United States General Accounting Office

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Report to the Chairman, Subcommittee on Defense, Committee on Appropriations, House of Representatives

June 1999

DEFENSE COMPUTERS

Management Controls Are Critical to Effective Year 2000 Testing

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Accounting and Information
Management Division

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June 30, 1999

The Honorable Jerry Lewis
Chairman, Subcommittee on Defense
Committee on Appropriations
House of Representatives

Dear Mr. Chairman:

You requested that we review the Department of Defense's (DOD) efforts to integrate and coordinate its various Year 2000 end-to-end test activities.[1] DOD's approach to conducting Year 2000 end-to-end testing is to have

- the military services conduct system integration testing,
- the Office of the Secretary of Defense (OSD) coordinate, facilitate, and monitor test and evaluation activities carried out by the military services, Defense agencies, and Commanders in Chief (CINC)[2] and, in some cases conduct end-to-end testing for key functional areas such as logistics, communications, and personnel, and
- the CINCs conduct military operational exercises to verify their Year 2000 mission readiness.

An important aspect of effective end-to-end testing is establishing and implementing management controls that help ensure that tests are planned, executed, and reported on, among other things, in an integrated fashion, and that managers receive timely, reliable, and verifiable information on test results and limitations. Thus, we agreed with your staff to determine whether (1) DOD's plans recognize relationships and dependencies among these test and evaluation activities and (2) DOD has established the management controls to ensure that its various Year 2000 end-to-end test and evaluation activities are effectively integrated. As DOD conducts

[1]End-to-end Year 2000 testing refers to testing performed to verify that a defined set of interrelated systems, which collectively support an organizational core business function or operation, interoperate as intended in a Year 2000 environment. There are three other phases of testing that should precede end-to-end testing, including software unit testing, software integration testing, and system acceptance testing.

[2]CINCs are responsible for DOD's unified combatant commands, which include the Atlantic Command, Central Command, European Command, Pacific Command, United States Forces Korea, Southern Command, Space Command, North American Aerospace Defense Command, Special Operations Command, Strategic Command, and Transportation Command.

specific test and evaluation events, we will be separately reporting to you on the DOD's effectiveness in managing these events, including its implementation of end-to-end test management controls. We performed our audit work from October 1998 through April 1999 in accordance with generally accepted government auditing standards. For additional information on our objectives, scope, and methodology, see appendix I. The Office of the Assistant Secretary of Defense provided written comments on a draft of this report. These comments are discussed at the end of this report and reprinted in appendix Ⅳ.

Results in Brief

DOD's end-to-end test and evaluation plans that were available at the time of our review recognize relationships and dependencies among various end-to-end test and evaluation activities. For example, the North American Aerospace Defense Command (NORAD) operational evaluation plans[3] linked the various service and Defense agency information systems to its mission-critical warfighting tasks and operational evaluation scenarios. Similarly, the Army systems integration test plan specified five phases of integration testing activities, one of which was end-to-end testing by the functional areas and another of which was operational evaluations by the combatant commands.

We also found that OSD and the Joint Chiefs of Staff (JCS), in order to integrate its various Year 2000 end-to-end test activities, are establishing test and evaluation management controls (structures and processes) that are consistent with the end-to-end test management controls specified in our Year 2000 test guide.[4] For example, in August 1998, the Secretary of Defense assigned the CINCs with responsibility for conducting Year 2000 exercises to verify operational readiness. Later in the same month, the Deputy Secretary of Defense assigned interorganizational responsibility and authority for the various end-to-end test activities to OSD functional area focal points to ensure Year 2000 readiness for key functional areas that support the combatant commands' operations.

Also, both OSD and JCS subsequently issued guidance to the military services, Defense agencies and activities, and the CINCs specifying how

[3]NORAD's plans for the first two phases of its operational evaluations were entitled Vigilant Virgo 99-1 and Amalgam Virgo 99-2.

[4]Year 2000 Computing Crisis: A Testing Guide (GAO/AIMD-10.1.21, issued as an exposure draft in June 1998; issued in final in November 1998).

these respective Year 2000 test and evaluation activities were to be planned, executed, and reported. Further, JCS and OSD have established data bases to collect specified data on the respective end-to-end test and evaluation activities. OSD has also established a Year 2000 test and evaluation function to independently evaluate, among other things, end-to-end test and evaluation results. To do this, the designated test director is in the process of defining an assurance-based approach and metrics for measuring the confidence that can be attached to specific test event results. However, this approach and associated metrics have yet to be established, and little time remains for doing so.

While DOD's planning efforts are being coordinated to recognize the relationships among end-to-end test and evaluation activities and it is establishing controls for managing these relationships, there are still significant challenges confronting DOD in the actual execution of these tests. The primary challenge, of course, is time. With less than 7 months remaining before the Year 2000 deadline, Defense cannot afford major slippages in its test and evaluation schedule nor does it have the luxury of redoing tests that prove ineffective or incomplete. Exacerbating this pressure is the fact that, according to Defense, 245 of DOD's 2,038 mission-critical systems—some of which are needed to execute test and evaluation activities—are not yet Year 2000 compliant, and thus may require invocation of system contingency plans as part of the test and evaluation event.

With so little time remaining for DOD's many organizational components to conduct hundreds of related end-to-end test events, it will be important that end-to-end test and evaluation events are well-managed. In particular, DOD must ensure that its established controls are effectively implemented for each test event. Also, we are recommending that DOD ensure that controls are established for independently ensuring that CINCs, military services, and Defense agencies adhere to established end-to-end test and evaluation guidance, plans, and standards. By doing this, the department's executive leadership can receive timely and reliable information on test results, progress, and limitations, such as gaps in the scope of end-to-end test events due to the unavailability of compliant systems or tested contingency plans. With such information, DOD leaders can act swiftly to address mission areas at risk by filling voids in test coverage either through additional end-to-end test and evaluation or through contingency planning. In commenting on a draft of this report, DOD concurred with our recommendations and noted that it is taking actions to implement a quality

assurance program and reinforce the importance of adhering to testing and evaluation management controls.

Background

To protect the security of the United States, DOD relies on a complex array of computer-dependent and mutually supportive organizational components, including the military services, CINCs, and Defense agencies. It also relies on a broad array of computer systems, which include weapon systems, command and control systems, satellite systems, inventory management systems, transportation management systems, health systems, financial systems, personnel systems, and payment systems. In turn, these systems share thousands of interface connections with systems belonging to private contractors, other government agencies, and international organizations.

To effectively ensure that this immense and complex array of organizational units and supporting computer systems is ready for the Year 2000, DOD must verify not only that individual systems function correctly in a Year 2000 environment, but also that sets of interrelated and interconnected systems properly interoperate in such an environment. The depth and complexity of DOD's organizational structure and its dependency on computer systems is further illustrated in appendix II.

GAO's Past Work on DOD's Overall Year 2000 Program Has Identified the Need for Management Controls

Over the last 2 years, we have reviewed DOD's Year 2000 efforts and progress, and made recommendations to strengthen program management. In response, DOD has taken steps to implement our recommendations by providing the controls and guidance needed to fix and test individual systems. It has also appropriately shifted its focus to core business areas (i.e., functional areas such as logistics and communications, and combatant commands' operational areas). Also, the Deputy Secretary has personally become actively engaged in directing and monitoring Year 2000 efforts. We recently testified that a key to the success of these steps rested in putting in place (i.e., establishing, implementing, and enforcing) effective management controls for DOD to have timely and reliable information to know what is going right and what is going wrong so that corrective action can be swift and effective.[5] We also identified the need for DOD to gain greater visibility into each of its core business area's Year 2000 risks and

[5]Year 2000 Computing Crisis: Defense Has Made Progress, But Additional Management Controls Are Needed (GAO/T-AIMD-99-101, March 2, 1999).

readiness. One of the critical areas of visibility that we cited in this regard was end-to-end test activities.

End-to-End Testing Is an Essential Part of an Effective Year 2000 Test Program

Complete and thorough Year 2000 testing is essential to provide reasonable, but not absolute, assurance that (1) new or modified systems process dates correctly and (2) an organization's ability to perform core business operations and functions will not be jeopardized after the millenium. To be done effectively, this testing should be managed in a structured and disciplined fashion.

Our Year 2000 test guide defines a step-by-step framework for managing all Year 2000 test activities. This framework sets forth five levels of test activity supported by continuous management oversight and control. The first level establishes the organizational key processes needed to effectively direct and support the next four levels. The other four levels define key processes for planning, conducting, and reporting on tests of incrementally larger system components, beginning with tests of software units and culminating with tests of sets of interrelated systems, referred to as end-to-end testing.

The purpose of end-to-end testing is to verify that a defined set of interrelated systems, which collectively support an organizational core business area or operation, interoperate as intended in an operational environment (either actual[6] or simulated). These interrelated systems include not only those owned and managed by the organization, but also the external systems with which they interface.

The boundaries for end-to-end tests are not fixed or predetermined, but rather vary depending on a given business function's or operation's system dependencies and criticality to the organizational mission. Therefore, in managing end-to-end test activities, it is important to analyze the interrelationships among core business functions/operations and their supporting systems and the mission impact and risk of date-induced systems failures. It is also important to work early and continually with functional/operational partners to ensure that related end-to-end test activities are effectively coordinated and integrated.

[6]Risks of testing in the production environment must be thoroughly analyzed and precautions taken to preclude damage to systems and data.

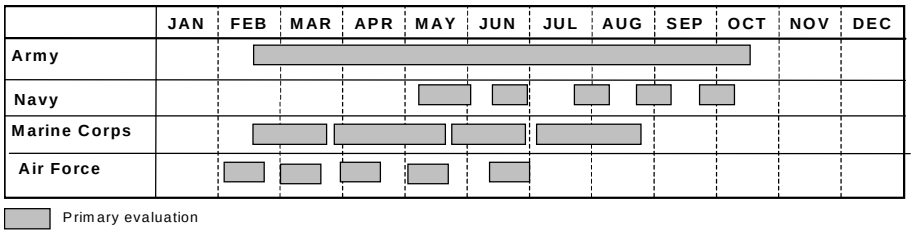
DOD Has Initiated Year 2000 End-to-End Test and Evaluation Activities

DOD has underway three closely related end-to-end test and evaluation efforts to verify that the department can perform core functional and operational missions in a Year 2000 environment. These are: (1) military service-sponsored system integration tests, (2) functional area Year 2000 end-to-end tests, and (3) CINC operational evaluations. Because the respective DOD organizational components that are conducting these test and evaluation efforts, as described earlier, are mutually dependent, each of these test efforts is also mutually dependent.

Military Service System Integration Testing

The military services are conducting system integration tests to ensure the correct functioning of the interfaces between interconnected systems and to demonstrate the Year 2000 readiness of selected business functions and operational capabilities. The services have developed system integration test plans that specify high-level test policy and schedules, and that build upon the individual system renovation and validation activities that they have already completed. The test plans specify how the military services will determine whether discrete systems can work together to perform the military service's missions, including organizing, training, and equipping their respective forces. For example, the Army plans to conduct the Air Defense Operations Test Case to demonstrate that the Air and Missile Defense Workstation can correctly exchange date/time information with Battlefield Functional Area Control Systems. As shown in figure 1, the military services have scheduled system integration tests from February 1999 through mid-October 1999.

Figure 1: Military Service System Integration Test Schedule (Calendar Year 1999)



Functional Area End-to-End Testing

In August 1998, the Deputy Secretary of Defense directed five OSD focal points, known as Principal Staff Assistants (PSAs), to ensure that their

respective lines of business or functional areas would continue to operate in the Year 2000.

Table 1: Functional Areas Designated for End-to-End Testing

Communications	Includes telecommunications and other systems used to transmit and receive information
Logistics	Includes management of material, operation of supply, maintenance activities, material transportation, base operations and support
Health/Medical	Includes providing medical care to active military personnel, dependents, and retirees
Personnel	Includes recruiting of new personnel, personnel relocation, civilian disability compensation, veterans education assistance, etc.
Intelligence	Includes collection, processing, integration, analysis and interpretation of available information concerning foreign countries or areas

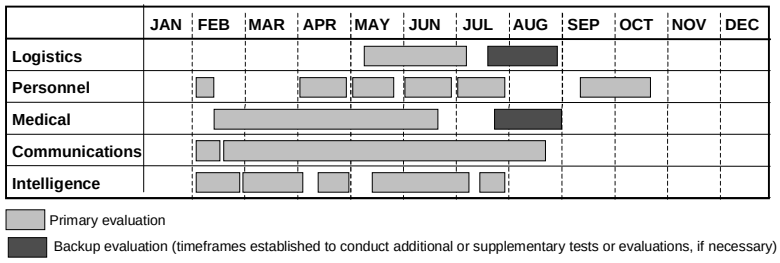
In response to the Deputy Secretary of Defense's direction, the PSAs, in collaboration with the military services and Defense agencies, are at various stages of planning and conducting Year 2000 functional end-to-end tests. Specifically, the PSAs have directed the appropriate military service and Defense agency components to identify core business processes, or "threads," within the respective functional areas. The PSAs are then to determine whether the military service and Defense agency testing and/or CINC Year 2000 operational evaluations (discussed in the next section) adequately assess the designated functional area threads. If not, the PSAs are to direct the appropriate military service or Defense agency component to develop, execute, and report the results of end-to-end tests to fill gaps in thread test coverage. In some cases, such as the health/medical functional area, the PSA may develop and execute the tests.

An example of a thread within the logistics functional area is the process that a soldier in the field follows to requisition and receive ammunition from the forward ammunition depot using the unit's automated requisitioning system and the appropriate distribution system. Testing this thread could involve the supply, transportation, reordering, and procurement activities.

Concurrent with the military services' and Defense agencies' functional thread designations, the PSAs have drafted high-level functional area end-to-end test plans and schedules and coordinated them with the military services and Defense agencies. As illustrated in figure 2, these plans show

that functional area end-to-end testing of specified threads will occur through October 1999.

Figure 2: End-to-End Testing Schedule for Functional Areas (Calendar Year 1999)



CINC Operational Evaluations

In August 1998, the Secretary of Defense directed the CINCs to plan and execute a series of simulated Year 2000 operational exercises.[7] According to the department, these exercises are to assess whether Defense can still perform the tasks that are critical to carrying out military missions in a Year 2000 environment (for example, tactical warning; transportation of goods, equipment, and personnel; deployment and sustainment of troops; command and control; air refueling; and aeromedical evacuation). DOD has defined almost 500 of these tasks.

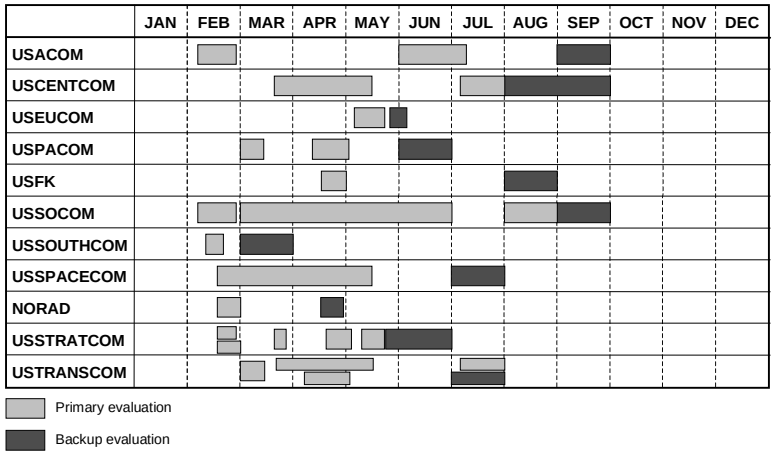
In response to the Secretary's direction, each CINC designated a particular operational mission(s) to evaluate and specified the minimum set of tasks needed to perform the mission(s). The CINCs then identified the minimum number of automated systems, known collectively as thin lines, that would be required to complete the critical tasks. For example, NORAD identified a thin line of 65 specific systems needed to complete its Integrated Tactical Warning/Attack Assessment task. Accordingly, it subsequently planned and conducted an operational evaluation to assess its capability to perform this task in a Year 2000 environment. That is, NORAD evaluated the capability of its systems to track and forward missile and space air threats to the National Military Command Center and Cheyenne Mountain Operations

[7]Memorandum from the Secretary of Defense, dated August 7, 1998, to the secretaries of the military departments, Chairman of the Joint Chiefs of Staff, Under Secretaries of Defense, et al., regarding Year 2000 compliance.

Center, with the mission support systems' clocks rolled forward to January 1, 2000.[8]

The CINCs, in collaboration with the military services and Defense agencies that support their respective operational missions, report that they are at varying stages of planning and executing their Year 2000 operational evaluations. According to DOD, JCS has scheduled 32 of these operational evaluations through September 1999 that will exercise a subset of DOD's tasks. As illustrated in figure 3, as of April 12, 1999, 13 evaluations had been reported as completed at seven different combatant commands.

Figure 3: CINC Operational Evaluations Schedule (Calendar Year 1999)



DOD Year 2000 End-to-End Test Plans Recognize Organizational and System Dependencies

The Deputy Secretary of Defense has acknowledged the need to ensure that DOD's Year 2000 end-to-end testing efforts recognize key mission relationships and dependencies between the CINCs, OSD functional areas, military services, and Defense agencies. Moreover, recent DOD Year 2000 test guidance specifies that the test plans should define relevant organizational and system relationships. Unless DOD's end-to-end test plans do so, the likelihood that key operations and functions will be adequately tested is greatly reduced.

[8]As noted in the introduction to this report, we will be reporting separately on DOD's effectiveness in managing this and other test and evaluation events.

We reviewed available plans for early operational evaluations as well as draft plans for the initial five functional end-to-end tests and the military service integration tests. Our review showed that DOD's Year 2000 end-to-end test and evaluation plans recognize relevant organization and supporting systems relationships and dependencies. The results of our review of the plans for the military service integration tests, functional area tests, and operational evaluations, respectively, are summarized below.

Military Service System Integration Test Plans

The military services have drafted system integration test plans. We reviewed the Army and the Navy system integration plans and found that they generally described relevant relationships with the functional area end-to-end test plans and the CINC operational evaluation plans.[9] For example, the Army plan defined its integration testing in five phases: (1) individual system testing, (2) OSD functional end-to-end testing, (3) CINC operational evaluations, (4) Army operational evaluation (to cover any mission threads the OSD and CINC testing did not), and (5) contingency assessment.[10] The Army plan also discussed the need to designate organizational responsibility for central, interorganizational coordination of each of the five phases.

Functional Area End-to-End Test Plans

Each of the initial five functional areas—communications, logistics, personnel, health/medical, and intelligence—have drafted test plans. Our review of drafts of these plans[11] showed that all five generally addressed relevant relationships with the CINC operational evaluations. For example, the logistics draft plan described how some functional threads relate to CINC operational thin lines, and it defined processes for coordinating and integrating more detailed test planning, execution, and reporting activities.

Also, the functional draft test plans generally described the relationships between the respective functional area testing and the military services' system integration testing. For example, the logistics test plan specified

[9]"U.S. Army Operation Order 99-01, Millennium Passage" (January 1999), "Naval Year 2000 Test Master Plan" (March 1999).

[10]Assessment designed to evaluate the ability of DOD to go to war in an environment degraded by Year 2000 failures.

[11]Updated plans included in our review were the December 15, 1998, plan for communications; the January 1999, plan for health and medical; the December 22, 1998, plan for intelligence; the January 31, 1999, plan for logistics; and the January 28, 1999, plan for personnel.

the military service and Defense agency components that are responsible for planning and conducting specific functional thread tests.

CINC Operational Evaluation Plans

We reviewed the operational evaluation plans for two completed CINC exercises that were performed jointly by NORAD and the U.S. Strategic Command. The first exercise,[12] performed from December 2 through 4, 1998, focused primarily on the missile warning element of NORAD's Integrated Tactical Warning and Attack Assessment function. The follow-on exercise,[13] conducted from February 15 through 28, 1999, involved a comprehensive evaluation of NORAD and the Strategic Command's thin-line systems for air warning, missile warning, space warning, and aerospace control. We found that these plans recognized the CINCs' dependence on various functional areas and systems. For example, the plans recognized the military service and Defense agency functional systems needed to support the commands' respective thin-line operational objectives.

However, DOD's execution of initial operational evaluations did not include actually testing certain thin-line functional systems, such as communications and intelligence systems, because the systems were not yet Year 2000 compliant. According to CINC documents, evaluations of the performance of these omitted systems will be included in other DOD organizations' test plans and verified later.

Also, at the time of our review, the DOD operational evaluations that we reviewed did not test any weapon systems. This is because DOD had originally chosen to rely on the military services' weapon systems integration tests. Since then, DOD has recognized the importance of including weapon systems in selected operational exercises and expanded the exercises to include weapon systems.

[12]Known as Vigilant Virgo 99-1.

[13]Known as Amalgam Virgo 99-2.

DOD Is Establishing Management Controls for Integrating End-to-End Testing

Our Year 2000 test guide defines management controls for effective Year 2000 test programs. These controls include organizational structures and processes (i.e., policies, procedures, plans, and standards) for ensuring that test activities, including end-to-end testing, are planned, executed, reported, and overseen in a structured and disciplined manner.

In the case of end-to-end testing, our guide discusses the need to ensure that relationships among organizations and their systems are effectively managed through interorganizational controls (structures and processes) that govern how testing will be planned, executed, reported, and overseen, and how test results will be used. For example, our guide describes the need to:

- clearly establish interorganizational responsibility and accountability for end-to-end test activities;
- establish organizational expectations (i.e., policies and guidance) for planning and executing end-to-end testing, including such things as (1) test coverage, test conditions, test metrics, and test reporting content, format, and frequency, and (2) expectations for integrating and coordinating related test activities; and
- establish mechanisms for ensuring that (1) end-to-end test expectations are being met, including quality assurance[14] controls to validate that collected information is reliable and (2) collected information is effectively shared and used to take needed corrective action.

Without such controls, organizations can limit both the effectiveness and efficiency of their end-to-end test activities.

DOD has taken a number of actions to establish the management controls needed to integrate and coordinate its various end-to-end test and evaluation activities that are consistent with our Year 2000 test guide. First, DOD assigned interorganizational responsibility and accountability for end-to-end test activities to the OSD PSAs. Specifically, in August 1998,[15] the Deputy Secretary of Defense charged the PSAs with ensuring that the

[14]The purpose of this quality assurance is to independently ensure that test and evaluation activities and results are complete and accurate and conform to test and evaluation plans, guidance, and standards.

[15]Memorandum from the Deputy Secretary of Defense, dated August 24, 1998, to the secretaries of the military departments, Chairman of the Joint Chiefs of Staff, Under Secretaries of Defense, et al., regarding Year 2000 verification of national security capabilities.

various functions that support DOD's operational missions can effectively operate in a Year 2000 environment.

Second, DOD issued guidance and direction on Year 2000 test planning, execution, and reporting. For example, in addition to its guidance on creating and executing operational evaluations, JCS issued draft guidance in October 1998 to the CINCs defining how Year 2000 operational evaluations should be planned and executed. This guidance, which was updated in April 1999,[16] addressed the need to ensure that these evaluations are coordinated with functional end-to-end tests and military service integration tests, and how the results should be analyzed and reported. Also, in late 1998, the Office of the Assistant Secretary of Defense for Command, Control, Communications, and Intelligence (OASD/C3I) began briefing functional representatives in Defense agencies and the military services on test expectations. Further, in March 1999, OASD/C3I issued appendix I to DOD's Year 2000 Management Plan,[17] which provides additional guidance on planning, executing, and evaluating functional end-to-end testing.

Third, DOD is establishing mechanisms for collecting information on end-to-end test progress and results and ensuring that it is reliable and available for management action. For example, JCS has developed a central data base to store and analyze selected data about each operational evaluation that the CINCs are required to report in their plans and in reports that are to be submitted to the Joint Chiefs of Staff following the evaluations.[18] OSD is defining end-to-end functional test metrics that will be collected from the functional thin line/system integration tests and stored/analyzed in an OSD data base. Also, in December 1998, OASD/C3I and JCS began holding biweekly Year 2000 meetings[19] with representatives from OASD/C3I, JCS, the CINCs, the military services, and the Defense agencies. The purpose of these meetings is to facilitate coordination and integration of the various end-to-end test activities that cut across

[16]Joint Staff Year 2000 Operational Evaluation Guide, Version 3.0, April 1, 1999.

[17]DOD Year 2000 Management Plan, Version 2.0, appendix I, Guidelines to Support DOD Y2K Operational Readiness.

[18]Joint Chiefs of Staff guidance requires the CINCs to submit reports 7 days and 30 days after the completion of a Year 2000 test that describe the evaluation, the critical mission(s) and task(s) and thin line systems that were assessed, failures that occurred during the evaluation, and actions to correct problems.

[19]Known within Defense as synchronization meetings.

organizational boundaries. Further, in February 1999, OASD/C3I established a Year 2000 test and evaluation function to independently evaluate, among other things, end-to-end test and evaluation results. To do this, the designated test director is in the process of defining an assurance-based approach and metrics for measuring the confidence that can be attached to specific test event results. However, this quality assurance approach and associated metrics have yet to be established, and little time remains for doing so.

DOD Must Ensure That Its End-to-End Test Events Effectively Implement Established Management Controls

An effective system of internal management controls requires both timely establishment of such controls (i.e., definition and institutional awareness and understanding) and consistent implementation of the controls (i.e., adherence and enforcement). As discussed above, we found that with the exception of the end-to-end test and evaluation quality assurance process, DOD has established end-to-end test management controls that are consistent with our Year 2000 test guide. However, establishing controls is only part of what DOD needs to do to ensure that its end-to-end test activities are effectively managed. DOD must also ensure that these controls are adhered to and enforced in planning, executing, and reporting the results of actual end-to-end test events.

Fully implementing and enforcing these end-to-end test management controls would be important if DOD was conducting only a handful of Year 2000 end-to-end test events and its component organizations' missions were not so dependent on compliant systems. However, DOD is conducting literally hundreds of end-to-end test activities and events within an intense 9-month period (February to mid-October 1999), and some of these activities are closely related. As a result, adherence to these controls is absolutely critical.

To illustrate this criticality, we discussed earlier in the report that some systems that are to be part of the thin-line operational evaluations are not yet compliant and thus are unavailable for a given test event. As of March 31, 1999, 245 of 2,038 mission-critical systems, some of which may be included in an operational evaluation, were reported as being not yet compliant.[20] In cases where systems are not yet ready, CINCs can either (1) implement the system contingency plan, (2) postpone the operational

[20]Appendix III provides examples of key systems that are currently behind schedule and describes their importance to Defense's mission.

evaluation until the necessary thin line of systems is ready, (3) not test the system and assume proper functioning of the thin line of systems, or (4) count on other DOD organizations to verify the missing thin line at a later date. Regardless, these delays and gaps can not only affect the particular end-to-end test event, but also can affect related test events.

While DOD is establishing end-to-end test management controls for identification and disposition of these delays and gaps in its various end-to-end test events, these controls must be followed to be effective. To do less could limit DOD's end-to-end testing effectiveness, and thus its Year 2000 operational readiness.

Conclusions

DOD has underway or planned hundreds of related Year 2000 end-to-end test and evaluation activities that must be completed in a relatively short time. Thus far, DOD is taking steps to ensure that these related end-to-end activities are effectively coordinated. This is evidenced by the fact that draft and final test and evaluation plans for the various functional and operational mission areas recognize relevant interorganizational relationships and dependencies, and the fact that important management controls have either been established or are being established.

However, DOD is far from successfully completing its various Year 2000 end-to-end test activities, and much remains to be addressed and accomplished. To effectively do so, DOD must ensure that it completes efforts to establish end-to-end test management controls specified in our Year 2000 test guide—namely, establishing an independent quality assurance program for ensuring that its test guidance, plans, and standards are being met and that any deviations or other reasons for low confidence in end-to-end test results are brought to the attention of senior managers. Also, it must ensure that it effectively implements all of the controls it has included in its various plans so that DOD executive leadership receives timely and reliable information on end-to-end test results and limitations. With such information, DOD leaders can act swiftly to correct known problems and to fill voids in test coverage either through additional end-to-end test and evaluation or through contingency planning.

Recommendations

We recommend that the Secretary of Defense (1) direct the Assistant Secretary for C3I to immediately implement a quality assurance program for end-to-end test and evaluation activities under the newly designated

Year 2000 test director to provide independent evaluations of test event results and (2) reiterate to the OSD, JCS, and military service end-to-end testing principals the importance of ensuring that established end-to-end test and evaluation management controls are implemented and enforced on their respective end-to-end events, and that deviations from these controls be disclosed through existing Year 2000 reporting mechanisms.

Agency Comments and Our Evaluation

The Office of the Assistant Secretary of Defense provided written comments on a draft of this report, which are reprinted in appendix IV. DOD concurred with both of our recommendations and outlined the actions it has planned, or already begun, to implement them. Regarding our recommendation that Defense immediately implement a quality assurance program for end-to-end test and evaluation activities, Defense acknowledged that such a program should have been implemented in the design phase of its testing activities and stated that it has initiated steps to implement a program that will include (1) Inspector General independent audits of test results, (2) military service operational test agencies' review of test results, and (3) funding to support service and agency operated independent verification and validation activities. Regarding our recommendation that the Deputy Secretary of Defense reiterate the importance of ensuring that test and evaluation management controls are implemented and enforced, Defense stated that it has begun implementing our recommendation by making modifications to its Year 2000 guidance and by reinforcing the importance of adhering to management and reporting controls at Year 2000 Executive-Service Principals' meetings, Year 2000 Steering Committee meetings, and the synchronization meetings.

We are sending copies of this report to Representative John P. Murtha, Ranking Minority Member, Subcommittee on Defense, House Appropriations Committee, Senator John Warner, Chairman, and Senator Carl Levin, Ranking Minority Member, Senate Committee on Armed Services; Senator Ted Stevens, Chairman, and Senator Daniel Inouye, Ranking Minority Member, Subcommittee on Defense, Senate Committee on Appropriations; Representative Floyd Spence, Chairman, and Ike Skelton, Ranking Minority Member, House Committee on Armed Services. We are also sending copies to the Honorable John Koskinen, Chair of the President's Year 2000 Conversion Council; the Honorable William Cohen, Secretary of Defense; the Honorable John Hamre, Deputy Secretary of Defense; General Henry Shelton, Chairman of the Joint Chiefs of Staff, Arthur Money, Senior Civilian Official of the Office of the Assistant

Secretary of Defense for Command, Control, Communications, and Intelligence; and the Honorable Jacob J. Lew, Director, Office of Management and Budget. Copies will also be made available to others upon request.

If you have any questions about this report, please call me at (202) 512-6240. Other key contributors of this report are listed in appendix V.

Sincerely yours,

Jack L. Brock, Jr.
Director, Governmentwide and Defense
Information Systems

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Abbreviations

C3I	Command, Control, Communications, and Intelligence
CINC	Commanders in Chief
CIO	Chief Information Officer
DOD	Department of Defense
DSN	Defense Switch Network
GCCS	Global Command and Control System
JCS	Joint Chiefs of Staff
NORAD	North American Aerospace Defense Command
OASD/C3I	Office of the Assistant Secretary of Defense for Command, Control, Communications, and Intelligence
OSD	Office of the Secretary of Defense
PSA	Principal Staff Assistant
TBMCS	Theater Battle Management Core System

Objectives, Scope, and Methodology

Our objectives were to determine if (1) DOD's plans for Year 2000 functional tests, military service integration tests, and operational evaluations recognize the relationships and dependencies among these test and evaluation activities and (2) DOD has established the management controls to ensure that its various Year 2000 end-to-end test and evaluation activities are effectively integrated. As such, this report does not address controls related to other Year 2000-related test activities, including software unit testing, software integration testing, and system acceptance testing. Nor does it address the actual implementation of controls for specific end-to-end test activities.

To accomplish the first objective, we reviewed Defense's Year 2000 Management Plan (Version 2.0, December 1998). We also analyzed end-to-end test plans initially issued in the October 1998 time frame by DOD officials at the direction of the Deputy Secretary of Defense for five functional areas: communications, health and medical, intelligence, logistics, and personnel. Since these plans were considered to be working documents, we also analyzed updated plans issued from December 1998 through January 1999 for the same five functions.[1] In addition, we obtained and reviewed test plans for two of the operational evaluations performed at the North American Aerospace Defense Command (NORAD) and U.S. Strategic Command, and also witnessed operational tests conducted during February 1999 at NORAD. We also reviewed integration testing plans for each of the military services—the Army, Navy, Air Force, and Marine Corps. We discussed these plans with the Deputy Secretary of Defense and other responsible DOD executives, including the Senior Civilian Official of the Office of the Assistant Secretary of Defense for Command, Control, Communications, and Intelligence, who serves in the capacity of the DOD Chief Information Officer (CIO), the Deputy CIO, Joint Chiefs of Staff and CINC officials, and Defense agency and military service personnel.

To accomplish the second objective, we reviewed Defense's Year 2000 Management Plan (Version 2.0, December 1998) and DOD Year 2000 guidance, such as guidance provided in memoranda regarding the Year 2000 initiative issued by the Secretary of Defense on August 7, 1998, and the Deputy Secretary of Defense on August 24, 1998, and other DOD guidance. We compared DOD's plans and guidance to controls defined in our Year

[1]Updated plans included in our review were the December 15, 1998, plan for communications; the January 1999, plan for health and medical; the December 22, 1998, plan for intelligence; the January 31, 1999, plan for logistics; and the January 28, 1999, plan for personnel.

2000 test guide[2] as a basis for identifying strengths and weaknesses. We also discussed Defense's management controls for Year 2000 testing efforts with the Deputy Secretary of Defense; CIO officials; Joint Chiefs of Staff and CINC officials; and Defense agency and military service personnel. Further, we attended monthly DOD Year 2000 Steering Committee meetings, Year 2000 synchronization meetings, and Year 2000 training sessions where various efforts to address DOD testing issues were discussed.

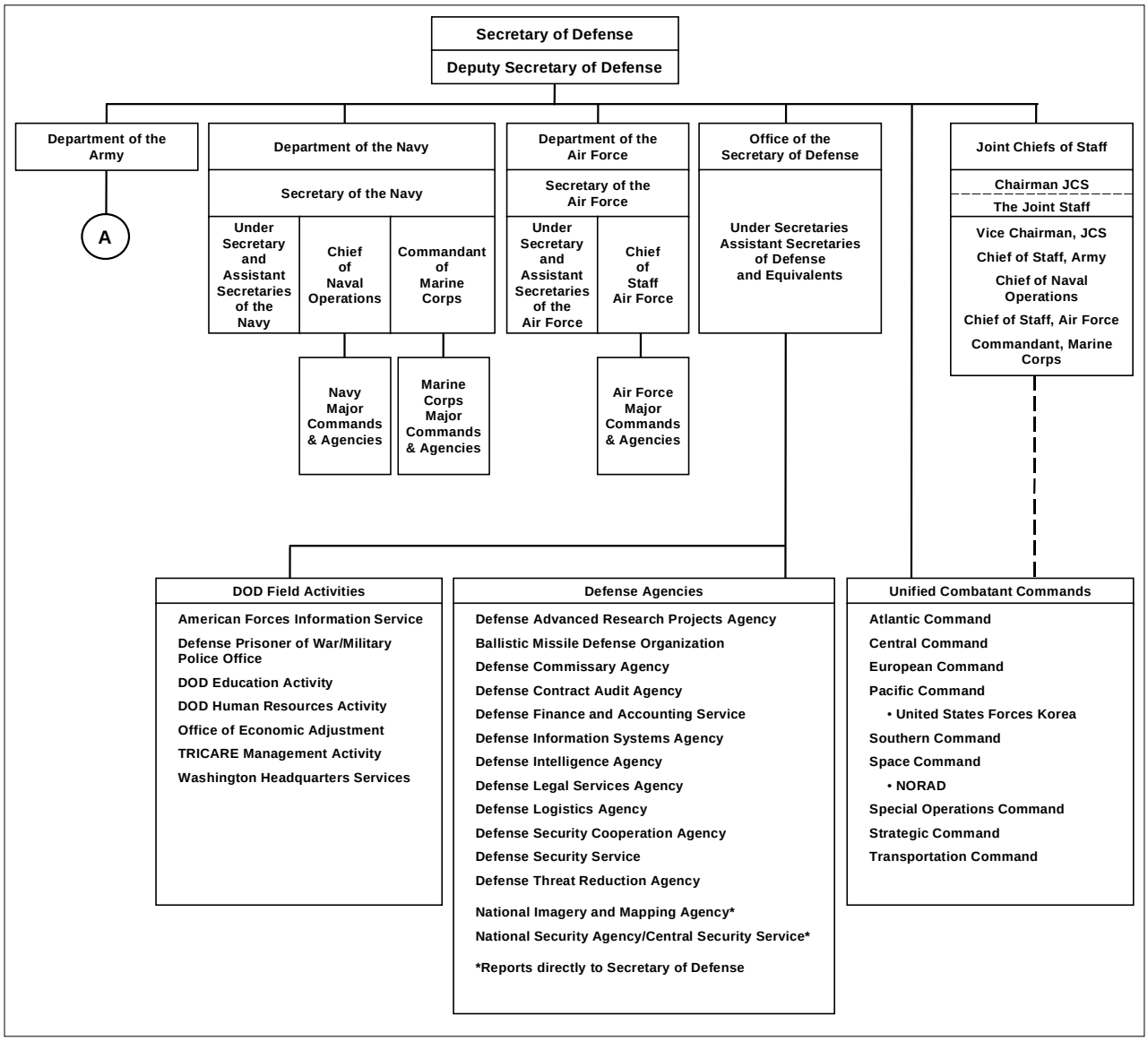
We performed our audit work from October 1998 through April 1999 in accordance with generally accepted government auditing standards.

[2] Year 2000 Computing Crisis: A Testing Guide (GAO/AIMD-10.1.21). Published as an exposure draft in June 1998 and finalized in November 1998.

Complexity of DOD's Organizational Structure and Reliance on Computer Systems

DOD is the largest and most complex organization in the world. To accomplish its missions, DOD employs a matrixed organizational structure. Administratively, DOD is organized into the following major organizational units: the Office of the Secretary of Defense (OSD); the Joint Chiefs of Staff (JCS); the unified combatant commands, such as the Atlantic Command and the Transportation Command; and the military services (Army, Navy, Air Force, and Marine Corps). (See figure II.1.)

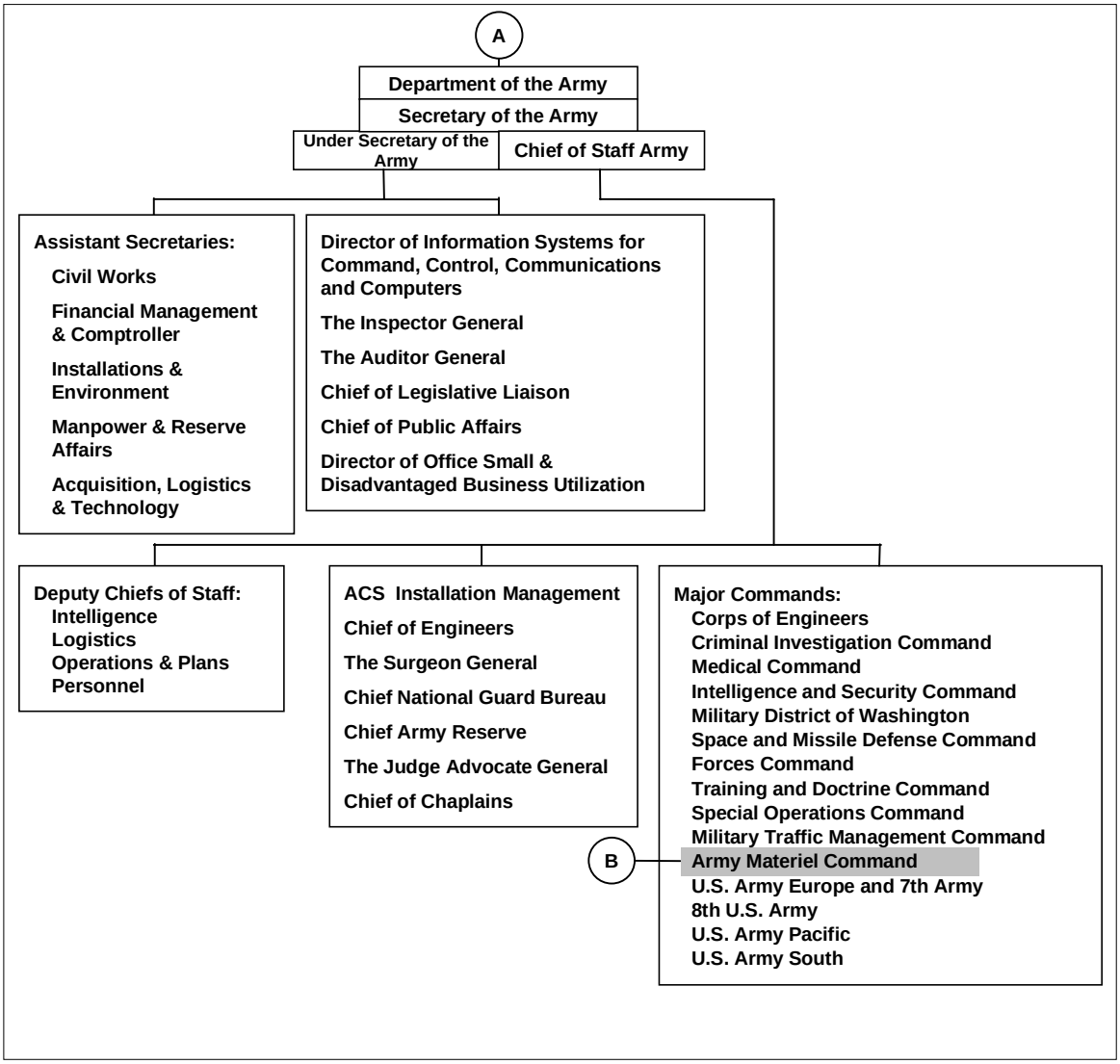
Figure II.1: High-Level DOD Organizational Chart



Under OSD are numerous large Defense agencies and field activities, including the Defense Logistics Agency, Defense Finance and Accounting Service, and Defense Information Systems Agency. Similarly, under each of the military services are many large organizational units. For example, the Army has 15 major commands and numerous other functional activities,

such as the Army Materiel Command and the 8th U.S. Army. (See figure II.2.)

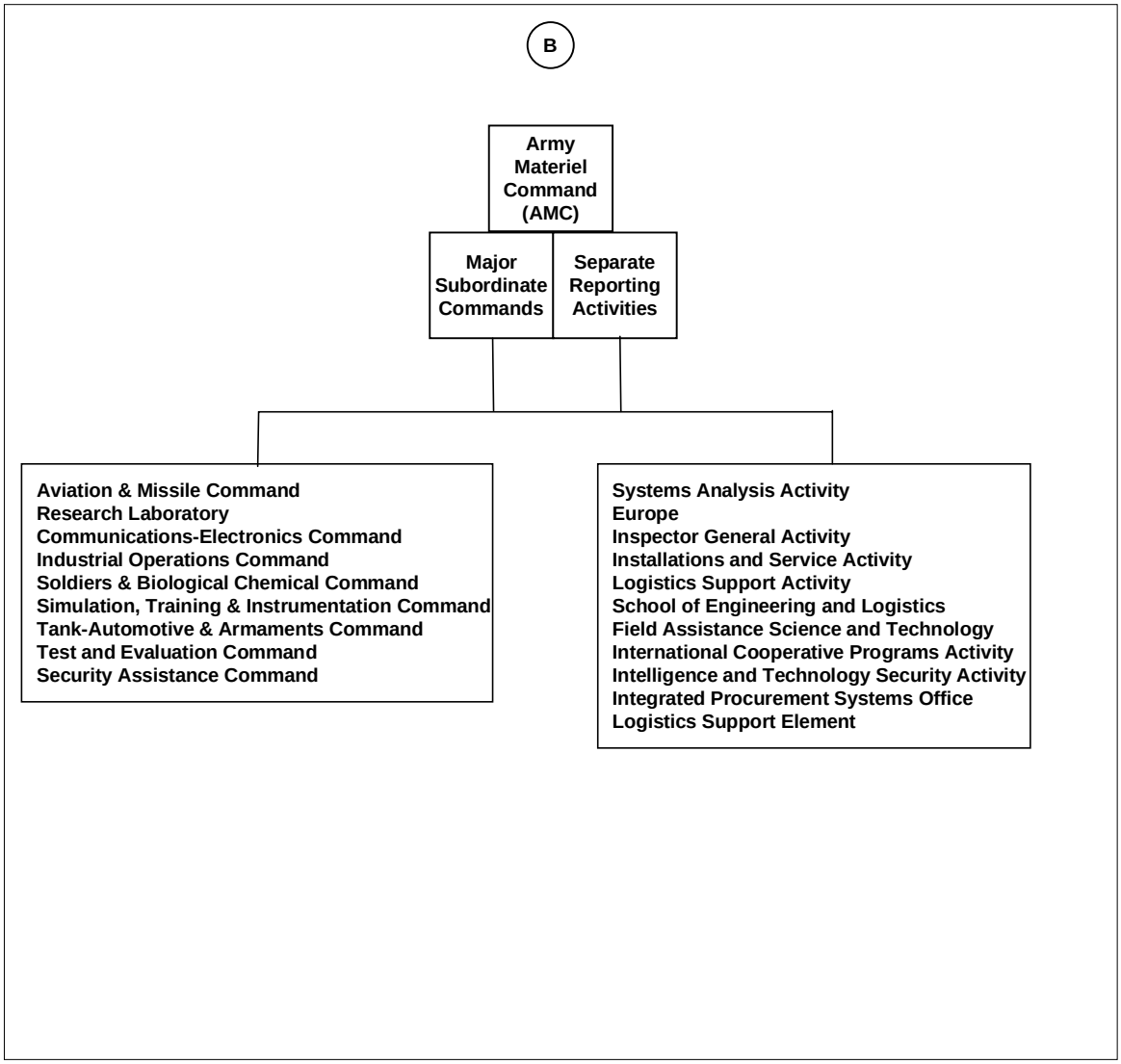
Figure II.2: High-Level Army Organizational Chart



All of these Army units are in turn very large organizations. The Army Materiel Command alone employs more than 65,000 civilian and military employees at 285 locations worldwide, and ranks in business volume with

the top 10 corporations in the U.S. It consists of nine subordinate commands (e.g., the Army Aviation and Missile Command, the Army Communications-Electronics Command, and the Army Research Laboratory) and 11 reporting activities (e.g., the Army Materiel Systems Analysis Activity and Army Materiel Command-Europe). (See figure II.3.)

Figure II.3: High-Level Army Materiel Command Organizational Chart



Operationally, DOD's combatant forces are assigned to a combatant command. Each of these combatant commands is responsible for military operations for specified geographic regions or theaters of operations. To support each of these commands, DOD has assigned specific operational support responsibilities to its many other organizational units, including OSD, the military services, Defense agencies, and other commands. For example, if a conflict erupted in the Pacific or Indian Oceans, the Pacific Command would be the DOD organizational unit responsible for all military operations in that region, and its CINC would report directly to the National Command Authority, which consists of the President of the United States and the Secretary of Defense. Also, the Pacific Command CINC would be supported by (1) military service components (e.g., U.S. Army Pacific, Marine Forces Pacific, U.S. Pacific Fleet, U.S. Pacific Air Forces), (2) subordinate unified commands (e.g., 8th U.S. Army, U.S. Forces Japan, U.S. Forces Korea), (3) standing joint task forces (e.g., Joint Interagency Task Force West, Joint Task Force-Full Accounting), and (4) other supporting units (e.g., Asia-Pacific Center for Security Studies, Joint Intelligence Center Pacific). In short, this specified mix of DOD organizational entities, and their supporting systems, would interoperate to collectively fulfill the specified Pacific Command mission.

DOD's Organizations Are System Reliant

DOD relies extensively on computer systems. Its portfolio includes weapon systems, command and control systems, satellite systems, inventory management systems, transportation management systems, health systems, financial systems, personnel systems, and payment systems. Collectively, DOD reports that it operates and maintains more than 1.5 million computers, 28,000 systems, and 10,000 networks. Further, DOD exchanges information with thousands of public and private sector business partners, which involve thousands of system and network interfaces.

Each of DOD's organizational units is also system reliant. For example, the Army depends on about 1,200 systems, of which roughly 400 are considered by the Army to be mission-critical. Each of its major commands similarly is system dependent. The Army Materiel Command, for example, has reported that it depends on approximately 650,000 computer applications and system infrastructure devices, about 1,800 of which support weapon systems (e.g., the AH-64A Apache and AH-64D Apache Longbow attack helicopters, the M1A2 Abrams tank system, the M2/M3A3 Bradley fighting vehicle, and the Patriot missile system). The command also reports that it

is responsible for 81 mission-critical business systems that involve 350 data exchange interfaces.

Examples of Key DOD Mission-Critical Systems Reported to Be Behind Schedule

We testified in March 1999[1] and April 1999[2] that while Defense had recently made progress by providing the controls and guidance needed to fix and test systems, it was behind schedule. The following are three examples of some of these systems.

- First, the Global Command and Control System (GCCS) system is deployed at more than 600 sites worldwide and is Defense's primary system for generating a common operating picture of the battlefield for planning, executing, and managing military operations. Completion of the component-level GCCS at some locations is currently scheduled for as late as September 30, 1999.
- Second, the Defense Switch Network (DSN), scheduled to be completed by September 30, 1999, is the primary long-distance voice communications service for DOD. DSN provides both dedicated and common-user voice communications services at all priority levels for command and control and special command and control users as well as routine service for administrative users throughout the department.
- Third, the Theater Battle Management Core System (TBMCS) is being developed by the Air Force and is intended to replace three Year 2000 non-compliant legacy systems. TBMCS is to be a primary support tool used by theater commanders to provide information to the warfighter and for peacetime and humanitarian operations. Because of developmental problems that have resulted in schedule slippages, the Air Force does not expect to fully implement TBMCS until September 30, 1999, at the earliest. Schedule slippages have also caused the Air Force to remediate a legacy system, the Contingency Theater Automation Planning System—scheduled to be completed in September 1999—in the event of further delays to TBMCS.

[1]Year 2000 Computing Crisis: Defense Has Made Progress, But Additional Management Controls Are Needed (GAO/T-AIMD-99-101, March 2, 1999).

[2]Year 2000 Computing Crisis: Federal Government Making Progress But Critical Issues Must Still Be Addressed to Minimize Disruptions (GAO/T-AIMD-99-144, April 14, 1999).

Comments From the Department of Defense

COMMAND, CONTROL, COMMUNICATIONS, AND INTELLIGENCE

OFFICE OF THE ASSISTANT SECRETARY OF DEFENSE
6000 DEFENSE PENTAGON
WASHINGTON, DC 20301-6000

June 10, 1999

Mr. Gene L. Dadaro
Assistant Comptroller General
Accounting and Information Management Division
U.S. General Accounting Office
Washington, DC 20548

Dear Mr. Dadaro:

This is the Department of Defense (DoD) response to the General Accounting Office (GAO) draft report, "DEFENSE COMPUTERS: Management Controls Are Critical to Effective Year 2000 Testing," dated May 18, 1999 (GAO Code 511656/OSD Case 1823). Overall, the DoD agrees with the report.

Detailed comments to the recommendations are provided as an enclosure. Factual and technical comments were provided directly to the GAO staff for consideration. The DoD appreciates this opportunity to comment on the draft.

Sincerely,

William A. Curtis
Principal Director, Year 2000

Enclosure

GAO DRAFT REPORT – DATED MAY 18, 1999
GAO CODE 511656/OSD CASE 1823

"DEFENSE COMPUTERS: MANAGEMENT CONTROLS ARE CRITICAL TO EFFECTIVE YEAR 2000 TESTING"

DEPARTMENT OF DEFENSE COMMENTS TO THE RECOMMENDATIONS

RECOMMENDATION 1: The GAO recommended that the Deputy Secretary of Defense (1) direct the Assistant Secretary for C3I to immediately implement a quality assurance program for end-to-end test and evaluation activities under the newly designated Year 2000 Test Director to provide independent evaluations of test event results. (p. 24/GAO Draft Report)

DOD RESPONSE: The Department of Defense concurs with this recommendation. As The Director of Testing, DoD Y2K Executive is establishing a Quality Assurance Program as a corrective action plan for End-to-End Testing and Evaluation. The Quality Assurance Program, therefore, is being established after the three major Departmental Testing and Evaluation Programs (CINC Operational Evaluations, Functional Area End-to-End Testing, Service Integration Testing) have been significantly underway for some time. The Quality Assurance Program that the Department is currently implementing will provide the means to Program testers and evaluators to independently determine the degree of confidence and assurance of the Y2K test results. Such program will be applicable to integration and end-to-end tests concluded, ongoing, and planned. The Quality Assurance Program will consist of the following main components: IG independent audits of test results, Service Operational test agencies review of test results, Code screening or scanning tools, funding to support independent Service and Agency-operated Independent Verification and Validation (IV & V) facilities, and assurance based testing models commonly practiced by the computer industry and software engineering researchers. At present, Code screening tools are being acquired by the Services with Departmental oversight. In addition, IV & V facilities are being established with Departmental oversight and funding, and assurance based testing models applicable to integrated system testing are currently being developed.

RECOMMENDATION 2: The GAO recommended that the Deputy Secretary of Defense reiterate to the OSD, JCS, and military service end-to-end testing principals the importance of ensuring that established end-to-end test and evaluation management controls are implemented and enforced on their respective end-to-end events, and that deviations from these controls be disclosed through existing Year 2000 reporting mechanisms. (p. 24/GAO Draft Report)

DOD RESPONSE: The Department of Defense concurs with this recommendation and is implementing it through a corrective action plan by a number of means. Established end-to-end evaluation management controls guidance is set out in the Appendix J, of the DoD Y2K Management Plan. As the testing program evolves and lessons-learned are acquired, control guidance is modified to reinforce the quality, depth, and applicability of management controls. The importance of ensuring established end-to-end test and evaluation management controls are implemented and enforced on end-to-end events, and that deviations from these controls be disclosed through existing DoD Year 2000 reporting mechanisms is also recognized and being done. In forums such as the weekly DoD Y2K Executive-Service Y2K principals, the bi-weekly Synchronization Meeting, hosted by the Testing Directorate in conjunction with the Joint Staff, and monthly DoD Y2K Steering Committee Meetings, results from testing are discussed, to include test results, management controls and any deviations from them. The most recent DoD Y2K Steering Committee on May 25, 1999, and the scheduled June DoD Y2K Steering Committees have been and will be devoted to the status of testing and management controls in CINC OpEvals, Functional End-to-End tests, and Service Integration Testing Programs. Additionally, the DoD Y2K Executive has personally conducted observation visits to events in each of the Testing Program's categories to particularly observe their organization, evaluation management controls, and results. These results have been shared at the Departmental level in scheduled meetings and individual reports. Deviations noted have been evaluated to determine their reason and impact on the quality of testing.

GAO Contact and Staff Acknowledgements

GAO Contact

Randolph C. Hite, (202) 512-6240

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