

# DRAFT AUDIT REPORT

## V-22 Osprey Joint Advanced Vertical Aircraft

**Project No. D2000AL-0101.000**  
(formerly Project No. OAL-0123)

**May 26, 2000**

*This proposed audit report is being issued to management to obtain comments and a statement of corrective actions to be taken. The report may be revised as a result of comments received and further reviews by the Office of the Inspector General, DoD.*

*Distribution of this proposed audit report outside DoD is not authorized. Safeguards must be taken to prevent publication or improper disclosure of the information in the report.*

*The final report that is issued from this draft will not have the "For Official Use Only" markings unless an exception to the Freedom of Information Act requires the markings.*

**PREPARED BY THE  
OFFICE OF THE INSPECTOR GENERAL  
DEPARTMENT OF DEFENSE**



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

May 26, 2000

MEMORANDUM FOR NAVAL INSPECTOR GENERAL

SUBJECT: Audit Report on V-22 Osprey Joint Advanced Vertical Aircraft  
(Project No. D2000AL-0101.000) (formerly Project No. 0AL-0123)

We are providing this draft report for review and comment. Management is requested to provide comments that conform to the requirements of DoD Directive 7650.3. For us to consider management comments in preparing the final report, we should receive them by June 26, 2000. We normally include copies of the comments in the final report. Matters considered by management to be exempt from public release should be clearly marked for Inspector General consideration.

Management comments should indicate concurrence or nonconcurrence with the finding and recommendations. Comments should 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. For additional information on this report, please contact Mr. Charles M. Santoni at (703) 604-9051 (DSN 664-9051) (csantoni@dodig.osd.mil) or Mr. Robert L. Shaffer at (703) 604-9043 (DSN 664-9043) (rshaffer@dodig.osd.mil). If management requests, we will provide a formal briefing on the results of the audit. See Appendix D for the report distribution.

  
Thomas F. Gimble

Director  
Acquisition Management Directorate

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Office of the Inspector General, DoD

Project No. D2000AL-0101.000

(formerly Project No. OAL-0123)

May 26, 2000

## V-22 Osprey Joint Advanced Vertical Aircraft

### Executive Summary

**Introduction.** The V-22 Osprey Joint Advanced Vertical Aircraft (V-22) is a tilt-rotor, short-take-off-and-landing aircraft, which was developed to fulfill multi-Service operational requirements. The V-22 operates as a helicopter for takeoffs and landings and, once airborne, converts to a turboprop aircraft. The V-22 acquisition is in the engineering, manufacturing, and development phase of the acquisition cycle and is scheduled for a Milestone III full-rate production decision in December 2000. The Program Manager, V-22 Osprey Joint Advanced Vertical Aircraft, manages the V-22 acquisition program under the Program Executive Officer, Air Anti-Submarine Warfare, Assault, and Special Mission Programs. As of December 31, 1999, the V-22 Program Management Office estimated that the total program cost for 458 V-22 aircraft (360 aircraft for the Marine Corps, 50 aircraft for the Air Force Special Operations Command, and 48 aircraft for the Navy) was \$38.1 billion (then-year dollars).

**Objective.** The overall audit objective was to evaluate the acquisition management of the V-22. Specifically, the audit determined whether the Marine Corps variant of the V-22 was ready for the Milestone III full-rate production decision scheduled for December 2000. We also reviewed the management control program as it applied to the audit objective.

**Results.** The V-22 aircraft had 23 major operational deficiencies that will not be corrected and tested before the Milestone III full-rate production decision in December 2000. Key test and evaluation objectives are required to be accomplished before the Milestone III review. In addition, DoD did not provide adequate funding for V-22 aircraft logistical support to obtain the required fully mission-capable rate of 75 percent. Unless the V-22 Program Management Office can demonstrate that these issues are being effectively addressed, the Milestone Decision Authority cannot be reasonably assured that the V-22 will meet all its operational requirements and be able to perform the full range of missions required by the Joint Operational Requirements Document. For details of the audit results, see the Finding section of the report. For a discussion of the management control program, see Appendix A.

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**Summary of Recommendations.** We recommend that the V-22 Program Management Office, prior to the Milestone III review, develop a detailed plan that includes the specific actions to correct the 23 major operational requirements deficiencies that were waived from operational testing, the dates when the operational requirements deficiencies will be corrected, the dates when the operational requirements deficiencies will be tested, the funding amount needed to correct the deficiencies and to retrofit existing aircraft, and the actions to provide adequate logistics support.

**Management Comments.** We request that the V-22 Program Manager comment on this report by June 26, 2000.

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## Background

The V-22 Osprey Joint Advanced Vertical Aircraft (V-22) is a tilt-rotor, short-take-off-and-landing aircraft, which was developed to fulfill multi-Service operational requirements. The V-22 operates as a helicopter for takeoffs and landings and, once airborne, converts to a turboprop aircraft. The V-22 carries up to 24 combat-equipped soldiers and has a self-deployment capability of 2,100 nautical miles with a single aerial refueling. The V-22 design incorporates advanced technologies in composite materials, survivability, fly-by-wire controls, and digital avionics.

The V-22 has three variants: The Marine Corps Combat Assault and Assault Support aircraft, which is designated as the V-22 baseline variant; the Navy variant, which is used for Combat Search and Rescue, Special Warfare, and Fleet Logistical Support; and the Air Force variant for Special Operations missions, which will maintain maximum commonality with the Marine Corps variant. Aircraft avionics peculiar to the Air Force mission requirements constitute the aircraft's differences.

As of December 31, 1999, the V-22 Program Management Office estimated that the total program cost for 458 V-22 aircraft (360 aircraft for the Marine Corps, 50 aircraft for the Air Force Special Operations Command, and 48 aircraft for the Navy was \$38.1 billion (then-year dollars).

The V-22 is in the engineering and manufacturing development phase of the acquisition cycle. The V-22 Program Manager manages the V-22 acquisition program under the Program Executive Officer, Air Anti-Submarine Warfare, Assault, and Special Mission Programs (the Program Executive Officer). Bell Helicopters Textron and Boeing Helicopters Division teamed up to develop and produce the V-22.

The V-22 will provide the Services with an improved capability for combat, combat support, combat service support, and special operations missions. The V-22 will conduct worldwide operations during contingencies; conventional and unconventional warfare; and tactical nuclear, biological, or chemical warfare. The primary missions of the V-22 will be amphibious assault, long-range infiltration, and resupply of Special Operations Forces. Secondary missions will include land assault, medical evacuation, fleet logistics support, and special warfare.

The V-22 program started in December 1981 and was originally managed by the Army until it was transferred to the Navy in January 1983. The Under Secretary of Defense (Acquisition, Technology, and Logistics) approved the Marine Corps variant of the V-22 to enter low-rate initial production in an April 25, 1997, Acquisition Decision Memorandum. The Acquisition Decision Memorandum also delegated future V-22 production decisions to the Navy. The Navy Acquisition Executive approved the Acquisition Program Baseline on July 16, 1998. The approved program cost for the V-22 aircraft is approximately \$53 billion (then-year dollars).

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In the December 31, 1999, Selected Acquisition Report, the V-22 Program Manager reported that no cost or schedule breaches had occurred to the Acquisition Program Baseline. The V-22 operational test and evaluation began on November 1, 1999, and the V-22 Program Manager was striving toward a Milestone III full-rate production decision in October 2000, which was 2 months before the December 2000 Milestone III date in the Acquisition Program Baseline.

As of December 31, 1999, the Program Management Office estimated the program acquisition unit cost for 458 V-22 aircraft was \$55 million each (FY 1986 base-year dollars), which was 6.3 percent more than the Acquisition Program Baseline estimate of \$52 million each for 523 aircraft. However, when escalation is considered, the Program Management Office estimate per unit cost for 458 V-22 aircraft was \$83.2 million (then-year dollars), which was 17.8 percent less than the Acquisition Program Baseline estimate of \$101.2 million for 523 aircraft.

## Objectives

The overall audit objective was to evaluate the acquisition management of the V-22. Specifically, the audit determined whether the Marine Corps V-22 was ready for a Milestone III full-rate production decision. The audit was conducted in accordance with the Inspector General, DoD, critical program management element approach. See Appendix A for a discussion of the audit scope and methodology, the management control program, and prior coverage.

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## V-22 Milestone III Full-Rate Production Decision

The V-22 program will not successfully complete the key operational test and evaluation objectives required to be accomplished before a Milestone III full-rate production decision. This condition occurred because 23 deficiencies in major operational effectiveness and suitability requirements had not been corrected and would not be tested in time for the Milestone III review in December 2000. In addition, adequate funding was not available to provide logistical support for the existing V-22 aircraft. Unless the V-22 Program Management Office can demonstrate that these issues are being effectively addressed, the Milestone Decision Authority cannot be reasonably assured that the V-22 will meet its operational requirements and be able to perform the full range of missions required by the Joint Operational Requirements Document.

### Milestone Decision

The V-22 will not successfully demonstrate test and evaluation of key operational requirements before the Milestone III full-rate production decision. The V-22 Program Management Office recognized that the V-22 aircraft would not meet its operational effectiveness and suitability requirements and all operational requirements would not be tested by the scheduled date of the full-rate production milestone decision. The Program Executive Officer requested waivers of these 23 major operational effectiveness and suitability requirements deficiencies from operational evaluation testing. However, the V-22 Program Management Office was striving for a Milestone III decision in October 2000, which is 2 months ahead of the scheduled Milestone III decision.

### Operational Effectiveness and Suitability

**Operational Testing.** Successful accomplishment of test and evaluation objectives is a key requirement for DoD weapon system acquisition decisions to commit significant additional resources to a program and to move from one acquisition phase to the next. Change 4 of DoD Regulation 5000.2-R, "Mandatory Procedures for Major Defense Acquisition Programs and Major Automated Information System Acquisition Programs," May 11, 1999, provides mandatory policies and procedures for the management and progression of acquisition programs. DoD Regulation 5000.2-R requires that test and evaluation programs be part of a strategy to provide information on risk and risk mitigation; to provide an assessment of technical performance specifications and system maturity; and to determine whether systems are operationally effective, suitable, and survivable for intended use. Test planning, at a minimum, must address all system components that are critical to achieving and demonstrating the contract technical performance specifications, operational effectiveness, and suitability that are required by the Joint Operational Requirements Document.

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The desire to meet milestones resulted in demands being made to complete operational test and evaluation quickly and to continue production. Consequently, program officials accepted a higher level of risk to get the program into production, despite uncertainties that the system would work as intended, rather than delaying the program and risk losing the funding. After the V-22 Program Management Office and the contractor conducted integrated operational assessments to determine the readiness of the V-22 for operational evaluation testing, the V-22 Program Management Office recognized that all of the operational requirements deficiencies would not be corrected in time for operational evaluation testing.

**Integrated Operational Assessments.** The Government and the contractor conducted integrated operational assessment testing of the V-22 to determine the potential operational effectiveness, suitability, and readiness of the aircraft for operational evaluation testing. The test was designed to assess critical operational effectiveness and suitability issues that must be examined during operational test and evaluation to determine the V-22 capability to perform its intended missions. Appendix B provides a list of the V-22 aircraft critical operational issues. The Naval Air Warfare Center released the results of the integrated operational assessment on September 20, 1999. The report stated that major tests planned for the V-22 were not completed. The report identified limitations in major operational effectiveness and stated that additional testing would be needed to resolve the critical operational issues; however, fixes would not be in place to support operational evaluation testing. The report further stated that late equipment delivery and faulty development, redesign, and associated testing hampered resolution of these deficiencies. In addition, the report recommended various flight envelope and mission limitations, and prohibited maneuvers and operations for operational evaluation testing. However, despite the limitations, the report recommended that the V-22 proceed to operational evaluation testing.

## Waiver of Testing Requirements

**Waiver Request.** The V-22 Test and Evaluation Master Plan, July 28, 1999, contains the measures of operational effectiveness and suitability derived from the V-22 Joint Operational Requirements Document. All V-22 critical operational issues were to be evaluated as part of operational testing. The V-22 Program Management Office recognized that all of the operational requirements deficiencies would not be corrected in time for operational evaluation testing. To not delay operational evaluation testing, the Program Executive Officer requested waivers of operational evaluation testing for major operational effectiveness and suitability requirements deficiencies that were noted during integrated operational assessments. Operational effectiveness is the overall degree of a system's mission accomplishment when it is used by representative personnel in the environment planned or expected for operational employment of the system. The V-22 was required to meet measures of operational effectiveness for payload, cruise speed, self-deployment capability, vertical short-take-off and-landing capability, shipboard compatibility, aerial refueling capability, and survivability. Operational suitability is the degree to which a

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system can be satisfactorily fielded, with consideration given to reliability, availability, compatibility, transportability, interoperability, wartime usage rates, maintainability, safety, human factors, manpower supportability, and logistics support. The V-22 was required to meet measures of operational suitability for reliability, availability, maintainability, and diagnostics.

Reliability, availability, and maintainability are among the most important criteria for an aircraft. They define the readiness and dependability of the aircraft performance. The V-22 Program Management Office stated that the aircraft would not meet the reliability, availability, and maintainability operational requirements until after operational test and evaluation was completed and over 1 year after the Milestone III full-rate production decision scheduled for December 2000. The Program Executive Officer also requested waivers for other stated operational requirements such as internal cargo payloads, shipboard short-take-off for mission-specific weights, the ability to operate in icing conditions, crashworthy auxillary fuel tanks, nuclear biological and chemical survivability, a ground collision avoidance and warning system, battle damage repair, exterior lighting for night vision goggle flight, and air combat maneuvering. The waiver requests stated that all deficiencies would not be corrected and tested for operational effectiveness and suitability before the Milestone III full-rate production decision in December 2000. The Program Executive Officer certified that the V-22 was ready for operational evaluation testing, even though he had requested waivers because the V-22 could not meet all operational effectiveness and suitability requirements.

**Waiver Approval.** The Director, Air Warfare Division, Office of the Chief of Naval Operations (the Director), concluded that the V-22 was ready to begin operational evaluation testing. In September 1999, the Director approved temporary waivers for 23 major operational requirements deficiencies. Waivers do not dispense with the requirement; instead, they postpone compliance with the requirement until after operational test and evaluation is completed. The deficiencies would not be corrected and tested until follow-on operational test and evaluation (follow-on testing), which will occur well after the Milestone III full-rate production decision scheduled in December 2000. In granting the waivers from operational test and evaluation, the Director expressed concern that the mean time between failure rate would not be met until after completion of operational evaluation testing. The Director rationalized that the V-22 exceeded all key performance parameters and that, although deficiencies in temporarily waived requirements would not be tested during operational evaluation, the V-22 Program did have a clearly established follow-on test and evaluation date.

The Director also approved waivers for 24 other non-major operational requirements deficiencies. Although these deficiencies reduced survivability and increased maintenance, the V-22 Program Management Office did not consider their impact upon the operation of the V-22 significant enough to delay operational evaluation testing or to commit scarce resources for their correction. Correction of the 24 non-major deficiencies depends solely upon additional funding becoming available.

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**Follow-on Operational Testing.** The V-22 Test and Evaluation Master Plan established four periods of follow-on testing for the V-22. Follow-on testing was scheduled to begin in October 2000. With the exception of installing a defensive weapon system on the aircraft, the V-22 Program Management Office planned to correct and test the other major operational requirements deficiencies by February 2002. Program management officials stated that they knew how to correct the deficiencies, and that the corrections would be made before the scheduled follow-on testing. However, the V-22 Program Management Office had not developed a detailed plan that included the actions required to correct the temporarily waived requirements deficiencies, the funding required to correct the deficiencies, and the funding required to retrofit existing aircraft. Appendix C lists the major operational requirements waivers that the Program Executive Officer requested and the dates by which the requirements deficiencies would be corrected and tested during follow-on testing. Appendix C also lists the non-major requirements deficiencies that were not planned to be corrected without additional funding.

### Logistics Support Funding

If the operational test and evaluation did demonstrate that the V-22 was technically sound, operationally effective, suitable, and survivable for its intended use, the V-22 Program Management Office would still not have the funds it needs to support the aircraft at the required level. The V-22 Program Management Office identified and effectively planned for each of the logistics support elements: Maintenance; Manpower and Personnel; Supply Support; Support Equipment; Technical Manuals and Technical Data; Training and Training Devices; Computer Resources Support; Facilities, and Packaging, Handling, Storage, and Transportation Planning. The Chief of Naval Operations requires a 75 percent, fully mission-capable rate for the V-22. However, the V-22 Program Management Office estimated that it needs additional funding of \$18.3 million in FY 2001 and \$47.8 million in FY 2002 to meet a 75 percent, fully mission-capable rate.

In formulating its budget request, the V-22 Program Management Office requested funding required to ensure that the V-22 aircraft achieved a 75 percent, fully mission-capable rate. To achieve that rate, the V-22 Program Management Office will require \$124.3 million for spare parts in FY 2001 and \$256.8 million in FY 2002. However, the DoD budget submitted to the President requested only \$106 million in FY 2001, a reduction of \$18.3 million, and only \$209 million in FY 2002, a reduction of \$47.8 million. That level of funding would provide the V-22 with a fully mission-capable rate of 70 percent in FY 2001 and 64 percent in FY 2002.

Funding shortfalls in Research, Development, and Test and Evaluation funding for FYs 1998 through 2001 prevented completing three repair projects that would have developed repair procedures and reduced the quantities of spare parts required to support the V-22. Delaying and terminating the repair projects

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for extremely expensive composite dynamic components means that repair procedures will not be provided, which will result in replacing the components instead of repairing them and adding spare parts requirements to an already underfunded account.

Congress increased the number of aircraft to be produced during low-rate initial production of the Marine Corps V-22. However, when Congress provided additional production funds for additional aircraft, it did not provide funding needed for the additional logistics support. By not providing the additional logistics support funding for the increased number of aircraft, Congress created an even larger logistics support funding shortfall within the V-22 Program. If the V-22 program is not fully funded to its required logistics support levels, it will not be able to:

- fully support the initial fielding of the V-22 aircraft,
- meet the requirement in the Joint Operational Requirements Document for rapid repair of minor battle damage by maintenance personnel in the field, and
- meet the 75 percent, fully mission-capable rate required by the Chief of Naval Operations.

The Program Executive Office is working with the Naval Air Systems Command to identify the requirements and funding needed to resolve the issues.

## Effects of a Full-Rate Production Decision

Successful test and evaluation objectives include testing system performance in a realistic environment and rigorously assessing critical performance to reduce uncertainty and risk that a system will not fulfill its requirements. The V-22 Program Management Office recognized that all operational requirements deficiencies would not be corrected in time for operational evaluation testing and the scheduled Milestone III full-rate production decision date. The V-22 did not meet all operational effectiveness and suitability requirements before entering operational evaluation testing, and temporary waivers were obtained to test the requirements during follow-on testing from October 2000 through July 2004. It is important for the V-22 Program Management Office to develop a detailed plan that includes the actions to correct the temporarily waived requirements deficiencies and the funding amounts to correct the deficiencies and retrofit existing aircraft. The V-22 Program Management Office also needs to effectively plan and execute all the logistics support elements to ensure that the soldier will be able to operate, maintain, and support the system. If the Navy Acquisition Executive approves the full-rate production decision in December 2000, the V-22 Program Management Office plans to begin full-rate production in FY 2001 and to produce about 66 aircraft by the time the follow-on testing has concluded in FY 2004.

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Beginning full-rate production at the same time that major deficiencies are still undergoing operational testing could result in the V-22 Program's incurring additional costs to correct deficiencies in existing aircraft, and also in fielding aircraft that will not be able to perform all of the missions required. Failure to test and correct the deficiencies could adversely affect the survivability, logistics support, and readiness of the aircraft and its ability to fully perform its intended mission. Therefore, we believe the V-22 Program Management Office needs to take additional steps to demonstrate that the aircraft is ready for a Milestone III full-rate production decision. If the full-rate production decision is held as planned in December 2000, and if the V-22 Program Management Office has not developed a plan to correct deficiencies and fund the logistics support requirements, the Milestone Decision Authority cannot be reasonably assured that the V-22 will meet all its operational requirements and be able to perform the full range of missions required by the Joint Operational Requirements Document.

## Recommendations

We recommend that the V-22 Program Manager, prior to the Milestone III review, develop a detailed plan that includes the following:

1. Specific actions required to correct the 23 waived major operational requirements,
2. Dates by which the operational requirements will be corrected,
3. Dates by which the operational requirements will be tested,
4. Funding amounts that will correct the deficiencies and retrofit existing aircraft, and
5. Actions to ensure adequate logistics support.

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## Appendix A. Audit Process

### Scope and Methodology

We performed this program audit from December 1999 through May 2000, in accordance with standards issued by the Comptroller General of the United States, as implemented by the Inspector General, DoD, and included such tests of management controls as deemed necessary.

We reviewed documentation dated from April 1995 through April 2000. We used criteria in the DoD Regulation 5000.2-R to perform the audit. To accomplish the audit objectives, we took the following steps:

- determined the users had adequately defined the aircraft requirements;
- determined the V-22 Program Management Office had developed and implemented an acquisition plan, a risk management plan, a logistics plan, a test and evaluation plan, and a manufacturing and production plan;
- determined the V-22 program's operational test and evaluation included all of the system's operational requirements, as defined in the Joint Operational Requirements Document;
- determined the V-22 Program Management Office had developed a configuration management program or process;
- determined the design of the V-22 aircraft was stable;
- determined the V-22 Program Management-Office had prepared a life-cycle cost estimate for the program;
- determined the V-22 Program Management Office's used integrated product teams and metrics; and
- reviewed management controls related to the audit objective.

We did not use computer-processed data to perform this audit. We visited or contacted individuals and organizations within the Department of the Navy. We also visited or contacted individuals and organizations within DoD. Further details are available upon request.

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**DoD-wide Corporate Level Government Performance and Results Act (GPRA) Goals.** In response to the GPRA, the Secretary of Defense annually establishes DoD-wide corporate level goals, subordinate performance goals, and performance measures. This report pertains to achievement of the following goal, subordinate performance goal, and performance measures:

**FY 2000 Corporate Level Goal 2:** Prepare now for an uncertain future by pursuing a focused modernization effort that maintains U.S. qualitative superiority in key warfighting capabilities. Transform the force by exploiting the Revolution in Military Affairs, and reengineer the Department to achieve a 21st century infrastructure. (00-DoD-2)

**FY 2000 Subordinate Performance Goal 2.4:** Meet combat forces' needs smarter and faster, with products and services that work better and cost less, by improving the efficiency of DoD acquisition processes. (00-DoD-2.4)

**FY 2000 Performance Measure 2.4.1:** Major Defense Acquisition Program Cost Growth (In Percents) (00-DoD-2.4.1)

**FY 2000 Performance Measure 2.4.2:** Major Defense Acquisition Program Cycle Time (00-DoD-2.4.2)

**FY 2000 Performance Measure 2.4.3:** Successful Completion of System Operational Test and Evaluation (OT&E) Events. (00-DoD-2.4.3)

**General Accounting Office High-Risk Area.** The General Accounting Office has identified several high-risk areas in the DoD. This report provides coverage of the Defense Weapons System Acquisition high-risk area.

## Management Control Program

DoD Directive 5010.38, "Management Control (MC) Program," August 26, 1996, and DoD Instruction 5010.40, "Management Control (MC) Program Procedures," require DoD managers to implement a comprehensive system of management controls that provides reasonable assurance that programs are operating as intended and to evaluate the adequacy of the controls.

**Scope of Review of the Management Control Program.** In accordance with DoD Directive 5000.1, "Defense Acquisition," March 15, 1996, and DoD Regulation 5000.2-R, Mandatory Procedures for Major Defense Acquisition Programs (MDAPs) and Major Automated Information System Acquisition Programs (MAIS), May 11, 1999, acquisition managers are to use program cost, schedule, and performance parameters as control objectives to implement the requirements of DoD 5010.38. Accordingly, we limited our review to management controls directly related to the acquisition management of the V-22.

In evaluating the management control process, we reviewed the risk-management program to determine the level of risk that the officials assigned to aspects of the aircraft. We also reviewed the FYs 1998 and 1999 Annual

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Statements of Assurance for the Navy to determine whether any weaknesses had been reported relating to the V-22 program. Because we did not identify a material management control weakness, we did not assess management's self-evaluation.

**Adequacy of Management Controls.** Management controls were adequate in that we did not identify any systemic management control weakness applicable to our audit objective.

## **Prior Coverage**

During the last 5 years, the General Accounting Office issued one audit report that discussed the requirements of the V-22.

General Accounting Office Report No. NSIAD-98-13 (OSD Case No. 1953), "Navy Aviation: V-22 Cost and Capability to Meet Requirements are yet to be Determined," October 22, 1997.

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## Appendix B. V-22 Critical Operational Issues

The Test and Evaluation Master Plan addresses certain critical operational issues for examination during operational test and evaluation. A critical operational issue is defined as a key operational effectiveness or operational suitability issue that must be examined to determine the system's capability to perform its mission.

### Effectiveness Issues

**Assault Support** - Will the V-22 demonstrate the operational performance necessary to effectively execute assault support operations in its intended operating environment?

**Self-Deployment** - Will the V-22 demonstrate the operational performance necessary to effectively self-deploy in its intended operating environment?

**Survivability** - Will the susceptibility and vulnerability characteristics of the V-22 allow the successful completion of its mission in its intended operating environment?

**Tactics** - Will the tactics developed for the V-22 support effective employment in its intended operating environment?

### Suitability Issues

**Reliability** - Will the V-22 be reliable in its intended operating environment?

**Availability** - Will the availability of the V-22 support its mission?

**Maintainability** - Will the V-22 be maintainable in its intended operating environment?

**Logistic Supportability** - Will the V-22 be logistically supportable?

**Compatibility** - Will the V-22 be compatible with its operating environment?

**Interoperability** - Will the V-22 effectively interface with corresponding systems or units of other U.S. and Allied forces in the execution of its intended operational mission?

**Training** - Will the V-22 be suitable for operator and maintenance personnel?

**Human Factors** - Will the man-machine interface of the V-22 be suitable?

**Safety** - Will the V-22 be safe to operate and maintain?

**Documentation** - Will the V-22 technical documentation support operation and maintenance of the V-22?

**Diagnostics** - Will the V-22 diagnostic capabilities be adequate, reliable, and accurate?

**Software** - Will the V-22 software be reliable, logistically supportable, mature, and year 2000 compliant?

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## Appendix C. Waived Operational Requirements for the V-22

### Major Deficiencies Waived from Operational Evaluation Testing

According to the V-22 Program Management Office, waivers are temporary and include identified corrective actions, but they are not available in the low-rate initial production aircraft configurations. The follow-on testing would test the items that were waived from operational testing.

#### Planned Correction in Follow-on Operational Test and Evaluation - III-A (October 2000 through January 2001)

- Inadequate cargo handling system
- Inadequate cockpit/cabin nuclear, biological, and chemical overpressure protection
- Excessive force required to disconnect the intercommunication system
- Radar altimeter ineffective during forward-hook and dual-point external loads
- Unable to align Light Weight Inertial Navigation System without Global Positioning System signal
- Aircraft not cleared to operate in icing conditions
- Maximum short take off (shipboard) 48,500 pounds rather than mission profile specific weight
- Aircraft not cleared to refuel from a KC-135 tanker
- Unable to embark and operate 24 aircraft from a general-purpose amphibious assault ship or multi-purpose amphibious assault ship
- Aircraft not cleared for air combat maneuvering.

#### Planned Correction in Follow-on Operational Test and Evaluation - III-B (December 2001 through-February 2002)

- False alarm rate not met
- Mean time between failure rate not met
- Pilot isolation from intercommunication system while transmitting in unsecured mode
- Low reliability of multifunction display
- Low reliability of the V-22B weapon system

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- Avionics Navigation System does not provide data other than World Geodetic System
- Deterioration and cracking of the nitrile rubber clamps
- Pilot and copilot seats incorporate nonqualified part list inertial reels in the shoulder harness restraint system
- AN/APR-39A(V)2 degraded Band 2 analysis of alternatives
- Crashworthy auxiliary fuel tanks not available
- Ground collision avoidance and warning system not available.

## **Planned Correction in Follow-on Operational Test and Evaluation - III-C (April through July 2003)**

No temporary waived operational requirements were scheduled for testing and evaluation during this period.

## **Planned Correction in Follow-on Operational Test and Evaluation - III-D (May through July 2004)**

Defensive weapon system not available.

## **Non-Major Operational Requirements Deficiencies**

Non-major operational requirements deficiencies or threshold requirements are considered valid, but they do not restrict the V-22 from meeting its mission. The V-22 Program Management Office believed that it did not need to delay operational test and evaluation or to commit scarce program resources to correct the following deficiencies before operational test and evaluation.

- Poor wheel braking system integration and pilot interference
- Adverse longitudinal stick requirements during conversion or reconversion from airplane mode
- Unacceptable drop out of mission computers
- Excessive lateral directional trim requirements during simulated in-flight refueling at 60 degree nacelle
- No indications of longitudinal maneuvering capability to the pilot
- Potential single pilot failure and multiple electrical power source grounds
- Improper direct current ground wire (PA75A1N and P75A0N) connections
- Feed tank vent location promotes impingement on the aircraft
- Excessive failure of mini-mark IV fasteners
- Aircraft settling due to loss of interim power

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- Inadequate installed performance of AN/AVR-2A system
- AN/AVR-2A false alarms
- Aircraft tie-down chains contact airframe
- Identification friend or foe Mode 4 fault indications
- Cabin door open/close
- Hydraulic line failures due to engine air particle separator motor failure
- Movement of aircraft to hangar aboard ship requires removal of refueling probe extension
- Position lights cannot be used with night vision goggles
- Infra-red searchlight is not dimmable
- Aircraft is limited to +/- 5 degree deck roll (+/- 8 degree is requirement)
- Do not have battle damage assessment and repair procedures
- Do not have chaff and flare expendable switches located in the scanner and observer stations
- Aircraft external and internal surfaces are not resistant to the adherence or effects of contaminant agents
- Hoist cable length is 205 feet instead of 235 feet.