Report No. DODIG-2017-014

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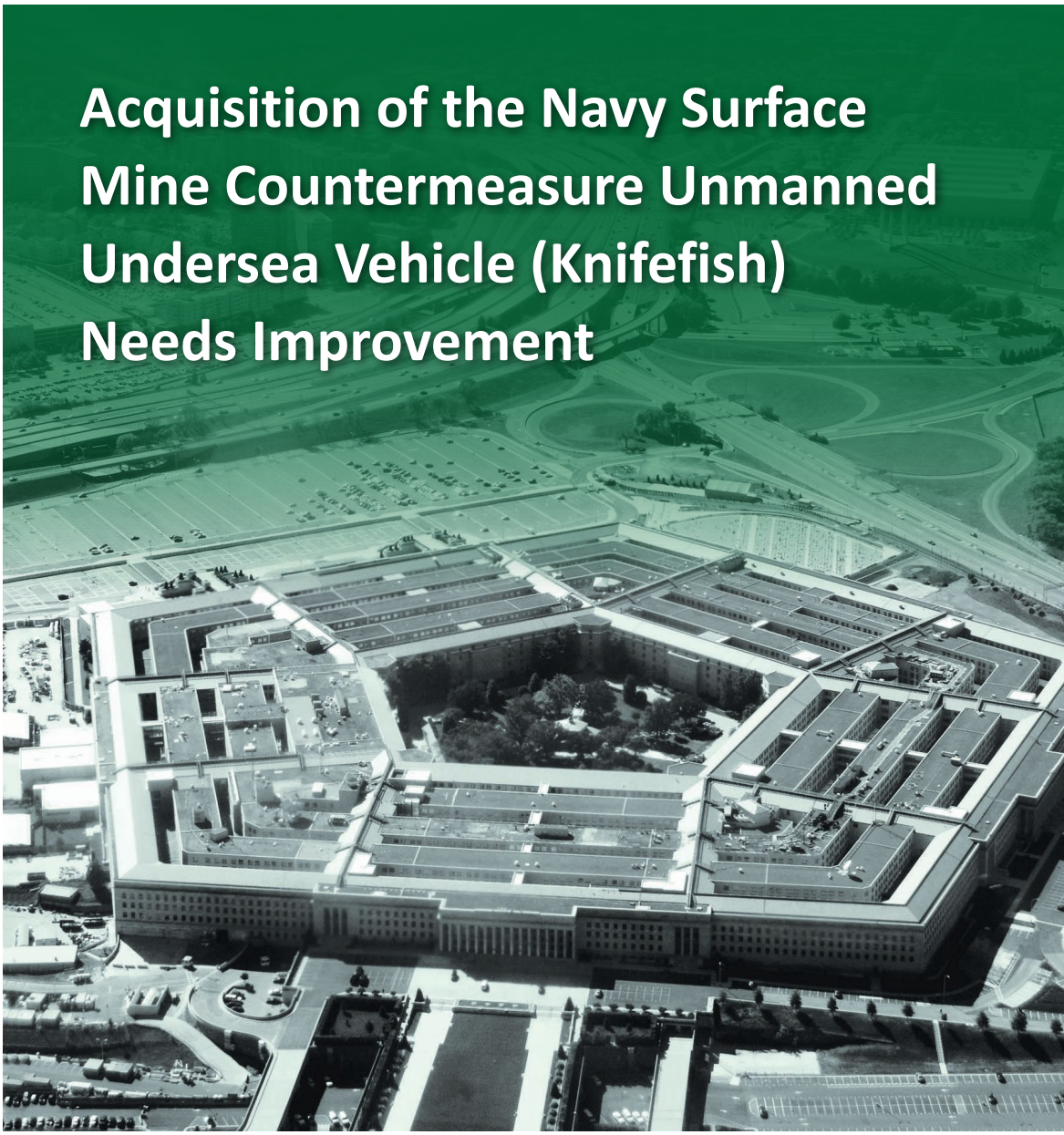
INSPECTOR GENERAL

U.S. Department of Defense

NOVEMBER 8, 2016

Acquisition of the Navy Surface Mine Countermeasure Unmanned Undersea Vehicle (Knifefish) Needs Improvement



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Results in Brief

Acquisition of the Navy Surface Mine Countermeasure Unmanned Undersea Vehicle (Knifefish) Needs Improvement

November 8, 2016

Objective

We determined whether the Navy effectively established requirements and planned testing to support procuring the Surface Mine Countermeasure Unmanned Undersea Vehicle (Knifefish).

Background

The Knifefish is a self-propelled, untethered, autonomous underwater vehicle designed to find underwater mines. The Knifefish is capable of operating independently in shallow ocean water, and is launched and recovered from the Littoral Combat Ship—a fast, agile ship designed for operations in environments near the shoreline.

Finding

The Navy did not effectively establish capability requirements and plan and execute testing to procure the Knifefish. Specifically, the Knifefish requirements developer (Expeditionary Warfare Division, N95) did not fully define requirements to support the communication interface and launch and recovery operations between the Knifefish system and the Littoral Combat Ship.

This occurred because the Knifefish requirements developer and the Littoral Combat Ship requirements developer (Surface Warfare Division, N96) did not coordinate to develop specific Knifefish requirements during the development of the two programs. The lack of coordination resulted in the Knifefish program office issuing engineering change proposals to redesign the Knifefish vehicle to correct

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Finding (cont'd)

communication interface and launch and recovery problems between Knifefish and the Littoral Combat Ship. These engineering change proposals increased program costs by $2.3 million. Additionally, the Knifefish program office did not effectively plan and execute testing because of funding shortfalls, which resulted in a 14-month delay in meeting program milestones. The program office condensed developmental test schedules and combined test events, which puts the program at risk of not being able to correct design problems identified during testing. Uncorrected design problems could jeopardize future testing and could require costly retrofits of the existing structural design of the Knifefish.

The Knifefish program is at risk of not being ready for the initial production decision in the fourth quarter of FY 2017. The Knifefish program was estimated to cost approximately $842.5 million[1] in research, development, test, and evaluation; procurement; and operational and maintenance funds. As of February 2016, the program office had received approximately $91.0 million of the program's estimated acquisition program baseline for research, development, test, and evaluation funds. However, the Knifefish program has not demonstrated the system's ability to perform the key performance parameter of single-pass detection, classification, and identification of bottom and buried mine capabilities. DoD guidance states that a failure to meet a primary requirement threshold (minimum) may result in a reevaluation or reassessment of the program or a modification of the production increments.

If the Knifefish cannot meet its primary requirement to detect, classify, and identify mines, the Navy could spend an additional $751.5 million in remaining funds for Knifefish research, development, test, and evaluation; procurement; and operations and maintenance to procure and sustain a system that may not achieve the capability the Navy originally planned.

[1] The estimated program cost and funds received were escalated to base-year FY 2017 dollars.

Results in Brief

Acquisition of the Navy Surface Mine Countermeasure Unmanned Undersea Vehicle (Knifefish) Needs Improvement

Recommendations

We recommend that the Director, Expeditionary Warfare Division (N95), coordinate with the Director, Surface Warfare (N96), to develop capability requirements in the Knifefish capability production document relating to communication interface and launch and recovery operations between the Knifefish system and the Littoral Combat Ship.

We recommend that the Director, Expeditionary Warfare Division (N95), coordinate with the Program Executive Officer, Littoral Combat Ship, to:

- assess and revalidate whether to continue with the Knifefish program as the solution to single-pass detection, classification, and identification of bottom and buried mines, and if so, fund the program accordingly; or
- cancel the program, putting $751.5 million in research, development, test, and evaluation; procurement; and operational and maintenance funds to better use.

Management Comments and Our Response

Comments from the Director, Expeditionary Warfare Division (N95), and the Commander, Naval Sea Systems Command, responding for Program Executive Officer, Littoral Combat Ship, partially addressed the recommendations. Specifically, the Director's comments did not explain how he plans to fully define the Knifefish communication interface and launch and recovery requirements in the capability production document. The Commander's comments did not explain his plans for assessing the Knifefish program as solution to single-pass detection, classification, and identification of bottom and buried mines. We request additional comments by December 8, 2016. Please see the Recommendations Table on the following page.

Recommendations Table

Management	Recommendations Requiring Comment	No Additional Comments Required
Director, Expeditionary Warfare Division	1, 2	
Program Executive Officer, Littoral Combat Ship	2	

Please provide Management Comments by December 8, 2016.

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INSPECTOR GENERAL
DEPARTMENT OF DEFENSE
4800 MARK CENTER DRIVE
ALEXANDRIA, VIRGINIA 22350-1500

November 8, 2016

MEMORANDUM FOR NAVAL INSPECTOR GENERAL

SUBJECT: Acquisition of the Navy Surface Mine Countermeasure Unmanned Undersea Vehicle (Knifefish) Needs Improvement (Report No. DODIG-2017-014)

We are providing this report for review and comment. The Navy did not effectively establish capability requirements and plan and execute testing to procure the Knifefish. The Knifefish program is at risk of not being ready for the initial production decision in the fourth quarter of FY 2017. Specifically, the Navy could spend an estimated $58.2 million procuring three Knifefish Unmanned Undersea Vehicles engineering developmental models and up to five Knifefish initial production systems without having demonstrated the system's ability to perform the key performance parameter of single-pass detection, classification, and identification of bottom and buried mine capabilities. We conducted this audit in accordance with generally accepted government auditing standards.

We considered management comments on the draft of this report when preparing the final report. DoD Instruction 7650.03 requires that recommendations be resolved promptly. Comments from the Director, Expeditionary Warfare Division (N95), and the Commander, Naval Sea Systems Command, partially addressed with the recommendations. Therefore, we request the Director, Expeditionary Warfare Division (N95), and the Commander, Naval Sea Systems Command, provide additional comments on the recommendations by December 8, 2016.

Please send a PDF file containing your comments to asm@dodig.mil. Copies of your comments must have the actual signature of the authorizing official for your organization. We cannot accept the /Signed/ symbol in place of the actual signature. If you arrange to send classified comments electronically, you must send them over the SECRET Internet Protocol Router Network (SIPRNET).

We appreciate the courtesies extended to the staff. Please direct questions to me at (703) 604-9077 (DSN 664-9077).

Jacqueline L. Wicecarver
Jacqueline L. Wicecarver
Acting Deputy Inspector General
for Audit

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Introduction

Objective

We determined whether the Navy effectively established requirements and planned testing to support procuring the Surface Mine Countermeasure Unmanned Undersea Vehicle (Knifefish). See Appendix A for a discussion of the scope and methodology.

Background

The Knifefish is an Acquisition Category III[2] program in the engineering and manufacturing development phase of the acquisition process. The Navy established the Knifefish as an acquisition program in September 2011, as part of the Littoral Combat Ship (LCS) Mine Countermeasure Mission Package. The Navy is developing the Knifefish in preparation for the low-rate initial production (initial production) decision planned for the fourth quarter of FY 2017.

The Knifefish is a minehunting system designed as a self-propelled, untethered, autonomous underwater vehicle. The Knifefish uses low-frequency broadband sonar sensors to detect, classify, and identify buried and bottom mines. The Knifefish is capable of operating independently in shallow ocean water, and is launched and recovered from the LCS or craft or ship of opportunity.[3] The Navy intends to use the Knifefish instead of marine mammals, such as dolphins and sea lions, which are currently used to detect mines on the ocean floor. Figure 1 is an illustration of the Knifefish detecting bottom mines.

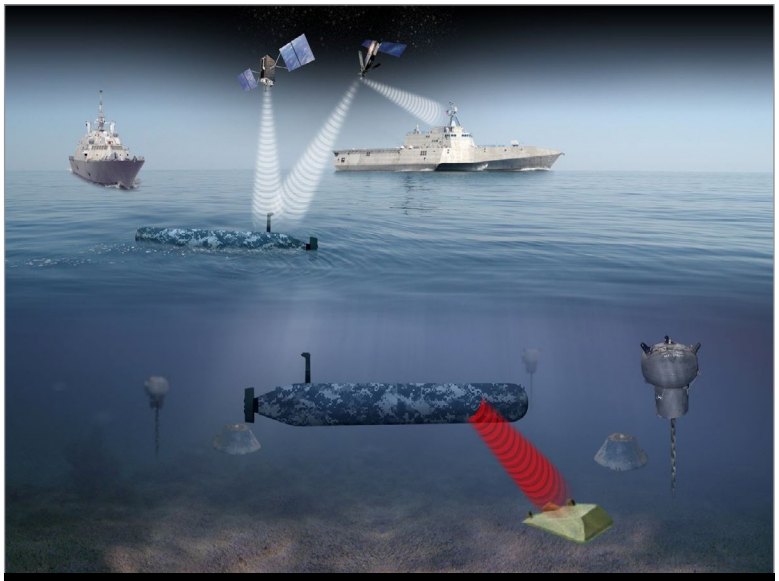


Figure 1. Knifefish Detecting Mines
Source: Unmanned Maritime Systems Program Office

[2] Acquisition Category III is an acquisition program for which the DoD Component head estimates eventual total expenditures for research, development, test, and evaluation of less than $185 million in FY 2014 constant dollars or, for procurement, less than $835 million in FY 2014 constant dollars.

[3] Craft or ship of opportunity can be a pier or dock or another ship or platform in the water. Throughout the report, LCS refers to both the LCS and craft or ship of opportunity.

As of February 2016, the Knifefish program budget request from FY 2011 to FY 2017 for developing and procuring the Knifefish totaled $101.5 million in research, development, test, and evaluation funds, which includes three Knifefish Unmanned Undersea Vehicle engineering development models. On September 30, 2011, the Navy awarded a $48.6 million cost-plus-incentive fee contract for development of the Knifefish. The contract included an option for the production of up to five initial production systems. The cumulative value of the contract and options, if exercised, is $86.7 million. As of March 29, 2016, the Navy has committed to pay $73.2 million on the contract.

Ships With Mine Countermeasures Mission Package

The LCS is a fast, agile ship designed for operations in environments near the shoreline. There are two types of LCS and each is equipped with mission packages that provide unique warfighting capabilities in three areas: antisubmarine warfare, surface warfare, and mine countermeasures. The Knifefish is one system in the LCS Mine Countermeasures Mission Package. The Navy is planning to deliver the LCS Mine Countermeasures Mission Package in four increments and plans to deliver the Knifefish in increment four. See Appendix B for the Mine Countermeasures Mission Package delivery plan by capabilities.

Knifefish Program Management

Program Management Office Unmanned Maritime Systems (PMS 406) is responsible for the planning, execution, and reporting of all test and evaluation activities associated with the Knifefish program. In addition, PMS 406 is responsible for coordinating with the LCS Mission Modules Program Office (PMS 420) to make certain that Knifefish integration with the LCS is successful.

The Program Executive Office LCS is the Knifefish milestone decision authority for the program. As the milestone decision authority, the Program Executive Office LCS is responsible for approving entry of the Knifefish program into the next phase of the acquisition process and for cost, schedule, and performance reporting to higher authorities, including congressional reporting. In addition, the Program Executive Office LCS provides oversight of the LCS and the LCS Mission Modules through its program management offices. One of those mission modules is the Mine Countermeasure Mission Package.

Office of the Chief of Naval Operations

The Office of the Chief of Naval Operations is responsible for the command and operations of Navy forces, and for shore activities[4] assigned by the Secretary of the Navy.

[4] Shore activities include facilities for the repair of machinery and electronics; communications centers; training areas and simulators; ship and aircraft repair; intelligence and meteorological support; storage areas for repair parts, fuel, and munitions; medical and dental facilities; and air bases.

Expeditionary Warfare Division (N95) is the Knifefish requirements developer and is responsible for establishing requirements, setting priorities, and directing overall planning and programming for expeditionary warfare systems and related labor, training, and readiness. N95 provides funding to PMS 406 for Knifefish development.

Surface Warfare Division (N96) is the LCS requirements developer and is responsible for determining force levels and shipboard and related support requirements involving the LCS and other weapon systems. N96 provides funding through the LCS Mission Modules program office (PMS 420) for Knifefish integration onto the LCS.

The Commander, Operational Test and Evaluation Force (COTF), is designated by the Chief of Naval Operations to be the Navy's sole independent agency for operational test and evaluation. COTF is responsible for providing objective assessments of the effectiveness and suitability of Navy systems, like the Knifefish, being tested in support of Navy and DoD acquisition programs, and how those systems affect mission accomplishment by sailors, marines, airmen, and soldiers. COTF provides these assessments to the Chief of Naval Operations. Table 1 shows the key organizations and officials responsible for the Knifefish program.

Table 1. Key Organizations and Officials Responsible for the Knifefish Program

Organization or Official	Knifefish Program Responsibilities
Program Executive Office LCS	Milestone decision authority. Approves entry of Knifefish into next acquisition phase.
Program Management Office Unmanned Maritime Systems (PMS 406)	Responsible for planning, execution, and reporting all test and evaluation activities associated with the Knifefish program.
LCS Mission Modules Program Office (PMS 420)	Responsible for integration of LCS mission modules.
Expeditionary Warfare Division (N95)	Knifefish requirements developer. Establishes requirements and provides funding for Knifefish development.
Surface Warfare Division (N96)	LCS requirements developer. Provides funding for Knifefish integration onto the LCS.

Review of Internal Controls

DoD Instruction 5010.40[5] requires DoD organizations to implement a comprehensive system of internal controls that provides reasonable assurance that programs are operating as intended and to evaluate the effectiveness of the controls. We identified internal control weaknesses in the Navy's establishment of requirements and planning of testing to support procuring the Knifefish. We will provide a copy of this report to the senior official responsible for internal controls in the Department of the Navy.

[5] DoD Instruction 5010.40, "Managers' Internal Control Program Procedures," May 30, 2013.

Finding

Navy Did Not Effectively Establish Requirements or Plan and Execute Testing

The Navy did not effectively establish capability requirements and plan and execute testing to procure the Knifefish. Specifically, the Knifefish requirements developer (N95) did not fully define requirements to support the communication interface and launch and recovery operations between the Knifefish system and the LCS.

The Navy did not fully define these requirements because the Knifefish requirements developer and the LCS requirements developer (N96) did not coordinate to develop specific Knifefish requirements during the development of the two programs. The lack of coordination resulted in the Knifefish program office issuing engineering change proposals[6] to redesign the Knifefish vehicle and increased program costs by $2.3 million.[7] Additionally, the Knifefish program office did not effectively plan and execute testing because of funding shortfalls, which resulted in a 14-month delay in meeting program milestones.

The Knifefish program is at risk of not being ready for the initial production decision in the fourth quarter of FY 2017. Specifically, the Navy could spend an estimated $58.2 million procuring three Knifefish Unmanned Undersea Vehicle engineering developmental models and up to five initial production systems without having demonstrated the system's ability to perform the key performance parameter (primary requirement) of single-pass detection, classification, and identification of bottom and buried mine capabilities. These initial production systems could require costly retrofits of existing structural design if problems are not corrected and may not satisfy test requirements in support of the full-rate production decision planned for the fourth quarter of FY 2018. The Navy will spend an additional $751.5 million in remaining funds for Knifefish research, development, test, and evaluation; procurement; and operations and maintenance.

[6] An engineering change proposal is a proposal recommending a change be considered to an original item of equipment, and the design or engineering change be incorporated into the article to modify, add to, delete, or supersede original parts.

[7] Totals may not equal the actual sum because of rounding.

Navy Did Not Effectively Define Requirements

The Knifefish requirements developer did not effectively establish capability requirements to procure the Knifefish. Specifically, the Knifefish requirements developer did not fully define requirements in the Knifefish capability development document[8] (CDD) to support the communication interface and launch and recovery operations between the Knifefish system and the LCS. The CDD identifies needed capability requirements at the Milestone B decision,[9] and guides the program office in making certain the contractor designs a system to meet mission capabilities. The Joint Capabilities Integration and Development System (JCIDS) Manual,[10] which was applicable at the time the CDD was being developed, stated that the sponsor designates "appropriate" system characteristics as requirements; however, the 2011 JCIDS Manual did not emphasize a sponsor's responsibility to make certain that the system characteristics most critical to meeting mission requirements are captured as requirements. As the Knifefish requirements developer develops the capability production document[11] in preparation for the initial production decision in the fourth quarter of FY 2017, it is required to comply with the updated 2015 JCIDS Manual.[12] The 2015 JCIDS Manual includes specific language on writing and reviewing capability development and production documents to require sponsors to include system characteristics most critical to mission effectiveness as requirements.

The Knifefish requirements developer did not effectively establish capability requirements to procure the Knifefish.

Communication Interface Requirement Not Fully Defined

The Knifefish requirements developer did not fully define the LCS communication interface as a requirement in the Knifefish CDD. For example, the Multi–Vehicle-Communication System (MVCS) should provide the LCS mission packages with the capability to exchange information with unmanned undersea vehicles, such as the Knifefish. The May 2009 performance specifications document[13]

8 "Capability Development Document for the Surface Mine Countermeasures Unmanned Undersea Vehicle," June 1, 2010.

9 Milestone B decision is when the milestone decision authority approves the program to enter into the engineering and manufacturing development acquisition phase.

10 "Manual for the Operation of the Joint Capabilities Integration and Development System," February 2009, updated January 31, 2011, (JCIDS Manual) enclosure B "Performance Attributes and Key Performance Parameters," section 3 "Development of KPPs."

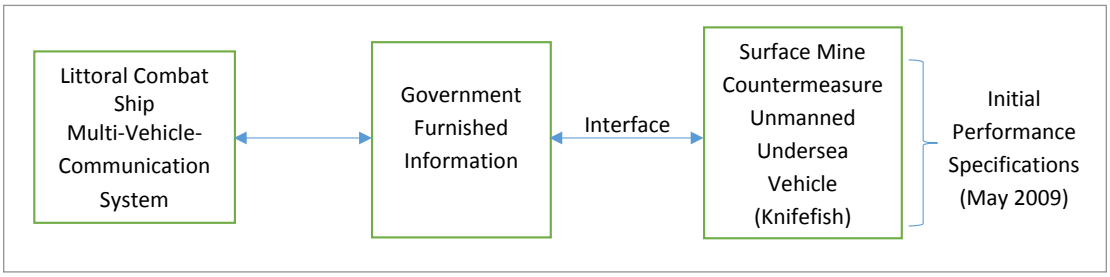
11 Capability production document is the document that validates the users' capability requirements for the initial production decision.

12 "Manual for the Operation of the Joint Capabilities Integration and Development System (JCIDS)," February 12, 2015, enclosure F "Deliberate Staffing Process," section 3 "Staffing of Draft/Initial ICDs, Joint DCRs, CDDs, and CPDs."

13 "Performance Specification for Surface Mine Countermeasure Unmanned Undersea Vehicle," May 21, 2009, establishes the functional requirements for the design, fabrication, testing, and delivery of the Knifefish.

required Knifefish communication capability with the LCS using Government Furnished Information,[14] which the LCS Mission Modules Program Office was to provide. Figure 2 shows the initial May 2009 LCS communication interface requirement.

Figure 2. Initial LCS Communication Interface Requirements



Source: DoD OIG

The Post Preliminary Design Review[15] report[16] dated August 7, 2012, stated the Knifefish MVCS design solution for interfacing with the LCS was not compatible with the LCS MVCS. The report stated that the Knifefish MVCS design was based on a system performance specification requirement that the Knifefish be able to communicate with the LCS MVCS using the Government Furnished Information. The report further stated it was clear at the preliminary design review in May 2012 that the LCS MVCS integration and the interface with the different systems was a program risk. The report stated that an MVCS working group would be established to investigate, manage, and resolve the many deficiencies associated with MVCS integration and the interfacing with the different systems.

In May and July of 2012, the MVCS working group met to develop a solution for resolving the Knifefish communication interface challenges. The working group proposed corrective action and advised that the contractor design, build, and incorporate hardware and software into the Knifefish vehicle to support communications and provide interface compatibility with the LCS without the Government Furnished Information. The Post Preliminary Design Review report stated that the new hardware required more space in the vehicle than initially planned using the Government Furnished Information.

On October 10, 2012, the Navy issued an engineering change proposal requesting the contractor to redesign the Knifefish vehicle to include new software and hardware so the Knifefish could interface and be compatible with the LCS MVCS

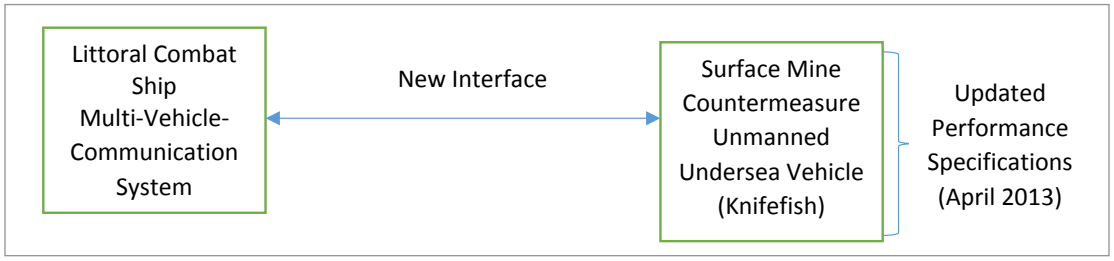
[14] This specific Government Furnished Information is a technical library consisting of interface descriptions, sonar processing descriptions, and automated target detection and classification software algorithm descriptions.

[15] A preliminary design review is a technical assessment that makes sure that the system under review has a reasonable expectation of being judged operationally effective and suitable to meet requirements.

[16] "Post Preliminary Design Review (PDR) Report for the Knifefish Program," August 7, 2012.

without the Government Furnished Information. This redesign required the contractor to lengthen the Knifefish vehicle by 3 feet. Figure 3 shows the revised Knifefish communication interface requirement without the use of Government Furnished Information. On May 9, 2013, the Navy modified the contract to include the engineering change proposal, which increased contract costs by approximately $1.2 million.

Figure 3. Updated LCS Communication Interface Requirement



Source: DoD OIG

Launch and Recovery Requirement Not Fully Defined

The Knifefish requirements developer did not fully define launch and recovery as a requirement in the Knifefish CDD. For the Knifefish program to fully accomplish its mission of detecting, classifying, and identifying buried and bottom mines, the Knifefish must be able to be launched and recovered from the LCS. While the CDD did not include a launch and recovery requirement, the performance specifications document included a requirement for a device to launch and recover the Knifefish vehicle from the LCS deck. Furthermore, the performance specifications document stated the launch and recovery device must be able to independently move the Knifefish vehicle to the ship's launch area for launch and recovery.

During the Preliminary Design Review in May 2012, the contractor presented a launch and recovery device design that created numerous LCS interface problems, including loading the launch and recovery device on the LCS deck and maneuvering the launch and recovery device on the ship. Regarding Knifefish recovery specifically, the contractor assumed the LCS would completely stop in the water and recover the Knifefish. However, the Navy's operational procedure for the LCS was to not travel below the speed of 3 nautical miles per hour during Knifefish vehicle recovery. The Navy tasked the contractor to identify alternate recovery methods compatible with the Navy's operational procedure that requires the LCS not to travel below 3 nautical miles per hour while recovering the Knifefish.

On April 8, 2013, the contractor proposed an engineering change to modify the hardware associated with the Knifefish launch and recovery from the LCS (see Figure 4). According to the contract, the alternative approach would allow the LCS to recover the Knifefish while maintaining course and speed in the water. However, almost 3 years later, the Knifefish program office acknowledged that there was still moderate risk that the launch and recovery design would not meet LCS operational requirements and could result in the Knifefish not being deployable from the LCS. According to the program office's risk mitigation plan, the launch and recovery risk will be recommended for closure when the launch and recovery system successfully completes testing and can demonstrate the launch and recovery capability. However, the program office does not expect to close the risk before September 2017. On December 30, 2014, the Navy modified the contract to include the engineering change proposal, which increased the contract cost by approximately another $1.2 million.

Figure 4. Knifefish Launch and Recovery Device Used by the Office of Naval Research
Source: Unmanned Maritime Systems Program Office

Lack of Coordination Between Requirements Developers

The Navy did not fully define requirements to support the communication interface and launch and recovery operations between the Knifefish and the LCS. Specifically, the Knifefish requirements developer and the LCS requirements developer did not coordinate to develop specific Knifefish requirements during development of the two programs. For example, one of the additional system attributes listed in the LCS capability development document[17] was the requirement for the LCS to launch and recover watercraft. Specifically, the requirement states the LCS must have the ability to safely launch, recover, and handle

[17] "Capability Development Document for Littoral Combat Ship Flight 0+," June 17, 2008.

a single mission package watercraft, such as the Knifefish, while traveling against the wind with low waves. When the Knifefish was added to the mine countermeasure mission package, coordination between the LCS requirements developer and the Knifefish requirements developer would have allowed this requirement to be included in the Knifefish requirements documents. Therefore, we recommend that the Knifefish requirements developer (N95) coordinate with the LCS requirements developer (N96) to develop capability requirements in the Knifefish capability production document relating to communication interface and launch and recovery operations between the Knifefish system and the LCS, unless Knifefish is no longer required.

When the Knifefish was added to the mine countermeasure mission package, coordination between the LCS requirements developer and the Knifefish requirements developer would have allowed this requirement to be included in the Knifefish requirements documents.

Program Office Did Not Effectively Plan and Execute Testing

The Knifefish program office did not effectively plan and execute testing because of funding shortfalls, which resulted in a 14-month delay in meeting program milestones. Secretary of the Navy Instruction (SECNAVINST) 5000.2E[18] states that the program manager must work with the developer, user, and testing communities to make sure that developmental and operational test and evaluation occur to verify that systems meet the Navy's capability requirement. The program manager is also responsible for making sure all necessary time and resources are planned and budgeted so tests are adequate to support decision makers and users through the acquisition life cycle. The program manager should document the test and evaluation planning in the test and evaluation strategy and in the test and evaluation master plan. The Instruction further states that early planning of test and evaluation will provide early identification of technical, operational, and system problems prior to system fielding.

Changes to Knifefish Testing Schedule

The Knifefish program office did not effectively plan testing. For example, the COTF originally planned to use developmental testing results for the operational assessment to support the initial production decision. However, developmental testing does not require the program office to test the system under realistic

[18] SECNAVINST 5000.2E, "Department of the Navy Implementation and Operation of the Defense Acquisition System and the Joint Capabilities Integration and Development System," September 1, 2011, section 4.2.1.2 Program Manager (PM).

conditions, as operational testing does. Operational test planning is important because it supports the determination that a system is operationally effective and suitable in a realistic operational environment. Furthermore, inadequate test planning can lead to test problems, poor system performance, and add cost to a program. COTF is now planning a separate operational testing event in first quarter FY 2017 that will allow the typical military users to test Knifefish under realistic conditions.

Operational test planning is important because it supports the determination that a system is operationally effective and suitable in a realistic operational environment.

In addition, the Knifefish program office is not effectively executing testing. Specifically, the Knifefish program office and contractor are shortening test schedules to minimize schedule delays. For example, the Knifefish program office originally planned to conduct developmental testing over a 21-month period, but revised test plans to shorten testing to a 9-month period. The program office also originally scheduled operational testing to occur over a 12-month period; however, it reduced the schedule to a 9-month period. Because the program office condensed developmental testing schedules and combined test events, the program is at risk of not being able to correct design problems identified, during testing. Uncorrected design problems could jeopardize future testing and require costly retrofits of the existing structural design. See Appendix C for a timeline of the testing events.

Research, Development, Test, and Evaluation Funding Shortfalls

The Knifefish program experienced research, development, test, and evaluation funding shortfalls. Specifically, on July 3, 2013, the program manager reported several funding shortfalls to the Navy milestone decision authority. These shortfalls related to research, development, test, and evaluation funding reductions and LCS integration requirements. Table 2 shows the events and amounts of the shortfalls.

Table 2. Knifefish Program Funding Shortfalls

Events	Amount (million)
FY 2012 congressional appropriation reduction for N95	$6.0
FY 2013 sequestration reduction for N95	$1.7
FY 2013 sequestration reduction for N96	$0.4
FY 2016 congressional appropriation reduction	$2.0
Total Congressional Cuts	**$10.1**
MVCS Integration	$1.2
LCS Launch and Recovery Integration	$2.6
Emergent SG270 Lithium Battery Platform Requirements	$2.0
Total Knifefish Shortfalls	**$5.8**

Because of the FY 2013 funding cuts totaling $2.1 million, the Knifefish contracting officer notified the contractor on July 8, 2013, that there would be no further FY 2013 funding placed against the contract. The contracting officer further explained that any work beyond the contract cost would be at the contractor's expense, and the Government would be under no obligation to reimburse for any cost incurred over the total contract amount. On July 23, 2013, the contractor responded to the contracting officer stating that it was the contractor's expectation, when funding was stable, that there would be a mutually agreed path forward. The contractor intended to submit an equitable adjustment proposal to extend the contractual period of performance, and include additional costs or reduced program scope.

On February 11, 2014, the contracting officer requested that the contractor submit a proposal for replanning the contract. The contractor submitted an updated plan and requested an equitable adjustment of $12.2 million for the work delay. After negotiations, in January 2015, the contractor and the Navy reached an agreement to pay the contractor $8.7 million for the equitable adjustment claim because of funding shortfalls to the Knifefish contract.

DoD Instruction 5000.02[19] states that transition into the engineering manufacturing and development phase requires full funding, which is programmed before the Milestone B decision.[20] Milestone B will not be approved without full funding. The Knifefish program office indicated in the acquisition plan[21] that the Navy planned to fully fund the program. Based on the acquisition program baseline, the Knifefish

[19] DoD Instruction 5000.02, "Operation of the Defense Acquisition System," December 8, 2008, enclosure 2 Procedures, section 6 Engineering and Manufacturing Development (EMD) Phase.

[20] Milestone B decision occurs when the milestone decision authority approves the program to enter into the engineering and manufacturing development acquisition phase.

[21] An acquisition plan is a formal document that identifies the actions necessary to execute the program.

program was estimated to cost, in base-year[22] FY 2017 dollars, approximately $842.5 million in research, development, test, and evaluation; procurement; and operational and maintenance funds. The program has continued to receive congressional funding cuts and continuing resolutions that have resulted in funding shortfalls, which continue to have significant cost and schedule impacts on the program. The program experienced additional congressional funding cuts of $2 million in FY 2016. As of February 2016, the program office has received approximately $91.0 million (60 percent) of the program's estimated acquisition program baseline[23] research, development, test, and evaluation cost in base-year 2017 dollars. If the program office does not receive the required funding, the program may not complete the necessary developmental and operational testing efforts. Therefore, we recommended that the requirements developer, in coordination with the milestone decision authority, assess and revalidate whether to continue with the Knifefish program as the solution to detect, classify, and identify bottom and buried mines or cancel the program. If the milestone decision authority decides to continue the program, it should fund it accordingly. If the milestone decision authority decides to cancel it, $751.5 million in research, development, test, and evaluation; procurement; and operational and maintenance funds would be put to better use.

If the program office does not receive the required funding, the program may not complete the necessary developmental and operational testing efforts.

Knifefish Program Is at Risk of Not Being Ready for Initial Production Decision

After almost 5 years of development, the Knifefish program is at risk of not being ready for the initial production decision in the fourth quarter of FY 2017. Specifically, the Navy could spend an estimated $58.2 million procuring three Knifefish Unmanned Undersea Vehicle engineering developmental models and up to five Knifefish initial production systems without having demonstrated the system's ability to perform the key performance parameter (primary requirement) of single-pass detection, classification, and identification of bottom and buried mine capabilities. Furthermore, these initial production systems could require costly retrofits of existing structural design if problems are not corrected and may not satisfy test requirements in support of the full-rate production decision planned for

[22] Base-year, also known as constant-year dollars, is a reference period that determines a fixed price level for comparison in economic escalation calculations or cost estimates.

[23] "Acquisition Program Baseline Agreement for the Surface Mine Countermeasure Unmanned Undersea Vehicle," July 11, 2011.

the fourth quarter of FY 2018. The Navy will spend an additional $751.5 million in remaining funds for Knifefish research, development, test, and evaluation; procurement; and operations and maintenance to procure and sustain a system that may not achieve the capability the Navy originally planned.

The Navy will spend an additional $751.5 million in remaining funds for Knifefish research, development, test, and evaluation; procurement; and operations and maintenance to procure and sustain a system that may not achieve the capability the Navy originally planned.

Minehunting Performance Requirement Not Demonstrated

As of March 2016, the Knifefish had not demonstrated the ability to perform a primary requirement for single-pass detection, classification, and identification of bottom and buried mines. The program office does not plan to start operational testing of the Knifefish until first quarter FY 2017. Knifefish program office personnel reported the Knifefish minehunting capability as high risk, even after almost 5 years of development. The JCIDS Manual[24] states that a failure to meet a primary requirement threshold (minimum) may result in a reevaluation or reassessment of the program or a modification of the production increments. The Knifefish program office personnel further reported that if the Knifefish cannot meet its primary requirement to detect, classify, and identify mines, errors could result in an excessive number of mine danger areas, and will unnecessarily delay mine clearance operations.

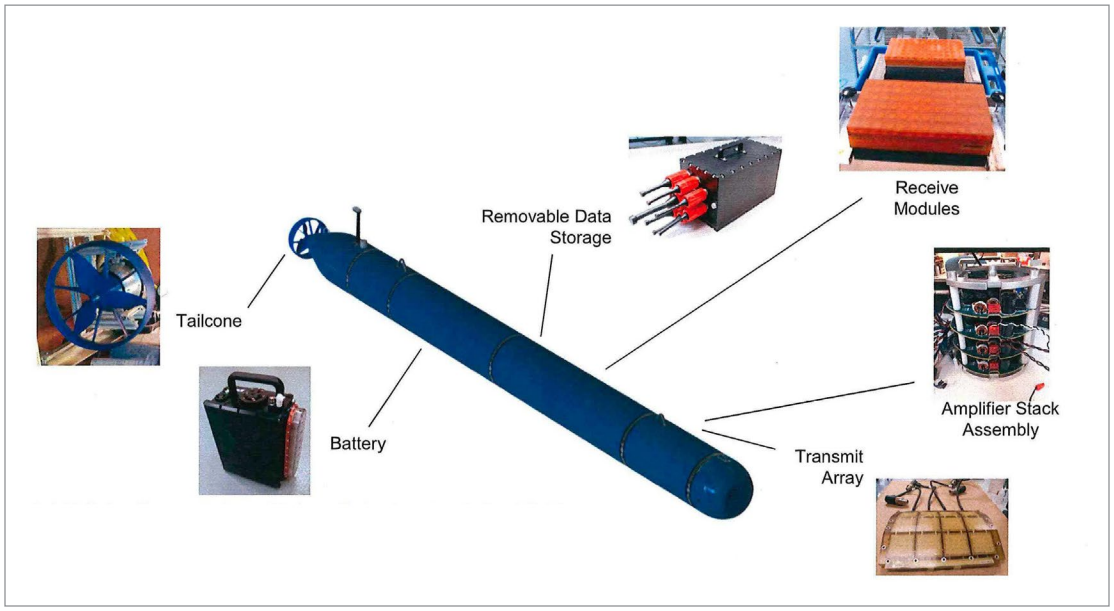
As of March 2016, the Knifefish had not demonstrated the ability to perform a primary requirement for single-pass detection, classification, and identification of bottom and buried mines.

Design Problems

The Knifefish program has experienced design problems, including problems with the vehicle's tailcone. During engineering testing, the contractor discovered excessive voltage spikes in the tailcone. The contractor worked approximately 6 months to fix voltage surging problems, causing delays in the developmental testing schedule. Figure 5 shows the subassemblies in the Knifefish.

[24] "Manual for the Operation of the Joint Capabilities Integration and Development System," February 2009, updated January 31, 2011, enclosure B Performance Attributes and Key Performance Parameters.

Figure 5. Knifefish Subassemblies



Source: Unmanned Maritime Systems Program Office

~~(FOUO)~~ [redacted].

~~(FOUO)~~ [redacted]

[25] The program assessment report is an independent DMCA assessment of contractor performance including predictive analysis.

Conclusion

The Knifefish requirements developer did not fully define requirements to support the communication interfaces and the launch and recovery operations between the Knifefish and the LCS. Specifically, the Knifefish and LCS communication interface requirements changed during the development of both programs, which caused a 3-foot increase in the Knifefish vehicle length and an approximately $1.2 million increase to program costs. The original structural design of the launch and recovery device created LCS loading problems, and the Knifefish program office did not specify in requirements documents that the LCS would not come to a complete stop in the water during Knifefish recovery. Additionally, the program office has not effectively planned testing of the Knifefish because of funding shortfalls, which resulted in a 14-month schedule delay.

Management Comments on the Finding and Our Response

The Director, Expeditionary Warfare Division, and the Commander, Naval Sea Systems Command, responding for the Program Executive Officer, LCS, each provided comments on the finding. This section summarizes those comments. For the full text of their comments, see the Management Comments section of the report.

Management Comments on the Navy Not Effectively Defining Requirements

Director, Expeditionary Warfare Division, Comments

The Director disagreed with the conclusion that the Navy did not effectively define requirements to support the communication interface and launch and recovery operations between the Knifefish system and the LCS. He stated that the CDD represented the Knifefish requirements for deployment from the LCS. Specifically, the Director stated that the CDD included a communication interface requirement that the Knifefish be designed to interface with the LCS command, control, communications, computers, and intelligence system. The Director stated that the draft audit report correctly identified the MVCS as the LCS system the Navy planned to use to communicate with the off-board unmanned vehicles, but that the report narrative shifted to the performance specifications, which identified the strategy for a Government-furnished interface between the Knifefish and the LCS. The Director stated that there was nothing wrong with the strategy, and that the change in strategy reflected the development of the program. He further stated that the program office supported the strategy by executing an engineering change proposal to reduce production unit cost.

The Director stated that the CDD also included a launch and recovery requirement that the Knifefish "shall be capable of being launched, recovered, and operated in significant wave heights of less than or equal to 4 feet." He stated that the requirements in the LCS CDD and LCS performance specifications set the launch and recovery sea state. The Director stated that the LCS CDD includes a requirement that the LCS be able to safely launch, recover, and handle a single mission package watercraft, such as the Knifefish, while traveling against the wind with low waves. He further stated that the Knifefish requirements in the Knifefish CDD for launch, recovery, operation, and maintenance are compatible with the LCS CDD watercraft launch and recovery requirement.

In addition, the Director responded that the CDD stated, "while designed specifically for use from LCS, the Knifefish system shall be able to be employed from other craft or ship of opportunity or pier side where sufficient power, launch and recovery, space and weight and communications are available." He commented that the Program Executive Officer LCS, the program managers, and the LCS resource sponsor are the best prepared to address how to meet the launch and recovery requirement.

Commander, Naval Sea Systems Command, Comments

The Commander disagreed with the conclusion that the Navy did not effectively define requirements. He stated that requirements developers appropriately defined and described the Knifefish capability requirements in the CDD, which included requirements for the Knifefish to be launched and recovered from the LCS and to communicate with the LCS by satellite. The Commander commented that the CDD should not include communication interface requirements because the CDD is not the appropriate place to specify communication interfaces and launch and recovery operations between the Knifefish system and the host platforms. The Commander stated that if the Knifefish system was required to be hosted by the LCS and launched and recovered from the LCS, it must meet LCS requirements. He further responded that these derived requirements were identified in the request for proposals and Knifefish system performance specifications.

Specifically, the Commander stated that the Knifefish performance specifications were derived with traceability from the Knifefish CDD, and required the Knifefish to have a communication system that complied with the LCS MVCS Interface Control Document. In addition, he stated the Knifefish performance specifications required the contractor to develop a Knifefish launch and recovery device that complied with the LCS Interface Control Document. He stated that because the MVCS and LCS Interface Control Documents were identified in the Knifefish performance specifications, the contractor was obligated to design a system that met all documented technical requirements.

The Commander agreed that the Navy issued two engineering change proposals for a total cost of $2.3 million; however, he stated that the draft audit report did not consider that the proposals resulted in a significant reduction in Knifefish system production unit costs, saving the program $10.1 million in procurement funds and $7.8 million over the life of the program.

The Commander commented that the report incorrectly stated that the Knifefish must be able to be launched and recovered from the LCS to fully accomplish its mission. He further stated that the Knifefish minehunting capabilities are not dependent on the LCS and reiterated that the Knifefish is designed to perform its mission from the LCS and other ships of opportunity.

The Commander commented that the report statement identifying that there is still moderate risk that launch and recovery design would not meet the LCS operational requirements does not align with the current risk plan. He stated that the launch and recovery risk is progressing through its mitigation plan and is identified as moderate risk. The Commander also stated that the Knifefish program would be ready to demonstrate launch and recovery from the LCS at the beginning of 2017. He further stated that once the launch and recovery device successfully completed testing and demonstrated the capability on both LCS versions, the program office would close the risk.

Our Response

We disagree with the Director and Commander that the requirements developer appropriately defined and described the Knifefish capability requirements in the CDD. While the CDD included a communication requirement for the Knifefish to interface with LCS command, control, communications, computers, and intelligence system, the communication requirement was identified as another system attribute (lower level requirement) indicating the requirement was important but not critical for the Knifefish to meet the mission. The Knifefish is designed to operate primarily from the LCS and function as part of the mine countermeasure mission package; therefore, communication with the LCS is critical for meeting its mission. Knifefish communication is required for reporting its position, providing equipment and sortie status, and depicting an overall operational view of all deployed unmanned systems, while keeping the ship and crew out of mined danger areas.

As written in the CDD, the Knifefish requirement for the communication interface with the LCS was not specific. The requirement, for example, did not address the following:

- specific LCS systems or any other platform the Knifefish must interface with, and
- bandwidth requirements.

The communication requirement should be measureable (quantifiable) and testable (verifiable) so a communication capability between Knifefish and the LCS can be verified. The Director further stated that the Knifefish CDD included a launch and recovery requirement. While we agree that, there is a launch and recovery primary requirement in the Knifefish CDD, the primary requirement addresses the maximum number of personnel required to launch, recover, operate, and maintain the Knifefish. In addition, the Knifefish CDD also included a system attribute identifying the sea state levels associated with Knifefish launch and recovery. However, the Knifefish CDD did not address other critical factors for delivering the launch and recovery capability, such as the speed of the LCS during operations, the time required for launch and recovery operations, or the weight of launch and recovery equipment. Like the communication interface requirement, the launch and recovery requirement should be measureable and testable so the capability can be adequately evaluated.

The 2011 JCIDS manual states that the CDD provides the operational performance attributes needed to design a proposed system and identifies the system-specific performance attributes necessary to provide the warfighter an operational capability. The manual states that each attribute should be measureable (quantifiable) and stated in testable (verifiable) terms. Furthermore, each attribute should identify a threshold (minimum) and objective (maximum) value. In addition, the "Defense Acquisition Guidebook," September 16, 2013, states that during system requirements and functional reviews, the system engineer is responsible for making sure that both explicit and derived performance requirements are defined and traceable, in both directions, between the draft CDD including primary requirements, key system attributes, and other attributes and the system performance specifications. By not fully defining the communication interface and launch and recovery requirements in the CDD, the program office issued two engineering change proposals to redesign the Knifefish vehicle, which increased contract costs by $2.3 million.

We disagree with the Commander's comment that the engineering change proposals resulted in a $7.8 million cost savings. Specifically, the MVCS and the launch and recovery engineering change proposals repriced the contract option for the initial production units increasing the cost by $93,781. However, the program office has not exercised the option.

We agree with the Commander's comment that the Knifefish minehunting capabilities are not dependent on the LCS; however, if the Knifefish cannot communicate with the LCS or cannot be launched and recovered from the LCS or other ship of opportunity, it will not accomplish its primary mission of being deployed, operated, and maintained from the LCS as part of the mine countermeasure mission package.

We revised the report to include additional information clarifying that the program office has a risk mitigation plan and anticipates closing the launch and recovery risk in the fourth quarter of FY 2017.

Management Comments on the Lack of Coordination Between Requirements Developers

Director, Expeditionary Warfare Division, Comments

The Director disagreed that there was a lack of coordination between requirements developers. He stated that the Knifefish and LCS requirements developers collaborated and cooperated in developing the Knifefish CDD. The Director stated that the Knifefish requirements developer was responsible for making sure that nothing in the Knifefish CDD would drive additional LCS requirements other than those identified in the LCS CDD. He stated that the report inaccurately summarized the LCS CDD watercraft launch, recovery, and handling requirement. The Director stated that the exact wording in the LCS CDD is:

> Watercraft Launch / Recovery / Handling: (Threshold: Sea state 3 best heading within 45 minutes) LCS Flight 0+ shall have the ability to safely launch, recover and handle (secure and traverse) any single Mission Package watercraft from an operational ready state while operating in the adverse wind speed and wave height / motion conditions associated with Sea States as described in Appendix F at best heading for the evolution.

The Director further stated that the LCS requires launch and recovery in up to sea state 3 and that the CDD does not reference the speed the LCS should be going during launch and recovery operations. He stated that the Knifefish CDD requirements for launch, recovery, operation, and maintenance are compatible with the LCS CDD watercraft launch and recovery requirement. In addition, the Director stated that there was no reference to support the report statement on the Navy's operational procedure to not travel below the speed of 3 nautical miles per hour during Knifefish vehicle recovery. He stated that either stopping or travelling at 3 nautical miles per hour would satisfy the Knifefish launch and recovery requirement.

Our Response

We disagree that the Knifefish and LCS requirements developers collaborated and coordinated on Knifefish requirements. In fact, the Director's comments on the recommendation imply that collaboration and coordination between the two requirements developers needs to be improved. He stated that improved coordination between requirements developers is being addressed with a memorandum of agreement that will align requirement responsibilities and funding under one requirements developer.

We do not agree with the Director's comments that we misstated the LCS launch and recovery requirement because we did not specifically reference the LCS launch and recovery requirement in the report. In the draft report, we stated that the Knifefish CDD did not include a launch and recovery requirement but that Knifefish launch and recovery requirements were included in the performance specifications. The report further identified that the launch and recovery design presented during the Preliminary Design Review in May 2012 identified LCS interface and launch and recovery problems; resulting in an engineering change proposal. Specifically, the draft report stated that when designing the Knifefish launch and recovery device, the contractor believed the LCS would come to a complete stop; however, according to the Preliminary Design Review Technical Review Summary Report, the operational procedure is for the LCS not to go below 3 nautical miles per hour.

Management Comments on the Program Office Not Effectively Planning and Executing Testing

Commander, Naval Sea Systems Command, Comments

The Commander disagreed with the report statement that the program office did not effectively plan and execute testing. He stated that congressional and sequestration reductions created multiple funding shortfalls for the Knifefish program. The Commander stated that the program office initially had an effective plan; however, in FY 2012 Congress reduced the Knifefish program budget by 50 percent. He stated that the funding cuts caused the program office to restructure the testing program to match the available budget. The Commander stated that Table 2 in the report did not reflect all congressional reductions and incorrectly labeled shortfalls as an "engineering change." The Commander further stated that the report incorrectly estimated the Knifefish program would cost approximately $1,056.8 million and had received approximately $92.6 million in then-year 2017 dollars. He stated that the amounts should be expressed in then-year dollars or in constant year 2017 dollars. The Commander explained that then-year refers to funding that includes the effects of inflation, whereas constant year funding is normalized to 1 year, without the effects of inflation. The Commander commented that the then-year dollars expressed in the acquisition program baseline included inflation associated with each year. The Commander suggested the audit team independently escalate each year to FY 2017 dollars for comparison to the total estimated program costs.

Our Response

We disagree that the program office effectively planned Knifefish testing. In August 2012, the Director, Operational Test and Evaluation, reviewed and approved the Knifefish Test and Evaluation Master Plan, dated May 23, 2012, and stated that

the test plan and schedule were very aggressive. Despite an already aggressive initial test schedule, the program office has further combined tests and condensed the schedule, which has reduced the initial test period to almost half. Additionally, the test plan was ineffective because COTF originally planned to use developmental testing results for the operational assessment to support the initial production decision. Unlike operational testing, developmental testing does not require the program office to test the system in realistic conditions. Furthermore, we acknowledge in the report that the program office did not effectively plan and execute testing because of funding shortfalls.

We agree that Table 2 did not reflect all congressional reductions and labeled shortfalls as an "engineering change," as was supported by program office documentation. We revised Table 2 to include the FY 2016 congressional reduction and deleted from the table the words "engineering change" and "design change." We further revised the report to restate the program costs in FY 2017 dollars.

Management Comments on the Knifefish Program Not Being Ready for Initial Production Decision

Commander, Naval Sea Systems Command, Comments

The Commander disagreed with report statements that the Knifefish program is not ready for initial production decision. According to the Commander, the Knifefish program is on track to meet its initial production decision in August 2017, as specified in the Knifefish acquisition program baseline agreement. The Commander further stated that the report included conflicting statements that the Knifefish program was both not ready for initial production decision and at risk of not being ready for the initial production decision. The Commander stated that while the program office recognizes there is some risk in achieving the initial production decision, it plans to mitigate the risk. The Commander reiterated that the program is required to demonstrate the key performance parameters prior to the initial production decision and further commented that the report did not take into account the efforts the program office has planned to support the decision.

The Commander commented that the report suggests that the initial production systems could require costly retrofits of the existing structural design, if problems are not corrected, and may not satisfy testing requirements to support the full-rate production decision. He again stated that the report did not take into consideration the program office's plans for addressing system problems before the initial production decision. The Commander stated that the report cited design problems identified in the early phase of the program during limited environmental and engineering testing, noting the intent of the tests is to determine whether issues exist. According to the Commander, systems rarely comply with environmental

testing during the early design phases. The Commander also stated that Knifefish reliability concerns are premature because the tested hardware is not likely the final design for fielding.

The Commander commented that it was incorrect and misleading to state that Knifefish program office personnel reported the Knifefish minehunting capability as a high risk, even after almost 5 years of development. He stated that the report referenced the program risk called "single-pass identification," a risk currently rated as high, and that this reference is a misinterpretation of the risk management process. The Commander stated that single-pass identification is a new capability and is a change from the way the Navy currently identifies mines. He stated that the program office captured the risk to document the need to change the Navy's approach to minehunting and to reconcile the Knifefish minehunting approach when the system is operational. The Commander stated that the program office planned to retire this risk using the engineering development model and initial production systems instead of developing an additional system prior to the production decision. He stated that the risk is following its burn down plan and is scheduled to be retired in FY 2017. The Commander further stated that the risk mitigation plan includes demonstrating results during testing, coordinating with the Navy Mine Warfare Command to develop new minehunting techniques and procedures, and modifying the capability production document to reflect the best methods for using the Knifefish.

Our Response

The Commander stated that the report included conflicting statements regarding the readiness of the Knifefish program for initial production. We clarified the report to state that the Knifefish program is at risk of not being ready for the initial production decision.

The Knifefish program, as of March 2016, had not demonstrated the ability to perform the primary requirement for single-pass detection, classification, and identification of bottom and buried mines. By not meeting this primary requirement, the Knifefish system would not meet its minehunting mission. We agree that the program office identified single-pass detection, classification, and identification as a high risk and developed a plan to close the risk. However, according to program documentation, the program office plans to close the risk even though the moderate program risk remains. If the program risk is realized, Knifefish will be unable to perform its primary requirement for single-pass detection, classification, and identification of bottom and buried mines, and the overall success of the Knifefish program will be jeopardized.

~~(FOUO)~~ We disagree with comments that the potential exists for retrofits, or that production units may not meet test requirements. [redacted] Furthermore, the Remote Minehunting System Independent Review Team, when assessing the Knifefish as the minehunting alternative, identified risks associated with the Knifefish command and control operations, recovery, the use of submerged electronics, and the lithium-ion battery. The Independent Review Team also noted concerns about the Knifefish system's search speed and the size and coverage of the search area. Because of design problems and the compressed test schedule, initial production systems might not meet testing requirements, and the existing structural design may require retrofits.

Recommendations, Management Comments, and Our Response

Redirected and Revised Recommendation

We redirected Recommendation 2 to the Director, Expeditionary Warfare Division, who is responsible for funding Knifefish development. We also revised the recommendation to clarify the need to assess and validate whether the Knifefish program is the best solution to perform single-pass detection, classification, and identification of bottom and buried mines.

Recommendation 1

We recommend that the Director, Expeditionary Warfare Division (N95), coordinate with the Director, Surface Warfare (N96), to develop capability requirements in the Knifefish capability production document relating to communication interface and launch and recovery operations between the Knifefish system and the Littoral Combat Ship, unless Knifefish is no longer required.

Director, Expeditionary Warfare Division, Comments

The Director, Expeditionary Warfare Division (N95) partially agreed, stating that the Knifefish and LCS requirements developers coordinated throughout the program and will continue to coordinate to develop the capability production document. He stated that the Knifefish and LCS requirements developers, the Program Management Office Unmanned Maritime Systems, and the Program Executive Office LCS participated in developing requirements and making decisions. However, the Director stated that to improve coordination between the Knifefish

and LCS requirements developers, a memorandum of agreement is being developed to align responsibilities for requirements and funding mine warfare under a single requirements developer. He further stated that the Knifefish communication interface with LCS communication systems and launch and recovery from LCS remain valid requirements.

Our Response

The Director partially addressed the specifics of the recommendation by stating that the establishment of a memorandum of agreement will improve coordination between the LCS and Knifefish requirement developers. However, the Director did not provide a timeframe for completion of the agreement. Furthermore, his comments did not fully address the development of the communication interface and launch and recovery operations requirements in the capability production document. The capability production document should clarify the Knifefish communication interface and launch and recovery requirement with the LCS. Specifically, the Knifefish capabilities for the communication interface, and launch and recovery requirement with the LCS should be measureable and testable. Therefore, we request that the Director provide additional comments on the final report explaining how he plans to fully define the Knifefish communication interface, and launch and recovery in the capability production document and provide an estimated date for completion.

Recommendation 2

We recommend that the Director, Expeditionary Warfare Division (N95), coordinate with the Program Executive Officer, Littoral Combat Ship to:

a. assess and revalidate whether to continue with the Knifefish program as the solution to single-pass detection, classification, and identification of bottom and buried mines, and if the program continues, fund it accordingly; or

b. cancel the program, putting $751.5 million in research, development, test, and evaluation; procurement; and operational and maintenance funds to better use.

Program Executive Officer, Littoral Combat Ship, Comments

The Commander, Naval Sea Systems Command, responding on behalf of the Program Executive Officer, Littoral Combat Ship, agreed, stating that in 2015, the Chief of Naval Operations and the Assistant Secretary of the Navy for Research, Development, and Acquisition engaged an Independent Review Team to conduct an in-depth assessment of the Navy's mine countermeasure programs. He stated that

the Independent Review Team determined that Knifefish was a superior alternative for providing a minehunting capability to the fleet. The Commander further stated that the Independent Review Team recommended accelerating the Knifefish program with additional capabilities and funding, which validated the Knifefish as the Navy's minehunting platform. He stated that the Program Executive Office LCS is confident the Knifefish program will support the Navy's solution to single-pass detection, classification, and identification of bottom and buried mines. The Commander stated that the Program Executive Officer LCS does not control funding for the program it executes; the Chief of Naval Operations and Congress determine the funding.

The Commander disagreed with the recommendation to cancel the Knifefish program. He stated that the Knifefish program withstood funding instability and in FY 2016, began in-water testing with the engineering developmental models. He stated that despite early program funding instability, the Knifefish is meeting its revised acquisition program baseline, and early test results are encouraging that the Knifefish will perform as expected. He stated that canceling the program would be premature and would create a gap in mine warfare capability.

Our Response

The Commander partially addressed the specifics of the recommendation. While we agree that the Chief of Naval Operations and the Assistant Secretary of the Navy for Research, Development, and Acquisition established an Independent Review Team to perform a technical assessment, the assessment evaluated the reliability and capability of the Remote Minehunting System and not the Knifefish program. As part of the independent review assessment, the team reviewed alternative systems that might be capable of providing a minehunting capability, including the Knifefish, and relied on projected performance data. However, because of the Knifefish program's high developmental risk, technical challenges, schedule slips, and aggressive test schedule, we request that the Commander provide additional comments on the final report explaining his plans for assessing the Knifefish program as solution to single-pass detection, classification, and identification of bottom and buried mines. The comments should provide an overall assessment of the program's ability to meet requirements, cost, and schedule goals and should provide an estimated date for completing the assessment.

Appendix A

Scope and Methodology

We conducted this performance audit from April 2015 through August 2016 in accordance with generally accepted government auditing standards. Those standards require that we plan and perform the audit to obtain sufficient, appropriate evidence to provide a reasonable basis for our findings and conclusions based on our audit objectives. We believe that the evidence obtained provides a reasonable basis for our findings and conclusions based on our audit objectives.

We interviewed personnel and performed fieldwork at the following organizations:

- Office of the Secretary of Defense, Director, Operational Test & Evaluation, Alexandria, Virginia;
- Office of the Chief of Naval Operations, Expeditionary Warfare Division, the Pentagon, Washington, D.C.;
- Office of the Chief of Naval Operations, the Surface Warfare Division, the Pentagon;
- Program Management Office Unmanned Maritime Systems (PMS 406), Washington Navy Yard, Washington, D.C.;
- LCS Mission Modules Program Office (PMS 420), Washington Navy Yard;
- Office of Naval Research, Arlington, Virginia; and
- Defense Contract Management Agency, Fairfax, Virginia.

We collected, reviewed, and analyzed documents dated from June 2008 through May 2016. We reviewed the acquisition strategy, capability development documents, test and evaluation master plan, preliminary and critical design reviews, risk management board briefings, program assessment reports, and contract including modifications.

To determine whether the Navy effectively established requirements and planned testing to support the procurement of the Knifefish, we compared the program planning and reporting documents with the policies and guidance in the following DoD and Navy issuances:

- "Manual for the Operation of the Joint Capabilities Integration and Development System," February 2009, updated January 31, 2011;
- "Manual for the Operation of the Joint Capabilities Integration and Development System (JCIDS)," February 12, 2015;

- DoD Instruction 5000.02, "Operation of the Defense Acquisition System," December 8, 2008;[26] and
- Secretary of the Navy Instruction (SECNAVINST) 5000.2E, "Department of the Navy Implementation and Operation of the Defense Acquisition System and the Joint Capabilities Integration and Development System," September 1, 2011.

Use of Computer-Processed Data

We relied on computer-processed data from the Electronic Document Access system to obtain contract modifications. To determine data reliability, we compared the data we obtained from the system with documentation we obtained from the program office. As a result of our analysis, we determined that the data within the system were sufficiently reliable for the purpose of our review.

Use of Technical Assistance

A general engineer and a computer engineer from the Technical Assessment Directorate, DoD Office of Inspector General, assisted with the audit. The engineers assisted the team in evaluating and reviewing Knifefish systems engineering, test and evaluation, and other acquisition planning related documents.

Prior Coverage

No prior coverage has been conducted on the Surface Mine Countermeasure Unmanned Undersea Vehicle (Knifefish) during the last 5 years.

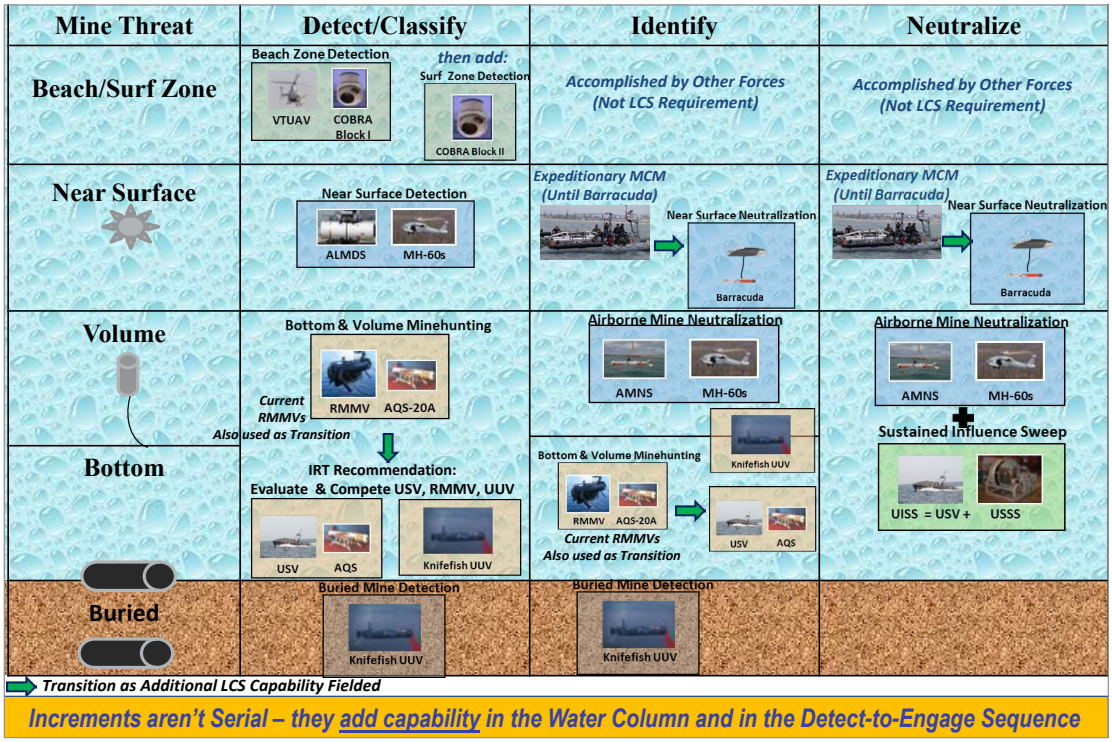
[26] This version of the Instruction was current at the time the Navy established the Knifefish as an acquisition program. The current version of the instruction is DoD Instruction 5000.02, January 7, 2015.

Appendix B

Mine Countermeasure Mission Package Delivery Plan

The following figure shows the LCS Mine Countermeasures Mission (MCM) Package delivery plan by capability.

Figure 6. Mine Countermeasure Capabilities



Source: LCS Mission Modules Program Office

LEGEND:

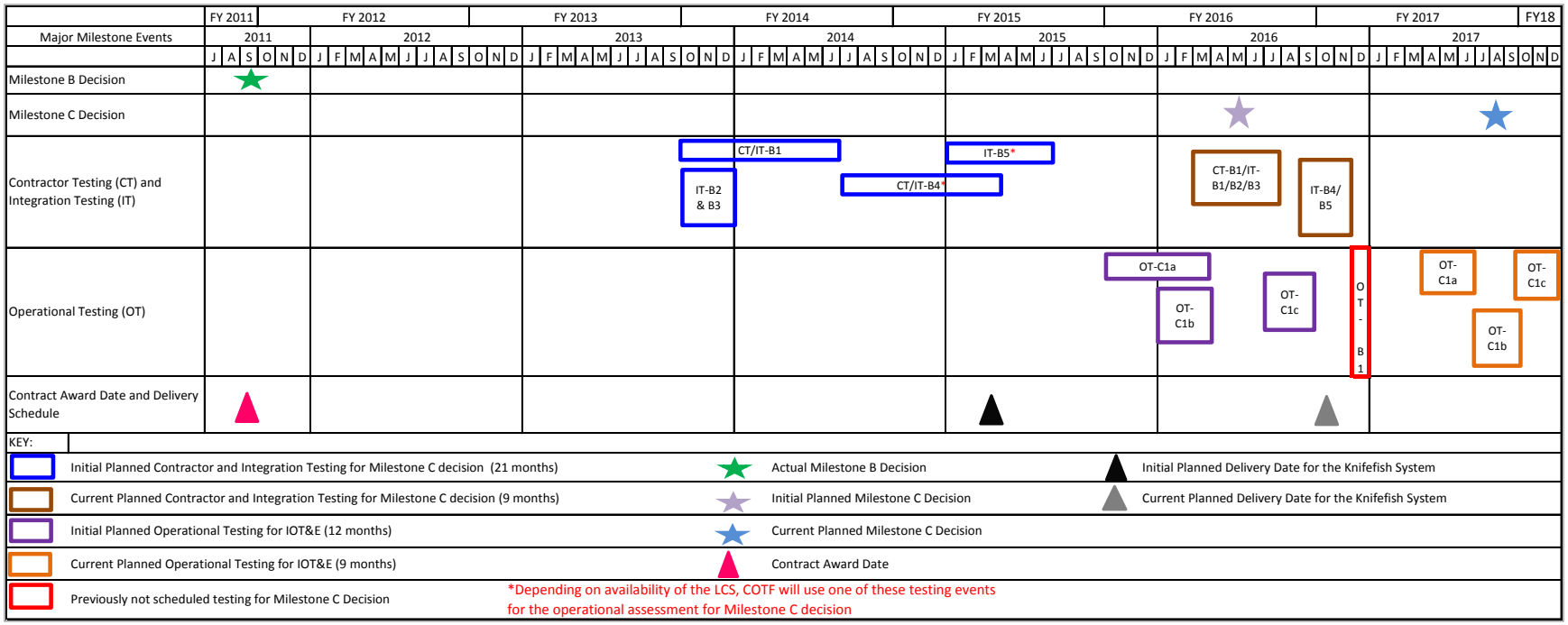
ALMDS	Airborne Laser Mine Detection	**RMMV**	Remote Multi-Mission Vehicle
AMNS	Airborne Mine Neutralization System	**UISS**	Unmanned Influence Sweep System
AN/AQS-20A	Minehunting Sonar System	**USSS**	Unmanned Surface Sweep System
COBRA	Coastal Battlefield Reconnaissance and Analysis	**USV**	Unmanned Surface Vehicle
IRT	Independent Review Team	**UUV**	Unmanned Underwater Vehicle
MCM	Mine Countermeasures	**VTUAV**	Vertical Takeoff Unmanned Aerial Vehicle

Appendix C

Timeline of Acquisition Milestones and Testing Events

The chart shows the initial and currently planned schedule of acquisition milestones and testing events for the Knifefish program as of May 16, 2016.

Figure 7. Timeline of Acquisition Milestones and Testing Events



Source: DoD OIG

Management Comments

Commander, Naval Sea Systems Command

Final Report Reference

DEPARTMENT OF THE NAVY
NAVAL SEA SYSTEMS COMMAND
1333 ISAAC HULL AVENUE, S.E.
WASHINGTON NAVY YARD, DC 20376-0001

In Reply to

7500
Ser SEA 00/ 276
1 Sep 16

From: Commander, Naval Sea Systems Command
To: Assistant Secretary of the Navy, Research, Development & Acquisition

Subj: DODIG DRAFT REPORT-ACQUISITION OF THE NAVY SURFACE MINE COUNTERMEASURE UNMANNED UNDERSEA VEHICLE (KNIFEFISH) NEEDS IMPROVEMENT (PROJECT NO. D2015-D000AJ-0158.000)

Encl: (1) NAVSEA Response to the Subject DODIG Draft Report

1. Enclosure (1) is NAVSEA's response to the subject draft audit report. NAVSEA concurs in principle with Recommendation 2.a. of the subject report. NAVSEA nonconcurs with Findings 1, 3, and 4, and Recommendation 2.b. of the subject report.

2. For additional information, contact [redacted]

J. MOORE

Copy to:
Department of Defense
Inspector General (w/encl)
NAVINSGEN (N15) (w/encl)

Commander, Naval Sea Systems Command (cont'd)

Final Report Reference

NAVSEA RESPONSE
TO
DODIG DRAFT REPORT ON ACQUISITION OF THE NAVY SURFACE MINE COUNTERMEASURE UNMANNED UNDERSEA VEHICLE (KNIFEFISH) NEEDS IMPROVEMENT
Project No.: D2015-D000AJ-0158.000

Date: 30 August 2016

Finding:

1) Navy Did Not Effectively Define Requirements

Nonconcur. The Knifefish capability requirements were appropriately defined by OPNAV N95 (referred to in the report as the Knifefish "requirements developer") and described in the Capability Development Document CDD); which included requirements for Knifefish to be hosted by and launched and recovered from the Littoral Combat Ship (LCS), and to communicate with LCS via Satelite. N95 would not, and should not, define the LCS communication interface in the Knifefish CDD because the Knifefish CDD is not the appropriate place to specify communication interfaces and launch & recovery (L&R) operations between the Knifefish system and the host platforms. Those derived requirements are specified in the Request for Proposals (RFP) and system performance specifications. By definition, if the Knifefish system is required to be hosted by and launched and recovered from LCS, it must meet the LCS requirements.

The Knifefish Performance Specifications were derived with traceability from the Knifefish CDD. The Knifefish Performance Specs required Knifefish to have a communication system that complied with the LCS Multiple Vehicle Communications System (MVCS) Interface Control Document (ICD) dated 2007. The Knifefish performance specifications also required the contractor to develop a Knifefish launch and recovery system that complied with the LCS ICD. By specifying the MVCS ICD and the LCS ICD in the Knifefish Performance specs, the contractor is under contractual obligation to design a system that meets all of the technical parameters in the MVCS ICD and the LCS ICD. All systems hosted on another platform must meet the host platform's requirements. This is common across all platforms. System performance specs are defined without detailed design solution to allow Industry the flexibility to implement cost effective and innovative solutions to meet the Navy's needs and save the taxpayers' money. Including additional detailed requirements in

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the Knifefish or LCS CDDs would have no contractual bearing on the design, as the CDDs are not referenced by the contract.

While the Knifefish program has implemented two Class 1 Engineering Change Proposals (ECPs) to date for a total cost of $2.3M, the report does not consider that the ECPs also resulted in a significant reduction in Knifefish system production unit costs, saving the program $10.1M in procurement funds. This results in a $7.8M net cost savings over the life of the program (approximately $500K per system, as documented in the L&R ECP contract modification.)

The report states that Knifefish must be able to be launched and recovered from the LCS to fully accomplish its mission. This is incorrect. Knifefish minehunting capabilities are not dependent on LCS. Knifefish is designed to fully perform its mission when it is launched and recovered from other ships of opportunity.

revised, page 8

The finding of "...almost 3 years later, the Knifefish program office acknowledged that there are still moderate risk that the launch and recovery (L&R) design would not meet the LCS operational requirements…" is not in alignment with the current Knifefish risk plan. The Knifefish program's risk management process maintains records of all program risks through the life of the program, and tracks and updates risks as they are mitigated or closed. The L&R risk is progressing through its mitigation plan and is currently tracked as Medium (L=2, C=5). According to the risk mitigation plan, the L&R risk will be recommended for closure when the L&R system successfully completes testing and the capability is demonstrated on both LCS variants. The Knifefish program will be ready to demonstrate L&R from LCS at the beginning of 2017.

2) Lack of Coordination Between Requirements Developers

This finding is for OPNAV N95 and N96 to address.

3) Program Office Did Not Effectively Plan and Execute Testing

Nonconcur. Recommend revising the statement from:

"The Knifefish program office **did not** effectively plan and execute testing because of funding shortfalls, which resulted in a 14-month delay in meeting program milestones"

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To:

"Due to unstable funding which resulted in a 14-month delay in the program, the Knifefish program office **could not** effectively plan and execute testing."

The Knifefish program experienced multiple funding shortfalls created by Congressional marks and Sequestration. PMS 406 initially had an effective plan based the original program funding as substantiated by an approved TEMP and MTEP. In FY12, Congress reduced the program's budget by 50%. These cuts interrupted the contractor's excellent progress, caused the contractor to slow down and extended out the program. After cuts occurred, PMS 406 restructured the test program to match the available budget, and coordinated with COMOPTEVFOR to develop test scenarios where conditions during developmental testing (DT) would be realistic and could satisfy as many OA objectives as possible with DT results.

revised, page 11

Page 11, Table 2 (Knifefish Program Funding Shortfalls) left out the FY16 $2.0M congressional cut. It also incorrectly labels shortfalls as "Engineering Change" shortfalls. Currently in the Knifefish program, all ECPs are specifically contract modifications. Additionally, there are other government costs associated with changes that do not go on the contract, but rather are funded directly to warfare centers. Recommend removing the words "Engineering Change" from both the MVCS Integration and LCS Launch and Recovery lines, if total costs (contractor plus government costs) are used. The values in the table of $1.2 and $2.6 are representative of total program costs vice engineering changes on the contract.

Table 2. Knifefish Program Funding Shortfalls

Events	Amount (million)
FY 2012 congressional appropriation reduction for N95	$6.0
FY 2013 sequestration reduction for N95	$1.7
FY 2013 sequestration reduction for N96	$0.4
FY 2016 Congressional cut	$2.0
Total Congressional Cuts	**~~$8.1~~ $10.1**
MVCS Integration ~~Engineering Change~~	$1.2
LCS Launch and Recovery Integration ~~Engineering Change~~	$2.6
Emergent SG270 Lithium Battery Platform ~~Design Change~~ Requirements	$2.0
Total Knifefish ~~Engineering Changes~~ Shortfalls	**$5.8**

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Recommended changes are as follows:

a. Include FY16 Congressional cut of $2M (which is not shown in original table)
b. Remove "Engineering Change" label from both MVCS and LCS L&R lines.
c. Remove "Design Change" from Emergent SG270 Lithium Battery line. No design changes were made, additional batteries and vehicle foam were ordered and additional tests were performed.

The report quoted Knifefish program to cost "in then-year FY17 dollars approximately $1,056.8 million", and "has received approximately $92.6 million ...in then-year 2017 dollars". This is incorrect since the amount should either be expressed in then-year dollars OR in constant year 2017 dollars. "Then-year" and "constant year" (e.g. FY17 dollars) calculations are mutually exclusive. Then-year refers to funding that already includes the effects of inflation; constant year funding has all been normalized to one year for "apples to apples" comparison, without the effects of inflation.

It appears that the report based the estimated program cost numbers on the July 2011 Knifefish APB "then-year dollars" and further escalated them to FY17 dollars. The then-year dollars in the APB are already inclusive of the inflation associated with each year. In order to normalize estimated funding from the APB, one would need to use the "base year dollars", or independently normalize each year of funding included in the "then-year" section. Similarly, with regards to the funding received to date, each year should be escalated independently to FY17 dollars for comparison to the total estimated program costs.

The corrected values that should be used in reference to the total estimated cost of the Knifefish program are approximately $839.6M in FY17 dollars. This is comprised of the following amounts (all expressed in FY17 dollars): RDT&E [redacted]; OPN [redacted]; and OM&N [redacted]. Each "then-year" amount should be independently escalated to FY17 dollars, to compare to the total program costs. The funding received to date on the Knifefish program is $89.99M in then-year dollars, and equals $94.7M in FY17 dollars. Based on these numbers the remaining estimated cost of Knifefish would be $839.6M minus $94.7M, which equals $744.9M in FY17 dollars. The majority of the $744.9M is future

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cost associated with Procurement and Operation & Maintenance cost of the Knifefish systems.

4) Knifefish Program Not Ready for Initial Production Decision

Nonconcur. The Knifefish program is on track to meet Low Rate Initial Production Decision (LRIP) in Aug 2017 as specified in the Knifefish Acquisition Program Baseline (APB) Agreement.

revised, page 12

The report states both that the "Knifefish Program Not Ready for Initial Production Decision" and also that "the Knifefish program is at *risk* of not being ready for initial production decision in 4th quarter FY2017", basing this statement on the fact that all KPPs have not been demonstrated as of the writing of the report. These two statements contradict each other. The program office recognizes that there is always some risk to achieving initial production decision and has plans to mitigate the risk, but does not agree that the program is "not ready for initial production decision". The Knifefish program is required to demonstrate KPPs prior to LRIP decision and the report does not take into account the planned efforts that the program has developed to support this effort. So at this time, the statement is purely speculative. Furthermore, the report asserts that initial productions systems could require costly retrofits of existing structural design if problems are not corrected and may not satisfy test requirements in support of full rate production decision. There is certainly a risk in any testing, but this statement also does not consider the planned efforts by the program to address issues prior to this decision.
The report also cited design problems during the early phase of the program and performance issues identified during limited environmental and engineering tests. The intent of performing these tests is to determine whether issues exist and rarely do systems fully comply with environmental testing during the early stages of design. At Preliminary Design Review, the program identified the problem areas and developed plans to mitigate the issues. To state a concern regarding reliability at this stage is premature as the hardware tested is highly likely not to be the final design that becomes fielded. It is unclear from this report on whether sufficient testing has occurred that represents statistical significance to support the statements.

The statement "Knifefish program office personnel reported the Knifefish minehunting capability as high risk, even after almost 5 years of development" is incorrect and misleading. PMS 406 vigorously objects to this statement.

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This refers to the Knifefish program risk titled "Single-pass Identification", currently rated as high risk (L=3, C=5), and is a misinterpretation of the risk management process. Single-pass ID is a new capability, developed by the Office of Naval Research (ONR) and transitioned to the Knifefish program at Technology Readiness Level (TRL) 6. Single-pass ID is a deviation from the way the Navy currently employs mine ID tactics. PMS 406 captured this risk to document the tactics changes required by the Navy Mine Countermeasure (MCM) community and the need to reconcile current Navy tactics when Knifefish enters the Fleet. The risk has already been reduced from L=4 to L=3, and will continue progressing through the documented mitigation plan.

PMS 406 has planned from the beginning of the program to retire this known risk using the Engineering Development Model (EDM) and LRIP systems vice developing a different/additional system prior to the production decision. Knifefish is not funded to the level to have those additional systems.

This risk is following its burn down plan and is scheduled to be retired in FY17. The mitigation plan includes demonstrating results during testing, coordinating with the Naval Mine Warfare Command to develop new minehunting techniques and procedures to reflect the Navy's new tactics using the Knifefish system, and modifying the Capability Production Document to reflect the optimum tactics.

In summary, this was a known risk at the beginning of the program which PMS 406 has always planned to retire in this way as the Navy did not have funding for the fabrication of any other "pre-production prototypes".

DODIG Audit Recommendation 2:

We recommend that the Program Executive Officer, Littoral Combat Ship:

a. assess whether to continue with the Knifefish program as the solution to one-pass detection, classification, and identification of bottom and buried mines, and if the program continues, fund it accordingly; or

b. cancel the program, putting $964.2 million in research, development, test, and evaluation; procurement; and operational and maintenance

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NAVSEA Response:

Recommendation 2.a. Concur in Principle. In 2015, the Chief of Naval Operations (CNO) and the Assistant Secretary of the Navy for Research Development and Acquisition (ASN RDA) chartered an Independent Review Team (IRT) to conduct an in-depth assessment of all the Navy's MCM programs. Knifefish was deemed superior based on the IRT's assessment of its progress and its capabilities. The IRT recommended accelerating the Knifefish program with additional capabilities and funding. This is a validation of the Knifefish program as a prime candidate for the Navy's minehunting platform. PEO LCS is confident that the Knifefish program will support the Navy's solution to one-pass detection, classification, and identification of bottom and buried mines.

Although PEO LCS would like all its programs to be optimally funded, PEO LCS does not control the funding of the programs it executes; that is determined by OPNAV and Congress. PEO LCS is committed to executing all its programs within budget. Multiple funding shortfalls, which delayed the Knifefish program schedule, have been the result of Congressional marks and Sequestration, not due to lack of commitment from the Navy.

Recommendation 2.b. Nonconcur. The Knifefish program has withstood funding instability and in FY16 and have begun in-water testing with the Engineering Development Models. Despite early program funding instability, the Knifefish program is meeting its revised APB. Early testing is encouraging that the Knifefish UUV will perform as expected. Developmental Testing and an Operational Assessment are scheduled for FY17, and will inform the Milestone Decision Authority for a Q4FY17 Milestone C. Cancelation of the program at this stage would be premature and would lead to a Mine Warfare capability gap.

Factual Issues:

In addition to the items noted above regarding the report's Findings and Recommendations, the report's Background section contains items noted below as factually incorrect.

Page 2: "the Navy awarded a $48.6 million cost-plus-incentive fee contract for the development of the Knifefish engineering development models and support equipment."

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Explanation: per Knifefish contract:

CLIN 0001 - [redacted]	
CLIN 0002 - [redacted]	
CLIN 0003 - [redacted]	
CLIN 0004 - [redacted]	
CLIN 0005 - [redacted]	
CLIN 0006 - [redacted]	
Total contract value	**$86.6M**

Total contract value = $86.6M

[redacted]

The sentence should read: "the Navy awarded a [redacted] cost-plus-incentive fee contract for the development of the Knifefish engineering development models and support equipment. As of March 29, 2016, the Navy has committed to pay $73.2 million on the contract. The $16.5M contract increase can be attributed to engineering change proposals ($2.3M), emergent Lithium battery certification requirement changes (approximately $1.0M), congressional cuts and sequestration ($10.1M), and integration and testing ($3.1M).

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Director, Expeditionary Warfare Division (N95)

Final Report Reference

DEPARTMENT OF THE NAVY
OFFICE OF THE CHIEF ON NAVAL OPERATIONS
2000 NAVY PENTAGON
WASHINGTON, DC 20350-2000

IN REPLY REFER TO
7502
Ser 16U139281
02 Sep 2016

From: Director, Expeditionary Warfare Division (N95)
To: Inspector General, Department of Defense

Subj: ACQUISITION OF THE NAVY SURFACE MINE COUNTERMEASURE UNMANNED UNDERSEA VEHICLE (KNIFEFISH) NEEDS IMPROVEMENT (PROJECT NO. D2015-D000AJ-0158.000)

Encl: Detailed comments on draft report.

1. The Memorandum for Naval Inspector General dated August 2, 2016 requests comment on the subject draft report.

2. OPNAV N95 does not concur with the finding that "the Knifefish requirements developer (Expeditionary Warfare Division, N95) did not fully define requirements to support the communication interface and launch and recovery operations between the Knifefish system and the Littoral Combat Ship." Information supporting the disagreement is detailed in the enclosure.

3. OPNAV N95 concurs with the recommendation to coordinate with the LCS requirements developer (N96) to develop capability requirements in the Knifefish capability production document relating to communication interface and launch and recovery operations between the Knifefish system and the LCS, but disagrees with the premise that such coordination has previously been lacking.

4. Point of contact is [redacted].

C. S. OWENS

Director, Expeditionary Warfare Division (N95) (cont'd)

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N95 Detailed Comments on Draft Report Project No. D2015-D000AJ-0158.000

IG Report page i:

"**Finding—** The Navy did not effectively establish capability requirements and plan and execute testing to procure the Knifefish. Specifically, the Knifefish requirements developer (Expeditionary Warfare Division, N95) did not fully define requirements to support the communication interface and launch and recovery operations between the Knifefish system and the Littoral Combat Ship."

N95 Response: The draft IG report is vague in claiming a failure to "fully define" a requirement. The CDD includes a communications interface requirement in paragraph 15.12.1 that states Knifefish "shall be designed for interface with the LCS Command, Control, Communications, Computers, and Intelligence (C4I) system." This requirement, as stated, is in keeping with the direction of the JCIDS manual as identifying essential attributes. Identifying specific systems or sub-systems to be procured, (i.e. a specific hardware solution) is inappropriate for a JCIDS document such as the CDD. The CDD defines the capability required (in this case interface with the LCS C4I system) not the specific component. The CDD is not the appropriate place to specify communication interfaces or launch and recovery operations between the Knifefish system and the host platforms. Those are specified in the Request for Proposals (RFP) and supporting documents such as the detailed performance specification.

The entire CDD represents a requirement for deployment of Knifefish from LCS. Paragraph 6.1.5 establishes the maximum number of LCS and Mine Countermeasures Mission Package (MCM MP) personnel that can be required for launch, recovery, operations and maintenance. Paragraph 6.3.5.2 states that "the SMCM UUV shall be capable of being launched, recovered, and operated in significant wave heights of less than or equal to 4 feet." As rationale for the requirement the CDD states "Launch and recovery sea state are bounded by requirements set forth in the LCS Flight 0+ CDD as well as the LCS performance specification document."

IG Report page 5:

"**Finding— Navy Did Not Effectively Establish Requirements or Plan and Execute Testing"**

"The Navy did not effectively establish capability requirements and plan and execute testing to procure the Knifefish. Specifically, the Knifefish requirements developer (Expeditionary Warfare Division, N95) did not fully define requirements to support the communication interface and launch and recovery operations between the Knifefish system and the LCS."

N95 Response: Same as above.

IG Report page 6:

"**Navy Did Not Effectively Define Requirements"**

"The Knifefish requirements developer did not effectively establish capability requirements to procure the Knifefish. Specifically, the Knifefish requirements developer did not fully define requirements in the Knifefish capability development document (CDD) to support the communication interface and launch and recovery operations between the Knifefish system and the LCS."

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N95 Response: Same as above.

IG Report page 6:

"**Communication Interface Requirement Not Fully Defined"**

"The Knifefish requirements developer did not fully define the LCS communication interface as a requirement in the Knifefish CDD."

N95 Response: As stated above, paragraph 15.12.1 in the CDD states the requirement for Knifefish communication interface with LCS. The draft IG report correctly identifies the Multi-Vehicle-Communication-System (MVCS) as the LCS system to be used for communication with off-board unmanned vehicles. The IG report then shifts to reference the performance specification (an acquisition document produced by the Program Manager, not the OPNAV sponsor) and the strategy of having the government (via the LCS Mission Modules Program Office) furnish the interface between the Knifefish and the MVCS as Government furnished information (GFI). There is nothing inherently wrong with this strategy. The fact that the strategy was later changed simply reflects the evolution of an acquisition program, supported by the Program Office in order to reduce overall procurement cost by executing an ECP to reduce production unit cost.

IG Report page 8:

"**Launch and Recovery Requirement Not Fully Defined"**

"The Knifefish requirements developer did not fully define launch and recovery as a requirement in the Knifefish CDD." … "While the CDD did not include a launch and recovery requirement, the performance specifications document included a requirement for a device to launch and recover the Knifefish vehicle from the LCS deck."

N95 Response: The CDD does include a Launch and Recovery (L&R) requirement. In fact, the entire document discusses employment of Knifefish from LCS. Specifically, CDD paragraph 6.1.5: "The SMCM UUV (i.e. Knifefish) shall require less than or equal to 5 individuals to launch, recover, operate and maintain the system in a 24 hour period. For LCS, existing personnel from the LCS and MCM MP detachment will operate and maintain the UUVs." Further, paragraph 6.3.5.2: "The SMCM UUV shall be capable of being launched, recovered, and operated in significant wave heights of less than or equal to 4 feet." … "Rationale: High seas can hinder launch and recovery operations. Launch and recovery sea state are bounded by requirements set forth in the LCS Flight 0+ CDD as well as the LCS performance specification document." And paragraph 15.12.4: "While designed specifically for use from LCS, the SMCM UUV system shall be able to be employed from other COO / SOO or pier side where sufficient power, launch / recovery, space and weight and communications are available." Specific launch and recovery equipment and method are within the realm of trade-space for developers and specification authors, and not appropriate for specific delineation by the Knifefish resource sponsor. PEO LCS and the program managers, along with the LCS resource sponsor, are best equipped to address the question of "how" to meet the L&R requirement. N96, the LCS resource sponsor, included in their CDD for LCS Flight 0+ the requirement "to safely launch, recover and handle (secure and traverse) any single Mission Package watercraft from an operational ready state while operating in the adverse wind speed and wave height / motion conditions associated

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with Sea States as described in Appendix F at best heading for the evolution." There is nothing incompatible between the Knifefish CDD requirement for launch, recovery, operation and maintenance and the LCS Flight 0+ CDD watercraft launch and recovery requirement.

IG Report page 9:

"Lack of Coordination Between Requirements Developers"

"The Navy did not fully define requirements to support the communication interface and launch and recover operations between the Knifefish and the LCS." "For example, one of the additional system attributes listed in the LCS CDD was the requirement for the LCS to launch and recover watercraft. Specifically, the requirement states the LCS must have the ability to safely launch, recover, and handle a single mission package watercraft, such as the Knifefish, while traveling against the wind with low waves." "Regarding Knifefish recovery specifically, the contractor assumed the LCS would completely stop in the water and recover the Knifefish. However, the Navy's operational procedure for the LCS was to not travel below the speed of 3 nautical miles per hour during Knifefish vehicle recovery."

N95 Response: N95 and N96 collaborated and cooperated in the development of the Knifefish CDD. N96 is responsible for the LCS CDD, and N95 is responsible for the Knifefish CDD, including the responsibility to ensure that nothing in the Knifefish CDD would drive additional requirements for the LCS other than those identified in the LCS CDD. The IG summary of the LCS Flight 0+ CDD is inaccurate. The exact wording from the CDD for LCS Flight 0+ is "6.3.6 Watercraft Launch / Recovery / Handling: (Threshold: Sea state 3 best heading within 45 minutes) LCS Flight 0+ shall have the ability to safely launch, recover and handle (secure and traverse) any single Mission Package watercraft from an operational ready state while operating in the adverse wind speed and wave height / motion conditions associated with Sea States as described in Appendix F at best heading for the evolution." The requirement is for L&R up to Sea State 3, best heading (There is no reference to maneuvering speed in the LCS Flight 0+ CDD). There is nothing incompatible between the Knifefish CDD requirement for launch, recovery, operation and maintenance and the LCS Flight 0+ CDD watercraft launch and recovery requirement. The IG report authors provide no reference to support the statement regarding "the Navy's operational procedure" to not travel below the speed of 3 nautical miles per hour during Knifefish vehicle recovery. Regardless, either condition (stopping or maneuvering at 3 knots) would satisfy N95's requirement for launch and recovery.

IG Report pages ii, 9-10:

"We recommend that the Knifefish requirements developer (N95) coordinate with the LCS requirements developer (N96) to develop capability requirements in the Knifefish capability production document relating to communication interface and launch and recovery operations between the Knifefish system and the LCS, unless Knifefish is no longer required."

N95 Response: The statement recommends an activity that has been occurring throughout the program and will continue to be conducted as part of CPD development. N95 and N96, as well as Program Managers from PMS-406 and PEO LCS have participated in requirements development and program decision-making. In order to improve the coordination between Resource Sponsors, a recommendation from the Remote Minehunting System (RMS)

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Independent Review Team (IRT) (February 2016) is being addressed via a Memorandum of Agreement (MOA) between N95 and N96. One goal of the MOA will be to align responsibility for requirements and funding Mine Warfare (MIW) under a single Resource Sponsor. Knifefish communication interface with LCS communication systems and launch and recovery from LCS remain valid requirements.

4

Glossary

Acquisition Category. Acquisition Categories include categories I, II, and III. Acquisition Category I programs have the highest dollar value and have the Defense acquisition executive as the milestone decision authority. Acquisition Category II and III programs have lower dollar values and the Component acquisition executive, or designee, serves as the milestone decision authority.

Acquisition Phase. Acquisition phase refers to all the tasks and activities needed to bring a program to the next major acquisition milestone. Acquisition phases provide a logical means of progressively translating broadly stated capabilities into well-defined, system-specific requirements and ultimately into operationally effective, suitable, and survivable systems.

A**cquisition Program Baseline.** Acquisition program baseline reflects the threshold and objective values for the minimum number of cost, schedule, and performance attributes that describe the program over its life cycle.

Capability Development Document (CDD). A capability development document defines authoritative, measurable, and testable parameters across one or more increments of a materiel capability solution by setting Key Performance Parameters (KPPs), Key System Attributes (KSAs), and additional performance attributes necessary for the acquisition community to design and propose systems and to establish programmatic baselines. The CDD must be validated before the Pre-Engineering and Manufacturing Development (EMD) review and supports the Milestone B decision review.

Capability Production Document (CPD). A capability production document provides authoritative, testable capability requirements, in terms of Key Performance Parameters (KPPs), Key System Attributes (KSAs), and additional performance attributes for the Production and Deployment (PD) phase of an acquisition program, and is an entrance criteria item necessary for each Milestone C acquisition decision. The capability production document must be validated prior to a Milestone C decision review.

Developmental Testing and Evaluation. Developmental testing and evaluation is any testing used to assist in the development and maturation of products, product elements, or manufacturing or support processes. It also includes any engineering-type testing used to verify the status of technical progress, verify that design risks are minimized, substantiate achievement of contract technical performance, and certify readiness for initial operational testing. Development

tests generally require instrumentation and measurements and are accomplished by engineers, technicians, or soldier operator-maintainer test personnel in a controlled environment to enable failure analysis.

Engineering Change Proposal. An engineering change proposal to the responsible authority recommending that a change to an original item of equipment be considered, and the design or engineering change be incorporated into the article to modify, add to, delete, or supersede original parts.

Engineering and Manufacturing Development (EMD) Phase. EMD is the third acquisition phase of the program life cycle, as defined and established by DoD Instruction 5000.02. This phase consists of two efforts, integrated system design and system capability and manufacturing process demonstration. This phase begins after acquisition Milestone B. A program planning to proceed into system capability and manufacturing process demonstration at the conclusion of the integrated system design will first undergo a post critical design review assessment to confirm design maturity and the initial product baseline.

Full-Rate Production. Full-Rate Production is contracting for economic production quantities following stabilization of the system design and validation of the production process.

Joint Capabilities Integration and Development System (JCIDS). JCIDS supports the Chairman of the Joint Chiefs of Staff and the Joint Requirements Oversight Council in identifying, assessing, and prioritizing joint military capability requirements.

Key Performance Parameters. Key performance parameters are those attributes of a system considered critical to the development of an effective military capability. A key performance parameter normally has a threshold representing the minimum acceptable value achievable to low-to-moderate risk, and an objective, representing the desired operational goal but at higher risk in cost, schedule, and performance.

Low-Rate Initial Production (LRIP). LRIP is the first effort of the Production and Deployment acquisition phase. This effort is intended to result in completion of manufacturing development to verify adequate and efficient manufacturing capability and to produce the minimum quantity necessary to provide production-representative articles for initial operational test and evaluation. LRIP establishes an initial production base for the system and permits an orderly increase in the system's production rate, sufficient to lead to full-rate production upon successful completion of operational (and live-fire, where applicable) testing. At Milestone B, the milestone decision authority determines the LRIP quantity for major defense acquisition programs and major systems.

Operational Effectiveness. Operational effectiveness is the measure of the overall ability of a system to accomplish a mission when used by personnel in the environment planned or expected for operational employment of the system considering organization, doctrine, tactics, supportability, survivability, vulnerability, and threat.

Operational Suitability. Operational suitability is the degree to which a system can be placed and sustained satisfactorily in field use with consideration being given to availability, compatibility, transportability, interoperability, reliability, wartime usage rates, maintainability, safety, human factors, habitability, manpower, logistics supportability, natural environmental effects and impacts, documentation, and training requirements.

Operational Test and Evaluation. Operational test and evaluation refers to the field test, under realistic conditions, of any item (or key component) of weapons, equipment, or munitions for the purpose of determining the effectiveness and suitability of the weapons, equipment, or munitions for use in combat by typical military users; and the evaluation of the results of such tests.

Preliminary Design Review (PDR). A technical assessment establishing the physically allocated baseline to ensure that the system under review has a reasonable expectation of being approved as operationally effective and suitable. This review assesses the allocated design documented in subsystem product specifications for each Configuration Item (CI) in the system and ensures that each function in the functional baseline has been allocated to one or more system CIs. The PDR establishes the allocated baseline (hardware, software, human/support systems) and underlying architectures to endure the system under review has a reasonable expectation of meeting the requirements within the allocated budget and schedule. Major Defense Acquisition Programs (MDAPs) are required to conduct this review prior to the completion of the Technology Development (TD) phase. Non-major programs also normally conduct this review prior to the completion of the TD phase, but may conduct it early in the Engineering and Manufacturing Development (EMD) phase, if program circumstances warrant.

Program Executive Officer (PEO). The program executive officer is a military or civilian official who has responsibility for directing multiple program managers for assigned acquisition programs. A PEO reports to, and receives guidance and direction from, the DoD Component acquisition executive.

Program Manager. The program manager is a designated individual with responsibility for and authority to accomplish program objectives for development, production, and sustainment to meet the user's operational needs. The program manager shall be accountable for credible cost, schedule, and performance reporting to the milestone decision authority.

Acronyms and Abbreviations

CDD	Capability Development Document
COTF	Commander, Operational Test and Evaluation Force
DCMA	Defense Contract Management Agency
JCIDS	Joint Capabilities Integration and Development System
LCS	Littoral Combat Ship
MVCS	Multi-Vehicle-Communication System
N95	Expeditionary Warfare Division
N96	Surface Warfare Division
PMS 406	Program Management Office Unmanned Maritime Systems
PMS 420	LCS Mission Modules Program Office
SECNAVINST	Secretary of the Navy Instruction

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