓			
8	Survivability			✓	
9	Vibration		✓		
10	Crew	✓			
11	Passengers	✓			
12	Endurance		✓		
13	External payload			✓	
14	Transportability		✓		
15	Vehicle signatures				✓
16	Interoperability			✓	
Total		3	8	4	1

Source: U.S. Navy.

Note: Naval Sea Systems Command, *ASDS Top Level Requirement Verification Matrix*, January 2003.

As indicated in table 1, all subordinate requirements for the first boat have not been met for eight key performance parameters that were judged as demonstrated. For example, the third parameter—transport depth (attached to the submarine host)—has three subordinate requirements. One has been demonstrated, but two are still in process. Similarly, the fifth parameter—concurrent lock in/lock out—has 12 subordinate requirements. Four have been demonstrated, but five are still in process and three require action.

Some requirements have also been delayed, reduced, and eliminated by the U.S. Special Operations Command. For example, the acoustic, or noise level, requirement, which is part of the vehicle signatures key performance

parameter, has been deferred until the second boat. The transportability parameter—although now considered demonstrated by the Naval Sea Systems Command—was also reduced. It no longer includes transport by C-17 aircraft, amphibious ships, and the SSN-21 submarine. Also, a degaussing system needed to lower the vehicle’s magnetic signature has been delayed and designated as a preplanned product improvement.⁴ Although a degaussing system was originally included in the ASDS design, the program used the funds for this system to cover other program expenses. If the vehicle has a large magnetic signature, it will have increased vulnerability to mines. Nonetheless, even with these reduced requirements, Navy and U.S. Special Operations Command officials believe that the ASDS is still a cost-effective capability that provides an improvement over existing vehicles.

Problems in Critical Components Remain Unsolved

In the past year, the ASDS program has made progress in resolving technical issues. Achievements include a successful new anchor design, improved battery design, sonar systems upgrades, improvements in configuration management control, renewed focus on ASDS logistics needs, completion of safety-critical software testing, and substantial progress in developing engineering drawings. For example, the original anchors have been redesigned and tested successfully to hold the ASDS level enough to provide a stable dive platform during ocean swells. The program has also succeeded in decreasing the operating temperatures of the silver-zinc batteries, which has reduced the frequency of electrical shorts and improved the batteries’ performance.

Nonetheless, there are still unresolved issues that prevent the vehicle from meeting its operational requirements. Battery reliability and acoustics are currently the most critical issues facing the program. The silver-zinc propulsion battery has limited the performance of the ASDS system. The first attempts to use silver-zinc batteries in the ASDS resulted in unexpected shorting and premature failure. One of the key reasons for the battery shorting was because of the high-temperature environment in which the battery operates. Through ongoing assessment and modifications, the Navy has been able to extend the endurance of a fully charged battery. Program officials have not determined whether the

⁴ Degaussing cables and other elements of a degaussing system were installed and electrical hull penetrators were added during construction of the first ASDS vehicle to shorten the time needed to create a functional degaussing system in the future. A power supply is the major part of the degaussing system that needs to be created.

battery's endurance can be extended to support all missions. In addition, the battery's demonstrated life—the number of times it can be recharged before requiring replacement—is much shorter than expected. Currently, the battery can only be recharged two to three times before failing, whereas 20 recharge cycles were expected. If the battery cannot last through the expected recharge cycles, the impact on the submarine's availability and operation and support costs will be significant because replacing the battery requires the boat to return to its base facility, be taken out of the water, and partially dismantled.

Although the Navy continues to mature the silver-zinc battery for the first boat, it is developing a lithium-ion battery as a replacement on the first boat and any additional boats. Program officials expect the lithium-ion battery to be developed by the summer of 2004. Lithium-ion battery technology, like silver-zinc, is not new; however, the challenge lies in adapting the technology to ASDS's size and environment.

To meet the acoustics portion of the vehicle signatures key performance parameter, the boat must be quiet enough to (1) evade detection while performing its mission of inserting SEALs into hostile territory and (2) not give away the location of the host submarine. However, the first boat makes too much noise and does not meet this acoustic requirement. The most significant noise offender at this point is the propeller. The program manager assembled a team of government and private experts to redesign the propeller by March 2003 in preparation for the operational evaluation in April 2003. However, more propeller work may be needed, and other acoustic problems may have to be addressed in order to meet the requirement. Therefore, the U.S. Special Operations Command deferred the acoustic requirement until delivery of the second boat—in several years—and will accept the noise level that the first boat achieves.

Design and Test Challenges Remain

The final design of the boat is still evolving, pending the resolution of existing problems and remaining testing—notably the operational evaluation. The program has made some progress in finalizing the drawings of the boat by catching up on engineering drawing updates. As of January 2003, the program had completed about 76 percent of approximately 12,000 revisions to the engineering drawings. Program officials expect to eliminate the remaining backlog of 2,846 revisions by August 2003.

Unresolved technical problems could have implications for the design of the ASDS and require further revisions to the boat's engineering drawings.

The ASDS boat includes an outer shell, or exostructure, and an inner, or “pressure,” hull. Many of the boat’s critical systems, such as the battery system, sonars, and anchors, are located between the outer shell and the inner hull. Future changes to any of these systems may require modifications to the design of the outer shell or inner hull. For example, the battery system is mounted to the inner hull. Replacing the silver-zinc battery system with a lithium-ion battery system will likely require modifications to the boat’s design.

Another factor that may affect the design of the ASDS is the statutory requirement to conduct realistic survivability testing. A key element of survivability is live-fire testing, which evaluates how vulnerable the boat’s design is to the shock of being under fire and assesses crew safety. These tests will need to be conducted both on the first boat alone and while the boat is attached to the host submarine. However, the program office has requested that the Director, Operational Test and Evaluation, waive full-up, system-level live-fire testing of the first boat. The law allows an alternative approach to full-up, system-level live-fire testing if it is impractical or overly costly, which is typically the case on submarines because live-fire testing would significantly damage or possibly destroy the boat. To date, an alternative approach has not been approved. Until the ASDS is tested in some manner to satisfy the live-fire requirement, the possibility of discovering the need for design modifications and upgrades will continue.

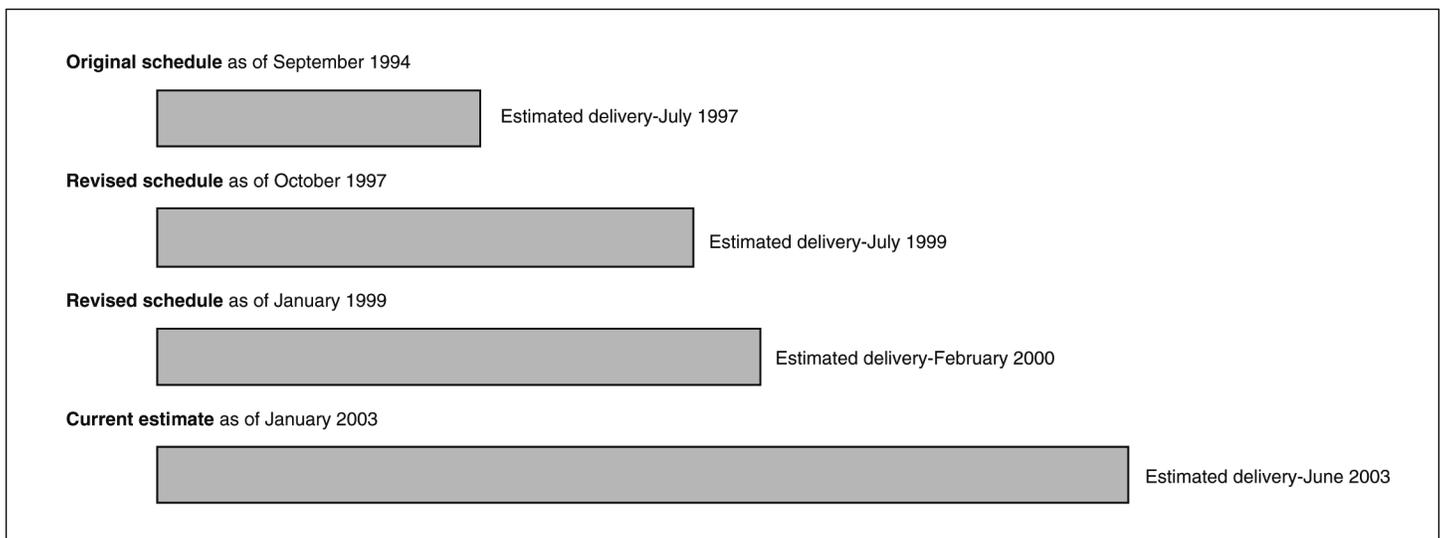
Difficulties Remain in Making Credible Schedule and Cost Projections

Consistent and substantial schedule delays and cost increases have characterized the ASDS program since its beginning. The program originally projected that the first boat could be delivered in fewer than 3 years; 9 years later, the first boat is still not fully operational. A variety of technical challenges and problems have contributed to these delays. In addition, according to the initial approved program baseline, adjusted to reflect six boats and two facilities, the program would cost \$527 million in fiscal year 2003 dollars. Currently, we project that the program will cost over \$2 billion. Continuing technical problems, obsolete estimates, and upcoming tests and demonstrations make it difficult to assess conclusively whether or not the ASDS program is stable or will incur additional delays and cost increases.

Schedule Delays and Cost Increases

Delivery of the first boat is now 6 years behind schedule, as shown in figure 1.

Figure 1: Estimated Delivery of the First Boat



Source: U.S. Navy and U.S. Special Operations Command.

The original program schedule called for delivery of the first boat in July 1997. The 1999 schedule called for delivery of the first boat in February 2000, almost 3 years late. This last program schedule has not been revised since June 1999.⁵ Although the first boat was conditionally accepted in August 2001, Navy officials now expect delivery of a fully acceptable boat from the contractor in June 2003, pending the completion of operational evaluation.

⁵ Navy officials informed us that a revised program schedule was recently drafted and is being reviewed by DOD officials.

As shown in table 2, the ASDS's cost increases essentially parallel the schedule delays.

Table 2: ASDS Program Costs for Six Boats and Two Facilities

Fiscal year 2003 dollars in millions					
Budget category	Development baseline (Oct. 1994) ^b	First rebaseline (Sept. 1998)	Last acquisition program rebaseline (June 1999)	GAO projection ^c (April 2002)	GAO projection ^d (January 2003)
Research, development, test and evaluation	\$131.4	\$244.2	\$310.8	\$437.6	\$467.7
Procurement	\$362.7	\$452.2	\$675.0	\$1,258.6	\$1,823.7
Military construction	\$33.0	\$37.4	\$36.8	\$51.7	\$51.7
Total^a	\$527.1	\$733.7	\$1,022.6	\$1,747.8	\$2,343.0

Source: U.S. Navy and U.S. Special Operations Command.

Note: GAO analysis of Navy and U.S. Special Operations Command data.

^aTotals may not add due to rounding.

^bThe development baseline was for 3 boats and 1 facility. To put this estimate on the same footing as the 1998 and 1999 estimates, GAO projected what the development baseline would equal for 6 ASDS and 2 facilities.

^cGAO projected the acquisition costs based on the U.S. Special Operations Command's actual funding for ASDS through fiscal year 2001 and projections through fiscal year 2007. Our projections are straight-line estimates and do not include any learning curve, economies of scale, or nonrecurring cost effects.

^dGAO projected the acquisition costs based on the U.S. Special Operations Command's actual funding for ASDS through fiscal year 2002 and projections through fiscal year 2009. Our projections are straight-line estimates and do not include any learning curve, economies of scale, or nonrecurring cost effects.

By the last approved acquisition program baseline in June 1999, total costs had almost doubled, and research, development, test and evaluation costs had more than doubled. The June 1999 program baseline has not been updated since, and updated cost estimates are not available.⁶ However, at the time of our briefing in April 2002, we projected that both of these costs had more than tripled.

⁶ Navy officials informed us that the acquisition program baseline was being revised.

Several Factors Make Future Cost and Schedule Performance Uncertain

Uncertainties about the schedule and cost of the ASDS program remain, making it difficult to predict future performance. The program faces additional cost and schedule risks as outlined below:

- The program has experienced continual delays in preparing and getting estimates approved. Specifically, none of the following has been finalized or approved: the acquisition program baseline, the test and evaluation master plan, the test plan for the operational evaluation, or the cost estimate.
- The solutions to several known technical problems need to be demonstrated through testing, and the results of this testing may reveal the need for additional changes.
- The operational evaluation could expose new problems, which may require redesign and other solutions. Further, if the operational evaluation is not rigorous enough, or the scope is too narrow, the program risks missing problems. For instance, any requirements deferred to the second boat will not be included in the operational evaluation. Some scope reduction has already occurred with the deferral of the propeller and the degaussing system. Moreover, we could not determine the rigor and scope of the operational evaluation due to the lack of an approved test plan.
- The wide, but now necessary, gap between the construction of the first two boats makes cost projections for the second and future boats more difficult due to loss of production base as well as obsolescence of certain technologies and systems that have been incorporated into the first boat.

Several Underlying Factors Contributed to the ASDS's Difficult Development

Developing the ASDS was clearly a difficult undertaking—a challenge under any circumstances. However, several factors either made the development effort more difficult than necessary or limited opportunities for responding to problems early. These include discovery of problems in system-level testing, a mismatch between requirements and resources at program start, and insufficient management attention. In retrospect, some of the ASDS's difficulties could have been foreseen and their effect lessened.

Discovery of Key Problems in System-Level Testing

While technical challenges, such as the battery and propeller, have caused schedule delays and cost increases, the effect of technical challenges and problems has been magnified because critical problems were not discovered until tests of the full ASDS system. Ideally, system-level testing occurs after components have successfully completed laboratory and subsystem testing. In a 2000 report on test and evaluation, we found that a best practice was to expose problems early in component and subsystem

level tests so that they could be corrected for less cost.⁷ Conversely, we found that when tests of a full system became the vehicle for discovering problems that could have been found out earlier, additional—and unanticipated—time, money, and effort had to be expended to overcome the problems. One firm referred to this phenomenon as “late cycle churn.”

It appears that the ASDS program is experiencing late cycle churn with the battery and acoustics problems. Early silver-zinc battery tests were performed under very limited, unrealistic environmental conditions. Consequently, the problems with the battery were not discovered until shortly after the first set of batteries was installed on the boat in December 2000. Similarly, acoustic tests of the propeller were not performed until February 2002—again, on the first boat. Had the battery and propeller acoustics problems been discovered earlier in more realistic component or subsystem level testing, their effect on schedule and costs might have been minimized.

Mismatched Requirements and Resources at Program Start

It is now clear that when the ASDS program began, the capabilities required of the boat outstripped the developer’s resources in terms of technical knowledge, time, and money. Our work on best practices has shown that when such a mismatch occurs at the outset of product development, a program is put in a poor position to succeed.⁸ Cost increases, schedule delays, and performance shortfalls are the typical consequences of such a mismatch.

Before product development begins, successful programs achieve a match between the product performance desired by the customer and the ability of the developer to marshal the resources necessary to develop such a product. It is essential that both parties understand the demands that the customer is making of the product and the challenges these pose for the developer before the parties commit to product development. Importantly, achieving this match is a managed outcome—on successful programs, it is done deliberately, using metrics for assessing technology and design risks.

⁷ U.S. General Accounting Office, *Best Practices: A More Constructive Test Approach Is Key to Better Weapon System Outcomes*, [GAO/NSIAD-00-199](#) (Washington, D.C.: July 31, 2000).

⁸ U.S. General Accounting Office, *Best Practices: Better Matching of Needs and Resources Will Lead to Better Weapon System Outcomes*, [GAO-01-288](#) (Washington, D.C.: Mar. 8, 2001).

In particular, the maturity of technology is an important weathervane for achieving a match between requirements and resources. On successful product development programs, developers will not allow immature technologies—those that require further development—to be included in the product design. Immature technologies make it very difficult to estimate a product development’s schedule and cost accurately.

If the developer does not have the requisite technologies, engineering and design knowledge, and sufficient time and money to deliver the desired product when it is needed, tradeoffs must be made. These include (1) lowering product requirements to match the developer’s resources or (2) deferring the program until the developer can make the additional investments to meet the customer’s requirements. When a match between requirements and resources is not achieved at the outset of product development, the ensuing program is much more susceptible to performance shortfalls, cost increases, and schedule delays. The competition for funds often makes the situation worse by enticing managers to be optimistic about the time and money needed to complete development.

The ASDS’s experience, as detailed in the preceding sections, has followed this path. Product requirements have been lowered, dropped, or deferred in an effort to match what the developer could deliver—tradeoffs that could perhaps have been made before product development began. Cost increases and schedule delays evidence the struggle of the developer to mature key technologies, such as the battery, and solve design problems, such as the propeller, while producing the first boat. The experience of the ASDS underscores the need for nascent and future weapon system programs to manage customer needs and developer resources so that a match is achieved before product development is approved.

Management Attention Has Been Insufficient

Weaknesses in the ASDS’s management compounded the problems resulting from the mismatch between user requirements and the developer’s resources. Management of the program on the part of both the government and the contractor has been insufficient; consequently, early opportunities to act on problems were missed. Moreover, direction by the Congress to elevate the oversight of the program to include a higher level of DOD review has not been followed fully, although the program has received heightened managerial attention. Recent steps taken to improve management of the program will help, but they have come very late in the product development process.

In August 1994, before the ASDS began product development, the DOD Inspector General reported serious problems with the program, including noncompliance with mandatory DOD acquisition guidance, and recommended increased senior-level DOD oversight and better coordination with the Joint Staff, the services, and defense agencies. However, the acquisition executive at the time disagreed, based on input from other sources, including the Naval Sea Systems Command's assessment that the program was technically sound and executable. Consequently, the Navy began product development with the award of the engineering and manufacturing development contract to Northrop Grumman as planned on September 29, 1994.⁹

In 1997 and 1999, two Navy independent review teams identified continuing problems with the ASDS program, including cost growth, schedule delays, and—perhaps most importantly—a lapse in effective program management by both the government and the contractor. Collectively, these problems necessitated developing a new baseline. Navy reviews identified several causes for the lapse in effective program management. These included:

- a lack of contractor experience in submarine design and construction;
- the government's lack of influence or visibility into problems between the contractor and the subcontractors;
- a focus on technical rather than management aspects of the program by both the program office and the contractor;
- ineffective oversight by the program office and little attention to the financial performance of the contractor; and
- frequent changes in the contractor's project management team.

As a result, the Navy created a management integrated product team comprised of the Naval Sea Systems Command's Program Manager for the Deep Submergence Program Office; a Northrop Grumman Senior Vice President; the U.S. Special Operations Command's Program Executive Officer, Maritime and Rotary Wing; and the Naval Special Warfare Command's Assistant Chief of Staff for Resources, Requirements, and Assessments to help deal with ASDS program problems.

⁹ The contract was originally awarded to Westinghouse Electric Corporation, which was subsequently bought by Northrop Grumman in 1996.

In August 1999,¹⁰ the Congress expressed its continuing concern over cost growth, development and testing activities, and level of oversight. It established the ASDS as an item of special interest that it would monitor closely. It also requested that—although ASDS may not meet the normal dollar threshold for automatic elevation to a major defense acquisition program (acquisition category I)—the program be elevated to an equivalent level of DOD review because of the “troubled history” and “concern that this program may not be out of difficulty yet.”¹¹ Programs designated as acquisition category I programs must meet certain statutory and DOD requirements applicable to such programs, including regular reporting to Congress; establishment of a firm baseline for measuring the program; a mechanism for addressing cost and schedule variances; establishment of cost, schedule, and performance goals; development of an independent life-cycle cost estimate by the Secretary of Defense’s Cost Analysis Improvement Group; and an independent operational test and evaluation. Further, elevation of the program to this higher acquisition category would result in a more disciplined program management approach under DOD’s acquisition system guidance, including following a prescribed process for making major decisions, providing documentation such as test results for those decisions, and holding formal reviews before making those decisions. This process, while intended to facilitate the management of major programs, also provides the mechanisms and opportunities for exercising oversight. In early 2001, the U.S. Special Operations Command informed the Navy that ASDS cost projections were approaching the acquisition category I program threshold and proposed elevating the status of the program.

In both instances, DOD declined to designate the ASDS as a major defense acquisition program. Rather, to increase management attention, DOD established new top-level overarching integrated product team reviews and placed the program on the oversight list of the Director, Operational Test and Evaluation. In fact, however, while the top-level overarching integrated product team was slated to meet twice each year to review the

¹⁰ House of Representatives Conference Report 106-301, pages 585-586, accompanying the National Defense Authorization Act for Fiscal Year 2000.

¹¹ The conferees presumably intended for DOD to designate the program as a major defense acquisition program, known as acquisition category I. A program is considered to be a major defense acquisition program if its total research and development expenditures are estimated to be at least \$365 million (in constant fiscal year 2000 dollars). In addition to the monetary threshold, programs can also be designated as category I under the discretion of the Secretary of Defense (for example, because of congressional interest).

ASDS's progress, it has only met two times, and has not met since May 2001. The lower-level integrating team has met more often. In any event, the program office has not developed a new program baseline, including an updated cost estimate, since 1999, which denied the teams current information even if they had made a more rigorous attempt to provide oversight.

Despite these and the earlier attempts at improving management attention, lapses in effective program management have continued. Most recently, Navy officials informed us that they have had to require the contractor to redo all of the required safety-critical software testing because the contractor did not provide documentation that this testing had been performed. This rework has contributed to recent schedule delays and cost increases. Program officials also informed us that in early 2002 they had to hire another contractor to investigate and develop solutions for the battery problems. This also has contributed to recent schedule delays and cost increases.

In November 2002, Congress directed the Secretary of Defense to conduct a complete review of the requirements, mission, management, and cost structure of the ASDS program and report to the congressional defense committees before obligating more than 50 percent of fiscal year 2003 ASDS procurement funding.¹² This review is in progress, and results are expected by late March 2003. Congress again intervened during the fiscal year 2003 congressional budget review. As a result of the review, DOD agreed that the first boat should be fully operational and meet the user's requirements before it commenced with the procurement of additional boats. Under the condition that the U.S. Special Operations Command would agree to resolve the technical issues with the first boat before declaring initial operational capability, Congress approved additional funding for the program.

At the program level, several management improvements have been made recently. While they will not necessarily address oversight, they should facilitate solving technical problems and improve the quality of program information. The program office and the U.S. Special Operations Command augmented their staffs and expertise in 2002 to meet the needs of the ASDS program. In addition, the ASDS program manager has enlisted

¹² House of Representatives Conference Report 107-772, page 436, accompanying the National Defense Authorization Act for Fiscal Year 2003.

outside experts from Battelle and Penn State University to investigate technical problems with the battery, sonars, and the propeller. The program office is also revising the Acquisition Strategy, the Approved Program Baseline, and the Test and Evaluation Master Plan. According to program officials, the new baseline will allow for more testing and information to be gathered before commitments are made to purchase additional boats.

Conclusions

After a troubled history, the ASDS program has made tangible progress, particularly in resolving technical problems. Nevertheless, as the program prepares to begin the April 2003 operational evaluation of the first boat, the ASDS still has not met all key performance requirements and must still solve significant technical problems. The challenge in solving known problems, coupled with the possibility of discovering new ones in upcoming tests, pose risks for achieving initial operational capability as planned and for having sound cost and schedule estimates. While every reasonable effort should be made to overcome the first boat's shortfalls and have a successful operational evaluation, decisions on investing in additional boats must be based on both sound information and a sound process for decision making.

The information decision makers will need includes demonstrable knowledge that (1) key design problems have been resolved, (2) the resulting mission performance of the ASDS is worthwhile, and (3) credible cost and schedule estimates for building follow-on boats, facilities, and operations and support are developed. It is important that the activities that will provide this information, such as improvements to the battery and propeller and the operational evaluation of the first boat, have sufficient scope and take place before key decisions are made. Good information, when it becomes available, must be used effectively. Thus, it is equally important that a formal process be followed for evaluating this information and making decisions. In particular, DOD decision makers should have the benefit of a formal, informed, transparent decision meeting before proceeding with purchases of additional boats.

Recommendations for Executive Action

Before the operational evaluation is held, we recommend that the Secretary of Defense ensure that the overall ASDS test and evaluation master plan and the specific test plan for the operational evaluation are both sufficient in scope and approved.

Before a decision to purchase additional boats is made, we recommend that the Secretary of Defense ensure that:

- the ASDS operational evaluation is completed as planned;
- solutions to key technical and performance problems are demonstrated;
- the most likely performance of the ASDS is reassessed on the basis of the operational evaluation and demonstrated solutions to problems;
- the ASDS program is designated a major defense acquisition program (acquisition category I);
- a formal milestone C decision, in accordance with DOD acquisition guidance, is held;
- the Cost Analysis Improvement Group develops an independent cost estimate for milestone C, based on the acquisition plan and planned product improvements;
- the program is funded to the level of the independent cost estimate; and
- the worthiness of proceeding with additional purchases is assessed against both (1) the ability of the ASDS to perform missions and be sustained and (2) the opportunity costs of investing in the ASDS versus other special operations needs.

If a decision to proceed with the purchase of additional boats is warranted, we recommend that the Secretary of Defense ensure that a follow-on test and evaluation of the second boat is planned and funded to demonstrate that remaining deficiencies have been corrected.

Agency Comments and Our Evaluation

DOD provided us with written comments on a draft of this report. The comments, along with our responses, appear in appendix I.

DOD concurred with our recommendation that, before an operational evaluation is held, DOD should ensure that the overall ASDS test and evaluation master plan and the specific test plan for the operational evaluation are both sufficient in scope and approved. DOD also concurred with our recommendation that, if a decision is made to purchase additional boats, a follow-on test and evaluation of the second boat is planned and funded to demonstrate that remaining deficiencies have been corrected. DOD partially concurred with our recommendation to elevate the level of management attention. Specifically, DOD concurred with all but a part of one of the particulars of this recommendation; that is, DOD has not yet determined the level of Cost Analysis Improvement Group involvement necessary for developing an independent cost estimate for milestone C.

DOD provided several comments that offered a more optimistic view of ASDS's status than we reported. Specifically, DOD commented that (1) while management attention had been lacking in the early part of the program, it has improved in recent years; (2) program cost and schedule performance have stabilized; and (3) 14 of 16 key performance parameters have been achieved.

We agree that management attention on the program has improved and noted this in the draft report. However, the difficulties the program has continued to experience in recent years, including the unavailability of current cost and schedule estimates, warrant increased attention. We do not share DOD's view that cost and schedule performance have stabilized. New estimates appear imminent for the first time since 1999, but their release alone will not provide stability—this will come from demonstrating that key requirements have been met and problems have been overcome. Regarding the achievement of 14 requirements, it is possible that DOD has completed more test reports since our draft report, but it has not provided such evidence.

DOD also provided technical comments, which we have incorporated as appropriate.

Scope and Methodology

During our review, we met with officials from the U.S. Special Operations Command; the Naval Sea Systems Command; the Naval Special Warfare Command, Navy SEAL Delivery Vehicle Team One; Submarine Force, U.S. Pacific Fleet; the Assistant Secretary of the Navy's Office of Research, Development, and Acquisition; the Office of the Under Secretary of Defense, Acquisition, Technology & Logistics, Naval Warfare; and the Office of the Director, Operational Test and Evaluation.

To determine the progress toward meeting requirements and technical challenges, we examined the Operational Requirements Document, the Acquisition Program Baseline, the ASDS Acquisition Strategy, program status documents, test results, and technical reports. We also discussed requirements and mission needs with the former Commander, Naval Special Warfare Command, and other key Navy and U.S. Special Operations Command officials.

To determine the ASDS program's ability to meet schedule and cost projections, we examined the U.S. Special Operations Command's budget requests, ASDS funding profiles, and other ASDS cost data. We compared the amounts that DOD requested in its budget submissions with amounts

approved by Congress. We reviewed documents from two Independent Review Team assessments, internal Naval Sea Systems Command Reports, legislative actions, contract documents, ASDS program status briefs, and presentations and responses to congressional staff.

To determine the underlying factors contributing to program problems, we reviewed numerous historical documents, including a 1994 DOD Inspector General report, and the 1997 and 1999 Independent Review Team assessments. We also drew upon our previous work on best practices for developing products.

We conducted our review from May 2002 to January 2003 in accordance with generally accepted government auditing standards.

We are sending copies of this report to the Secretary of Defense; the Secretary of the Navy; the Commander, U.S. Special Operations Command; the Director of the Office of Management and Budget; and interested congressional committees. We will also make copies available to others upon request. In addition, the report will be available at no charge on the GAO Web site at <http://www.gao.gov>. Major contributors to this report were Catherine Baltzell, Mary Quinlan, Charles Cannon, Robin Eddington, Gary Middleton, Charles Perdue, and Adam Vodroska. If you have any questions regarding this report, please call me at (202) 512-4841.



Paul L. Francis
Director
Acquisition and Sourcing Management

Appendix I: Comments from the Department of Defense

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



ACQUISITION,
TECHNOLOGY
AND LOGISTICS

OFFICE OF THE UNDER SECRETARY OF DEFENSE

3000 DEFENSE PENTAGON
WASHINGTON, DC 20301-3000

10 MAR 2003

Mr. Paul Francis
Director, Acquisition and
Sourcing Management
U.S. General Accounting Office
Washington, D.C. 20548

Dear Mr. Francis:

This is the Department of Defense (DoD) response to the General Accounting Office (GAO) draft report, "DEFENSE ACQUISITIONS: Advanced SEAL Delivery System Program Needs Increased Oversight," dated February 21, 2003 (GAO Code 120155/GAO-03-442). The Department partially concurs with the statements in the draft report and partially concurs with the GAO recommendations.

The Department acknowledges the cost increases and schedule delays associated with this program and the lack of management attention during the early part of the program. Management attention has improved in recent years; and, since the inception of increased OSD oversight in summer 2000, Integrating Integrated Product Teams and Overarching Integrated Product Teams have reviewed this program more often than a majority of the Department's Major Defense Acquisition Programs. Additionally, program cost and schedule performance have stabilized.

During developmental testing, the ASDS vehicle (ASDS-1) achieved Operational Requirements Document (ORD) threshold levels for 14 of its 16 required Key Performance Parameters (KPPs). The Survivability KPP (all systems meet Mil-S-901C shock requirements) will be met by April 2003. The Vehicle Signature KPP is required by the ORD to be met on the second vehicle. These results will be reviewed by the Program Executive (Submarines) at an Operational Test Readiness Review; and, if satisfactory, he will certify the program to begin operational evaluation in spring 2003. Given the capabilities of the vehicle with the new propeller installed, U.S. Special Operations Command believes that ASDS-1 provides significant operational capability. While we acknowledge the need for design changes to address the existing technical issues (i.e., battery reliability and vehicle radiated noise), there are funded plans in place to accomplish these changes. The degree of uncertainty at this point in the program is comparable to other first-of-class systems.



**Appendix I: Comments from the Department
of Defense**

The Department will designate ASDS as an Acquisition Category I program and reinstate Milestone C as a condition for buying additional vehicles. An independent cost estimate will be performed to support a Milestone C decision; however, the Director, Defense Systems has not yet determined the level of CAIG involvement necessary. The DoD will ensure approval of a Test and Evaluation Master Plan before the start of operational evaluation, and, if necessary, will plan and fund a Follow-on Test and Evaluation.

The detailed comments to the report statements and recommendations are provided in the enclosure. Suggested technical changes have been provided separately.

The Department appreciates the opportunity to comment on the draft report.

Sincerely,



Glenn F. Lamartin
Director
Defense Systems

Enclosure

GAO DRAFT REPORT – DATED FEBRUARY 21, 2003
GAO CODE 120155/GAO-03-442

“DEFENSE ACQUISITIONS: Advanced SEAL Delivery System Program
Needs Increased Oversight”

DEPARTMENT OF DEFENSE COMMENTS
TO THE GAO STATEMENTS AND RECOMMENDATIONS

GAO STATEMENTS

GAO STATEMENT A: The Advanced SEAL Delivery System (ASDS) has not met all requirements. (pgs. 3-5/GAO Draft Report)

DOD COMMENTS: During developmental testing, the ASDS vehicle (ASDS-1) achieved Operational Requirements Document (ORD) threshold levels for 14 of its 16 required Key Performance Parameters (KPPs). These results will be reviewed at an Operational Test Readiness Review; and, if satisfactory, the program will be certified to begin operational evaluation in spring 2003. The Survivability KPP (all systems meet Mil-S-901C shock requirements) will be met by April 2003. The Vehicle Signature KPP is required by the ORD to be met on the second vehicle.

The GAO concludes that requirements are not met since some subordinate requirements have not been demonstrated. The outstanding subordinate requirements either exceed ORD threshold values or apply to future host platforms. For example, the Transport Depth (submarine host) KPP has been demonstrated to the ORD objective level for all ships currently configured to carry ASDS. The subordinate requirements for SSN 21 Class submarines, cited in the report, have not been demonstrated since SSN 23 (the designated SSN 21 Class host) is still under construction.

Given the capabilities of the vehicle with the new propeller installed, U.S. Special Operations Command believes that ASDS provides significant operational utility.

GAO STATEMENT B: GAO stated that there are still serious unresolved issues that prevent the vehicle from meeting its operational requirements. Battery reliability and acoustics are currently the most critical technology issues facing the program. (pgs. 5-6/GAO Draft Report)

DOD COMMENTS: The silver-zinc propulsion battery does not provide the projected number of re-charge cycles, which limits the number of missions before the battery must be replaced. The battery satisfies the Maximum Combat Range and Endurance KPPs, but at an increased logistics cost. The Department is continuing to develop improvements to the existing silver-zinc battery. These improvements have already improved battery

See comment 1.

performance, however, additional work is continuing. In addition, the Department is developing a Lithium Ion battery replacement as an alternate solution. The incorporation of this battery is planned and will not have a significant impact on vehicle design.

Radiated noise measurements made during developmental testing revealed that the propeller was the biggest noise contributor. A composite propeller was designed based on an existing validated model. This model provides engineering confidence that the new propeller will resolve the propeller noise problems without further modifications up to a specified speed. The new propeller will be installed and acoustically monitored during operational evaluation. Other noise sources will be corrected as necessary.

U.S. Special Operations Command has stated that the deficiencies noted above do not preclude operational use of the first vehicle.

GAO STATEMENT C: Difficulties remain in making credible schedule and cost projections. (pgs. 6-9/GAO Draft Report)

See comment 2.

DOD COMMENTS: Program cost and schedule performance has stabilized and has been on track during the past year. The degree of design uncertainty at this point in the program is comparable to other first-of-class systems; and, the Department believes credible projections are now possible. The Navy recently completed a credible independent cost estimate, which was provided to GAO. The cost estimate considered the current technical challenges and projected engineering changes.

GAO STATEMENT D: Management attention has been insufficient. (pgs. 10-13/GAO Draft Report)

See comment 3.

DOD COMMENTS: Since the inception of increased OSD oversight in summer 2000, this program has been reviewed at the Integrating Integrated Product Team and Overarching Integrated Product Team levels more often than a majority the Department's ACAT I programs.

GAO RECOMMENDATIONS

RECOMMENDATION 1: Before beginning the operational evaluation, the GAO recommended that the Secretary of Defense ensure that the overall ASDS test and evaluation master plan and the specific test plan for the operational evaluation are both sufficient in scope and approved. (p. 13/GAO Draft Report)

DOD RESPONSE: Concur. Departmental policy for all programs that are on the Department of Defense Test and Evaluation oversight list requires approval of these plans prior to operational evaluation. For ASDS, the Director, Operational Test and Evaluation

will approve the Test and Evaluation Master Plan and Commander Operational Test and Evaluation Force Operational Test Plan before the start of operational evaluation.

RECOMMENDATION 2: Before a decision to purchase additional boats is made, the GAO recommended that the Secretary of Defense ensure that:

- the ASDS operational evaluation is completed as planned;
- solutions to key technical and performance problems are demonstrated;
- the most likely performance of the ASDS is reassessed on the basis of the operational evaluation and demonstrated solutions to problems;
- the ASDS program is designated a category I major defense acquisition program;
- a formal Milestone C decision, in accordance with DoD acquisition guidance, is held;
- the Cost Analysis Improvement Group develops an independent cost estimate for Milestone C, based on the acquisition plan and planned product improvements;
- the program is funded to the level of the independent cost estimate; and
- the worthiness of proceeding with additional purchases is assessed against both (1) the ability of the ASDS to perform missions and be sustained and (2) the opportunity costs of investing in the ASDS versus other special operations needs. (pgs. 13-14/GAO Draft Report)

DOD RESPONSE: Partially Concur. ASDS has exceeded the Major Defense Acquisition Program threshold for RDT&E expenditures. The Department in turn will designate it as an Acquisition Category (ACAT) I program. A Milestone C decision will be reinstated in the program, and will address ASDS affordability and effectiveness. An independent cost estimate will be performed to support a Milestone C decision; however, the Director, Defense Systems has not yet determined the level of CAIG involvement necessary. The other recommendations will be incorporated as a matter of policy for ACAT I programs.

RECOMMENDATION 3: If a decision to proceed with the purchase of additional boats is warranted, the GAO recommended that the Secretary of Defense ensure that a follow-on test and evaluation of the second boat is planned and funded to demonstrate correction of remaining deficiencies. (p. 14/GAO Draft Report)

DOD RESPONSE: Concur. Departmental policy for all programs on the Department of Defense Test and Evaluation oversight list requires assessment of the need for further testing following the completion of operational evaluation. The operational evaluation test results will be reviewed at Milestone C, and, if necessary, a follow-on test and evaluation program will be planned and funded.

The following are GAO's comments on the Department of Defense's letter dated March 10, 2003.

GAO Comments

1. DOD did not provide any new evidence that 14 of ASDS's 16 key performance parameters have been met. As we discussed in our report, program officials had earlier judged that 11 of the first boat's key performance parameters had been met, 4 were still in process, and 1 required action. We did not count those in process as being met, because test reports were not yet completed. It is possible that some of these reports have since been completed, but DOD has not provided this information.

DOD also did not provide any new evidence that outstanding subordinate requirements either exceed required values or apply only in the future. As we discuss in our report, as of January 30, 2003, DOD documentation showed that numerous subordinate requirements for the first boat—which must be met to demonstrate the key performance parameters—had not yet been fully demonstrated. We have noted that in some instances, future requirements were actually planned for the first boat, but deferred.

2. We continue to believe that uncertainties about the schedule and cost of the ASDS program remain and make it difficult to develop credible projections. As we discuss in this report, progress has been made in correcting various technical problems with the ASDS. However, serious technical problems and significant uncertainty remain. Operational testing has not yet begun and may reveal additional problems, which could require redesign and other solutions. In addition, the program has experienced continual delays in preparing and getting schedule and cost estimates approved. While officials have told us that the acquisition program baseline with an updated schedule is currently being revised, the baseline has not yet been completed and approved. The ASDS program is still operating with the June 1999 acquisition program baseline, which is now considerably out of date. Consequently, credible criteria for measuring program cost and schedule stability—and whether or not the program is on track—are still lacking. Finally, the problems of loss of production base and obsolescence of certain technologies remain for the second boat.

The Navy did recently provide GAO with several briefing slides that were based on an independent cost estimate, but they are not the actual estimate. Specifically, the briefing slides show some—but not all—costs

for the second boat only. They did not provide details about estimation methodology or about what costs are included and excluded.

3. As we discuss in this report, we recognize that management attention has increased in recent years. Nevertheless, we continue to believe that the ASDS program needs additional management attention, particularly at higher DOD levels. Our conclusion is based on the current status of the ASDS program itself, including the challenges and risks it faces, and the significant investment it now represents. DOD's statement that the ASDS program has been reviewed more often than a majority of acquisition category I programs is difficult to evaluate without seeing evidence. Nonetheless, the number of times a program is reviewed does not necessarily equate to the right kind of management attention.

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