

Audit



Report

OFFICE OF THE INSPECTOR GENERAL

**THE CRITICAL DESIGN REVIEW PROCESS FOR MAJOR
DEFENSE ACQUISITION PROGRAMS**

Report Number 93-017

November 5, 1992

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The following acronyms are used in this report.

AWACS.....	Airborne Warning and Control System
CDR.....	Critical Design Review
EPLRS.....	Enhanced Position Location Reporting System
Javelin.....	Advanced Antitank Weapon System - Medium
Joint STARS.....	Joint Surveillance Target and Attack Radar System
Mil-Std.....	Military Standard
RSIP.....	Radar System Improvement Program (for the Aircraft Warning and Control System)
SSN-21.....	Seawolf Class Nuclear Attack Submarine
V-22 Osprey.....	Joint Advanced Vertical Lift Aircraft



INSPECTOR GENERAL
DEPARTMENT OF DEFENSE
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November 5, 1992

MEMORANDUM FOR UNDER SECRETARY OF DEFENSE FOR ACQUISITION

**SUBJECT: Audit Report on the Critical Design Review Process
for Major Defense Acquisition Programs
(Report No. 93-017)**

We are providing this final audit report for your review and comments. On June 30, 1992, a draft of this report was provided to you for comments. As of October 28, 1992, we had not received responses to the draft report.

DoD Directive 7650.3 requires that all audit recommendations be resolved promptly. Therefore, comments must be made by January 04, 1993. If appropriate, you may propose alternative methods for accomplishing desired improvements. This report does not identify any quantifiable monetary benefits. Recommendations are subject to resolution in accordance with DoD Directive 7650.3 in the event of nonconcurrence or failure to comment.

We appreciate the courtesies extended to our audit staff. If you have any questions on this audit, please contact Mr. Russell A. Rau, Program Director, at (703) 693-0186 (DSN 223-0186) or Mr. Brian Flynn, Project Manager, at (703) 693-0400 (DSN 223-0400). Appendix F lists the planned distribution of this report.

Robert J. Lieberman
Assistant Inspector General
for Auditing

Enclosure

cc:

Secretary of the Army
Secretary of the Navy
Secretary of the Air Force

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Office of the Inspector General

AUDIT REPORT NO. 93-017
(Project No. 1AE-0051)

November 5, 1992

**THE CRITICAL DESIGN REVIEW PROCESS
FOR MAJOR DEFENSE ACQUISITION PROGRAMS**

EXECUTIVE SUMMARY

Introduction. Critical design review (CDR) is defined as a review to determine if the detailed system design meets the performance and engineering requirements of development specifications. During CDR, the Government must ensure that all design areas are adequately examined, that design weaknesses are identified, and that solutions for design-related problems are available. The Government must use the results of the CDR to assess the readiness of the system to progress to the next acquisition phase. The design reviews and associated testing of design features let the Government review the complete system design and evaluate its capability to satisfy total mission requirements. Presently, DoD proposes acquisition strategies that focus on developing, but not on producing, systems. Those strategies require that CDR be effective and not rely on later production efforts to resolve design deficiencies.

Objectives. The overall audit objective was to evaluate the effectiveness of the CDR process for major Defense acquisition programs. We also evaluated the internal controls for the CDR process.

Audit Results. The CDR process for the six major Defense acquisition programs reviewed was ineffective in ensuring that the detailed design and supporting documentation satisfied mission requirements before proceeding with production. We identified 15 types of deficiencies in the CDR processes of the six major Defense acquisition programs. We discussed those deficiencies in this report under the categories of planning, performance and control, and acceptance of the CDR process. Because existing directives, guidance, and procedures were inadequate, the primary objectives of CDRs have not been met. Premature, ineffective, and incomplete CDRs have not established that major Defense acquisition programs can meet performance requirements. Also, those CDRs have not stabilized design for production or provided early identification of cost, schedule, and performance deficiencies for the system design. As a result, the Government has paid for incomplete design efforts and did not maintain adequate control over the design process.

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Internal Controls. The audit identified material internal control weaknesses. Controls to track actions that correct current and prior design deficiencies were inadequate to ensure that corrective actions were sufficient or actually taken. Also, controls were not established to ensure that senior acquisition management received enough information on CDR results to make sound management decisions. Part I discusses the controls assessed.

Potential Benefits of Audit. The monetary benefits to be realized by implementing the recommendations were not readily quantifiable (Appendix D).

Summary of Recommendations. We recommended that the Under Secretary of Defense for Acquisition:

- o establish CDR as an acquisition program baseline for Defense programs;

- o establish criteria to start and complete all phases of CDR;

- o require that CDR be made a separately priced contract line item in development contracts with contractual provisions for individual withholds for each open action item until corrective action is completed;

- o report delays in completion of, and significant program changes because of, CDRs to senior acquisition officials; and

- o expedite issuance of revised guidance for the CDR process.

Management Comments. No comments were received in response to the draft report. Comments to the final report are requested from the Under Secretary of Defense for Acquisition by January 4, 1993. We were informed that comments were being prepared and would be submitted in response to this final report.

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The Acquisition Management Directorate, Office of the Assistant Inspector General for Auditing, DoD, prepared this report. Copies of the report can be obtained from the Information Officer, Audit Planning and Technical Support Directorate, at (703) 614-6303 (DSN) 224-6303).

PART I - INTRODUCTION

Background

Critical design review (CDR) is essential in a well-disciplined, full-scale development program. DoD Instruction 5000.2, "Defense Acquisition Management Policies and Procedures," February 23, 1991, defines CDR as a review conducted to:

- o determine if the detailed design of a system meets the performance and engineering requirements of the development specification;
- o establish the detailed design compatibility among the end item and other items of equipment, facilities, computer programs, and personnel;
- o assess producibility and risk areas; and
- o review the preliminary product specifications.

DoD Instruction 5000.2 does not give specific guidance to conduct the CDR but does require tailored application of Military Standard (Mil-Std) 1521B, "Technical Reviews and Audits for Systems, Equipments, and Computer Software," June 4, 1985.

The Government must identify specific design reviews to impose on a development program and include them in Requests for Proposals, with any resulting contracts. Generally, the system-engineering management process includes system, preliminary, and critical design reviews phased to the maturation of the design. The CDR is done when a program nears the end of its design phase, during engineering and manufacturing development. The purpose of the CDR is to identify design weaknesses or faults.

During the CDR, the Government must ensure that all design areas are adequately examined, that design weaknesses are identified, and that solutions for design-related issues are available. The Government must use the CDR results to assess the readiness of the system to progress to the next acquisition phase. If the system under development is complex, the CDR may be an incremental review. Separate CDRs are performed for the system computer's hardware and software. The CDRs and associated testing of design features let the Government review the complete system design and evaluate its capability to satisfy total mission requirements. The CDR process also lets the Government develop the production configuration. The CDR is conducted on each configuration item before design release and production.

Presently, DoD is emphasizing acquisition strategies that focus on developing, but not on producing, Defense systems. This approach necessitates that CDRs be effective and not rely on later production efforts to resolve design deficiencies.

Objectives

Our overall objective was to evaluate the effectiveness of the CDR process for major Defense acquisition programs. We also evaluated the internal controls for the CDR process. The DoD Inspector General began this audit to determine if deficiencies identified in the CDR process for the Navy A-12 aircraft are unique to the A-12 Program or are systemic in major Defense acquisition programs. This audit is one of a series to assess the overall effectiveness of implementation of acquisition management recommendations incorporated in the Secretary of Defense's "Defense Management Report."

Scope

To accomplish our objectives, we examined the CDR performed on six major Defense acquisition programs in the engineering and manufacturing development phase. Those programs were judgmentally selected and included the following two programs each from the Army, Navy, and Air Force:

Army

- o EPLRS (Enhanced Position Location Reporting System)
- o Javelin (Advanced Antitank Weapon System - Medium)

Navy

- o V-22 Osprey (Joint Advanced Vertical Lift Aircraft)
- o SSN-21 (Seawolf Class Nuclear Attack Submarine)

Air Force

- o RSIP (Radar System Improvement Program for the Aircraft Warning and Control System [AWACS])
- o Joint STARS (Joint Surveillance Target and Attack Radar System)

The audit universe consisted of the major Defense acquisition programs listed in the "Selected Acquisition Report."

We examined the design and design review requirements in acquisition plans, acquisition strategy reports, operational requirements documents, requests for proposals, contracts, contract modifications, test and evaluation master plans, developmental test reports, operational test and evaluation reports, minutes of design review meetings, action items from design reviews, and documentation to resolve action items. We interviewed the program management, procurement contracting officer, Defense plant representative office, and contractor personnel to determine the policies and procedures followed in design review. We examined the CDR information given to senior acquisition management in the "Defense Acquisition Executive Summary" and other reports.

This program results audit was made from June 1991 through May 1992 and included the CDR records and actions noted above from January 1982 to May 1992. The audit was made in accordance with auditing standards issued by the Comptroller General of the United States as implemented by the Inspector General, DoD, and so included necessary tests of internal controls. Appendix E lists activities visited or contacted.

Internal Controls

We evaluated the adequacy of internal controls over the CDR process. As part of our evaluation, we assessed:

- o Federal, DoD, and Component regulations, instructions, directives, and other guidance on the CDR process;

- o Defense component implementing procedures and compliance with regulations; and

- o oversight of the CDR process by the Office of the Secretary of Defense and the DoD components.

The audit identified material internal control weaknesses, as defined by Public Law 97-255, Office of Management and Budget Circular A-123, and DoD Directive 5010.38. Controls to track actions that correct current and prior design deficiencies were inadequate to ensure that corrective actions were sufficient or actually taken. Internal controls also were insufficient to ensure adequate planning, performance, and acceptance of CDRs. Recommendations 1. through 4., if implemented, will correct these weaknesses. Also, controls were not established to ensure that senior acquisition management received enough information on the CDR results to make sound management decisions. Recommendations 5. and 6., if implemented, will correct these weaknesses.

This report will be provided to senior officials responsible for internal control within DoD and each of the Military Components (Appendix F).

Prior Audits and Other Reviews

We identified five audits and one Navy special inquiry issued since June 1989 or currently ongoing that identified deficiencies in the CDR process for major Defense acquisition programs. Appendix C synthesizes these reports.

Other Matters of Interest

The Air Force commissioned the Air Force Systems Command* to study the preliminary and critical design review processes in use for its major Defense acquisition programs. The study was made from February 1991 through August 1991. The study found that significant improvements were needed to strengthen the Air Force's design-review processes. As a result, a draft policy statement and guidelines for the design review processes have been prepared. This explains design review objectives, scheduling, implementing design reviews, participants' responsibilities, and later actions. Compliance with the policy and guidelines will be required for all acquisition strategies forwarded to milestone decision authority 60 days after approval of the policy. However, the policy had not been officially adopted at the time of the audit.

* On July 1, 1992, after our audit work was completed, the Air Force Systems Command and the Air Force Logistics Command merged to become the Air Force Materiel Command.

PART II - FINDING AND RECOMMENDATIONS

THE CRITICAL DESIGN REVIEW PROCESS

The CDR process for major Defense acquisition programs was ineffective in ensuring that the detailed design and supporting documentation satisfied mission requirements before proceeding with production. Deficiencies in the planning, performance, acceptance, and control of CDRs were identified. Appendix A summarizes the deficiencies for each of the major Defense acquisition programs included in this audit. The process was ineffective due to inadequacies in and ineffective compliance with existing directives, guidance, and procedures for planning, performance, control, and acceptance of the CDR process. As a result, the primary objectives of CDRs were not met. Premature, ineffective, and incomplete CDRs did not establish that major Defense acquisition programs could meet performance requirements. The reviews also did not stabilize design for production or provide early identification of cost, schedule, and performance deficiencies for the system design. As a result, the Government paid for incomplete design efforts and lost control over the design process.

DISCUSSION OF DETAILS

Background

An acquisition strategy is prepared for each major Defense acquisition program. The acquisition strategy is introduced during the concept exploration/definition phase and updated, as necessary, during successive phases through to the production phase. The acquisition strategy is the basic planning document for each major Defense acquisition program. An acquisition plan is prepared based on the acquisition strategy and identifies specific contractual actions needed to develop and produce the weapon system identified in the acquisition strategy. Based on the need to clearly and precisely communicate Government requirements and intentions to industry, requirements necessary for planning, executing, and controlling the CDR process should be addressed in the acquisition plan and included in requests for proposals made to contractors for the engineering and manufacturing development of major Defense acquisition programs.

Planning for Critical Design Review

Inadequate Contract Provisions. Contracts for three of the six programs included in our audit lacked provisions to conduct the CDR effectively. As the following table shows, five of the six contracts lacked provisions for withholding payments for open action items resulting from the CDR process:

<u>Major Defense Acquisition Program</u>	<u>Statement of Work</u>	<u>Contract Line Item Number</u>	<u>Contract Data Requirements List</u>	<u>Withhold Provisions</u>
EPLRS	No	No	Yes	No
Javelin	Yes	No	Yes	No
V-22 Osprey	Yes	Yes	Yes	Yes
SSN-21	Yes	Yes	Yes	No
RSIP	Yes	Yes	Yes	No
Joint STARS	Yes	No	Yes	No

In our opinion, contract terms for effectively implementing CDRs should minimally include:

- o a Statement of Work asking the contractor to plan for and conduct a CDR,

- o a separately priced contract line item tied to the successful completion of the CDR from which withholds can be established, and

- o withhold provisions to ensure satisfactory completion of action items resulting from the CDR.

No contract requirements for critical design review. A CDR-planning disconnect existed between the EPLRS development contract provisions and the acquisition plan. The EPLRS acquisition plan for the final phase of development required using quarterly design reviews, special design reviews, production and readiness reviews, and technical interchange meetings to monitor contractor progress. The acquisition plan also set up a program milestone schedule requiring a system design review, preliminary design review, and a CDR no later than 12 months after contract award. However, these design reviews were not included in the Statement of Work. Instead, the procurement contracting officer included a Statement of Work tasking the contractor to conduct a detailed design review to establish a design freeze on the hardware and software baselines. This language is similar to language used in Statements of Work that require contractors to conduct a CDR. However, the language neither required that the detailed design review be based on objective criteria, such as Mil-Std 1521B, nor was the language supported by a contract line item number.

The detailed design review was never identified as such in the contractor's cost performance reports or in the minutes of in-process reviews conducted during and after that period. The contractor had permission from the program office to replace the detailed design review with two program reviews in August and December 1986, respectively, and one production readiness review in December 1986. The program reviews and the production readiness review did not provide the necessary coverage,

identification, and closure of action items to satisfy the effort required of the CDR as outlined in Mil-Std 1521B.

Inadequate or unclear Statement of Work. The E-8A aircraft was selected as the original platform for the Joint STARS program. In the E-8A aircraft contract, CDR was discussed only in one sentence in the Statement of Work. As a result of this lack of contract emphasis in the planning stage, the program office needed a concentrated effort to get the contractor through the CDR. Our audit found that the contractor clearly did not understand what was expected by the Air Force to conduct a successful CDR. However, the program office improved the CDR process when it needed to replace the E-8A aircraft with the E-8C aircraft as a platform for the Joint STARS program. It developed a contract that incorporated an excellent Statement of Work for the CDR.

No provisions for withholds. Five of the six major Defense acquisition programs reviewed did not include provisions in their engineering and manufacturing development contracts for withholding progress payments for incomplete CDR actions. The Federal Acquisition Regulation and the DoD Supplement to the Federal Acquisition Regulation provide that Administrative Contracting Officers have the authority to withhold all or a portion of progress payments when compliance with contract provisions are incomplete. However, in our opinion, these general provisions of the Federal Acquisition Regulation and the DoD Supplement to the Federal Acquisition Regulation are subject to contractor misunderstanding and dispute. For example, we found that the Joint STARS and EPLRS program offices did not employ withholds even though CDR or other design changes caused significant schedule slips. Including provision for withholds for incomplete CDR actions in the Statement of Work in Requests for Proposals and contracts would clarify for contractors the importance the Government places on CDR, what the Government considers full compliance, and the monetary penalties for incomplete compliance.

Superseded military specifications. The November 1990 engineering and manufacturing development contract for E-8C aircraft used as platforms for the Joint STARS program incorporated Mil-Std 1521A, "Technical Reviews and Audits for Systems, Equipments, and Computer Programs," June 1, 1976, as the CDR criterion. However, Mil-Std 1521A had been superseded by Mil-Std 1521B on June 4, 1985. The new E-8C contract should have included the Military Standard in effect when the contract was awarded.

Program office personnel said that Mil-Std 1521B was not used because the E-8C aircraft replaced earlier selected E-8A aircraft, and the program manager did not want to use CDR requirements that were not in effect for the E-8A aircraft. The program manager's strategy for E-8C technical review included only differences between the E-8A aircraft and E-8C aircraft, not

all configuration items and computer software configuration items for the E-8C aircraft. However, Mil-Std 1521B is more comprehensive as to documentation to be reviewed during CDR.

Mil-Std 1521B also includes two more significant reviews, the software specification review and the test readiness review. The software specification review is conducted before the preliminary design reviews, and critical design reviews are conducted during the engineering and manufacturing development phase to review the final computer software configuration item requirements and operational concept. The test readiness review comes after the software CDR to ensure that the contractor is prepared for formal computer software configuration item testing.

Performance and Control of Critical Design Review

Although five of the six systems reviewed had formal CDRs, they did not accomplish their primary purpose. Specifically, the design reviews were done when detailed design of the system was incomplete, action items resulting from the CDR were unresolved, determinations were not made as to whether corrective action was contractor or Government responsibility, and action items were inadequately tracked to assure that design issues were resolved. The reviews were ineffective because no criteria or procedures guided the CDR process. Another factor was that program milestone schedules drove the reviews. As a result, major technical or performance issues or both remained unresolved after the CDRs were considered complete. This delayed program development and transferred any cost and technical risk of redesign to the Government. Appendix B summarizes the plan and accomplishment of design reviews for the major Defense acquisition programs included in this audit. Also, Appendix B summarizes the impact of delays in design reviews on configuration audits and initial operating capability for each acquisition program.

Premature and Schedule-Driven Critical Design Reviews. The scheduling and executing of CDRs were premature and schedule-rather than event-driven. CDR should not be started until the system design is stable, since it is at this point in the development that the Government is preparing the system for final configuration and transition into production. The CDR should set design stability and end with acceptance of the design. A thorough CDR is the Government's last chance to identify design weaknesses and to determine if the proposed design meets contract specifications and performance requirements. However, our audit found that the Government proceeded with CDRs even when events that should precede the CDR had not occurred.

The CDR conference is run by the contractor. Normally, engineering and manufacturing development contracts assign responsibility for the agenda and minutes of the CDR conference to the contractor. The contractor must present proposed production design to the Government at this point. The

Government must critically review the detailed design to determine if it meets the contract specification and performance requirements.

Detailed drawings presented to the Government at the CDR conference were incomplete. As a result, compliance with contract specifications and performance requirements could not be determined, solutions to apparent technical and performance issues could not be determined, and the contractor could not ensure that the design was stabilized.

Premature critical design review. Four of six programs reviewed held the CDR before the detail design was substantially complete. Therefore, major unresolved technical issues were known before holding the CDR.

This was the case for the Javelin and V-22 Osprey programs. The CDR for the Javelin program was accomplished and most action items were closed even though testing disclosed major design deficiencies in safety and performance. The Joint STARS and EPLRS programs also entered CDR prematurely. In both cases, the maturity of system design was not the driving factor for scheduling the CDRs. Rather, their CDRs were tied to specific dates set in the contracts or based on preestablished fielding plans. An accelerated development strategy was used in both programs, which may have led to this condition. The remaining technical issues for the systems reviewed were so substantial that the stability of the design was questionable. By conducting the CDR when the design was unstable, the basic goals of the CDR process were unattainable. Detail design for configuration items should be mostly complete before the CDR. However, the status of drawings and the solution of technical problems were incomplete when the CDR was held. This approach had significant adverse effects on the programs in terms of risk, schedule delays, cost increases, and design instability. Specifically, premature acceptance of CDR transfers risk associated with the design to the Government.

For example, our audit made the following findings:

- o CDR for the V-22 Osprey program was held when only 70 percent of the detailed drawings were available.

- o CDR participants for the Javelin program were not given an opportunity to review detailed drawings or study the detailed design before the CDR conference. After the CDR was considered complete, later testing revealed the need for major redesign of Javelin components. No plans existed to conduct a review of the redesigned components.

- o More contracts for design studies were funded for the V-22 Osprey program following the CDR.

o Technical and performance issues for the Javelin program were not raised in the CDR conference but during working group committee meetings that were not attended by all participants.

o The Net Control Station Trainer, developed under the EPLRS program, was subject to a CDR by Mil-Std 1521A. It was identified with a contract line item number for \$1.4 million and delineated in the Statement of Work. The award to manufacture the Net Control Station Trainer was based on the Army's need to train enough operation and maintenance personnel for the Net Control Station by the first-unit-equipped date. Because deficiencies were found during technical tests, ending in March 1989, the EPLRS first-unit-equipped date went from April 1989 to a conditional first-unit-equipped date of May 1994 and an initial-operating-capability date of February 1997. As a result, the production Net Control Station Trainer delivered in 1989 will need to be reengineered each time design of the not-yet-stabilized Net Control Station is changed.

Schedule-driven critical design review. Our review of the six major Defense acquisition programs indicated that CDR emphasized meeting milestone schedules rather than the readiness of program design for CDR. For example, CDR contract provisions established milestones for the CDR within specified months of contract award rather than when events, such as completing detailed drawings, indicated that a program was ready for CDR. In the JAVELIN program, an initially compressed development schedule arbitrarily set the CDR for 9 months after contract award.

Proceeding with the CDR to maintain schedule actually prolonged the process. Government decisions to accept the design could not be made because the CDR was premature in the design process. Holding the arbitrarily scheduled CDR conference did not result in a critical review of the design but rather a cursory review of drawings presented by the contractor. The CDR should result in accepting a design that is ready for manufacture. This was not the case for any system reviewed. Extending the development phase was the outcome. The very thing the programs hoped to accomplish, maintaining schedule, was not accomplished; in fact, it was extended.

Even though the EPLRS program did not conduct a formal CDR, the acquisition strategy was based on fielding EPLRS a year before fielding the Forward Area Air Defense Command, Control, and Intelligence system for which EPLRS was to provide data communications. This was a primary factor for following contract schedule. Accelerated acquisition to include concurrent development and testing was eliminated from the EPLRS program in 1989, when an event-based strategy with technical baseline parameters was adopted.

The Joint STARS program established ambitious design review milestones. The CDR was scheduled for 19 months after the contract was signed. However, because preliminary design review was delayed, the CDR was held 38 months after the contract was signed. The System Program Director delayed preliminary design review because the contractor was not ready with the design data and solutions needed for a successful preliminary design review. Even after the preliminary design review, the lack of design maturity became apparent during CDR when the level of design data needed for successful CDR was not provided and agreement could not be reached on how to close open action items from both the preliminary and critical design reviews.

Conducting design reviews when programs are not ready increases the risk that major design deficiencies will go undetected until later. In our opinion, the CDR for the Joint STARS program was held to give the appearance that progress was being made and that the program was not further behind the preestablished contract schedule for CDR. Also, it appears that the CDR was held in the expectation that needed design and test solutions could be found in the follow-on technical reviews.

Conducting Critical Design Reviews. The CDR conferences were conducted more as a briefing on the design status than as a CDR to determine if it met contract and performance requirements. For example, we found no challenges to the system design by personnel who participated in the CDRs. Technical issues affecting overall system performance were deferred to working group committees. Usually, regular reviews and discussions of system design take place between the system program office and the contractor, while working groups focus on specific design problems. These meetings must not replace the formal CDR, which should lead to Government acceptance of the design. The deferral of action items to working groups does not complete the CDR of the component or system. Instead, the working group sessions should precede the CDR, with challenges to the design presented before or during the CDR. By not adhering to essential criteria or establishing guidelines for performing the CDR, the chance for finding technical and design deficiencies after the CDR increases, which delays completing the program and increases program cost.

The Navy's V-22 Osprey program shows how conducting the CDR conference contributes to ineffective design. The V-22 Osprey program office accepted the contractor's proposed design at CDR, based mainly on a design-status briefing by the contractor. To address and overcome design ambiguities, the program office later awarded more contracts for design studies.

Guidance Provided Attendees. Existing guidance on the CDR process does not set forth actions expected of Government and contractor representatives. Minutes of CDR meetings indicate that more than 100 people attended these meetings. However, notices of the upcoming CDRs did not contain information or

instructions to attendees as to their responsibilities during the CDRs. Most attendees had no input to the CDR meetings. Again, the CDR seemed to be a cursory review of the design presented by the contractor.

Control of Action Items. Two of the six major Defense acquisition programs reviewed inadequately tracked action items generated during CDRs. The Federal Acquisition Regulation and its supplements do not require CDRs. Contract provisions must establish and delineate requirements for CDRs. So, the contract provisions for CDR determine if corrective actions for action items resulting from CDRs are within the scope of the contract ("in scope" items) and a contractor's responsibility or not within the scope of the contract ("out of scope" items) and thus the Government's responsibility. In scope/out of scope decisions should be made when action items resulting from CDR are identified. These decisions should specify if the required corrective action is within the scope of the contract and payable by the contractor or outside the scope of the contract and payable by the Government.

The EPLRS and Joint STARS programs did not track or maintain the status of corrective actions for all action items. These program management offices relied on their contractors to maintain such records. We got the documentation needed to accomplish our review of these systems from contractors. In our opinion, to control action items and properly ensure adequate resolution, the program office must maintain:

- o complete records for all design issues requiring action,
- o determinations whether each issue is in scope or out of scope,
- o the action approved to resolve each issue, and
- o the due date for completing the approved action.

Managing Critical Design Reviews. All major Defense acquisition programs reviewed had shortcomings in CDR management. Appendix A lists each program's identified shortcomings. The Javelin program is discussed because it shows many of the identified shortcomings. Most critical design analyses of the Javelin were done in working group meetings after the CDR was considered complete. As of the completion of our Javelin audit verification work in May 1992, the program was still trying to resolve design-related technical deficiencies discovered after the CDR.

Detailed drawings were unavailable before the CDR to determine compliance with performance specifications. Issues reviewed and discussed during the CDR were those found in the normal course of a development program and were easily resolved. The critical review of proposed design, which should be done during the CDR,

was done instead during working group meetings after the CDR. Also, no plans exist to do another CDR for the Javelin program, although at least two major components will be redesigned.

Program management representatives conceded that the CDR was held because the contract scheduled it by a certain date. Although the Javelin program was not ready for the CDR by the scheduled date, the CDR was conducted.

For the EPLRS program, informal technical meetings were held instead of a formal CDR. Although the EPLRS system is an improvement over an already fielded Position Location Reporting System, the importance of a CDR for the improvements is not lessened. The EPLRS design was not ready when the CDR was conducted on a trainer version of the system. Planned design changes for the system were postponed as growth items. Design was insufficient to enable its acceptance. A properly conducted CDR should result in Government acceptance of the design.

Acceptance of Critical Design Reviews

Mil-Std 1521B states that the program manager provides formal acknowledgment of completing the CDR to the contractor after receiving the CDR minutes. The contracting agency sets the adequacy (acceptance) of the contractor's CDR performance by notification of:

- o approval that the review was satisfactorily completed,
- o contingent approval that the review is not considered completed until resolution of resultant action items, or
- o disapproval if the review was seriously inadequate.

Acceptance should acknowledge that the CDR was conducted and resultant action items have been resolved to the Government's satisfaction.

Process Closed Before Action Items Complete. The program managers and procuring contracting officers accepted CDRs with significant action items unresolved and without commensurate monetary withholds or effective tracking to ensure satisfactory completion.

Critical design review as a contract line item. When CDR was a contract line item and withholds were exercised, this control operated well to ensure that the contractor completed the action items before receiving full compensation for CDRs. For three of the five programs, their contracts included a contract line item with a separate price for the CDR. This contract leverage gave the contracting officers control of the action item closure. For example, though the contract included no specific provision for withholding payments for open action items resulting from the CDR process, the RSIP program office continued

to withhold \$851,922 until all action items were successfully closed out. However, unless contract leverage is enforced, accepting CDRs can occur with action items open after the Government has paid for design reviews. This situation seriously compounds the difficulty in ensuring satisfactory closure of CDR.

For example, the V-22 Osprey program office had 23 CDR action items open at the completion of the CDR in December 1986 and recommended a withhold of \$4.5 million to encourage quick closure of the action items. However, the contractor disagreed with the recommended withhold amount. So, the withhold was reduced to \$500,000. However, even this reduced withhold amount was later released to the contractor while action items had not been completed. The contracting officer during our audit could not explain why the previous contracting officer had released the entire amount withheld.

Critical design review when not a contract line item.
When CDR was not a contract line item, we found that the contract clauses encouraged accepting CDR and deferring completion of open action items. The Javelin and Joint STARS programs accepted their CDRs with significant unresolved action items. Joint STARS contract clauses defined successful completion of the CDR as "full compliance with Military Standard 1521A, and publication of critical design review minutes which include a mutually agreed to schedule for completion of all unresolved tasks" (emphasis added). In July 1990, an agreement was made on a schedule to close out 35 of the remaining 56 action items. Moreover, the Joint STARS contract had an award fee tied to completing the CDR successfully.

In October 1990, the award fee board approved and awarded \$450,000 to the contractor (\$750,000 total award fee available). The contracting officer recommended against any fee because the contractor's performance was unsatisfactory during the CDR. In the agreement, the contractor was reminded that although the mutually agreed to schedule for completing unresolved tasks signifies the closure of CDR according to the "special contract requirements section," the contractor is still responsible for closing out open items. However, the Joint STARS program's release of the award fee removed the incentive for quick closure of open action items. The contract clauses should have allowed a monetary withhold commensurate with the significance of the open action items instead of rewarding the contractor for unsatisfactory performance.

The Government lost its chance to encourage contractors through monetary withholds to expedite completion of the open action items. As a result, although CDRs were closed, production baselines were not established and design work continued on three of the major Defense acquisition programs included in our audit.

Reporting Critical Design Review Results and Completion.
Program managers needed to improve their reported CDR results and completion milestone dates in the "Defense Acquisition Executive Summary" report for senior acquisition management's use.

DoD Instruction 5000.2, "Defense Acquisition Management Policies and Procedures," February 23, 1991, states that the "Defense Acquisition Executive Summary" report should provide the milestone decision authority with adequate information to oversee acquisition programs and provide, regularly and systematically, advance indications of potential and actual program problems before they become significant.

Reported results. The CDR results reported to senior acquisition management in "Defense Acquisition Executive Summary" reports were incomplete and inaccurate because CDR has not been clearly identified as a reportable baseline requirement. Our review of these reports for five of the six major Defense acquisition programs showed that the reported CDR results were incomplete and inaccurate. The program managers did not report CDR-related events sufficiently to track the CDRs progress from report to report. For each of the five acquisition programs, the information reported was insufficient to determine the CDRs status or results. For example, we reviewed the reported results in nine reports for the Joint STARS program from starting the CDR through resolving the open action items (November 1988 to March 1992). We found only two comments that addressed CDR results.

- o August 1989 report date: "Grumman is developing the plan to resolve remaining open critical design review action items."

- o February 1989 report date: "The software test portion of critical design review was successfully completed."

The reported information was incomplete and misleading. The plan to resolve the remaining CDR open action items was not agreed to until July 1990, 1 year after the reports stated that the contractor was developing the plan. Moreover, although the software test portion of the CDR was reported as completed, our review showed that 66 action items were open. So, actually it was not completed and could not be completed until the action items were closed.

Such reporting is misleading and does not give accurate CDR results. This condition occurs, in part, because DoD Instruction 5000.2 does not address how to report CDR results, status, and completion. Also, program managers were not always thorough in reporting CDR results. So, the information reported in the "Defense Acquisition Executive Summary" was not useful to the senior acquisition management.

Although the Javelin and Joint STARS programs had been restructured by the Defense Acquisition Board (in September 1991 and October 1989, respectively), few open action items had been closed during the programs' restructuring periods. So, we do not believe the Defense Acquisition Board was fully aware of the open action items; we question how lacking such knowledge affected the decisionmaking process. For example, we believe the Conventional Systems Committee of the Defense Acquisition Board approved the advance buy of components for the Joint STARS program without complete knowledge of the CDR status, the status of action items resulting from the CDR, an assessment of the impact of open action items on the program's ability to meet the users needs, or the estimated completion date for the CDR.

Documented completion dates. The acquisition program baselines did not include CDR completion dates. The most-repeated phrase in the "Defense Acquisition Executive Summary" reports was that "the critical design review has been successfully completed." However, this meant only that the CDR conference was held, not that CDR had actually been completed. There was no information on the action items resulting from the CDR conference, on whether the Government and contractor had mutually agreed-on actions to close out the items, or on the mutually agreed proposed completion dates.

Decisionmakers in the acquisition chain can effectively control major Defense acquisition programs only if they are kept informed of emerging problems. The information needed comes from a monitoring system based on the premise of management by exception. Acquisition program baselines are an integral part of the DoD monitoring system. DoD Instruction 5000.2, part 11, section A, requires that acquisition program baselines contain objectives for key cost, schedule, and performance parameters. Key parameters include thresholds beyond which the program manager may not trade off without authorization from the Defense Acquisition Board. DoD Instruction 5000.2, part 16, section F, lists CDR as a key schedule parameter, thus requiring notification to, and authorization from, the Defense Acquisition Board in the event of CDR schedule breach. However, DoD Instruction 5000.2 does not specify if the baseline schedule established for the CDR should be the CDR initiation, the CDR conference, or the CDR completion.

Although CDR dates were included in baselines for the five major Defense acquisition programs in our audit that had CDR contractual requirements, the programs did not list CDR completion dates. No such requirement exists in DoD Instruction 5000.2, although such information may be provided.

Though not required because its CDR baseline included only the scheduled CDR start date, the RSIP program office provided a deviation report to senior acquisition management in August 1991 when the system CDR was delayed by 8 months. All program offices would be required to provide deviation reports to senior

acquisition management if the CDR completion dates were specified in the baseline and breached. Program managers should document CDR completion dates in their baseline schedules so that slippages in completion dates are brought to the attention of senior acquisition management, explained, and corrected while the Government still controls the design process.

Conclusion

The CDR process deficiencies identified in our audit were due to inadequacies in and ineffective compliance with existing directions, guidance, and procedures for planning, performance, control, and acceptance of the CDR process. For example, CDR completion dates were not included in acquisition program baselines because DoD Instruction 5000.2 does not clearly specify such a requirement. Because CDR completion dates are not included in baselines, no requirement exists to notify or obtain authorization from the Defense Acquisition Board when scheduled completion dates are breached. As a result, acquisition executives perform oversight responsibilities without knowledge of breaches in scheduled CDR completion dates.

When CDR was a contract line item and withholds were exercised, we found that this control ensured that the contractor completed the action items before receiving full compensation for CDRs. We feel that this control should be mandated for all major Defense acquisition programs.

We found that CDRs were conducted and closed prematurely because of adherence to schedules established in development contracts, rather than adherence to a logical sequence of demonstrated accomplishments. Acquisition strategies should be event-driven and based on rigorous, objective assessments of a program's status and the plans for managing design risk. The acquisition strategy and associated contracting activities must explicitly link milestone decision reviews to accomplishments in development, testing, and initial production. Exit criteria should be set for CDR initiation and completion. The acquisition strategy must reflect the interrelationships and schedule of acquisition phases and events based on a logical sequence of demonstrated accomplishments, not on fiscal or calendar expediency.

At each milestone decision point, assessments should be made of the status of program execution and the plans for the program's remaining phases. The risks associated with the program and the adequacy of risk management planning must be explicitly addressed. Also, critical program-specific results required in each phase, called exit criteria, should be set. Exit criteria should be gates through which a program must pass during that phase. DoD Instruction 5000.2, part 2, paragraph B.3.b., provides that exit criteria can include the requirement to conduct a CDR before committing funds for long lead-item procurement.

Decisionmakers in the acquisition chain can effectively control major Defense acquisition programs only if they are informed of emerging problems. We believe that the CDR results, including changes in contract specifications and performance of mission requirements, should be reported as they occur to the chairperson of the appropriate Defense Acquisition Board committee and the Service acquisition executive for all major Defense acquisition programs.

We also identified some deficiencies in the control of the CDR process. Impending revision of Mil-Std 1521B, or equivalent guidance, should include procedures to track action items, document compliance with all CDR functions, and provide information and guidance to CDR attendees.

We have reviewed aspects of the Navy Technical Education Program related to the design review process and consider the material appropriate for training and instructing participants in critical design reviews. The conduct of a design review in accordance with the guidelines established in the Navy program would assist in correcting certain deficiencies identified in this report.

RECOMMENDATIONS FOR CORRECTIVE ACTION

We recommend that the Under Secretary of Defense for Acquisition:

1. Require for all major Defense acquisition programs that completion of critical design review be made an acquisition program baseline as defined by DoD Instruction 5000.2, "Defense Acquisition Management Policies and Procedures," February 23, 1991, with a scheduled completion date. Only the Under Secretary of Defense for Acquisition should be able to waive this requirement.
2. Establish exit criteria in the integrated program summaries (supporting milestones I and II) for starting and completing all phases of initial, preliminary, and critical design review.
3. Require that completing critical design review (defined as a mutually agreed plan of action, approved by the Government, with in scope/out of scope determinations resolved) be an exit criterion for proceeding with entry into production (prototype, pilot, or low-rate production).
4. Make the critical design review a separately priced contract line item in development contracts with contractual provisions for individual withholds for each open action item until action items are closed out.

5. Require reporting of the actual results of critical design reviews, including changes in contract specifications and performance on mission requirements, to the chairperson of the cognizant Defense Acquisition Board committee and Service acquisition executive for all major Defense acquisition programs.

6. Expedite issuance of the revised Military Standard 1521B, "Technical Reviews and Audits for Systems, Equipments, and Computer Software," June 4, 1985, or equivalent guidance, to include specific procedures for:

- o tracking actions to close out open action items;
- o documenting compliance with all critical design review functions (such as recording minutes of critical design review meetings, attendees, agreed-to actions); and
- o providing adequate data, guidance, and instructions to critical design review attendees well before critical design review meetings.

MANAGEMENT COMMENTS

We requested that comments on the draft report be provided to us by August 31, 1992. As of October 28, 1992, we had not received responses to the draft report. However, we were informed that comments were being prepared and would be submitted in response to this final report.

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PART III - ADDITIONAL INFORMATION

- APPENDIX A - Summary of Deficiencies for Each Major Defense Acquisition Program Audited
- APPENDIX B - Plan and Accomplishment of Critical Design Review for Programs Audited
- APPENDIX C - Prior Audits and Other Reviews
- APPENDIX D - Summary of Potential Benefits Resulting from Audit
- APPENDIX E - Activities Visited or Contacted
- APPENDIX F - Report Distribution

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APPENDIX A - SUMMARY OF DEFICIENCIES FOR EACH MAJOR DEFENSE ACQUISITION PROGRAM AUDITED

	<u>EPLRS</u>	<u>Javelin</u>	<u>V-22</u>	<u>Osprey</u>	<u>SSN-21</u>	<u>RSIP</u>	<u>Joint</u>
							<u>STARS</u>
PLANNING FOR CDR							
o Inadequate Contract Provisions	X	X					X
o Schedule Driven	X	X	X				X
o Scheduled Prematurely	X	X	X				X
PERFORMANCE AND CONTROL OF CDR							
o Unresolved Design Problems	X		X				X
o Excessive Delay in Completing CDR							X
o Production Award before Design Stabilized	X						
o CDR Held before Program Ready	X	X	X				X
o In/Out of Scope Determinations Not Made	X		X			X	X
o Tests Begun with Action Items Unresolved							X
o Lack of Instructions For Attendees		X	X				X
ACCEPTANCE OF CDR							
o CDR Closed before Action Items Complete	X	X	X				X
o Inadequate Follow Through							X
o Lack of CDR Documentation	X						X
INTERNAL CONTROLS							
o Inadequate Procedures	X						X
o Lack of Senior Management Review	X	X	X		X	X	X

* This program was an Air Force pilot program for modeling CDR procedures.

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APPENDIX B - PLAN AND ACCOMPLISHMENT OF CRITICAL DESIGN REVIEW FOR PROGRAMS AUDITED

Nominal Time (Years)	(0-2)	(2-3)	(3-6)	(3-8)	(15-40)
System Acquisition Phases	Concept Exploration Phase	Demonstration/Validation Phase	Full Scale Development Phase	Production Phase	Operation and Support Phase
Timing of Design Reviews and Audits Per MIL-STD 1521B	None	System Design Reviews (SDR)	Critical Design Review (CDR) Preliminary Design Review (PDR)	Physical Configuration Audit (PCA)	Initial Operating Capability (IOC)
Milestone 0	Milestone I	Milestone II	Milestone III	Milestone IV	
Programs					
		SDR	Plan CDR Actual CDR *	PCA	Original Current
EPLRS		NONE	12/85 4/86 8/86 12/86	10/92	9/89 2/97
JAVELIN		NONE	NA 1/90 3/90 7/90	NA	NA NA
SSN-21 (Components)		NONE	5/85 4/90 4/90 4/90	NA	NA NA
V-22 Osprey		NONE	NA 11/86 12/86 12/86	NA	NA NA
RSIP		NONE	2/90 12/90 1/91 9/91	11/93	11/95 9/96
JOINT STARS		NONE	11/85 9/86 4/87 11/88	NONE	9/96 3/97

* Replaced by Detailed Design Review

NA - Data not available

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APPENDIX C - PRIOR AUDITS AND OTHER REVIEWS

DoD Inspector General Audits

- o Report 92-112, "The Ultra-High Frequency Follow-on Satellite," June 30, 1992, disclosed that CDR was not planned until after complex components of the design were fabricated and assembled. This condition existed because the program office did not implement the provisions in Military Standard 1521B, "Technical Reviews and Audits for Systems, Equipments, and Computer Software," December 19, 1985, which encourages the performance of incremental CDRs during weapon-system development. As a result, the design deficiencies identified at the planned CDR could adversely affect satellite number 4 deployment requirements or result in the Government paying the contractor 90 percent of the costs for a dysfunctional satellite extremely high frequency capability.
- o Report 91-007, "Selected Acquisition Actions in the C-17 Aircraft," November 2, 1990, reported that a contract option for four aircraft was exercised before completing CDR of all mission computer software. Completion of the CDR, a prerequisite to the option, was required by a November 1988 modification of the full-scale development contract. The C-17 program director considered the CDR, made in April 1989, to be adequate and complete, although the contractor had completed the detail design for only about 60 percent of all mission computer software. The C-17 program development had experienced major delays. Unless all required mission computer software was developed before the C-17 passed from the development test and evaluation phase to the operational test and evaluation phase, the C-17 program schedule would be further delayed.
- o Report 89-077, "Acquisition of the V-22 Joint Services Advanced Vertical Lift Aircraft," June 14, 1989, reported that the portions of the CDR completed at the time of the audit followed applicable military standards and specifications. The Naval Air Systems Command had identified 14 issues that were not to be closed until "proof of concept" occurred during the first flight.

APPENDIX C - PRIOR AUDITS AND OTHER REVIEWS (Continued)

General Accounting Office Audits

- o Report IMTEC-91-30, "Submarine Combat System," August 1991, reported that the Navy and contractor considered CDR complete although required design tasks were still ongoing. Navy and contractor officials stated that CDR was completed in September 1990; then the contractor began coding and hardware development. However, certain detailed design tasks, contained in Defense Standard 2167, "Defense System Software Development," June 4, 1985, and incorporated into the contract, were to be completed before CDR but were still ongoing in November 1990. For example, detailed design descriptions for the software that will control the Seawolf's weapons or the data base management system that will store critical navigation and target data used for launching these weapons were not completed in September 1990. These descriptions are critical because they provide a blueprint for programmers to code the system. Coding done before completing these tasks will have to be modified if the code does not conform to the eventual detailed design description.

Navy Special Administrative Inquiry

- o Naval General Counsel Report, "A-12 Administrative Inquiry," November 29, 1990, found that the Navy accepted CDR as complete although many significant issues were unresolved. Associated testing requirements for CDR Phase II were also accepted as complete although an aircraft mock-up meeting contract specifications was not available for required critical testing.

APPENDIX D - SUMMARY OF POTENTIAL BENEFITS RESULTING FROM AUDIT

<u>Recommendation Reference</u>	<u>Description of Benefit</u>	<u>Type of Benefit</u>
1.	Internal control. Require that completing CDR be made an acquisition program baseline with a scheduled completion date.	Undeterminable monetary benefit. Advantages of improved control over the CDR are not readily quantifiable.
2.	Internal control. Establish exit criteria for starting and completing CDR.	Undeterminable monetary benefit. Affects of delaying CDR until the program is adequately prepared are not readily quantifiable.
3.	Internal control. Require that completing CDR be made an exit criterion for proceeding with production (prototype, pilot, or low-rate production).	Undeterminable monetary benefit. Benefits of delaying production until all design issues are adequately resolved are not readily quantifiable.
4.	Internal control. Make CDR a separately priced contract line item with provisions for individual withholds for open action items.	Undeterminable monetary benefit. Advantages of improved control over the CDR process are not readily quantifiable.

APPENDIX D - SUMMARY OF POTENTIAL BENEFITS RESULTING FROM AUDIT
(Continued)

<u>Recommendation Reference</u>	<u>Description of Benefit</u>	<u>Type of Benefit</u>
5.	Internal control. Report the actual CDR results to the Defense Acquisition Board and Service acquisition executive.	Undeterminable monetary benefit. Affects of providing senior acquisition management the data needed to exercise program oversight are not readily quantifiable.
6.	Internal control. Expedite issuance of procedures for: <ul style="list-style-type: none"> o tracking action items; o documenting compliance with all CDR functions; and o providing data, guidance, and instructions to attendees well before CDR meetings. 	Undeterminable monetary benefit. Advantages of improved control of the CDR process are not readily quantifiable.

APPENDIX E - ACTIVITIES VISITED OR CONTACTED

Office of the Secretary Of Defense

Office of the Under Secretary of Defense for Acquisition,
Washington, DC

Department of the Army

Office of the Assistant Secretary of the Army (Research,
Development and Acquisition), Washington, DC
All Source Analysis System Program Office, McLean, VA
EPLRS Program Office, Fort Monmouth, NJ
Javelin Program Office, Redstone Arsenal, AL

Department of the Navy

Office of the Assistant Secretary of the Navy (Research,
Development and Acquisition), Washington, DC
SSN-21 Seawolf Program Office, Naval Sea Systems Command,
Washington, DC
V-22 Osprey Program Office, Naval Air Systems Command,
Washington, DC

Department of the Air Force

Office of the Assistant Secretary of the Air Force (Acquisition),
Washington, DC
Air Force Program Executive Office Organization, Washington, DC
AWACS RSIP System Program Office, Electronics Systems Division,
Hanscom Air Force Base, MA
Joint STARS System Program Office, Electronics Systems Division,
Hanscom Air Force Base, MA
Peacekeeper Rail Garrison System Program Office, Ballistic
Missile Organization, Norton Air Force Base, CA

APPENDIX E - ACTIVITIES VISITED OR CONTACTED (Continued)

Defense Agencies

Defense Logistics Agency, Cameron Station, Alexandria, VA
Defense Plant Representative Office, Bell Helicopter
Corporation, Fort Worth, TX
Defense Plant Representative Office, Boeing Aerospace Company,
Seattle, WA
Defense Plant Representative Office, Boeing Vertol Company,
Philadelphia, PA
Defense Plant Representative Office, Grumman Melbourne Systems
Division, Melbourne, FL
Defense Plant Representative Office, Hughes Aircraft
Corporation, Fullerton, CA
Defense Plant Representative Office, Texas Instrument
Corporation, Dallas, TX
Defense Plant Representative Office, Westinghouse Electric
Corporation, Baltimore, MD

Non-Government Activities

Bell Helicopter Corporation, Fort Worth, TX
Boeing Aerospace Company, Seattle, WA
Boeing Vertol Company, Philadelphia, PA
Grumman Melbourne Systems Division, Melbourne, FL
Hughes Aircraft Corporation, Fullerton, CA
Texas Instrument Corporation, Dallas, TX
Westinghouse Electric Corporation, Baltimore, MD

APPENDIX F - REPORT DISTRIBUTION

Office of the Secretary of Defense

Under Secretary of Defense for Acquisition

Department of the Army

Secretary of the Army

Assistant Secretary of the Army (Research, Development and Acquisition)

Inspector General, Department of the Army

Program Manager, All Source Analysis System

Program Manager, Enhanced Position Location Reporting System

Program Manager, Javelin (Advanced Antitank Weapon System)

Department of the Navy

Secretary of the Navy

Assistant Secretary of the Navy (Financial Management)

Assistant Secretary of the Navy (Research, Development and Acquisition)

Program Manager, SSN-21 Seawolf

Program Manager, V-22 Osprey

Department of the Air Force

Secretary of the Air Force

Assistant Secretary of the Air Force (Acquisition)

Assistant Secretary of the Air Force (Financial Management and Comptroller)

System Program Office, Joint Surveillance Target and Attack Radar System

System Program Office, Peacekeeper Rail Garrison

System Program Office, Radar System Improvement Program for the Airborne Warning and Control System

Defense Agency

Defense Logistics Agency

APPENDIX F - REPORT DISTRIBUTION (Continued)

Non-DoD Federal Organizations

Office of Management and Budget
U.S. General Accounting Office, National Security and
International Affairs Division, Technical Information Center

Congressional Committees:

Senate Subcommittee on Defense, Committee on Appropriations
Senate Committee on Armed Services
Senate Committee on Governmental Affairs
Ranking Minority Member, Senate Committee on Armed Services
House Committee on Appropriations
House Subcommittee on Defense, Committee on Appropriations
Ranking Minority Member, House Committee on Appropriations
House Committee on Armed Services
House Committee on Government Operations
House Subcommittee on Legislation and National Security,
Committee on Government Operations

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