Audit Report

OFFICE OF THE INSPECTOR GENERAL

AIRCRAFT DEPOT MAINTENANCE PROGRAMS

Report Number 91-098 June 17, 1991

Department of Defense

The following acronyms are used in this report.

GAO.....General Accounting Office
MSG-1.....Maintenance Steering Group-1
MSG-2.....Maintenance Steering Group-2
MSG-3.....Maintenance Steering Group-3

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

June 17, 1991

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

SUBJECT: Report on the Audit of Aircraft Depot Maintenance Programs (Report No. 91-098)

We are providing this final report for your information and use. The audit was made from April through November 1990. The audit objective was to evaluate the maintenance programs that were designed to reduce aircraft depot maintenance costs. Comments on a draft of this report were considered in preparing the final report. We made the audit at the request of the Office of the Deputy Assistant Secretary of Defense (Logistics), Assistant Secretary of Defense (Production and Logistics).

The DoD Reliability Centered Maintenance and Navy Aircraft Service Period Adjustment Programs have been effectively used to reduce depot maintenance requirements and costs. However, the Navy and the Air Force have not fully complied with the requirement to use the analytical procedures of reliability centered maintenance to determine depot level maintenance tasks for all aviation systems. As a result, we estimated that the Navy and the Air Force are not taking advantage of the opportunity to reduce depot maintenance costs by up to $832.8 million over the 6-year Future Years Defense Program ($138.8 million annually). We also identified additional savings of $31.2 million that the Navy can realize over the 6-year Future Years Defense Program ($5.2 million annually), by fully considering the results of its Aircraft Service Period Adjustment Program inspections in developing the scheduled depot maintenance interval for Naval aircraft.

DoD Directive 7650.3 requires that all audit recommendations be resolved promptly. Therefore, the Assistant Secretary of the Navy (Research, Development, and Acquisition) and the Assistant Secretary of the Air Force (Financial Management and Comptroller) must provide completion dates, as appropriate, and final comments on the unresolved recommendations and monetary benefits by August 16, 1991. See the "Status of Recommendations" section at the end of each finding for the unresolved recommendations and the specific requirements for your comments.

As required by DoD Directive 7650.3, the comments should indicate concurrence or nonconcurrence in the findings and each recommendation addressed to you. If you concur, describe the

corrective actions taken or planned, the completion dates for actions already taken, and the estimated completion dates of planned actions. If you nonconcur, please state your specific reasons. If appropriate, you may propose alternative methods for accomplishing desired improvements.

The Navy's comments regarding monetary benefits were responsive. We request that the Navy track the monetary benefits it realizes as it completes its reliability centered maintenance analyses and agree to report them to the Office of the Assistant Inspector General for Analysis and Followup. We also request that the Air Force clarify its position as to whether there will be monetary benefits and agree to report the monetary benefits its realizes, as it completes reliability centered maintenance analyses, to the Office of the Assistant Inspector General for Analysis and Followup. Recommendations and potential monetary benefits are subject to resolution in accordance with DoD Directive 7650.3 in the event of nonconcurrence or failure to comment. We also ask that your comments indicate concurrence or nonconcurrence with the internal control weaknesses highlighted in Part I.

The courtesies extended to the audit staff are appreciated. If you have any questions on this audit, please contact Mr. Dennis Payne at (703) 614-6227 (DSN 224-6227) or Mr. James Kornides at (703) 614-6223 (DSN 224-6223). The planned distribution of this report is listed in Appendix G.

Edward R. Jones
Deputy Assistant Inspector General
for Auditing

Enclosure

cc:
Secretary of the Army
Secretary of the Navy
Secretary of the Air Force
Assistant Secretary of Defense (Production and Logistics)
Assistant Secretary of the Army (Financial Management)

Office of the Inspector General

AUDIT REPORT NO. 91-098 **June 17, 1991**
(Project No. 0LB-0058)

AIRCRAFT DEPOT MAINTENANCE PROGRAMS

EXECUTIVE SUMMARY

Introduction. This audit was requested by the Office of the Deputy Assistant Secretary of Defense (Logistics), Assistant Secretary of Defense (Production and Logistics). DoD's FY 1990 budget for aircraft depot maintenance was about $2.5 billion. Several maintenance programs, such as the DoD Reliability Centered Maintenance Program and the Navy Aircraft Service Period Adjustment Program, are being used by the Military Departments to reduce aircraft depot maintenance costs. DoD policy requires that the Reliability Centered Maintenance Program be used as the basis for developing and sustaining preventative maintenance programs throughout DoD.

Objectives. Our objective was to evaluate the maintenance programs that were designed to reduce aircraft depot maintenance costs. Specifically, we were requested to evaluate the effectiveness of the implementation of the Reliability Centered Maintenance and the Aircraft Service Period Adjustment Programs and determine if the programs were meeting their objectives of reducing costs. We also evaluated the impact of these maintenance programs on mission capability and determined the effectiveness of internal controls.

Audit Results. The DoD Reliability Centered Maintenance and Navy Aircraft Service Period Adjustment Programs have been effectively used to reduce depot maintenance costs for many aviation systems. These programs have also reduced the time aircraft have been away from the aviation activity undergoing depot maintenance. This has improved mission capability by increasing the operational availability of aircraft. Further improvements and savings can be made, as summarized below.

o The Navy and the Air Force have not fully complied with the requirement to use the analytical procedures of reliability centered maintenance to determine depot level maintenance tasks and intervals for all aviation systems. As a result, the Navy and Air Force are not taking advantage of opportunities to reduce depot maintenance costs (Finding A).

o The Navy has not fully considered the results of its Aircraft Service Period Adjustment Program inspections in developing the scheduled depot maintenance intervals for its aircraft. As a result, the Navy is not taking advantage of the opportunity to reduce aircraft inspection costs (Finding B).

Internal Controls. Internal controls of the Navy and Air Force were not sufficient to ensure compliance with DoD requirements to perform and sustain reliability centered maintenance analysis for aircraft systems that undergo depot maintenance. Additional details are provided in the Internal Controls section of Part I of this report (page 2).

Potential Benefits of Audit. We estimated that the Navy could reduce depot maintenance costs by up to $372 million over the 6-year Future Years Defense Program ($62 million annually); and the Air Force could reduce depot maintenance costs by up to $460.8 million over the 6-year Future Years Defense Program ($76.8 million annually), by fully implementing and sustaining reliability centered maintenance analysis. We also estimated that the Navy could reduce its Aircraft Service Period Adjustment Program inspection costs by $31.2 million over the 6-year Future Years Defense Program ($5.2 million annually) by fully considering the results of prior inspections in developing the optimum intervals for scheduling aircraft for depot level maintenance. Additional details are included in Appendix E.

Summary of Recommendations. We recommended that plans be established by the Navy and Air Force to perform reliability centered maintenance analyses for all aircraft scheduled for depot level maintenance. We also recommended that the Navy fully consider the results of its Aircraft Service Period Adjustment Program inspections in developing scheduled intervals for depot maintenance of its aircraft.

Management Comments. The Navy and the Air Force agreed to take recommended corrective actions but disagreed with the estimated monetary benefits. Additional comments are required from the Assistant Secretary of the Navy (Research, Development, and Acquisition) and the Assistant Secretary of the Air Force (Financial Management and Comptroller) by August 16, 1991. Part II of this report includes a full discussion of the responsiveness of management comments to this report. Part IV contains a complete copy of the management comments.

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This report was prepared by the Logistics Support Directorate, Office of the Assistant Inspector General for Auditing, DoD. Copies of the report can be obtained from the Information Officer, Audit Planning and Technical Support Directorate, (703) 614-6302.

PART I - INTRODUCTION

Background

DoD's FY 1990 budget for aircraft depot maintenance was about $2.5 billion. The Military Departments are using several maintenance programs to reduce aircraft depot maintenance costs. A primary program is the Reliability Centered Maintenance Program. Another related program is the Navy's Aircraft Service Period Adjustment Program.

The Reliability Centered Maintenance Program seeks to reduce maintenance costs when aircraft undergo depot maintenance by repairing only those items needing repair. The decision on what items need to be repaired is determined through logical disciplined analytical procedures. In 1978, DoD sponsored the publication of "Reliability Centered Maintenance," a textbook that definitized these analytical procedures. In August 1984, DoD issued its first formal directive on reliability centered maintenance, DoD Directive 4151.16, "DoD Equipment Maintenance Program." This Directive states that reliability centered maintenance is the basis for establishing and sustaining preventative maintenance programs for all DoD equipment.

The reliability centered maintenance concept was an outgrowth of earlier maintenance programs developed by the commercial airline industry and the Government. This included Maintenance Evaluation and Program Development, generally known as Maintenance Steering Group-1 (MSG-1), which was first developed in 1968. The MSG-1 was updated with MSG-2 in 1970 and MSG-3 in 1980. Neither MSG-1 analytical procedures nor MSG-2 analytical procedures provided fully for the disciplined decision logic that has enhanced the savings obtainable through reliability centered maintenance analytical procedures. The MSG-3 program, which has been widely adopted by the commercial airline industry, is similar in objectives and procedures to the Reliability Centered Maintenance Program.

The Navy's Aircraft Service Period Adjustment Program provides for a field level inspection of each aircraft before its scheduled depot maintenance. The schedule for depot maintenance for aircraft that pass the inspection is extended for 12 months. At the end of each 12-month period, the aircraft is reinspected until the aircraft fails the inspection. It is then inducted for depot maintenance. The intent of this Program is to reduce depot maintenance costs by reducing the number of depot inductions required by an aircraft over its life cycle.

Objectives

The audit was requested by the Office of the Deputy Assistant Secretary of Defense (Logistics), Assistant Secretary of Defense (Production and Logistics). Our objective was to evaluate the

maintenance programs that were designed to reduce aircraft depot maintenance costs. Specifically, we were requested to evaluate the effectiveness of the implementation of the Reliability Centered Maintenance Program and the Aircraft Service Period Adjustment Program and determine if the Programs were meeting their objectives of reducing costs. We also evaluated the effect of these maintenance programs on mission capability and determined the effectiveness of internal controls.

Scope

The audit included all major aviation systems that receive depot level maintenance. The audit was performed at the Military Departments' headquarters and at aviation depots in each of the Military Departments. We evaluated the records relating to actions taken by the Military Departments to implement and sustain the analytical procedures of reliability centered maintenance for depot level maintenance of aircraft and aircraft engines. The audit concentrated on the review of actions that took place between 1985 and 1990. Air Force aircraft engines were excluded because of recent coverage by the Air Force Audit Agency (see Appendix A, "Prior Audits and Other Reviews"). We also evaluated the records relating to the Navy's Aircraft Service Period Adjustment Program.

This economy and efficiency audit was made from April through November 1990 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 internal controls as were considered necessary. Activities visited or contacted during the audit are listed in Appendix F.

Internal Controls

We evaluated the effectiveness of internal controls established by the Military Departments to comply with the requirements of DoD Directive 4151.16 to implement and sustain reliability centered maintenance analysis. 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 were not effective to ensure Navy and Air Force compliance with DoD requirements to perform and sustain reliability centered maintenance analysis for all aircraft systems that undergo depot maintenance. Recommendation A.1. in this report, if implemented, will assist in correcting this weakness. We have estimated that the monetary benefits that can be realized by implementing the recommendation are up to $832.8 million over the 6-year Future Years Defense Program ($138.8 million annually). A copy of the final report will be provided to the senior officials responsible for internal controls within the Navy and Air Force.

Prior Audits and Other Reviews

Problems in implementation of the Reliability Centered Maintenance Program at aviation depots have been previously reported in a number of prior reports. There were also reports on the Aircraft Service Period Adjustment Program. A summary of reports issued within the last 5 years is in Appendix A.

Other Matters of Interest

The Department of Defense Appropriations Act of 1991 required the Air Force to implement by April 1, 1991, a predepot induction field level aircraft inspection program similar to the Navy's Aircraft Service Period Adjustment Program.

PART II - FINDINGS AND RECOMMENDATIONS

A. RELIABILITY CENTERED MAINTENANCE AT AVIATION DEPOTS

Although the Reliability Centered Maintenance Program has been effectively used to reduce maintenance requirements and costs for many systems in DoD, the Navy and the Air Force have not fully complied with the requirement to use the maintenance concept to determine depot level maintenance tasks and intervals for all aviation systems. The Navy aviation depots cited lack of funding while the Air Force aviation depots cited the availability of other depot maintenance programs with similar objectives as their reasons for failure to fully implement and sustain reliability centered maintenance analysis. We attributed the cause of the condition to lack of oversight and emphasis by the command headquarters. The Navy could reduce depot maintenance costs by up to $372 million over the 6-year Future Years Defense Program ($62 million annually); and the Air Force could reduce depot maintenance costs by up to $460.8 million over the 6-year Future Years Defense Program ($76.8 million annually) by fully implementing and sustaining reliability centered maintenance analyses for all aviation systems receiving depot level maintenance.

DISCUSSION OF DETAILS

Background

DoD Directive 4151.16, "DoD Equipment Maintenance Programs," Enclosure 3, paragraph 3.a., states that reliability centered maintenance shall be the basis for establishing and sustaining preventative maintenance programs for all DoD equipment. It is applicable during all phases of equipment acquisition and life cycle support. It applies to all levels of maintenance and is the means for justifying new or modified preventative maintenance tasks and for continuing evaluation of existing tasks. Paragraph 2.d. of the Directive provides that reliability centered maintenance is to be sustained by updating analyses when needed because of modifications due to product improvements, changes in mission assignments, changes in operational scenarios, and other changes in related functions. Each Military Department has an implementing instruction.

In 1985, after a General Accounting Office (GAO) survey found delayed implementation of the Reliability Centered Maintenance Program by DoD, the Military Departments were requested to report to Congress their progress in implementing the Program. The Military Departments reported in December 1985 that the Reliability Centered Maintenance Program had been implemented for the majority of their aircraft at the organizational and

intermediate levels of maintenance and on some aircraft at the depot level. Each Military Department provided a schedule for implementing the Reliability Centered Maintenance Program for the remainder of their aviation systems.

Army. The Army has effectively implemented and sustained reliability centered maintenance analyses for all Army aviation systems. In 1985, the Army identified to Congress 41 remaining depot aviation maintenance documents (Depot Maintenance Work Requirements) that required reliability centered maintenance analysis. The Army completed the implementation of reliability centered maintenance for these 41 documents in FY 1988 and as a result achieved an average 14-percent reduction in its depot maintenance costs. The Army also applied reliability centered maintenance analysis to all new aviation depot maintenance tasks started since the Army's 1985 report to Congress. In addition, the Army has continued to monitor program implementation and has, as needed, updated the analyses for aviation depot maintenance documents that the Army brought under the Reliability Centered Maintenance Program before its 1985 report to Congress.

Savings achieved by applying reliability centered maintenance to new aviation depot maintenance tasks started since 1985 is undeterminable, because there is no prior data for comparison purposes. We believe, however, that the 14-percent savings achieved by the Army where comparative records are available is reflective of its overall aviation depot maintenance savings.

Navy. The Navy has not fully implemented and sustained reliability centered maintenance analyses for all Naval aviation systems requiring depot maintenance. Naval Air Systems Command Instruction 4790.20, "Reliability Centered Maintenance," November 22, 1988, requires that all Naval aviation depots use the analytical procedures of reliability centered maintenance to establish and sustain preventative maintenance programs for all aviation systems. Although internal control procedures existed to provide for compliance with the requirements of DoD Directive 4151.16 and Naval Air Systems Command Instruction 4790.20 to implement and sustain reliability centered maintenance analyses, their enforcement has been ineffective because of a lack of oversight and emphasis by Naval Air Systems Command Headquarters. Strengthened internal control enforcement procedures are needed.

In its December 1985 report to Congress, the Navy reported that it had applied reliability centered maintenance analysis to 11 types of Naval aircraft requiring depot level maintenance (A-4, A-6, A-7, E-2, F-4, F-14, H-46, H-60, P-3, S-3, and T-2 aircraft). We determined that reliability centered maintenance analysis was not performed. Instead, MSG-2 analysis was performed on the depot level tasks for 10 of these aircraft and no analysis was performed for the H-46 aircraft.

The Navy also reported to Congress in December 1985 that it planned to implement the analytical procedures of reliability centered maintenance for five additional types of aircraft requiring depot maintenance (C-130, H-1, H-2, H-3, and OV-10 aircraft). At the time of our audit, the Navy had performed no analysis of the C-130, H-1, and OV-10 aircraft, and had performed only an MSG-2 analysis of the H-2 and H-3 aircraft.

As early as 1978, the Military Departments were aware of shortcomings in MSG-2 analysis. DoD's textbook "Reliability Centered Maintenance" states that while MSG-2 techniques are quite similar to the analytical procedures of reliability centered maintenance, the analytical procedures of reliability centered maintenance are more rigorous and there is greater confidence in their outcome.

Unlike MSG-2 analytical procedures, the more rigorous analytical procedures of reliability centered maintenance provide for the use of operating information to modify the maintenance program after the aviation system enters service. The more rigorous procedures also provide comprehensive methods for establishing task intervals, consolidating tasks into efficient work packages, treating structural problems, and performing inspections. This rigorous disciplined decision logic approach has significantly enhanced the savings obtainable through reliability centered maintenance analyses over that obtainable through MSG-2 analytical procedures. The commercial airline industry has recognized the weaknesses in MSG-2 procedures, and has now largely supplanted this earlier program with the MSG-3 program. The analytical procedures included in the commercial airline's MSG-3 program are quite similar in nature and scope to those included in DoD's Reliability Centered Maintenance Program.

Most of the Navy's aviation depots applied MSG-2 analytical procedures to their assigned aviation systems in the mid-1970's and early 1980's and have not revised or sustained the original analyses at the depot level. For example, MSG-2 analysis was applied to the S-3 aircraft in the early 1970's. The Navy has never updated the analysis on the S-3 aircraft using either MSG-2 analytical procedures or the now required analytical procedures of reliability centered maintenance. Also, many of the depot tasks performed on Naval aircraft at the time of the audit were not part of the tasks subjected to MSG-2 analysis during the 1970's and early 1980's. For example, we reviewed the 104 depot level tasks that were being performed during the E-2 aircraft's depot repairs. We compared depot level tasks to those subjected to MSG-2 analysis and found that 81 of the 104 tasks (78 percent) were never subjected to MSG-2 analysis. Similar conditions existed on the F-14 aircraft. Of the 160 depot level maintenance tasks performed on the F-14 aircraft at the time of the audit, 77 tasks or 48 percent had not been subjected to MSG-2 analysis.

In April 1990, the Vice Chief of Naval Operations completed a limited study of the implementation of the Reliability Centered Maintenance Program at Naval Aviation Systems Command field activities (including two Naval aviation depots). The study revealed that reliability centered maintenance analyses were performed mostly during acquisition of the aircraft system and then put aside and not sustained. The Naval Aviation Systems Command field activities had misconceptions about reliability centered maintenance requirements. The activities perceived that reliability centered maintenance analysis was only required during acquisition of the aircraft system. They did not fully understand that reliability centered maintenance was intended to be an ongoing process with updates and revisions being made to the analysis as conditions changed during the aircraft system's operating phase. They also were not documenting analyses, and had not fully administered the discipline of implementing the analysis process.

Engineers at the Navy aviation depots we visited informed us that they did not perform and update reliability centered maintenance analyses because the depot did not have sufficient engineering resources. The engineering staffs stated that they were kept busy reacting to fleet problems and could not obtain funding for additional personnel needed to perform analyses.

Naval Air Systems Command Instruction 4790.20, paragraph 5.d.(8) requires Naval aviation depots to submit reliability centered maintenance work load and funding requirements to the Naval Aviation Systems Command Headquarters in their Annual Product Support Execution Plan. We examined FY 1990 and earlier funding documents and found that reliability centered maintenance was often given low priority by the Naval Air Systems Command and the Navy's aviation depots.

Naval Air Systems Command personnel stated that reliability centered maintenance was removed as a separate line item in the depots' engineering budgets in 1982, and was consolidated with other groupings of funds to provide the depots with greater flexibility in determining how to use the funds. Depot personnel have cited in their funding requests the need to perform reliability centered maintenance analysis as one of their prime justifications for seeking restoration of cuts made in their engineering budget by the Naval Air Systems Command. These funding requests have cited significant savings that could be derived through performing reliability centered maintenance analyses. For example, the Commanding Officer, Naval Aviation Depot, Cherry Point, North Carolina, stated in a 1989 letter to the Naval Air Systems Command Headquarters that if engineering funding could be provided to perform reliability centered maintenance analyses of the C-130 and OV-10 aircraft, the costs of performing fleet maintenance tasks for these aircraft could be reduced significantly. The Commander estimated that fleet maintenance staff hours for the C-130 aircraft fleet could be

reduced from 160,000 hours to 100,000 hours annually, a reduction of 37.5 percent. He also estimated that the fleet maintenance staff hours for the OV-10 aircraft fleet could be reduced from 41,000 hours to 27,000 hours annually, a reduction of 34 percent.

The lack of oversight by the Naval Aviation Systems Command Headquarters concerning how the depots prioritized the use of engineering funds appeared to be contrary to its philosophy regarding reliability centered maintenance. Since 1985, the Naval Aviation Systems Command has been at the forefront of the Navy's efforts to implement the reliability centered maintenance concept. It has led the effort in DoD to establish joint regulations on reliability centered maintenance and has developed software to simplify the preparation of reliability centered maintenance worksheets.

The Navy has demonstrated that by performing and sustaining reliability centered maintenance analyses, it can reduce work load and costs at the depot level. For example, by sustaining its analysis of the TF-30 aircraft engine, the Norfolk Naval Aviation Depot reduced maintenance costs per flying hour on the engine. Also, Norfolk Naval Aviation Depot personnel attributed increases in its meantime between failures on the TF-30 engine to the sustainment of reliability analysis.

Appendix B identifies 11 Navy aviation systems that would benefit from reliability centered maintenance analysis of their depot maintenance requirements. This list excludes aviation systems that are scheduled to be retired from the fleet in the near future. Based on the 14-percent average reduction in depot maintenance costs that the Army has achieved over the past 5 years for aviation systems it has brought under the analytical procedures of reliability centered maintenance, we estimate that the Navy could avoid up to $372 million in depot maintenance costs over the 6-year Future Years Defense Program ($62 million annually) by performing and sustaining reliability centered maintenance analyses for these aircraft systems. Actual savings, as indicated by the Commanding Officer, Naval Aviation Depot, Cherry Point, North Carolina, may be far greater.

The Air Force Audit Agency in its July 3, 1989 Report No. 7106213, "Review of Maintenance Concepts for Overhauling Aircraft Engines," provided information indicating that actual savings from fully implementing reliability centered maintenance analytical procedures may be greater. This report stated that studies by the GAO, commercial airlines, Defense, and other Government representatives estimated that there was potential for reducing maintenance costs by 20 percent.

Air Force. The Air Force has not fully implemented or sustained reliability centered maintenance analyses for all aircraft requiring depot maintenance. Air Force Logistics Command Regulation 66-35, "Reliability Centered Maintenance Program," October 30, 1987, requires that the analytical

procedures of reliability centered maintenance be used to establish and sustain all preventative maintenance programs for aircraft. Although internal control procedures existed to provide for compliance with the requirements of DoD Directive 4151.16 and Air Force Logistics Command Regulation 66-35 to implement and sustain reliability centered maintenance analyses, their enforcement has been ineffective because of a lack of emphasis by Air Force Logistics Command Headquarters.

The Air Force reported to Congress in 1985 that it had used MSG-2 analytical procedures to determine the depot maintenance tasks required for the B-52, F-4, F-16, and KC-135 aircraft.

We requested copies of the MSG-2 worksheets that were used to determine the required depot tasks for the F-4 and F-16 aircraft and were informed that the Air Force had not applied MSG-2 to the depot level tasks on those aircraft. Worksheets were available indicating that the depot level maintenance tasks for the B-52 and KC-135 aircraft, as well as the C-5 and C-141 aircraft, had been analyzed using MSG-2 analytical procedures during the mid-1970's. However, as stated in the Navy section of this finding, MSG-2 analytical procedures had many shortcomings that were greatly improved by the analytical procedures of reliability centered maintenance.

There was little evidence of oversight by Air Force Logistics Command Headquarters to ensure that the air logistics centers performed follow-on analysis (sustainment) after the initial MSG-2 analysis was completed, or that they used the analytical procedures of reliability centered maintenance to determine the validity of new depot maintenance tasks. As a result, many of the depot tasks performed on Air Force aircraft at the time of the audit were not part of the tasks subjected to MSG-2 analysis during the 1970's. For example, we reviewed the 60 depot level tasks that were being performed during the C-5 aircraft's depot overhauls. We compared the depot level tasks to those subjected to MSG-2 analysis in 1978 and found that 40 of the 60 tasks were never subjected to MSG-2 analysis. Similar conditions existed on the KC-135 aircraft. Of the 101 depot level maintenance tasks performed on the KC-135 aircraft at the time of the audit, 56 tasks or 55 percent had not been subjected to MSG-2 analysis in the 1970's.

Air logistics center personnel stated that there was no need to sustain the analyses because there are numerous other programs that have similar objectives and come to the same conclusions. Engineering personnel stated that they relied on a number of other programs including the Aircraft Structural Integrity Program and the Maintenance Requirements Review Board to determine the required depot level maintenance tasks.

We were provided no support for the conclusions that other programs were as comprehensive as and provided the same potential for cost reductions that have been obtained through the Reliability Centered Maintenance Program. Further, the Air Force Logistics Command Regulation 66-35, section B., paragraph 11., states that the results of the Aircraft Structural Integrity Program reviews should be used in the reliability centered maintenance analysis for structurally significant items. While the Aircraft Structural Integrity Program contributes information to form conclusions during reliability centered maintenance analysis, it is not a substitute for reliability centered maintenance analysis. Also, earlier studies by contractors and the GAO concluded that programs, such as the Maintenance Requirements Review Board, were not as effective as and did not provide the objective evidence needed to validate depot maintenance tasks that the Reliability Centered Maintenance Program produced.

Appendix C identifies Air Force aircraft that would benefit from reliability centered maintenance analysis of their depot maintenance requirements. Based on the 14-percent average reduction in depot maintenance costs that the Army has achieved over the past 5 years for aviation systems it has brought under the analytical procedures of reliability centered maintenance, we estimate that the Air Force could avoid up to $460.8 million of depot maintenance costs over the 6-year Future Years Defense Program ($76.8 million annually) by performing and sustaining reliability centered maintenance analyses on Air Force aircraft.

RECOMMENDATIONS, MANAGEMENT COMMENTS, AND AUDIT RESPONSE

1. We recommend that the Commander, Naval Air Systems Command, and the Commander, Air Force Logistics Command, establish and implement a time-phased plan to bring their aviation depots into compliance with the requirements of DoD Directive 4151.16, to perform and sustain reliability centered maintenance analysis for all depot level aviation system maintenance tasks. The plan should provide for full implementation by October 1, 1992.

Navy comments. The Principal Deputy Assistant Secretary of the Navy (Research, Development, and Acquisition) concurred in principle with the recommendation stating that the Navy had developed a schedule to fully implement reliability centered maintenance analysis requirements by October 1, 1992. The Navy agreed to quantify the actual monetary benefits when the analyses are completed, but estimated that the savings would not exceed 5 percent. The Navy believes that analyses performed to initially determine depot maintenance requirements for today's fielded systems using MSG-2 methodology, a predecessor to the

analytical procedures of reliability centered maintenance, will reduce the savings potential from the 14-percent estimate cited in this report. The complete text of the Navy's comments is in Part IV.

Audit response. The Navy's comments to the recommendation are fully responsive. We request that the Navy agree to report the actual monetary benefits that it achieves, as it completes reliability centered maintenance analyses, to the Office of the Assistant Inspector General for Audit Analysis and Followup.

Air Force comments. Although the Air Force nonconcurred, the Deputy Assistant Secretary of the Air Force (Communications, Computers, and Logistics) agreed to complete and sustain the analytical procedures of reliability centered maintenance analysis for all aircraft cited in the report except the E-3 aircraft. The exemption for the E-3 aircraft was based on the small size of the fleet and the comparability of the maintenance requirements to those for the Boeing 707 commercial aircraft. The Air Force also stated that the F-4 aircraft would be exempted because plans for its phaseout are being implemented. (The F-4 aircraft was excluded from our audit because of this expected phaseout.) The estimated completion date for the F-15 aircraft was December 1992 instead of the recommended October 1, 1992. The estimated completion date for the B-52 and C-135 (KC-135) aircraft had not been established.

The Air Force stated that it would not realize the 14-percent savings estimated in the report. The Air Force believes that other programs it follows to determine maintenance requirements will reduce the potential for achieving savings through the application of the analytical procedures of reliability centered maintenance. The complete text of the Air Force's comments is in Part IV.

Audit response. We agree with the Air Force's position concerning the E-3 aircraft and have changed the final report to exclude it from the discussion. The proposed completion date of December 1992 for the F-15 aircraft is acceptable. We request that the Air Force provide its planned completion dates for the B-52 and KC-135 aircraft in its response to the final report.

The Air Force did not provide an estimate of the monetary benefits that it expects to achieve through its proposed actions to perform the reliability centered maintenance analyses. We request that the Air Force clarify its position on benefits to be realized in its comments to this final report. We also request that the Air Force agree to report the actual monetary benefits it achieves, as it completes its analyses, to the Office of the Assistant Inspector General for Analysis and Followup.

2. We recommend that the Commander, Naval Air Systems Command, and the Commander, Air Force Logistics Command, report and track the material weaknesses related to compliance with the requirements of DoD Directive 4151.16, as required by DoD Directive 5010.38, "Internal Management Control Program."

Navy comments. The Principal Deputy Assistant Secretary of the Navy (Research, Development, and Acquisition) concurred in principle. The Navy did not provide proposed action. We request the Navy provide planned action and an estimated completion date in response to the final report.

Air Force comments. The Deputy Assistant Secretary of the Air Force (Communications, Computers, and Logistics) concurred.

STATUS OF RECOMMENDATIONS

		Response Should Cover:			
Number	Addressee	Concur/ Nonconcur	Proposed Action	Completion Date	Related Issues*
1.	Navy				M
	Air Force		X	X	M,IC
2.	Navy		X	X	IC
	Air Force				IC

* M = monetary benefits; IC = internal control weakness

B. EXTENDING THE OPERATING SERVICE PERIOD OF NAVY AIRCRAFT

The Navy has not fully considered the results of its predepot induction inspections conducted under its Aircraft Service Period Adjustment Program in developing the most optimum intervals for scheduling aircraft for depot level maintenance. This condition occurred because the Navy relied primarily on analyses performed under its MSG-2 Program to establish its scheduled intervals for depot level maintenance. By fully considering the results of previous Aircraft Service Period Adjustment Program inspections in developing the most optimum interval for scheduling aircraft for depot level maintenance, the Navy could reduce the number of inspections performed annually and reduce its inspection costs by $31.2 million over the 6-year Future Years Defense Program ($5.2 million annually).

DISCUSSION OF DETAILS

Background

The Navy has implemented a predepot induction inspection program, the Aircraft Service Period Adjustment Program, to reduce aviation depot maintenance costs. Prior to inducting aircraft for depot maintenance, an inspection team visits the aviation activity to assess the aircraft's need for depot level maintenance. By limiting the induction of aircraft for depot level maintenance to only those aircraft requiring significant repairs, the Navy has reduced aviation depot maintenance costs. Any aircraft that passes the inspection is retained at the aviation activity for another year and is then subject to another inspection.

The Navy's inspection program was first used in 1984. Since then all eligible Navy aircraft have been included in the program. In June 1990, the Navy reported to Congress that it was unable to exactly quantify the savings it derived from the inspection program, but it estimated that the annual savings resulting from implementation of the Aircraft Service Period Adjustment Program and MSG-2 Program were approximately $200 million.

Scheduling Navy Aircraft for Depot Level Maintenance

The Navy did not fully consider the results of the predepot induction inspections conducted under its Aircraft Service Period Adjustment Program in developing the most optimum period for scheduling aircraft for depot level maintenance. The Navy relied primarily on analyses performed under its MSG-2 Program to establish scheduled depot level maintenance intervals. We

believe that the additional information that the Navy has obtained since its implementation of the Aircraft Service Period Adjustment Program in 1984 should also be considered.

Because Aircraft Service Period Adjustment inspections are performed only when an aircraft is scheduled for depot level maintenance, any lengthening of the scheduled intervals between depot level maintenance will reduce the number of inspections performed over an aircraft's life cycle. The cost of each inspection ranged from $9,900 to $148,500 in FY 1989.

Several types of Naval aircraft have experienced a high pass rate for their initial inspections, which would indicate that the optimum depot level maintenance interval for these types of aircraft can be safely extended. For example, the A-6, E-2, F-14, and T-34B aircraft have passed their initial inspections at a rate greater than 75 percent, since inception of the inspection program in 1984. In addition, several equivalent aircraft in the Air Force have longer cycles between scheduled depot maintenance intervals than the Navy does, which further indicates that the Navy intervals for several aircraft can be lengthened.

During the Naval Aviation Systems Command's review of the implementation of the Navy's Aircraft Service Period Adjustment Program, completed for the Vice Chief of Naval Operations in 1990, fleet users made recommendations that depot maintenance intervals be adjusted as a result of positive inspections.

Although the Navy has not lengthened the scheduled depot maintenance intervals on many of its aircraft for many years, changes in the intervals have occurred when the Aircraft Service Period Adjustment Program inspections have identified aircraft that require shorter intervals between scheduled depot maintenance. For example, because of high failure rates during initial inspections of the A-7 aircraft, the Navy reduced the scheduled depot maintenance interval from 48 months to 36 months. Similar adjustments have not been made for aircraft that have high pass rates for their initial and follow-on annual inspections.

Substantial savings in inspection costs can be achieved by lengthening the periods between scheduled depot level maintenance for types of aircraft that have experienced high inspection pass rates. For example, by lengthening the scheduled depot maintenance interval for the Navy's 450 F-14 aircraft from 44 months to 56 months, the Navy could eliminate an average of 26 inspections per year. (The assumption is that only 25 percent of the F-14 aircraft would pass their inspection at the conclusion of 56 months.) This lenthening of the scheduled depot maintenance intervals would produce annual savings in inspection costs of $1.6 million.

As detailed in Appendix D, similar savings could be realized on the A-6 and E-2 aircraft. Each of these aircraft has experienced a pass rate of more than 75 percent on the first inspection. We estimate that the Navy could reduce inspection costs by $31.2 million over the 6-year Future Years Defense Program ($5.2 million annually), by extending the scheduled depot maintenance interval for these aircraft.

RECOMMENDATION, MANAGEMENT COMMENTS, AND AUDIT RESPONSE

We recommend that the Commander, Naval Air Systems Command, lengthen the scheduled depot maintenance intervals for the A-6, E-2, F-14, and other aircraft fleets that have experienced pass rates in excess of 75 percent for their initial Aircraft Service Period Adjustment Program inspections.

Navy comments. The Principal Deputy Assistant Secretary of the Navy (Research, Development, and Acquisition) concurred in principle with the recommendation, stating that the scheduled maintenance interval for the E-2, A-7, and C-2 aircrafts had been extended and that possible extensions for the A-6 and F-14 aircraft were under review. The Navy stated that the T-34B aircraft (included in the draft report recommendation) is being converted to the commercial T-34C aircraft maintenance plan. The Navy does not, however, believe that this reduction in inspection requirements will result in any savings, because as the age of the fleet increases maintenance requirements will increase. The full text of the Navy's comments is in Part IV.

Audit response. The T-34B aircraft has been removed from the recommendation. The savings cited in the report are based solely on the reduction in inspection costs that can be achieved from lengthening the scheduled maintenance interval for aircraft. The Navy stated that the interval has already been increased for three types of aircraft, including two that were not in our savings computations (A-7 and C-2 aircrafts), and that two additional aircraft types (F-14 and A-6 aircrafts) are under review for possible extensions. The decision to extend the maintenance interval for the A-7 aircraft represents a reversal of the previous decision cited in this report to decrease the interval. We request that the Navy provide information on the results of these reviews or the scheduled completion date for these reviews in response to the final report. The reductions in inspection requirements will reduce inspection costs. We agree that the aging of the fleet might result in additional maintenance costs. The cited savings in inspection costs might represent one source of funds that could be better used to meet any increase in maintenance costs resulting from the aging of the fleet. We request that the Navy reconsider its position on monetary benefits in its response to the final report.

STATUS OF RECOMMENDATION

Number	Addressee	Response Should Cover: Concur/ Nonconcur	Proposed Action	Completion Date	Related Issues*
B.	Navy			X	M

* M = monetary benefits

PART III - ADDITIONAL INFORMATION

APPENDIX A - Prior Audits and Other Reviews

APPENDIX B - Navy Aircraft and Engines Requiring Reliability Centered Maintenance

APPENDIX C - Air Force Aircraft Requiring Reliability Centered Maintenance

APPENDIX D - Reductions in Navy Inspection Costs Achievable by Extending the Scheduled Maintenance Interval for Aircraft that Frequently Pass Their First Aircraft Service Period Adjustment Inspection

APPENDIX E - Summary of Potential Monetary and Other Benefits Resulting from Audit

APPENDIX F - Activities Visited or Contacted

APPENDIX G - Report Distribution

APPENDIX A: PRIOR AUDITS AND OTHER REVIEWS

General Accounting Office Report Code No. NSIAD/MRA&L 391512, (no OSD case number assigned), "Survey of Reliability Centered Maintenance," March 13, 1985, stated that the Military Departments have made slow progress in fully implementing the Reliability Centered Maintenance concept, and that, as a result, there are many opportunities for increased applications in each of the Military Departments. DoD management comments were not requested. As a result of the report, Congress required the Military Departments to submit a list of the systems to which Reliability Centered Maintenance had been applied and a plan for implementation of the program for other systems. DoD submitted a consolidated report in December 1985.

General Accounting Office Report No. GAO/NSIAD-87-157 (OSD Case No.7214), "Navy Maintenance, the P-3 Aircraft Overhaul Program Can Be Improved," June 29, 1987, stated that the Navy could increase aircraft availability and reduce overhaul cost by performing more Aircraft Service Period Adjustment Program inspections to determine if overhauls are necessary. The General Accounting Office concluded that a $12 million savings in overhaul costs would have been realized if inspections had been performed. The Navy took action to improve the scheduling of P-3 aircraft in its depots and implemented a series of initiatives to make its depots operate more efficiently.

Air Force Audit Agency Report No. 7106213, "Review of Maintenance Concepts for Overhauling Aircraft Engines," July 3, 1989, stated that the Air Force Logistics Command's planning and implementing actions for the Reliability Centered Maintenance Program for Air Force aircraft engines were not effective. The report stated that studies by the General Accounting Office, commercial airlines, Defense, and other Government representatives estimated that there was a potential for reducing maintenance costs by 20 percent by fully implementing reliability centered maintenance analytical procedures. Management agreed to take action to improve the planning and scheduling of reliability centered maintenance analysis for its aircraft engines.

Center for Naval Analyses Report No. CRM 90-174, "Aircraft Service Period Adjustment and the Effect of Deferred Depot Maintenance on Airframe Rework Cost," March 1991, evaluated whether the increased periods between depot maintenance inductions resulting from implementation of the Aircraft Service Period Adjustment Program adversely affected the amount of depot maintenance required. The Center concluded that the cost savings from the reduced number of depot maintenance inductions required over an aircraft's life cycle as a result of the program more than offset the additional maintenance costs that occurred during each depot visit.

Center for Naval Analyses Draft Report No. CRM 90-178, "Aircraft Service Period Adjustment Program and Depot-Level Pipeline Growth," July 25, 1990, discussed recent trends in deferral rates and depot rework work load resulting from the Aircraft Service Period Adjustment Program. The Center examined whether increases in the depot rework pipeline resulted because of the additional maintenance necessary when aircraft finally were inducted. The Center concluded that the program had a relatively small impact.

APPENDIX B: NAVY AIRCRAFT AND ENGINES REQUIRING RELIABILITY CENTERED MAINTENANCE

Aircraft/Engine	Annual Depot Maintenance Cost 1/ ($ millions)	Annual Savings 2/ ($ millions)	Savings Over 6 Years
A-4	$ 31.7	$ 4.4	$ 26.4
A-6	104.6	14.6	87.6
C-130	18.8	2.6	15.6
E-2	23.9	3.3	19.8
F-14	92.6	13.0	78.0
H-46	17.1	2.4	14.4
J-52	74.3	10.4	62.4
OV-10	2.0	0.3	1.8
P-3	44.4	6.2	37.2
S-3	21.9	3.1	18.6
T-64	12.1	1.7	10.2
Totals	$443.4	$62.0	$372.0

1/ The annual depot maintenance cost was computed by applying the average cost of depot maintenance per aviation system in FY 1989 times the average annual number of aircraft scheduled to undergo depot maintenance over the next 6 years.

2/ The estimated annual savings was computed by taking 14 percent of annual depot maintenance cost. The 14 percent was derived from the average Army savings on aviation maintenance tasks that the Army has brought under the Reliability Centered Maintenance Program since 1985.

APPENDIX C: AIR FORCE AIRCRAFT REQUIRING RELIABILITY CENTERED MAINTENANCE

Aircraft	Annual Depot Maintenance Cost 1/ ($ millions)	Annual Savings 2/ ($ millions)	Savings Over 6 Years ($ millions)
B-1	$ 14.1	$ 2.0	$ 12.0
B-52	64.5	9.0	54.0
C-5	17.0	2.4	14.4
C-130	60.1	8.4	50.4
C-141	58.4	8.2	49.2
F-15	85.1	11.9	71.4
F-111	127.7	17.9	107.4
KC-135	121.5	17.0	102.0
Totals	$548.4	$76.8	$460.8

1/ The annual depot maintenance cost was computed by applying the average cost of depot maintenance per aircraft in FY 1989 (except for the B-1 aircraft) times the average annual number of aircraft scheduled to undergo depot maintenance over the next 6 years. Because the B-1 aircraft had no programmed depot maintenance in FY 1989, the FY 1990 budgeted depot maintenance cost per aircraft was used.

2/ The estimated annual savings was computed by taking 14 percent of the annual depot maintenance cost. The 14 percent was derived from the average Army savings on aviation maintenance tasks that the Army has brought under the Reliability Centered Maintenance Program since 1985.

APPENDIX D: REDUCTIONS IN NAVY INSPECTION COSTS ACHIEVABLE BY EXTENDING THE SCHEDULED MAINTENANCE INTERVAL FOR AIRCRAFT THAT FREQUENTLY PASS THEIR FIRST AIRCRAFT SERVICE PERIOD ADJUSTMENT INSPECTION

Aircraft	Average Number Inspections Eliminated Per Year 1/	Cost Per Inspection 2/	Annual Savings ($ million)	Savings Over 6 Years
A-6	40.1	$69,700	$2.8	$16.8
E-2	10.5	78,200	0.8	4.8
F-14	26.4	61,650	1.6	9.6
Totals			$5.2	$31.2

1/ The elimination in average number of inspections per year assumes current depot maintenance intervals are extended by 12 months.

2/ Cost per inspection represents the average cost incurred per inspection for that type of aircraft during FY 1989.

APPENDIX E: SUMMARY OF POTENTIAL MONETARY AND OTHER BENEFITS RESULTING FROM AUDIT

Recommendation Reference	Description of Benefit	Amount and/or Type of Benefit
A.1.	Economy and Efficiency. The Navy and the Air Force will be able to reduce depot maintenance tasks and related costs by applying analytical procedures from the Reliability Centered Maintenance Program.	Funds Put to Better Use. The Navy could avoid up to $372 million of depot maintenance costs over the 6-year Future Years Defense Program ($62 million annually), and the Air Force could avoid up to $460.8 million of depot maintenance costs over the 6-year Future Years Defense Program ($76.8 million annually).
A.2	Internal Control. Helps ensure implementation of Recommendation A.1.	Included above.
B.	Economy and Efficiency. The Navy will be able to reduce the number of Aircraft Service Period Adjustment Program inspections and related inspection costs by extending the scheduled depot maintenance interval for aircraft that have had pass rates in excess of 75 percent for their initial inspection.	Funds Put to Better Use. The Navy could avoid $31.2 million of inspection costs over the 6-year Future Years Defense Program ($5.2 million annually).

APPENDIX F: ACTIVITIES VISITED OR CONTACTED

Office of the Secretary of Defense

Deputy Assistant Secretary of Defense (Logistics), Office of the Assistant Secretary of Defense (Production and Logistics), Washington, DC

Department of the Army

Chief of Staff for Logistics, Office of the Deputy Chief of Staff for Logistics, Washington, DC
Army Materiel Command, Alexandria, VA
Material Readiness Support Activity, Lexington Blue Grass Army Depot, Lexington, KY
Tank and Automotive Command, Detroit, MI
Sharpe Army Depot, Stockton, CA
Corpus Christi Army Depot, Corpus Christi, TX

Department of the Navy

Chief of Naval Operations, Washington, DC
Headquarters, Naval Air Systems Command, Arlington, VA
Headquarters, Naval Sea Systems Command, Arlington, VA
Naval Aviation Maintenance Office, Patuxent River, MD
Marine Corps Research, Development and Acquisition Command, Arlington, VA
Naval Operating Base, Norfolk, VA
Naval Aviation Depot, Alameda, CA
Naval Aviation Depot, Cherry Point, NC
Naval Aviation Depot, Jacksonville, FL
Naval Aviation Depot, Norfolk, VA
Naval Aviation Depot, North Island, CA
Naval Aviation Depot, Pensacola, FL

Department of the Air Force

Deputy Chief of Staff, Logistics and Engineering, Washington, DC
Headquarters, Air Force Logistics Command, Wright Patterson Air Force Base, Dayton, OH
Sacramento Air Logistics Center, McClellan Air Force Base, CA
Warner-Robins Air Logistics Center, Robins Air Force Base, GA
San Antonio Air Logistics Center, Kelly Air Force Base, TX
Oklahoma City Air Logistics Center, Tinker Air Force Base, OK
Ogden Air Logistics Center, Hill Air Force Base, UT

APPENDIX G: REPORT DISTRIBUTION

Office of the Secretary of Defense

Assistant Secretary of Defense (Production and Logistics)
Assistant Secretary of Defense (Public Affairs)
Comptroller of the Department of Defense

Department of the Army

Secretary of the Army
Assistant Secretary of the Army (Financial Management)
Army Audit Agency

Department of the Navy

Secretary of the Navy
Assistant Secretary of the Navy (Financial Management)
Naval Audit Service

Department of the Air Force

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

Defense Agency

Director, Defense Contract Audit Agency
Director, Defense Logistics Studies Information Exchange

Non-DoD Activities

Office of Management and Budget
  National Security Division, Special Projects Branch
U.S. General Accounting Office
  NSIAD Technical Information Center

Congressional Committees:

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

PART IV - MANAGEMENT COMMENTS

Department of the Navy

Department of the Air Force

COMMENTS OF THE DEPUTY ASSISTANT SECRETARY OF THE NAVY (RESEARCH, DEVELOPMENT AND ACQUISITION)

DEPARTMENT OF THE NAVY
OFFICE OF THE ASSISTANT SECRETARY
(Research, Development and Acquisition)
WASHINGTON, D C 20350-1000

MAY 2 1 1991

MEMORANDUM FOR THE DEPARTMENT OF DEFENSE ASSISTANT INSPECTOR GENERAL FOR AUDITING

Subj: DRAFT REPORT ON THE AUDIT OF AIRCRAFT DEPOT MAINTENANCE PROGRAMS (PROJECT NO. OLB-0058) - ACTION MEMORANDUM

Ref: (a) DODIG Memo of 6 March 91

Encl: (1) DON Response to Draft Audit Report

Reference (a) requested comments on the subject draft audit report concerning the programs designed to reduce aircraft depot maintenance costs. The Navy response is provided in enclosure (1).

We generally agree with the draft report findings and recommendations. As outlined in the enclosed comments, the Navy is taking specific actions to ensure that the programs are continually updated.

Genie McBurnett

Genie McBurnett

Copy to:
NAVINSGEN
NAVCOMPT (NCB-53)

Department of the Navy Response

to

DODIG Draft Report of March 6, 1991

on

Aircraft Depot Maintenance Programs
Project No. OLB-0058

Finding A:

The Navy has not fully complied with the requirement to use the Reliability Centered Maintenance Program to determine depot level maintenance tasks and intervals for all aviation systems. The Navy could reduce depot maintenance costs by up to $372 million over the 6-year Future Years Defense Program ($62 million annually).

Recommendation A-1:

We recommend that the Commander, Naval Air Systems Command,

1. Establish and implement a time-phased plan to bring their aviation depots into compliance with the requirements of DOD Directive 4151.16 to perform and sustain reliability centered maintenance analysis for all depot level system tasks. The plan should provide for full implementation by October 1, 1992

2. Report and track the material weakness related to compliance with the requirements of DOD Directive 4151.16, as required by DOD Directive 5010.38, "Internal Management Control Program."

DON Position:

Concur in Principle: The Navy has complied with the application of RCM in initially determining depot maintenance requirements for todays fielded systems. The MSG-II methodology, as used in the original RCM application document, NAVAIR 00-25-400, and the present RCM logic used in MIL-STD-2173 (AS) are evolutions of the same process. The Navy agrees that adequate enforcement of continued use of RCM and funding of the program requirements are a concern. The Navy has developed a schedule to put a program structure in place, and to update RCM findings by Type, Model, and Series commencing in Oct. 1991, with an expected completion date of 1 Oct. 1992. The monetary benefits and the costs incurred will be quantified when RCM update is complete, but the benefits are not expected to exceed 5% since most savings associated with performing the RCM analysis are achieved up front and the initial analysis has already been performed. Upon completion of the update, the savings will be identified.

Findings B:

The Navy has not fully considered the results of its Aircraft Service Period Adjustment Program inspections in developing the scheduled depot maintenance intervals for its aircraft. As a result the Navy is missing the opportunity to reduce aircraft inspection costs. The Navy could reduce its Aircraft Service Period Adjustment Program inspection costs by $31.8 million over the 6-year Future Years Defense Program ($5.3 million annually) by fully considering the results of prior inspections in developing the optimum intervals for scheduling aircraft for depot maintenance.

Recommendation B-1:

We recommend that the Commander, Naval Air Systems Command, lengthen the scheduled depot maintenance interval for the A-6, E-2, F-14, T-34B and other aircraft fleets that have experienced pass rates in excess of 75 percent for their initial Aircraft Service Period Adjustment Program inspections.

DON Comments:

Concur in Principle: RCM is a program which considers aircraft safety and the economics of preventative maintenance opportunities. NAVAIR's ASPA program evaluates an aircraft's material condition. It is a CNO requirement that existing OSPs be validated, and potentially extended, each year. During the most recent review the E-2, A-7 and C-2 aircraft OSPs were extended. The F-14 and A-6 aircraft are under review and the T-34B is being converted to the commercial T-34C maintenance plan. Part of the rationale for recommended extensions comes, in some part, from the results of past ASPA evaluations. NAVAIR looks on ASPA as a program which changes the basis for SDLM induction from "on-time" to "on-condition". The average age of the fleet currently is 14.7 years. It is anticipated that as the age increases the ASPA pass rate will decrease. With the increasing age of the fleet and the changes in aircraft acquisition, savings throughout the FYDP as a result of extensions are not expected to materialize.

COMMENTS OF THE DEPUTY ASSISTANT SECRETARY OF THE AIR FORCE (COMMUNICATIONS, COMPUTERS AND LOGISTICS)

DEPARTMENT OF THE AIR FORCE
WASHINGTON, D.C. 20330-1000

OFFICE OF THE ASSISTANT SECRETARY

06 MAY 1991

MEMORANDUM FOR ASSISTANT INSPECTOR GENERAL FOR AUDITING
OFFICE OF THE INSPECTOR GENERAL
DEPARTMENT OF DEFENSE

SUBJECT: DOD (IG) Draft Report, "Aircraft Depot Maintenance Programs," Project No. OLB-0058 - INFORMATION MEMORANDUM

This is in reply to your memorandum for the Assistant Secretary of the Air Force (Financial Management and Comptroller) requesting comments on the findings and recommendations made in the subject report. The Air Force nonconcurs with the audit's projected savings relative to the sustainment of RCM analysis on its weapon systems.

LLOYD K. MOSEMANN, II
Deputy Assistant Secretary
(Communications, Computers & Logistics)

2 Attachments
1. Management Actions
2. General Comments

Draft Report of Audit, Aircraft Depot Maintenance Programs (Project No. OLB-0058)

RECOMMENDATION A.1 We recommend that the Commander, Naval Air Systems Command, and the Commander, Air Force Logistics Command establish and implement a time-phased plan to bring their aviation depots into compliance with the requirements of DoD Directive 4151.16 to perform and sustain reliability centered maintenance analysis for all depot level aviation system maintenance tasks. The plan should provide for full implementation by October 1, 1992.

MANAGEMENT ACTIONS

Nonconcur. Although Air Force has been deficient in sustaining an RCM documentation trail, Air Force aircraft preventive maintenance tasks are a result of rigorous analyses that have the same objective as RCM. Initial Reliability Centered Maintenance (RCM) analyses accomplished on Air Force aircraft have been combined with operational experience, age exploration results, and predictive program evaluations to result in the establishment and continual refinement of preventive maintenance programs. This combination has enabled minimum preventive maintenance schedules that include only those tasks necessary to economically preserve aircraft safety and operating reliability. Tasks, intervals, and work packages are regularly evaluated to confirm their effectiveness and efficiency and are updated based on operational data, process or product improvements, and/or changes in mission assignments. Although this approach accomplishes the RCM objective of realizing the inherent reliability of equipment at a minimum expenditure of resources, an audit trail which specifically documents the RCM decision logic process has not totally been sustained. However, the validation and documentation of depot level tasks through the RCM decision logic process will not result in significant changes to those tasks.

Examples substantiating the effectiveness of the Air Force approach to preventive maintenance can be found within each Air Force weapon system program. Modifications, the use of improved materiels and processes, and operational experience are focused on the high cost drivers of preventive maintenance to result in continual program improvements. The following example from the F-15 program is provided to substantiate this point:

Two scrubs of the F-15 preventive maintenance program were recently conducted. The first scrub resulted in the reduction of field and depot level inspections through the implementation of the Force Structural Maintenance Plan. By using actual aircraft usage data from the signal data recorder and counting accelerometer, inspections for critical fatigue tracked locations are projected based on individual aircraft usage. Therefore, the preventive maintenance safety inspections are accomplished only

when aircraft usage dictates. In the second scrub, depot level experience enabled the cost effective elimination of fuel cell bladder inspections for the number 1, 2, and 3A fuel tanks. The remaining tasks included in the F-15 preventive maintenance program were validated using field and depot level experience and damage tolerance analysis. In summary, the absolute minimum critical work required to keep the F-15 airworthy is included in its preventive maintenance program. This approach is consistent with the objective of RCM, although, the F-15 RCM documentation has not been updated to reflect changes in its preventive maintenance.

The projected Air Force savings of 14% is based on savings realized through the application of RCM analysis to Army aviation components; this basis is not technically sound. Army RCM benefits were derived through the evaluation of 41 components, many of which consist of moving mechanical parts, from three aircraft systems. Prior to the application of RCM, the Army had "hard time" overhaul requirements for these components, regardless of their condition. It was these hard time tasks that required aircraft depot induction. The application of RCM to these components eliminated the hard time overhaul requirements and, correspondingly, the hard time requirement for depot induction.

To evaluate the need for individual aircraft depot inductions, the Army established their Airframe Condition Evaluation (ACE) and Aircraft Analytical Corrosion Evaluation (AACE) programs which call for a yearly inspection to assess aircraft condition. This approach is similar to the way the Air Force maintains the A-7, A-37, F-16, T-37, T-38 and C-130H (post FY78) weapon systems, which also do not have scheduled depot maintenance programs. Air Force relies on the organizational field level inspection programs and Analytical Condition Inspection (ACI) sampling programs to identify specific conditions requiring depot level support. In most cases, this support is provided by depot field teams.

Prior to the Army's application of RCM and the establishment of the ACE and AACE programs, the Air Force did not have a scheduled depot maintenance program for its helicopter fleet. The field level inspection programs and the ACI sampling programs were used to cost effectively maintain the Air Force helicopter fleet. Since the Army is the lead service for helicopter support, and has eliminated hard time depot level maintenance requirements, the Air Force now uses the Army ACE and AACE concepts in its helicopter maintenance. The Air Force H-60 helicopter fleet has been in service for more than 9 years, and no aircraft have required depot induction.

The Army savings realized are a direct result of the elimination of hard time overhaul requirements and the associated scheduled

depot maintenance. Since Army aircraft receive depot maintenance only after ACE and AACE program evaluations, the aircraft components realize their inherent reliability. Army depot programs are not comparable to Air Force depot maintenance, nor are they applicable to Air Force weapon systems. Air Force depot maintenance is primarily based on extensive damage tolerance analyses and testing of critical structures, individual aircraft tracking programs, and known operational deficiencies identified by companion programs. As a result of these thorough analyses, Air Force preventive depot level maintenance includes only airworthiness and/or mission essential tasks that must be inspected and/or repaired at the depot; validating these tasks through the RCM decision logic process will not result in their elimination. Since the Air Force has no hard time tasks to eliminate as a result of documenting the application of RCM, the 14% projected savings will not be realized.

Although the Air Force will not realize the projected 14% savings, we will validate aircraft depot level preventive maintenance tasks using the RCM decision logic process, and will ensure the completion and sustainment of corresponding documentation. Target completion dates for applicable Air Force aircraft and substantiation for exemptions and deferrals are as follows:

AIRCRAFT	TARGET COMPLETION DATE
B-1	Sep 91
B-52	TBD
C-5	Dec 91
C-130	Mar 92
C-135	TBD
C-141	Sep 92
E-3	Will be exempt
F-4	Will be exempt
F-15	Will be deferred
F-111	Sep 92

Due to manpower shortages, depot level task validations for the B-52 and C-135 will be contracted out. A target completion date for the validations will be established by June 1991.

Validation of depot level tasks for the F-15 will be deferred until December 1992, based on a current initiative to develop an automated method for the accomplishment of RCM analysis and the corresponding documentation requirements. The F-15 system program manager has taken the lead on this initiative which should result in the effective sustainment of an RCM audit trail for each Air Force aircraft. This initiative is targeted to reduce manpower efforts associated with RCM analysis by 20 to 1.

The E-3 fleet consists of 34 aircraft. During the acquisition phase, RCM analysis requirements were waived based on E-3 comparability to the Boeing 707 commercial aircraft. All E-3 structurally critical locations were screened through the use of durability and damage tolerance analysis (fracture mechanics) to determine Aircraft Structural Integrity Program (ASIP) inspection requirements. An Analytical Condition Inspection (ACI) sampling program based on the latest version of MSG-2 commercial inspection programs and service bulletins is used to further refine E-3 preventive maintenance requirements. The resulting preventive maintenance program is limited to items where there is a known problem based on E-3 experience, or an anticipated problem based on 707 commercial aircraft experience. Commercial MSG-2 analysis and experience, supplemented with the results of the ASIP and ACI programs, meet the objective of RCM. Based on its small fleet size, and the commercial MSG-2 program experience that is continually available at no charge, the Air Force exempted the E-3 from further RCM analysis on October 26, 1978.

The F-4 is fast approaching the end of its economic service life, and plans for its phase-out are being implemented. Accomplishing updated RCM analyses would take approximately two and one half years and would be extremely expensive. After the completion of RCM documentation requirements, there would be few F-4 aircraft within the Air Force fleet and no opportunity to derive the benefits associated with a preventive maintenance program that includes complete RCM documentation. The existing preventive maintenance program necessary to maintain the airworthiness of the F-4 is cost effective. Since no benefits can be derived through the completion of the F-4 RCM documentation trail, an official Air Force exemption will be implemented by August 1991.

RECOMMENDATION A.2. Report and track the material weaknesses related to compliance with the requirements of DOD Directive 4151.16, as required by DOD Directive 5010.38, "Internal Management Control Program."

MANAGEMENT ACTIONS: Concur with intent. Air Force will report and track the materiel weaknesses associated with an incomplete depot level RCM documentation trail in accordance with DOD Directive 5010.38, "Internal Management Control Program."

GENERAL COMMENTS

ADDITIONAL MANAGEMENT COMMENTS: The draft audit report contains inaccurate information regarding the Reliability and Maintainability Management Information System (REMIS). Although REMIS can be used to enhance the application of RCM, there are currently no plans for a specific module that will accomplish RCM analysis.

Deleted from the report