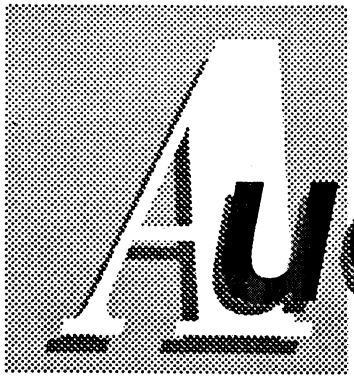

OFFICE OF THE INSPECTOR GENERAL

# FUNCTIONAL AND PHYSICAL CONFIGURATION AUDITS OF THE ARMY KIOWA WARRIOR PROGRAM

Report No. 96-063 January 31, 1996

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**Acronyms**

| | |
|---|---|
| FAA | Federal Aviation Administration |
| FCA | Functional Configuration Audit |
| PCA | Physical Configuration Audit |

INSPECTOR GENERAL
DEPARTMENT OF DEFENSE
400 ARMY NAVY DRIVE
ARLINGTON, VIRGINIA 22202-2884

January 31, 1996

MEMORANDUM FOR AUDITOR GENERAL, DEPARTMENT OF THE ARMY

SUBJECT: Audit Report on Functional and Physical Configuration Audits of the Army Kiowa Warrior Program (Report No. 96-063)

We are providing this audit report for review and comments. This report is the first in a series of reports resulting from our audit of functional and physical configuration audits of Defense systems. DoD Directive 7650.3 requires that all recommendations be resolved promptly. Because the Army did not comment on a draft of this report, we request that the Army provide comments on this final report by March 1, 1996.

Management comments should indicate concurrence or nonconcurrence with the findings and each recommendation and material management control weakness. Comments must describe actions taken or planned in response to agreed-upon recommendations and provide the completion dates of the actions. State specific reasons for any nonconcurrence and propose alternative actions, if appropriate.

We appreciate the courtesies extended to the audit staff. Questions on the audit should be directed to 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). See Appendix G for the report distribution. The audit team members are listed inside the back cover.

Robert J. Lieberman
Assistant Inspector General
for Auditing

**Office of the Inspector General, DoD**

**Report No. 96-063** **January 31, 1996**
(Project No. 5AE-0032.00)

# Functional and Physical Configuration Audits of the Army Kiowa Warrior Program

## Executive Summary

**Introduction.** The OH-58D Kiowa Warrior (Kiowa Warrior) helicopter is designed to perform armed reconnaissance, command and control, and target acquisition/designation in adverse weather conditions. The Kiowa Warrior is a modification of the OH-58D Army Helicopter Improvement Program helicopter to provide air-to-ground weapon systems and multipurpose light helicopter capabilities. The Army began producing Kiowa Warrior helicopters in FY 1991. In total, the Army plans to acquire 366 Kiowa Warrior helicopters at an estimated cost of $3.2 billion (then-year dollars). As of October 1995, the Army had accepted delivery of 234 Kiowa Warrior helicopters and provided 28 Kiowa Warrior helicopters under foreign military sales to Taiwan.

**Audit Objective.** The primary audit objective was to evaluate the adequacy of the functional and physical configuration audit process for the acquisition of the Kiowa Warrior Program. We evaluated whether functional and physical configuration audits verified and documented that configuration items agree with their configuration identifications and were complete, accurate, and satisfied program requirements. We also evaluated the management control program as it related to our audit objective. The Kiowa Warrior Program is one program reviewed in our ongoing audit of management of functional and physical configuration audits of Defense systems.

**Audit Results.** The functional and physical configuration audit process for the Kiowa Warrior Program needs improvement.

o The Kiowa Warrior Program Office did not adequately manage the functional and physical configuration audit process for the Kiowa Warrior Program. As a result, the Program Office may incur additional costs from reverse engineering, redesign, and retrofit during production (Finding A).

o The Kiowa Warrior Program Office accepted the Federal Aviation Administration's performance of type certification for the Kiowa Warrior's turboshaft engine in place of Allison Engine Company's performance of the contractually required functional and physical configuration audits. As a result, the Kiowa Warrior Program cannot be assured that the engine has a stable product baseline and that product baseline documentation adequately describes all Kiowa Warrior unique functional and physical characteristics, acceptance testing criteria, and post-production testing. Further, the contractor may have received windfall compensation by not being required to perform the configuration audits (Finding B).

Recommendations in this report, if implemented, will improve the functional and physical configuration audit process for the Kiowa Warrior Program. Also, the management control program could be improved because we identified a material weakness applicable to our primary audit objective (Appendix A). We summarized the potential benefits of the audit in Appendix E.

**Summary of Recommendations**. We recommend that the Kiowa Warrior Program Office complete the Kiowa Warrior helicopter product baseline, verify closure status of configuration audit action items, obtain complete drawings and technical data packages, designate a DoD representative to supplement the Federal Aviation Administration engine inspection and certification process, and correct engine problems before awarding future engine production contracts.

**Management Comments and Audit Response.** The Army did not respond to a draft of this report. Therefore, we request the Army to provide comments on this final report by March 1, 1996.

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# Part I - Audit Results

# Audit Background

This report discusses the adequacy of the functional and physical configuration audit process for the Kiowa Warrior Program. A functional configuration audit (FCA) is the 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 baseline. A physical configuration audit (PCA) is a formal examination to verify that the configuration item "as built" conforms to the technical documentation that defines the item. Appendix B provides definitions of technical terms used in this report.

**Configuration Audit Guidance.** DoD guidance for performing functional and physical configuration audits is in DoD Instruction 5000.2, "Defense Acquisition Management Policies and Procedures," February 23, 1991, and various military standards. Currently, this guidance is being revised. Appendix C discusses DoD guidance and proposed revisions.

**Kiowa Warrior Program.** The OH-58D Kiowa Warrior (Kiowa Warrior) helicopter is designed to perform armed reconnaissance, command and control, and target acquisition/designation in adverse weather conditions. The Kiowa Warrior is a modification of the OH-58D Army Helicopter Improvement Program (OH-58D Kiowa) helicopter to provide air-to-ground weapon systems and multipurpose light helicopter capabilities. The OH-58D Kiowa was a modification of the OH-58A Kiowa helicopter to provide a new propulsion system and new mission equipment packages. The Army produces Kiowa Warrior helicopters by:

o modifying existing OH-58A Kiowa helicopters into the OH-58D Kiowa helicopter configuration and then modifying that configuration into the Kiowa Warrior configuration,

o modifying existing OH-58D Kiowa helicopters into the Kiowa Warrior configuration, or

o manufacturing the Kiowa Warrior helicopter from base materials for foreign military sales.

The Army began modifying OH-58A and OH-58D Kiowa helicopters into the Kiowa Warrior configuration in FYs 1991 and 1992, respectively. In total, the Army plans to modify 181 OH-58A and 185 OH-58D Kiowa helicopters at an estimated cost of $3.2 billion (then-year dollars). As of October 1995, the Army had accepted delivery of 234 Kiowa Warrior helicopters and provided 28 Kiowa Warrior helicopters under foreign military sales to Taiwan.

In September 1990, the Army awarded a firm-fixed-price contract to Bell Helicopter Textron, Incorporated, Fort Worth, Texas, for the initial modification of the OH-58A Kiowa helicopter into the Kiowa Warrior configuration. Subsequently, the Army issued nine additional contracts for modification of the OH-58A and OH-58D Kiowa helicopters. To produce the Kiowa Warrior helicopters, the Army is providing Bell Helicopter with major

system components as Government-furnished equipment. The contractors for the Government-furnished equipment are McDonnell Douglas Corporation, Monrovia, California (mast-mounted sight); Honeywell Incorporated, Albuquerque, New Mexico (control display subsystem); and Allison Engine Company, Indianapolis, Indiana (turboshaft engine).

## Audit Objective

The audit objective was to evaluate the adequacy of the functional and physical configuration audit processes for the acquisition of the Kiowa Warrior Program. Specifically, we determined whether functional and physical configuration audits:

- verified and documented that configuration items agreed with their configuration identifications and
- were complete, accurate, and satisfied program requirements.

We also evaluated the management control program as it related to our audit objective. Our evaluation of management controls was limited as a result of Inspector General, DoD, Report No. 96-028, "Implementation of the DoD Management Control Program for Major Defense Acquisition Programs," November 28, 1995, that evaluated the effectiveness of the management control program that the Defense Acquisition Executive and the Service Acquisition Executives used for major Defense acquisition programs.

The Kiowa Warrior Program is one program reviewed in our ongoing audit of management of the functional and physical configuration audits of Defense systems. In Appendix A, we discuss the scope and methodology used to accomplish the objective as well as management controls and prior audit coverage.

# Finding A. Managing the Functional and Physical Configuration Audit Process

The Kiowa Warrior Program Office did not adequately manage the functional and physical configuration audit process for the Kiowa Warrior Program. This condition occurred because Program Office officials had not:

o established a product baseline through the physical configuration audit process for the OH-58D Kiowa helicopter,

o established a tracking system to control and monitor changes made by the contractor and to verify that corrective action was taken by the contractor to close action items that resulted from functional and physical configuration audits, and

o required drawings and technical data packages to be complete.

As a result, the Kiowa Warrior Program Office had not assured that configuration items agreed with their configuration identifications, that the contractor had satisfied program requirements, that all functional and physical configuration audit deficiencies were corrected, and that necessary changes were incorporated into the system before production. Accordingly, the Program Office may incur additional costs from reverse engineering, redesign, and retrofit during production.

## Configuration Audit Background

**Configuration Management Guidance.** Configuration management guidance is in DoD Instruction 5000.2 and Military Standard 1521B, "Technical Reviews and Audits for Systems, Equipment, and Computer Resources," June 4, 1985.

**DoD Instruction.** The DoD Instruction 5000.2, part 9, section A, "Configuration Management," requires program managers to establish an effective configuration management program to implement the decisions made in the systems engineering process by:

o identifying, documenting, and verifying the functional and physical characteristics of a configuration item;

o controlling changes to an item and its documentation;

o recording the configuration of actual items;

o auditing the configuration item and its configuration identification; and

o providing a configuration status accounting to track changes in configuration items.

**Military Standard.** Military Standard 1521B contains guidance for conducting functional and physical configuration audits applicable to the Kiowa Warrior Program.

**Technical Data Management Guidance.** The DoD Instruction 5000.2, part 9, section B, "Technical Data Management," requires program managers to establish an effective program for managing technical data and technical manuals. Technical data are required to define and document an engineering design or product configuration sufficient to allow duplication of the original items and are used to support production, engineering, and logistics activities.

**Conducting Configuration Audits.** For the Taiwan foreign military sales version of the Kiowa Warrior, the Kiowa Warrior Program Office did not conduct functional or physical configuration audits. For the OH-58D Kiowa helicopter, the Program Office performed an FCA in June 1984; however, it never conducted a PCA. For the modifications of the OH-58D Kiowa helicopter that converted that helicopter into the Kiowa Warrior configuration, the Program Office conducted:

o three FCAs between October 1991 and June 1994 and is planning to conduct a fourth FCA at an unspecified date and

o seven PCAs between October 1991 and August 1994.

Appendix D shows the status of the action items identified at the FCAs and PCAs.

## Functional and Physical Configuration Audit Process

The Kiowa Warrior Program Office had not performed functional and physical configuration audits of the Taiwan version of the Kiowa Warrior helicopter and physical configuration audits of the OH-58D Kiowa helicopter to establish a product baseline. Also, the Program Office had not verified the closure of functional and physical configuration audit action items and obtained complete drawings and technical data packages for the OH-58D Kiowa helicopter.

**Establishment of Product Baseline.** The Kiowa Warrior Program Office did not establish a product baseline through the functional and physical configuration audit process for the Taiwan version of the Kiowa Warrior helicopter because it considered the product baseline established for the OH-58D Kiowa helicopter to be sufficient. However, the product baseline for the OH-58D Kiowa helicopter was not sufficient because the Program Office had not conducted a PCA on the OH-58D Kiowa helicopter. The Kiowa Warrior Program Office contended that it conducted a PCA on the OH-58D Kiowa

helicopter; however, it did not provide copies of the PCA minutes to support its contention. Bell Helicopter, the producer of the helicopter, stated that it was unaware of any PCA conducted on the OH-58D Kiowa helicopter.

By not establishing product baselines through the functional and physical configuration audit process, the Kiowa Warrior Program Office has not reviewed and approved documentation that described the functional and physical characteristics of configuration items for the Taiwan version of the Kiowa Warrior and the physical characteristics for the OH-58D Kiowa helicopter. Further, Military Standard 1521B requires that the physical configuration audit process establish a product baseline for each system. As a result, the Program Office has not assured that the designs for the Taiwan version of the Kiowa Warrior and for the OH-58D Kiowa helicopter were stable before production.

**Tracking and Closing of Action Items.** The Kiowa Warrior Program Office had not:

o tracked all open action items from the critical design review of the modifications to the OH-58D Kiowa helicopter to validate that changes were made to the system during the functional and physical configuration audits and

o tracked and closed out all action items from each FCA and PCA before it certified the audits as complete (See Appendix D).

Kiowa Warrior Program Office officials relied on Bell Helicopter to track and close all action items. As a result, the Program Office did not have direct DoD oversight over the tracking and closing out of action items and has not independently assured that FCA and PCA deficiencies were corrected before release of the design for Kiowa Warrior helicopter production.

**Drawing and Technical Data Packages.** In 1989, the Assistant Secretary of the Army (Research, Development and Acquisition) issued an acquisition decision memorandum to modify the OH-58D Kiowa helicopter into the Kiowa Warrior configuration. The Kiowa Warrior Program Office issued a military interdepartmental purchase request to a Government-owned, contractor-operated facility, Serv-Air, Lexington, Kentucky, to perform selected modifications as part of the overall modification. Those modifications involved application of the multipurpose light helicopter kits.

To modify the OH-58D Kiowa helicopter, Serv-Air had to perform reverse engineering and redesign work because the Kiowa Warrior Program Office had not previously obtained complete drawings and technical data packages as contracted for on the OH-58D Kiowa helicopter. Serv-Air officials indicated that the Program Office had accepted drawings that did not provide sufficient detail to make the necessary modifications. Nevertheless, Kiowa Warrior Program Office officials indicated that they authorized limited production of the helicopter because of the urgency of the requirement to modify the OH-58D Kiowa helicopter. They believe that the benefits far outweighed any reverse engineering and redesign work costs as demonstrated by the helicopter's usefulness during Operation Desert Storm.

Serv-Air's reverse engineering and redesign work of the OH-58D Kiowa helicopter was limited to the multipurpose light helicopter kits. Therefore, the Program Office used incomplete OH-58D Kiowa helicopter drawings and technical data packages when it performed functional and physical configuration audits on the modifications to the OH-58D Kiowa helicopter. As a result, the Program Office had not established a stable product baseline, determined whether the configuration items matched their configuration identifications, and verified that system requirements were met before production.

## Effect on Functional and Physical Configuration Process

Without performing functional and physical configuration audits for the Taiwan version of the Kiowa Warrior and physical configuration audits for the OH-58D Kiowa helicopter, the Kiowa Warrior Program Office had not assured that:

o the designs for the Taiwan version of the Kiowa Warrior and for the OH-58D Kiowa helicopter were stable before production and

o configuration items agreed with their configuration identifications and that the contractor had satisfied program requirements.

Also, the Kiowa Warrior Program Office had not formally closed all action items identified at the functional and physical configuration audits of the modifications to the OH-58D Kiowa helicopter. Therefore, the Program Office had not assured that all deficiencies were corrected and necessary changes were incorporated into the system before production. As a result, the Program Office may incur additional costs from reverse engineering, redesign, and retrofit because of incomplete drawings and technical data packages.

## Recommendations, Management Comments, and Audit Response

**A. We recommend that the Kiowa Warrior Program Manager:**

**1. Complete the Kiowa Warrior helicopter product baseline by identifying, documenting, and verifying the physical characteristics of the configuration items that were not validated by the functional and physical configuration audits of the modifications to the OH-58D Kiowa helicopter.**

**2. Track and verify closure status of functional and physical configuration audit action items.**

**3. Obtain complete drawings and technical data packages before conducting future functional and physical configuration audits.**

**Management Comments.** As of the date of this final report, we had not received comments from the Kiowa Warrior Program Manager to a draft of this report issued November 9, 1995. We requested the comments by January 12, 1996.

**Audit Response.** The DoD Directive 7650.3 requires that all audit recommendations be resolved promptly. Therefore, we request that the Army provide comments on this final report.

# Finding B. Functional and Physical Configuration Audits of the Turboshaft Engine

The Kiowa Warrior Program Office accepted the Federal Aviation Administration's (FAA) performance of type certification for the Kiowa Warrior's turboshaft engine in place of Allison Engine Company's performance of the contractually required functional and physical configuration audits. However, that FAA certification was not a totally adequate replacement for the configuration audits because the FAA certification process did not ensure independent DoD oversight to verify proper functioning and design of the engine against Kiowa Warrior Program-unique requirements. Further, the Program Office did not require the contractor to perform the functional and physical configuration audits because of a management oversight. As a result, without independent DoD oversight, the Kiowa Warrior Program cannot be assured that the engine has a stable product baseline and that product baseline documentation adequately describes all Kiowa Warrior unique functional and physical characteristics; acceptance testing criteria; and tests necessary for deployment and installation, logistics support, training, and disposal of the engine. Further, the contractor may have received windfall compensation by not being required to perform the configuration audits.

## Guidance and Configuration Management Plan

**DoD Configuration Management Guidance.** Configuration management guidance applicable to the Kiowa Warrior Program is in two military standards. Military Standard 973, "Configuration Management" requires that the Program Office's configuration management plan for a system define how configuration management will be implemented, including policies and procedures. Military Standard 1521B, "Technical Reviews and Audits for Systems, Equipment, and Computer Resources," contains guidance for conducting functional and physical configuration audits applicable to the Kiowa Warrior Program.

**Federal Aviation Administration Certification Guidance.** Federal Aviation Regulation, part 21, subchapter C, "Aircraft," requires that a contractor's application for an aircraft engine type certificate be accompanied by a description of the engine design features, the engine operating characteristics, and the proposed engine operating limitations. The contractor must allow the Federal aviation administrator to make any inspection and any flight and ground test necessary to determine compliance with the applicable FAA requirements. Further, the contractor makes all inspections and tests necessary to determine whether:

o the system complies with the applicable airworthiness, aircraft noise, fuel venting, and exhaust emission requirements;

o materials and products conform to the specifications in the type design;

o parts of the products conform to the drawings in the type design; and

o the manufacturing processes, construction, and assembly conform to those specified in the type design.

**Configuration Management Plan.** In September 1981, the Kiowa Warrior Program Office issued fixed-priced-incentive contract DAAK50-81-C-0021 to Bell Helicopter Textron for engineering and manufacturing development of the Kiowa helicopter. Allison Engine Company, a subcontractor, prepared a configuration management plan for the Kiowa helicopter engine, stating that:

> DDA [Allison] will perform configuration management audits, i.e., FCA and PCA, following the Federal Aviation Administration type certification of the 250-C30 engine. These audits will be witnessed by local Government representatives and will be conducted on one of the early production units for the purpose of (1) assuring that acceptance test data verify the engine has achieved the required performance, and (2) assuring that Physical Configuration Identification describes the physical configuration of the engine for which test data are verified.

## Configuration Audit Requirement

The Kiowa Warrior Program Office did not require Allison Engine Company to perform the functional and physical configuration audits required by the configuration management plan because of a management oversight and the engine is considered a commercial product. Program Office officials stated that the functional and physical configuration audit requirement "fell through the cracks" because the requirement was neither explicitly required in the statement of work nor required to be submitted as a data item. The Program Office also considered the FAA type certification for the engine, 250-C30R, as an acceptable replacement for the configuration audits. The FAA type certification process may be an acceptable alternative to the performance of FCAs and PCAs, if performed properly. However, the FAA certification was not a totally adequate replacement for the configuration audits because the engine was not originally a commercial engine and the certification process lacked Government oversight.

**Commercial Engine.** The OH-58D Kiowa helicopter engine was not originally a commercial product, but, instead, a military product. Allison originally developed the engine for military application on the OH-58D Kiowa helicopter. Since then, Allison has used deviants for commercial application.

**Certification.** The FAA certification process lacked independent DoD oversight. Specifically, the FAA selected and authorized an Allison employee to oversee most of Allison's testing of the Kiowa Warrior 250-C30 engine. The FAA participated in only five of the tests. Further, the FAA authorized an Allison employee to certify that the engine complied with FAA certification requirements. Because the FAA did not request support from DoD representatives, such as the Defense Contract Management Office or the Kiowa Warrior Program Office, no DoD employee verified that Allison effectively performed the FAA type certification process to ensure that the engine meets military-unique requirements. We are concerned about this lack of independent oversight because:

- a contractor employee, performing the FAA certification testing, gives the appearance of a conflict of interest;
- the Program Office does not have independent DoD assurance that the engine has a stable product baseline that meets the military's unique performance specifications; and
- the Program Office cannot be assured that the engine's product baseline documentation adequately describes all Kiowa Warrior unique functional and physical characteristics; acceptance testing criteria; and tests necessary for deployment and installation, logistics support, training, and disposal of the engine.

## Stable Product Baseline

The multiple engine design problems that occurred after the Kiowa Warrior Program entered the production phase showed that DoD oversight is needed to supplement FAA oversight during the FAA certification process to ensure a stable product baseline and reduce engine problems. Problems identified after engine production included engine rebuilds, cold starts, flight test complications, and acceptance testing failures.

**Engine Rebuilds.** Allison performed multiple engine rebuilds before delivering the engines to the Army. Deliveries stopped in November 1994 due primarily to low engine horsepower and high fuel consumption. In response, Allison evaluated the problem; however, the engines were not delivered until October 1995 rather than December 1994 in accordance with contract requirements.

**Problems With Cold Starts.** Army users at a conference at Fort Bragg, North Carolina, on April 17 through 18, 1995, expressed concerns about problems with engine cold starts and auto-acceleration. Specifically, during cold weather, the users experienced:

- difficulty in starting the engine and
- problems with the engine spontaneously accelerating.

The Kiowa Warrior is required to operate in all climates; however, the requirement for the Kiowa Warrior to operate in all climates was not being met.

**Flight Test Issues.** Bell Helicopter identified problems with the engines during flight tests. In 1994, one-third of the new engines delivered from Allison Engine Company to Bell Helicopter were rejected due to problems identified during flight tests. Major problems included compressor stalls, leaks, and bad gear assemblies.

**Results of Performance Acceptance Tests.** As of July 1995, Allison delivered 44 engines on the current production contract. Only 11 of those engines (25 percent) passed the performance acceptance test on the first attempt. When an engine did not pass the test, the Kiowa Warrior Program Office required Allison to rework the engine until it passed. For the 44 engines delivered, the primary problems requiring rework are shown in the following table.

**Identified Engine Problems**

| Problem Identified | Number of Engines |
|---|---|
| Low Horsepower | 20 |
| High Specific Fuel Consumption | 17 |
| Leaks | 15 |
| Delayed/Slow/No Start | 13 |
| Cyclic Whine | 12 |
| Vibration Problems | 7 |

In 1997, the Army plans to replace the current 250-C30R/1 engine with the 250-C30R/3 engine. Since the 250-C30R/3 engine will be an upgrade of the 250-C30R/1 engine configuration, the Kiowa Warrior Program Office needs to ensure that Allison has corrected problems with the 250-C30R/1 engine before issuing a contract for the 250-C30R/3 engine.

## Consideration From Bell Helicopter Textron

Before 1987, when Allison Engine Company was a subcontractor of Bell Helicopter Textron, the Kiowa Warrior Program Office did not request or receive consideration from Bell Helicopter Textron for Allison not performing the functional and physical configuration audits. The configuration management plan for the 250-C30 Kiowa helicopter engine required Allison to perform functional and physical configuration audits of the engine. However, Program Office officials stated that Allison did not perform the configuration audits because the requirement "fell through the cracks" and the engine is considered a commercial product. Therefore, since the engineering and manufacturing development contract with Bell was a fixed-price-incentive contract, we assume that Bell included costs in its bid proposal for Allison to accomplish the contractually specified configuration audits. We were unable to verify that Bell

included the cost for the configuration audits in its contract proposal or costing data. However, since the Program Office did not require the configuration audits of the engine, Bell may have received windfall compensation for configuration audits not performed. During the audit, the Program Office officials stated that they will pursue a determination with the contracting officer to ensure that Bell did not realize windfall compensation.

## Need for a Memorandum of Agreement

For a future version of the engine, 250-C30R/3, the Kiowa Warrior Program Office also plans to accept the FAA type certification in lieu of conducting functional and physical configuration audits. To avoid the appearance of a conflict of interest and to ensure the FAA certification process is performed to the Government's satisfaction, the Program Office and the Defense Contract Management Office Allison should establish a memorandum of agreement to have the Defense Contract Management Office Allison monitor future FAA certifications for Kiowa Warrior engines. The memorandum should be coordinated with the FAA and establish the scope of responsibility for the contract administration office. Such responsibilities may include:

o participation in and support of FAA certification process;

o surveillance of the development and production process for the engine;

o review of engineering change proposals; and

o verification that the engine has achieved the performance specified in the Army's functional or product baseline and conforms to technical documentation.

## Recommendations, Management Comments, and Audit Response

**B. We recommend that the Kiowa Warrior Program Manager:**

**1. Prepare a memorandum of understanding with the Defense Contract Management Area Office, Allison, Indianapolis, Indiana, designating a DoD representative to supplement the Federal Aviation Administration inspection and certification process for future Kiowa Warrior engines.**

**2. Correct system problems identified on the 250-C30R/1 engine before awarding the contract for the production of the 250-C30R/3 engine.**

**Management Comments.** As of the date of this final report, we had not received comments from the Kiowa Warrior Program Manager to a draft of this report issued November 9, 1995. We requested the comments by January 12, 1996.

**Audit Response.** The DoD Directive 7650.3 requires that all audit recommendations be resolved promptly. Therefore, we request that the Army provide comments on this final report.

# Part II - Additional Information

# Appendix A. 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 November 1995 and reviewed data dated from October 1981 through October 1995. To accomplish the objective, we:

o examined contract DAAK50-81-C-0021, valued at $148.0 million, with Bell Helicopter Textron, Incorporated;

o reviewed production lot contracts, retrofit contracts, and other contracting documents including proposals, contract modifications, delivery orders, justification and approvals, contract data requirements lists, contract line items, statements of work, and related correspondence;

o reviewed minutes from critical design reviews at Bell Helicopter, McDonnell Douglas Corporation, and Honeywell Incorporated;

o reviewed the minutes of the functional and physical configuration audits conducted on the Kiowa Warrior and the action items generated during those audits;

o reviewed engineering change proposals, waivers, deviations, and other documentation pertaining to the functional and physical configuration audits; 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 Kiowa Warrior Program Office, the Army Aviation and Troop Command, the Defense Plant Representative Offices, and four contractors. Appendix F 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, and accordingly included such tests of management controls as we deemed necessary. We did not rely on computer-processed data

to support our findings and recommendations because the areas reviewed did not contain computer-processed data. Technical experts from the Software Engineering Branch, Technical Assessment Division, Inspector General, DoD, assisted in the review of the functional and physical configuration audits of the Kiowa Warrior at Honeywell Incorporated, Albuquerque, New Mexico.

## Management Control Program

**Requirement for Management Control Review.** 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 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 Service 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. The report made recommendations to the Under Secretary of Defense for Acquisition and Technology and the Under Secretary of Defense (Comptroller) to correct the situation. As a result, we limited our review to management controls over the functional and physical configuration audit process at the Kiowa Warrior Program Office; the Defense Contract Management Area Operations, Phoenix, Arizona; and the Defense Contract Management Office, Allison, Indianapolis, Indiana, part of the Defense Contract Management Area Operations, Fort Benjamin Harrison, Indiana. Those area operation offices provided contract administration responsibilities for the Kiowa Warrior Program.

**Adequacy of Management Controls.** We identified a material management control weakness for the Kiowa Warrior Program as defined by DoD Directive 5010.38. Management controls for the Kiowa Warrior Program were not adequate to ensure that the physical characteristics of the configuration items were properly identified, documented, and verified; the closure status of functional and physical configuration audit action items was adequately tracked and verified; and complete drawings and technical data packages are obtained before conducting future functional and physical configuration audits. Recommendations A.1. through A.3., if implemented, will provide effective configuration management and effective tracking and closure verification of action items and ensure complete drawings and technical data packages before performance of functional and physical configuration audits (Appendix E). We

will provide a copy of this report to the senior official responsible for management controls in the Office of the Assistant Secretary of the Army (Financial Management and Comptroller).

**Adequacy of Management's Self-Evaluation.** The Kiowa Warrior Program Office identified acquisition as an assessable unit. However, in its evaluation, the Program Office did not identify any material weaknesses related to functional and physical configuration audits because the evaluation of acquisition covered a much broader area. The Defense Contract Management Area Operations Office in Phoenix and the Defense Contract Management Office, Allison, in conjunction with the Defense Contract Management Area Operations Office at Fort Benjamin Harrison, developed assessable units from their performance measurement goals and conducted vulnerability assessments for those units not meeting performance goals. In addition, the offices used process-oriented contract administration services as a management control tool. This approach requires teaming between the Government and industry to improve high risk contract administration services. The functional and physical configuration audit process is not considered a high risk contract administration services area.

## Prior Audit Coverage

During the last 5 years, the General Accounting Office; the Office of the Inspector General, DoD; and the Army Audit Agency have not issued reports on the Kiowa Warrior Program addressing FCA and PCA issues.

# Appendix B. Definitions of Terms

**Allocated Baseline.** The initially approved documentation describing a configuration item's functional and interface characteristics that are allocated from those of a higher level of configuration item. The allocated baseline consists of the development specifications that define functional requirements for each configuration item. The program office normally establishes the allocated baseline at the preliminary design review, but no later than the critical design review.

**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.

**Critical Design Review.** A review conducted to:

o determine that the detailed design satisfies performance and engineering requirements of the development specification;

o establish the detailed design compatibility requirements of the development specification;

o establish the detailed design compatibility among the item and other items of equipment, facilities, computer program, and personnel;

o assess producibility and risk areas; and

o review the preliminary product specifications.

**Functional Baseline.** Documentation describing a system's or a segment's functional characteristics and the verification required to demonstrate the achievement of those specified functional characteristics. The required system or segment specification establishes the functional baseline.

**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.

**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.

**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 utilized 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. Approval by the Government program office 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.

# Appendix C. Functional and Physical Configuration Audit Guidance

The DoD Instruction 5000.2, "Defense Acquisition Management Policies and Procedures," February 23, 1991, and selected military standards provide guidance concerning functional and physical configuration audits. This guidance is being revised. In June 1994, the Secretary of Defense directed the use of performance and commercial specifications and standards instead of military specifications and standards, unless no practical alternative meets the needs of the user. In response, the Defense Standardization Improvement Council is reviewing what standards should be canceled to comply with the Secretary of Defense guidance. Also, a working group is rewriting DoD Directive 5000.2 to rely more heavily on commercial specifications and may cancel DoD Manual 5000.2M, "Defense Acquisition Management Documentation and Reports," February 23, 1991. Completion of the rewrite is expected to occur during 1996.

## DoD Instruction 5000.2

A draft change, October 11, 1995, to DoD Instruction 5000.2 discusses the acquisition management process, program definition, program structure, program design, program assessments and decision reviews, and periodic reporting. The program design section discusses, in part, configuration management. It states that the configuration management process controls the system products, processes, and related documentation and includes:

- o identifying, documenting, and verifying the functional and physical characteristics of an item;
- o recording the configuration of an item;
- o controlling changes to an item and its documentation; and
- o providing a complete audit trail of decisions and design modifications.

## Military Standards

The following military standards concerning functional and physical configuration audits are applicable to the Kiowa Warrior Program.

o Military Standard 1521B, "Technical Reviews and Audits for Systems, Equipment, and Computer Resources," establishes guidance for conducting the FCA and PCA.

o Military Standard 480B, "Configuration Control - Engineering Changes, Deviations and Waivers," establishes the requirement, formats, and procedures to use when preparing configuration control documentation.

o Military Standard 973, "Configuration Management," defines the configuration management requirement applicable to Defense materiel items.

The Defense Standardization Improvement Council incorporated the FCA and PCA segments of Military Standard 1521B into Military Standard 973. The remaining segments of Military Standard 1521B were subsequently canceled. Military Standard 480B was also replaced by Military Standard 973 in April 1992. The Defense Standardization Improvement Council plans to cancel Military Standard 973 after a non-Government configuration management standard that meets the needs of the Government is implemented.

# Appendix D. Functional and Physical Configuration Audits of the Kiowa Warrior Program

Tables D-1 and D-2 show the status of the action items, as of August 15, 1995, that the Kiowa Warrior Program Office identified at the functional and physical configuration audits of the modifications to the OH-58D Kiowa helicopter conducted by Bell Helicopter.

**Table D-1. Functional Configuration Audits**

| Component | Date Audit Performed | No. of Action Items | No. of Open Action Items |
|---|---|---|---|
| Remote Rocket Assembly | October 1991 | 20 | 0 |
| Mission Equipment Package | January 1992 | 33 | 17 |
| Audio Distribution Unit | June 1994 | 13 | 10 |
| 5,500-pound Qualification | TBD* | | |

*Contractor has not yet established a date to perform the FCA for the 5,500-pound Qualification.

**Table D-2. Physical Configuration Audits**

| Component | Date Audit Performed | No. of Action Items | No. of Open Action Items |
|---|---|---|---|
| Remote Rocket Assembly | October 1991 | 14 | 0 |
| Transmission | January 1992 | 10 | 0 |
| Tail Rotor Gearbox | January 1992 | 10 | 0 |
| Weapons Pylon | January 1992 | 10 | 0 |
| Aircraft | February 1992 | 13 | 0 |
| Audio Distribution Unit | June 1994 | 12 | 5 |
| Multi-Purpose Light Helicopter | August 1994 | 72 | 1 |

# Appendix E. Summary of Potential Benefits Resulting From Audit

| Recommendation Reference | Description of Benefit | Type of Benefit |
|---|---|---|
| A.1. | Program Results and Management Control. Will provide effective configuration management that directly impacts system reliability, performance, supportability, and readiness. | Nonmonetary. |
| A.2. | Program Results and Management Control. Will provide effective tracking and closure verification of action items. | Nonmonetary. |
| A.3. | Program Results and Management Control. Will ensure complete drawings and technical data packages before performance of functional and physical configuration audits. | Nonmonetary. |
| B.1. | Program Results. Will ensure the effective use of Government resources for future Kiowa Warrior helicopter engines. | Nonmonetary. |
| B.2. | Program Results. Will ensure that the problems associated with current engines will not carry over to future engines. | Nonmonetary. |

# Appendix F. 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 for Acquisition and Technology, Washington, DC
    Computer-Aided Acquisition and Logistic Support, Alexandria, VA
  Defense Standardization Improvement Council, Alexandria, VA

## Department of the Army

Army Materiel Command, Alexandria, VA
  Army Aviation and Troop Command, Saint Louis, MO
  Army Chemical and Biological Defense Command, Aberdeen Proving Ground, MD
  Army Test and Evaluation Command, Aberdeen Proving Ground, MD
Assistant Secretary of the Army (Research, Development and Acquisition), Washington, DC
  Kiowa Warrior Program Office, Saint Louis, MO

## Other Defense Organizations

Defense Logistics Agency, Fort Belvoir, VA
  Defense Contract Management Command, Fort Belvoir, VA
    Defense Contract Management Area Operations, Fort Benjamin Harrison, IN
      Defense Contract Management Office, Allison, Indianapolis, IN
    Defense Contract Management Area Operations, Phoenix, AZ
    Defense Contract Management Area Operations, San Francisco, CA
    Defense Plant Representative Office, Bell Helicopter, Fort Worth, TX
    Defense Plant Representative Office, McDonnell Douglas Corporation, Huntington Beach, CA
    Defense Plant Representative Office, McDonnell Douglas Corporation, Monrovia, CA

## Non-Defense Federal Organizations

Department of Transportation, Washington, DC
  Inspector General, Department of Transportation, Washington, DC
  Regional Operations Center, Federal Aviation Administration, Boston, MA
    Aircraft Certification Office, Federal Aviation Administration, Chicago, IL

## Government-Owned, Contractor-Operated Facility

Serv-Air, Blue Grass Depot Activity, Lexington, KY

## Contractors

Allison Engine Company, Indianapolis, IN
Bell Helicopter Textron, Incorporated, Fort Worth, TX
Honeywell Incorporated, Albuquerque, NM
McDonnell Douglas Corporation, Monrovia, CA

# Appendix G. Report Distribution

## Office of the Secretary of Defense

Under Secretary of Defense for Acquisition and Technology
  Director, Defense Logistics Studies Information Exchange
Under Secretary of Defense (Comptroller)
  Deputy Chief Financial Officer
  Deputy Comptroller (Program/Budget)
Assistant to the Secretary of Defense (Public Affairs)

## Department of the Army

Commander, Army Materiel Command
  Commander, Army Aviation and Troop Command
Assistant Secretary of the Army (Financial Management and Comptroller)
Assistant Secretary of the Army (Research, Development and Acquisition)
  Program Executive Office, Aviation
    Program Manager, Kiowa Warrior Program Office
Auditor General, Department of the Army

## Department of the Navy

Auditor General, Department of the Navy

## Department of the Air Force

Auditor General, Department of the Air Force

## Other Defense Organizations

Director, Defense Contract Audit Agency
Director, Defense Logistics Agency
Director, National Security Agency
  Inspector General, National Security Agency

## Non-Defense Federal Organizations and Individuals

Office of Management and Budget
Inspector General, Department of Transportation
Technical Information Center, National Security and International Affairs Division, General Accounting Office
Chairman and ranking minority member of each of the following congressional committees and subcommittees

- Senate Committee on Appropriations
- Senate Subcommittee on Defense, Committee on Appropriations
- Senate Committee on Armed Services
- Senate Committee on Governmental Affairs
- 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

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