

Audit



Report

OFFICE OF THE INSPECTOR GENERAL

**FUNCTIONAL AND PHYSICAL CONFIGURATION
AUDITS OF THE NAVY TACTICAL COMMAND
SYSTEM-AFLOAT**

Report No. 96-211

August 14, 1996

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Acronyms

NTCS-A
TAC

Navy Tactical Command System-Afloat
Tactical Advanced Computer



INSPECTOR GENERAL
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Report No. 96-211

August 14, 1996

**MEMORANDUM FOR ASSISTANT SECRETARY OF THE NAVY (FINANCIAL
MANAGEMENT AND COMPTROLLER)**

**SUBJECT: Audit of Functional and Physical Configuration Audits of the Navy
Tactical Command System-Afloat (Project No. 5AE-0032.04)**

Introduction

We are providing this report for your information and use. This report is the fifth in a series of reports resulting from our audit of functional and physical configuration audits of Defense systems. A functional configuration audit is a formal examination of functional characteristics of test data for configuration items to verify that the items have achieved their specified performance. A physical configuration audit is a formal examination to verify that the configuration items "as built" conform to the technical documentation that defines the item. Enclosure 2 provides definitions of technical terms used in this report.

Audit Results

The Navy Tactical Command System-Afloat (NTCS-A) Program Office adequately managed the functional and physical configuration audit process. Based on the audit, the NTCS-A Program Office began updating its configuration management plan to incorporate current functional and physical configuration management procedures. NTCS-A management controls were adequate.

Audit Objective

The audit objective was to evaluate the adequacy of the functional and physical configuration audit processes for the acquisition of the NTCS-A. Specifically, we determined whether functional and physical configuration audits verified and documented that configuration items agreed with their configuration identifications, were complete and accurate, and satisfied program requirements. We also evaluated the management control program as it related to our audit objective. In Enclosure 1, we discuss the scope and methodology used to accomplish the objective as well as management controls and prior audit coverage.

Audit Background

Navy Tactical Command System-Afloat. The NTCS-A is an acquisition category II program. The NTCS-A provides afloat, Joint, and Allied Commanders a single, integrated command, control, and intelligence system. The system receives, processes, displays, and maintains current geo-locational information on friendly, hostile, and neutral land, sea, and air forces. The NTCS-A is integrated with intelligence and environmental information in all aspects of wartime and peacetime missions of the Navy. In total, the Navy plans to install the NTCS-A on 251 ships at an estimated cost of \$898 million. As of June 20, 1996, the Navy had installed 207 systems.

Development of the NTCS-A began in 1991, when the Navy integrated seven existing systems to form the NTCS-A. Those systems were the Tactical Flag Command Center, the Afloat Correlation System, the Electronic Warfare Coordination Module Subsystem, the Prototype Ocean Surveillance Terminal, the Joint Operational Tactical System, the Fleet Imagery Support Terminal, and the Naval Intelligence Processing System. Because user requirements are dynamic, the NTCS-A Program Office is employing an evolutionary acquisition strategy to develop and field software upgrades of the NTCS-A as user requirements are refined.

The NTCS-A Program Office acquires nondevelopmental-item hardware and commercial off-the-shelf software from various contractors to assemble and upgrade the NTCS-A. The Research, Development, Test, and Evaluation Division of the Naval Command, Control, and Ocean Surveillance Center, San Diego, California, integrates the upgraded software into the NTCS-A. Enclosure 3 shows a diagram of the NTCS-A.

Configuration Management Guidance. The DoD Regulation 5000.2-R, "Mandatory Procedures for Major Defense Acquisition Programs (MDAPS) and Major Automated Information System (MAIS) Acquisition Programs," March 15, 1996, and the NTCS-A Configuration Management Plan contain configuration management guidance.

DoD Regulation. The DoD Regulation 5000.2-R establishes requirements for configuration management. Subpart 4.3, "Systems Engineering," requires that the program manager use a systems engineering process that includes configuration management to control the system products, processes, and related documentation. Further, DoD Regulation 5000.2-R mandates that, as part of systems engineering, the program manager should establish a configuration management process to identify, document, and verify the functional and physical characteristics of an item; record the configuration of an item; control changes to an item and its documentation; and provide a complete audit trail of decisions and design modifications.

Configuration Management Plan. In April 1992, the NTCS-A Program Office prepared a configuration management plan (the Plan). The primary objective of the Plan is to ensure that the design, development, production, and testing of the NTCS-A are monitored, controlled, and substantiated so that the system fulfills its specified mission. The Plan

implements the Space and Naval Warfare Systems Command policy for configuration management of NTCS-A, establishes an NTCS-A Configuration Control Board and subsystem configuration control boards (subsystem boards), and provides policy and procedures for operation of those control boards within the NTCS-A. The Plan discusses technical and administrative direction and surveillance to identify and document the characteristics of designated configuration items, to control changes to those characteristics, and to record and report change processing and implementation status.

Discussion

The NTCS-A Program Office adequately managed the functional and physical configuration audit process and tailored its configuration management process to include the configuration control process and developmental and operational testing results. Based on our audit, the NTCS-A Program Office began updating the Plan to include procedures for identifying, documenting, and verifying the functional and physical characteristics of configuration items to conform with current practices.

Conducting Functional and Physical Configuration Audits. In August 1991, the NTCS-A Program Office conducted scheduled functional and physical configuration audits of the NTCS-A software version 1.1. The configuration management plan required that configuration audits be:

- o performed in accordance with Military Standard 1521B, "Technical Reviews and Audits for Systems, Equipments, and Computer Software," June 4, 1986, which established guidance for conducting functional and physical configuration audits, and

- o scheduled and conducted to verify that the configuration of each item is in compliance with its applicable specifications, drawings, and computer listings.

NTCS-A Program Tailors Requirement. On April 10, 1995, the Defense Standardization Improvement Council canceled Military Standard 1521B and incorporated the functional and physical configuration audit requirements into Military Standard 973, "Configuration Management," April 17, 1992. Military Standard 973 requires audits of configuration items to verify conformance to specifications, drawings, interface control documents, and other contract requirements.

After the incorporation, the NTCS-A Program Office decided to no longer conduct specific functional and physical configuration audits. Instead, for subsequent NTCS-A software versions, the NTCS-A Program Office decided to use the configuration control process and developmental and operational testing results to identify, document, and verify the functional and physical characteristics of configuration items. The Program Office, however, did not update the NTCS-A configuration management plan to show its tailored configuration verification process.

Configuration Control Process. Configuration control involves the systematic coordination, evaluation, approval or disapproval, and release of approved changes to the established configuration baseline. The NTCS-A has two levels of configuration control: the NTCS-A Configuration Control Board and the subsystem boards.

NTCS-A Configuration Control Board. The NTCS-A Configuration Control Board is at the program level to support the objectives of the NTCS-A and its subsystems configuration change control program. The NTCS-A Configuration Control Board evaluates and approves change requests used to document deficiencies or recommended improvements and changes in software, hardware, documentation, and training. If approved, the change request becomes an engineering change proposal.

Subsystem Boards. The subsystem boards are located at the Naval Command, Control, and Ocean Surveillance Centers in San Diego, California, and Portsmouth, Virginia. The subsystem boards review and forward change requests to the NTCS-A Configuration Control Board.

Developmental Testing. The Research, Development, Test, and Evaluation Division of the Naval Command, Control, and Ocean Surveillance Center, San Diego, California, is the independent verification and validation agent, the developmental test and evaluation organization, and the software support organization for the NTCS-A. In those roles, it:

- o conducts independent reviews of the software product for functional effectiveness and technical sufficiency;
- o reviews, evaluates, and monitors the contents of all software specifications and software tests;
- o reviews and makes recommendations on the identification of computer software configuration items;
- o conducts acceptance testing of software releases;
- o performs maintenance of software releases;
- o provides input to the configuration status accounting system records;
- o maintains current versions of software descriptive documentation and software media; and
- o participates in functional and physical configuration verifications.

Operational Testing. The Commander, Operational Test and Evaluation Force (Test Force), Norfolk, Virginia, is responsible for operational test and

evaluation of the NTCS-A and for making recommendations concerning whether software upgrades of the NTCS-A satisfy user operational requirements. Specifically, the Test Force:

- o participates in integrated product teams and working level test planning working groups to develop affordable acquisition and test strategies throughout the program design process that translate operational requirements into a system solution;

- o conducts system software development process reviews to assess process maturity and to help the developing agency identify areas for process improvement;

- o plans and conducts operational tests;

- o observes developmental testing and factory acceptance and qualification testing to provide early feedback to the developing agency regarding potential shortcomings in system effectiveness of suitability; and

- o reports whether a system is operationally effective, suitable, and survivable before fielding.

The Test Force conducted its latest operational evaluation of the NTCS-A from October 13 through 27, 1995. The purpose of the evaluation was to determine the operational effectiveness and operational suitability of the NTCS-A software version 2.2.0.5 functioning in the tactical advanced computer (TAC)-3 processor. Additionally, the Test Force conducted an operational assessment of the desktop computer processor upgrade and the TAC-4 processor as a workstation using the version 2.2.0.5 software. Based on its operational evaluation, the Test Force concluded that:

- o the NTCS-A was operationally effective and suitable as upgraded with the version 2.2.0.5 software functioning in the TAC-3 processor, and

- o the TAC-4 processor and the desktop computer processor upgrades were potentially operationally effective and suitable.

Identifying and Tracking Corrective Actions. The subsystem boards review, classify, and prioritize NTCS-A software, documentation, and design problems identified during developmental and operational testing as well as fleet operations. The subsystem boards designate the deficiencies as action items and assign them to the Research, Development, Test, and Evaluation Division of the Naval Command, Control, and Ocean Surveillance Center, who corrects the action items immediately or during future software upgrades. The Naval Command, Control, and Ocean Surveillance Center tracks the completion of the action items in its enhanced automated configuration status accounting system.

Software Configuration Status Accounting System. In late 1994, the Research, Development, Test, and Evaluation Division of the Naval Command, Control, and Ocean Surveillance Center implemented an enhanced automated

configuration status accounting system to track current and future software deficiencies for the NTCS-A. That automated configuration status accounting system:

- o records and reports the actual status of change requests at all times,
- o identifies and tracks software version numbers and release numbers comprising a software build,
- o notifies the change requestor when a correction has been made, and
- o validates software releases against the baseline.

Before implementation of the automated configuration status accounting system, the NTCS-A Program Office could not demonstrate that the Research, Development, Test, and Evaluation Division of the Naval Command, Control, and Ocean Surveillance Center had taken appropriate actions to correct all NTCS-A software deficiencies identified before 1994 and had incorporated necessary changes into the NTCS-A software baseline.

Tailored Configuration Verification Process. The NTCS-A Program Office's revised and tailored configuration verification process conforms with requirements in DoD Regulation 5000.2-R. Using an evolutionary acquisition strategy for a software intensive system, the NTCS-A Program Office demonstrated that functional and physical characteristics of software items can be effectively verified using the results of developmental and operational tests and operational experience in the fleet. By implementing the tailored configuration verification process, the NTCS-A Program Office no longer needed to have specific functional and physical configuration audits of software configuration items.

Conclusion

Even though the NTCS-A Program Office no longer conducts specific functional and physical configuration audits, the current NTCS-A configuration control process results in an operationally effective and suitable NTCS-A configuration that satisfies user operational requirements. On June 25, 1996, the NTCS-A Program Office advised us that it is updating its configuration management plan to incorporate its current procedures for identifying, documenting, and verifying the functional and physical characteristics of configuration items.

We request that the NTCS-A Program Office provide us with a copy of the updated plan. Because of the success of the NTCS-A Program Office in effectively tailoring the configuration control process for a software intensive system that uses an evolutionary acquisition strategy, the NTCS-A Program Manager should submit the plan to the Deputy Under Secretary of Defense (Acquisition Reform) to be included in the Defense Acquisition Deskbook as an example of a way to tailor the configuration management process for a software intensive system that uses an evolutionary acquisition strategy.

Management Comments

We provided a draft of this report to you on July 29, 1996. Because the report contains no findings or recommendations, written comments were not required, and none were received. Therefore, we are publishing this report in final form.

We appreciate the courtesies extended to the audit staff. If you have questions on this report, please contact Mr. John E. Meling, Audit Program Director, at (703) 604-9091 (DSN 664-9091) or Mr. Jack D. Snider, Audit Project Manager, at (703) 604-9087 (DSN 664-9087). Enclosure 5 lists the distribution of this report. The audit team members are listed inside the back cover.



David K. Steensma
Deputy Assistant Inspector General
for Auditing

Enclosures

Scope and Methodology

This appendix discusses the scope and methodology used to accomplish the objective as well as management controls and prior audit coverage.

Scope

We conducted this audit from January through June 1996 and reviewed data dated from August 1988 through June 1996. To accomplish the objective, we:

- o reviewed the minutes of the functional and physical configuration audits conducted on the NTCS-A and the action items generated during those audits;

- o reviewed contracts and other contracting documents, including determination and findings, acquisition plans, technical direction letters, and delivery orders;

- o reviewed configuration status accounting system documentation and reports;

- o reviewed configuration management plans, test plans, and developmental and operational test reports; and

- o discussed issues relating to the effectiveness of the functional and physical configuration audit process with personnel from the Office of the Secretary of Defense and with program, technical, and contracting officials at the NTCS-A Program Office; the Space and Naval Warfare Systems Command; the Research, Development, Test, and Evaluation Division and the In-Service Engineering Division, East Coast, of the Naval Command, Control, and Ocean Surveillance Center; and the Commander, Operational Test and Evaluation Force. Enclosure 4 lists the organizations visited or contacted.

Methodology

We conducted this program audit in accordance with auditing standards issued by the Comptroller General of the United States, as implemented by the Inspector General, DoD. We included such tests of management controls as we deemed necessary. We did not rely on computer-processed data to develop conclusions on this audit. Technical experts from the Technical Assessment Division of the Analysis, Planning, and Technical Support Directorate, Inspector General, DoD, and a consultant from the Acquisition Management Directorate, Inspector General, DoD, assisted in the review of functional and physical configuration audit software documentation and contracting procedures, respectively.

Management Control Program

DoD Directive 5010.38, "Internal Management Control Program," April 14, 1987, requires DoD organizations to implement a comprehensive system of management controls that provides reasonable assurance that programs are operating as intended and to evaluate the adequacy of the management controls.

Scope of Review of Management Control Program. We limited our review because of relevant coverage in Inspector General, DoD, Report No. 96-028, "Implementation of the DoD Management Control Program for Major Defense Acquisition Programs," November 28, 1995. The report discussed the effectiveness of the management control program that the Defense Acquisition Executive and the Component Acquisition Executives used for major Defense acquisition programs. The report concluded that the acquisition community had not effectively integrated DoD Management Control Program requirements into its management assessment and reporting processes. As a result of the report recommendations, the Under Secretary of Defense for Acquisition and Technology integrated DoD Directive 5010.38 requirements into the March 15, 1996, revision to DoD Directive 5000.1, "Defense Acquisition," and DoD Regulation 5000.2-R. Acquisition managers are now to use program cost, schedule, and performance parameters as control objectives to implement the DoD Directive 5010.38 requirements. The managers are to identify material weaknesses through deviations from approved acquisition program baselines and exit criteria in the Defense Acquisition Executive Summary report. Accordingly, we limited our review to management controls over the functional and physical configuration audit process at the NTCS-A Program Office. We did not assess management's self-evaluation of those controls.

Adequacy of Management Controls. In 1992, the NTCS-A Program Office conducted a management control review. The Program Office determined that management controls were in place and the risk was low. However, the management control review did not specifically cover functional and physical configuration audits as part of an assessable unit. Even though the Program Office did not evaluate functional and physical configuration audits, we did not identify a material management control weakness for configuration audits.

Prior Audit Coverage

During the last 5 years, the General Accounting Office; the Office of the Inspector General, DoD; and the Naval Audit Service have not issued reports on the NTCS-A addressing functional and physical configuration audit issues.

Definitions of Technical Terms

Acquisition Categories. Categories established to provide decentralized decisionmaking and execution and compliance with statutorily imposed requirements. The categories consist of I, major Defense acquisition programs; IA, major automated information systems; II, major systems; and III, all other acquisition programs.

Configuration Control Board. A Government or contractor board composed of technical and administrative representatives who recommend approval or disapproval of proposed engineering changes to a configuration item's current approved configuration documentation. The board also recommends approval or disapproval of proposed waivers and deviations from a configuration item's current approved configuration documentation.

Configuration Identification. The process of establishing and describing the contractual baselines and related configuration items.

Configuration Item. An aggregation of hardware, firmware, or computer software or any of their discrete portions that satisfies an end use function and is designated by the Government for separate configuration management.

Configuration Management. Technical and administrative direction and surveillance actions taken to identify and document functional and physical characteristics of an item, to control changes to a item and its characteristics, and to record and report change processing and implementation status.

Configuration Management Plan. A document defining how configuration management will be implemented, including policies and procedures, for a particular acquisition or program.

Configuration Status Accounting System. A system implemented to record and report information needed to manage configuration items effectively, including a record of the approved configuration documentation and identification, the status of proposed changes to that configuration, and the implementation status of approved changes. The purpose of a configuration status accounting system is to effectively manage the configuration of a system and ensure accurate identification of each configuration item and delivered unit.

Engineering Change Proposal. A contractor document describing and justifying a proposed engineering change and applicable costs that is submitted to the Government for approval or disapproval.

Evolutionary Acquisition. An acquisition strategy used to procure a system that evolves during development to achieve an overall system capability. An underlying factor in evolutionary acquisition is the need to field a well-defined core capability quickly in response to a validated requirement, while planning through an incremental upgrade program to eventually enhance the system to provide the overall system capability.

Definitions of Technical Terms

Firmware. The combination of a hardware device and computer instructions or computer data that reside as read-only software on the hardware device.

Functional Configuration Audit. A formal examination of functional characteristics of test data for configuration items to verify that the item has achieved the performance specified in its functional or allocated identification. If the item was developed at Government expense, the functional configuration audit must be performed before acceptance of the item. The functional configuration audit must be performed on a prototype or the configuration to be released for production of the operational quantities.

Integrated Product and Process Development. A management process that integrates all activities from product concept through production and field support, using multidisciplinary teams to simultaneously optimize the product and its manufacturing and supportability to meet cost and performance objectives.

Low-Rate Initial Production. The production of a system in limited quantity to provide articles for operational test and evaluation and to establish an initial production rate sufficient to lead to full-rate production upon successful completion of operational testing.

Nondevelopmental item. Any item of supply that:

- o is available in the commercial marketplace;
- o is in use by an agency or department of the United States with which the United States has a mutual Defense cooperation agreement;
- o requires only minor modification to meet the requirements of the procuring agency; or
- o is currently being produced, but is not in use or available in the commercial marketplace.

Physical Configuration Audit. A formal examination to verify that the configuration item "as built" conforms to the technical documentation that defines the item. The physical configuration audit includes a detailed audit of engineering drawings, specifications, technical data, and tests used in production of the item. The physical configuration audit may be conducted on the first full-rate production or the first low-rate initial production item. Government program office approval of the product specification and satisfactory completion of the physical configuration audit establishes the product baseline. A contractor is required to process all subsequent changes to the product baseline by the formal engineering change proposal process.

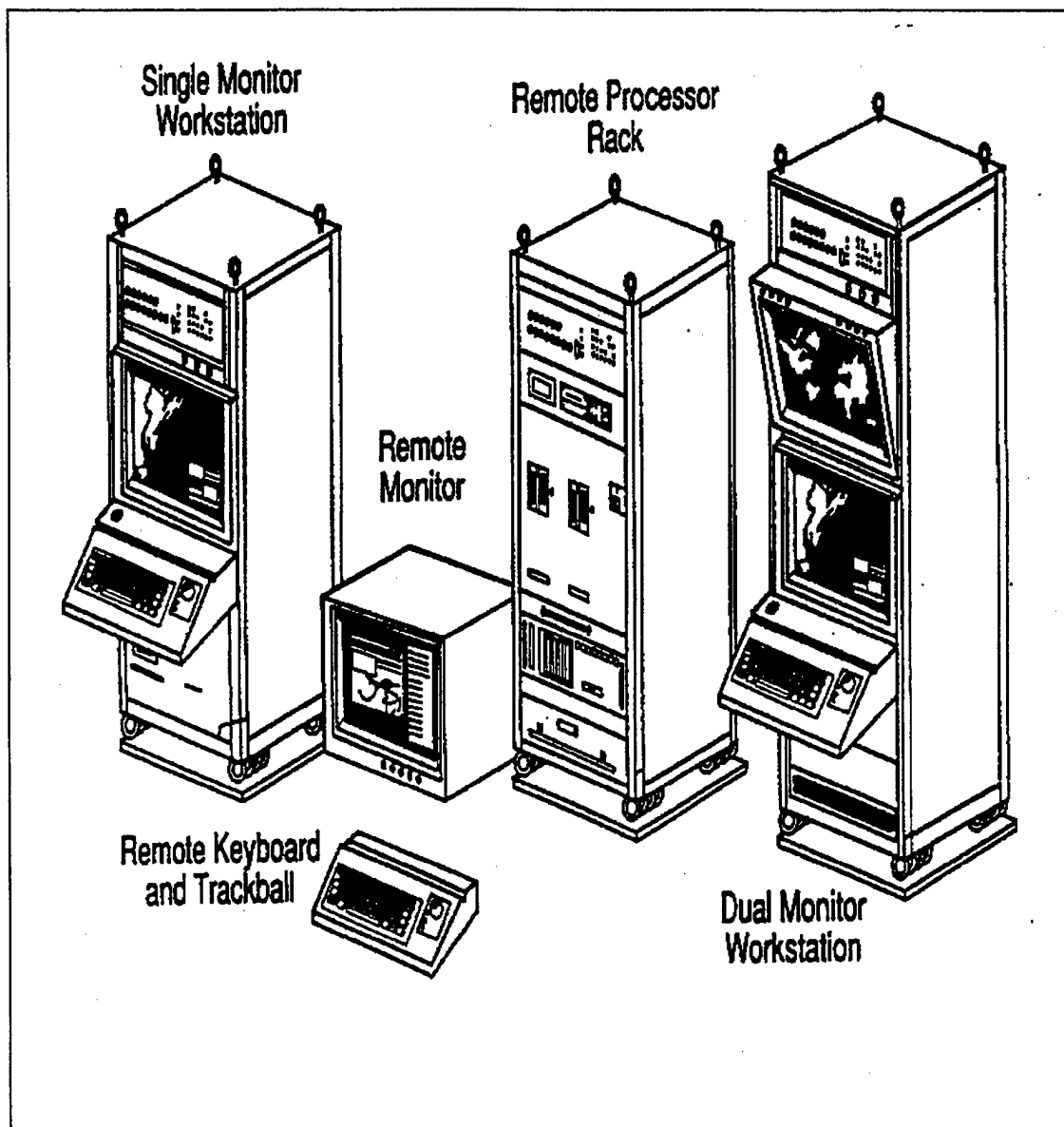
Product Baseline. The initially approved documentation describing:

- o all necessary functional and physical characteristics of the configuration item;
- o any required joint and combined operations;
- o the selected functional and physical characteristics designed for production acceptance testing; and
- o tests necessary for deployment, installation, support, training, and disposal of the configuration item.

Prototype. An original or model on which a later item is formed or based.

Specifications. A document intended primarily for use in procurement that clearly and accurately describes the essential technical requirements for items, materials, or services, including the procedures for determining whether the requirements have been met.

Navy Tactical Command System-Afloat System



Organizations Visited or Contacted

Office of the Secretary of Defense

Under Secretary of Defense for Acquisition and Technology, Washington, DC
Principal Deputy Under Secretary of Defense (Acquisition and Technology),
Washington, DC
Computer-Aided Acquisition and Logistic Support, Alexandria, VA
Defense Standardization Improvement Council, Alexandria, VA

Department of the Navy

Assistant Secretary of the Navy (Research, Development and Acquisition),
Washington, DC
Naval Information Systems Management Center, Arlington, VA
Space and Naval Warfare Systems Command, Arlington, VA
Command, Control, Communications, Computers, and Intelligence Directorate,
Arlington, VA
Navy Tactical Command System-Afloat Program Office, Arlington, VA
Naval Command, Control, and Ocean Surveillance Center, San Diego, CA
Research, Development, Test, and Evaluation Division, San Diego, CA
In-Service Engineering Division, East Coast, Portsmouth, VA
Commander, Operational Test and Evaluation Force, Norfolk, VA

Other Defense Organization

Defense Logistics Agency, Fort Belvoir, VA

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House Committee on Appropriations
House Subcommittee on National Security, Committee on Appropriations
House Committee on Government Reform and Oversight
House Subcommittee on National Security, International Affairs, and Criminal
Justice, Committee on Government Reform and Oversight
House Committee on National Security

Audit Team Members

The Acquisition Management Directorate, Office of the Assistant Inspector General for Auditing, DoD, prepared this report.

Patricia A. Brannin
John E. Meling
Jack D. Snider
Cordelia Grace-Scott
Debra A. Calhoun
Lisa M. Waller
Gregory R. Donnellon
Garry D. Durfey
Samuel H. Metzler
Noelle G. Blank
Teresa D. Bone

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