Audit Report

IMPACT OF YEAR 2000 ISSUES ON THE AEGIS WEAPON SYSTEM

Report No. 99-176 June 2, 1999

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Department of Defense

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Acronyms

NSWCDD	Naval Surface Warfare Center Dahlgren Division
Y2K	Year 2000

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

June 2, 1999

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

SUBJECT: Audit Report on Impact of Year 2000 Issues on the Aegis Weapon System (Report No. 99-176)

We are providing this report for information and use. Because this report contains no adverse findings or recommendations, no written comments were required, and none were received. Therefore, we are publishing this report in final form.

We appreciate the courtesies extended to the audit staff. For additional information on this report, please contact Mr. Robert K. West at (703) 604-8983 (DSN 664-8983) (rwest@dodig.osd.mil) or Mr. Robert W. Otten at (703) 604-8997 (DSN 664-8997) (rotten@dodig.osd.mil). See Appendix C for the report distribution. The audit team members are listed inside the back cover.

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Office of the Inspector General, DoD

Report No. 99-176 **June 2, 1999**
Project No. 8AD-0053.01

Impact of Year 2000 Issues on the Aegis Weapon System

Executive Summary

Introduction. This report is one in a series of reports that the Inspector General, DoD, is issuing in accordance with an informal partnership with the DoD Chief Information Officer to monitor DoD efforts to address the year 2000 computing challenge.

Objectives. The overall audit objective was to evaluate whether the Navy Aegis Program Office effectively planned, executed, and coordinated year 2000 management strategies to ensure that operations are not disrupted by year 2000-related issues. Specifically, we reviewed year 2000 test plans and reports, initialization procedures, system interfaces, system certification, and contingency plan for the Aegis weapon system.

Results. The Aegis Program Office took an aggressive and proactive approach to ensure that the Aegis weapon system should not be disrupted by year 2000-related issues. The Aegis Program Office management ensured that:

- tests were planned and executed in accordance with the Navy Master Test Plan,
- comprehensive initialization procedures were developed,
- external interfaces were identified and memorandums of agreement were prepared,
- the Aegis weapon system was properly certified year 2000 compliant, (September 17, 1998), and
- year 2000 issues were effectively coordinated with other organizations.

In addition, the Aegis Program Office was highly responsive to our concerns on year 2000 risk assessments and contingency plans. Although the Aegis Program Office had prepared a contingency plan, they did not fully address risk assessments and other key elements in the Navy Year 2000 Guidance Package. However, when we brought these matters to management's attention, they took immediate action to fully address risk assessments and revise the contingency plan. Therefore, this report contains no recommendations. See the Finding section of the report for details of the audit results.

Management Comments. We provided a draft of this report on May 19, 1999. Because this draft report contains no adverse findings or recommendations, written comments were not required, and none were received. Therefore, we are publishing this report in final form.

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Background

Aegis Weapon System. The Aegis weapon system is the Navy's most advanced, shipboard anti-aircraft and anti-missile weapon system, whose mission is to defeat enemy aircraft, missiles, surface ships, and submarines, and to attack land targets. The Aegis weapon system is a highly integrated combat system capable of simultaneous warfare on many fronts: air, surface, subsurface, and strike. The Aegis weapon system is installed on the *Ticonderoga*-Class cruisers and the Arleigh Burke-Class destroyers. Its key components are the weapons control system, Aegis display system, command and decision system, operational readiness test system, standard missile-2, fire control system, vertical launching system, and radar system. The Aegis weapon system is designed to play a major role in shielding the Navy well into the 21st century.

Aegis Program Office. The Aegis Program Office is the procuring activity and developer of the Aegis weapon system and is responsible for the integration of the Aegis weapon system with the ship's combat system. The Aegis Program Office reports to the Program Executive Officer, Theater Surface Combatants.

Naval Surface Warfare Center, Dahlgren Division. The Aegis Program Office assigned the Naval Surface Warfare Center Dahlgren Division (NSWCDD) as the lead laboratory and life-support engineering agent for the Aegis program. NSWCDD is a key organization in the Aegis weapon system year 2000 (Y2K) effort and is responsible for assisting the Aegis Project Office in developing, acquiring, and supporting the ship's combat system. As the Aegis life-support engineering agent, NSWCDD supports in-service combat system engineering, Aegis computer program lifetime engineering, combat system configuration and data management, and design and activation of Aegis engineering and training facilities.

DoD Y2K Management Plan. In April 1997, the Assistant Secretary of Defense (Command, Control, Communications, and Intelligence), in his role as the DoD Chief Information Officer, initially issued the DoD Year 2000 Management Plan (DoD Management Plan). The latest version, January 25, 1999, provides the overall DoD strategy and guidance for inventorying, prioritizing, repairing, or retiring systems, and monitoring Y2K progress. The DoD Management Plan states that the DoD Chief Information Officer has overall responsibility for overseeing the DoD solution to the Y2K problem.

Navy Strategy. The Navy prepared and issued a Y2K Action Plan, a Y2K Contingency and Continuity-of-Operations Planning Guide, and a Naval Y2K Master Test Plan to outline the Navy management effort and strategy and to define Y2K roles, responsibilities, and reporting requirements. Although the Navy placed strong emphasis on mission-critical systems, its goal is to evaluate all Y2K-vulnerable systems and equipment and to renovate those that have a Y2K concern.

Navy Y2K Action Plan. The Navy Y2K Action Plan, September 1998, provides the Navy strategy and management approach to addressing its Y2K date processing problem. Specifically, it provides guidance for inventorying systems, prioritizing systems, retiring systems, and monitoring Y2K progress.

Navy Y2K Contingency and Continuity-of-Operations Planning Guide. The Navy Y2K Project Office published the Navy Y2K Contingency and Continuity-of-Operations Planning Guide, November 1, 1998, to help ensure that no loss of mission capability would result from a Y2K problem. The planning guide assists afloat and ashore organizations and units to identify and revise existing contingency plans. The planning guide addresses the key elements of the Navy Y2K strategy for contingency planning and the roles and responsibilities of the Navy Commands for preparing accurate and functional contingency plans.

Y2K Master Test Plan. On August 20, 1998, the Navy Y2K Project Office published the Y2K Master Test Plan, which included a multitiered, three-level test strategy to ensure the operational readiness of its mission-critical functions and capabilities before, on, and after the year 2000. The three test levels are system certification, functional testing, and integration validation. At Level I (system certification), all systems are evaluated for possible Y2K problems at the intra-ship level. At Level II, functional testing is performed to ensure that needed operational capabilities to support warfighter missions are maintained throughout the Fleet at the inter-ship level. Level II emphasizes the end-to-end testing of high technical risk Y2K renovations and testing of systems that provide basic operations. Level III validates the final system integration on a task-force level, and includes Battle Groups, Expeditionary Warfare Groups/Amphibious Ready Groups, Middle Eastern forces, and other deployers. Level III testing is performed in concert with Battle Group Systems Integration Testing and Final Integration Testing.

Objectives

The overall audit objective was to evaluate whether the Aegis Program Office effectively planned, executed, and coordinated Y2K management strategies to ensure that operations are not disrupted by Y2K-related issues. Specifically, we reviewed the Aegis weapon system Y2K test plans and reports, initialization procedures, system interfaces, system certification, and contingency plan. See Appendix A for a discussion of the scope, methodology, and a summary of prior audit coverage.

Aegis Program Office Y2K Management Efforts

The Aegis Program Office took an aggressive and proactive approach to ensure that the Aegis weapon system is not disrupted by Y2K-related issues. Program office managers successfully planned, executed, and coordinated their Y2K efforts with key organizations supporting the Aegis weapon system to ensure a smooth transition into the year 2000. As a result, the Aegis weapon system should be at low risk for disruption by Y2K-related issues.

Y2K Planning and Execution

Risk Assessments. The Aegis Program Office contingency plan did not fully address Y2K risk assessments. We discussed our concerns with program officials, and they agreed to revise the contingency plan to address the key elements in the Navy Y2K guidance.

Test Plans and Reports. The NSWCDD prepared, executed, and published test plans and reports for Level I component testing and Level II system testing. NSWCDD also prepared the initialization procedures that fleet commanders will use to conduct Fast Cruise Testing and Battle Group System Integration Testing.

Level I Component Testing. The Aegis weapon system is composed of eight major components. NSWCDD prepared individual test plans for each component and published reports on all of the Aegis weapon system computer programs tested. Based on component Level I test results, NSWCDD concluded that although computer displays did not always respond properly in Y2K testing, the components were operationally Y2K compliant and would not degrade mission capabilities because of Y2K display errors. Those display errors will be corrected in the newest Aegis weapon system baseline, which is scheduled for Y2K certification in July 1999.

Level II System Testing. The NSWCDD published the system Level II test plan and test report on March 23, 1998, and June 8, 1998, respectively. NSWCDD conducted Y2K tests at the Aegis Combat Systems Center, Wallops Island, Virginia, by simulating the operation of the Aegis weapon system and the Aegis combat system. Based on system Level II test results, the Aegis weapon system computer program's tactical mode of operation is not adversely affected by the clock rollover into the year 2000 and beyond.

Level II Fast Cruise Testing. Fast Cruise testing is an operational test conducted on a ship in port, as opposed to testing at sea. One aspect of Fast Cruise testing is to test selected weapon systems and functional support systems for Y2K compliance. The U.S.S. *Chosin* (CG 65), a *Ticonderoga*-Class Aegis cruiser was one of several classes of ships that participated in a Fast Cruise test. The U.S.S. *Chosin* Fast Cruise tested the Aegis weapon system and the

machinery control system. The Level II test results showed that the Aegis weapon system encountered no mission degrading, Y2K-related anomalies.

Level III Testing. From March 1 through March 4, 1999, the U.S.S. *Constellation* Battle Group was the first of five Battle Groups to conduct a Y2K system integration test. The system integration test was designed to validate the Battle Group's Y2K readiness in an operational environment and to identify Y2K interoperability issues. The Commander-in-Chief, Pacific Fleet, conducted the test, and according to the Navy, the results showed that the Aegis weapon system was not affected by Y2K issues.

Initialization Procedures. Initialization procedures provide system operators with steps to advance the system clock, observe and record Y2K data, and then roll back the clock to its prior date. Implementation of the initialization procedures allows system operators to validate the system's capability to operate in the year 2000 and beyond. NSWCDD developed the Aegis weapon system's initialization procedures, which were subsequently used in the Fast Cruise and Battle Group Y2K system integration tests.

System Interfaces. The Aegis Program Office took aggressive action to identify potential system interfaces. The Program Office used a contractor to assist in identifying 66 system interfaces and conducting system-level analyses of message traffic that interfaced with the Aegis weapon system. The Aegis Program Office prepared memorandums of agreement for each of those systems.

System Certification. On September 17, 1998, the Program Executive Officer for Theater Surface Combatants certified that all Aegis weapon system operational baselines in service were Y2K operationally compliant. The certification was based on a NSWCDD technical assessment, which included a requirements review, design data (interface design specifications and source code), and a formal test of all system components.

Contingency Plan. On December 4, 1998, the Program Office approved and signed a Y2K contingency plan for the Aegis weapon system. We reviewed the contingency plan and determined that it did not fully address the requirements of the Navy Y2K Contingency and Continuity-of-Operations Planning Guide, issued by the Navy Y2K Project Office on November 1, 1998. Specifically, the Aegis weapon system contingency plan did not completely address risk assessments, interfaces, contingency actions, contingency plan validation and testing, and procedures to recover lost or damaged data. We discussed these conditions with Program Office management. The Aegis Program Office initiated immediate action to fully address the key elements of the Navy Y2K contingency plan guidance in the Aegis weapon system contingency plan; therefore, no recommendation is made in the report.

Program Coordination

The Aegis Program Office was effective in coordinating issues in support of the Aegis weapon system Y2K effort. The Program Office coordinated with the

Naval Sea Systems Command to maintain the Navy Y2K database. In addition, the Program Office participated in the Naval Sea Systems Command Afloat Y2K meetings and is a member of the Y2K Integrated Process Team. The Y2K Integrated Process Team provides monthly Y2K status briefings to the Program Executive Officer, Theater Surface Combatants.

Inspector General, DoD, Technical Assessment

Engineers from the Office of the Inspector General, DoD, met with Lockheed Martin engineers to assess the Aegis weapon system for potential Y2K impact. The engineers reviewed engineering schematics for the following three judgmentally selected system components: the SPY-1 radar; the vertical launching system; and the Aegis clock. The engineers verified that the reviewed components did not process dates and, therefore, should not have a Y2K impact. See Appendix B for the technical assessment of the Aegis weapon system.

Conclusion

The Aegis Program Office should be commended for its Y2K effort. The Navy technical review and testing of Aegis weapon system and the revision of the contingency plan should sustain Aegis weapon system readiness and warfighting capability through the year 2000 and beyond.

Appendix A. Audit Process

This is one in a series of reports being issued by the Inspector General, DoD, in accordance with an informal partnership with the Chief Information Officer, DoD, to monitor DoD efforts to address the Y2K computing challenge. For a list of audit projects addressing the issue, see the Y2K webpage on IGnet at http://www.ignet.gov.

Scope

Work Performed. We reviewed applicable DoD and Navy Y2K guidance on risk assessments, system and integration testing, initialization procedures, system interfaces, system certification, and contingency plans. We interviewed key Navy and contractor officials from the Aegis Program Office, NSWCDD, the Naval Sea Systems Command, the Commander-in-Chief Pacific Fleet, and the Lockheed Martin Corporation on the management approach for implementing the Aegis weapon system Y2K program and initiatives. We evaluated Aegis weapon system Y2K test plans, component and system-level testing reports, initialization procedures, system interfaces, system certification, and contingency plan. The engineers also conducted a technical assessment of three major Aegis weapon system components and reviewed technical drawings, system specifications, and applicable vendor information for potential Y2K issues.

DoD-Wide Corporate-Level Government Performance and Results Act Goals. In response to the Government Performance and Results Act, the DoD has established 6 DoD-wide corporate-level performance objectives and 14 goals for meeting the objectives. This report pertains to achievement of the following objective and goal.

> **Objective:** Prepare now for the uncertain future. **Goal:** Pursue a focused modernization effort that maintains U.S. qualitative superiority in key warfighting capabilities. **(DoD-3)**

DoD Functional Area Reform Goals. Most major DoD functional areas have also established performance improvement reform objectives and goals. This report pertains to achievement of the following functional area objective and goal:

> **Information Technology Management Functional Area.**
> **Objective:** Provide services that satisfy customer information needs.
> **Goal:** Upgrade technology base. **(ITM-2.3)**

General Accounting Office High-Risk Area. The General Accounting Office has identified the resolution of the Y2K conversion problem as one of several high-risk areas in DoD. This report provides coverage of that problem of the overall Information Management and Technology high-risk area.

Methodology

Use of Computer-Processed Data. We did not use computer-processed data for this audit. We reviewed Y2K documents dated from December 1995 through April 1999.

Audit Type, Dates, and Standards. We performed this economy and efficiency audit from September 1998 through April 1999, in accordance with the auditing standards issued by the Comptroller General of the United States, as implemented by the Inspector General, DoD. We did not review the management control program related to the overall audit objective because DoD recognized the Y2K issue as a material management control weakness area in the FY 1998 Annual Statement of Assurance.

Contacts During the Audit. We visited or contacted individuals and organizations within DoD and held discussions with Navy contractors. Further details are available on request.

Summary of Prior Coverage

The General Accounting Office and the Inspector General, DoD, have conducted multiple reviews related to Y2K issues. General Accounting Office reports can be accessed over the Internet at http://www.gao.gov. Inspector General, DoD, reports can be accessed over the Internet at http://www.dodig.osd.mil.

Appendix B. Technical Assessment of the Aegis Weapon System

Technical engineers in the Office of the Inspector General, DoD, judgmentally selected three major components of the Aegis weapon system to assess for potential Y2K impact. Engineers from the Lockheed Martin Launching Systems Division assisted in reviewing the SPY-1 radar system, the Vertical Launching System, and the Aegis Clock.

SPY-1 Radar System

The SPY-1 radar system is a multifunction phased-array system capable of searching, detecting, and tracking air and surface targets. We reviewed engineering schematics from the top level down to the circuit-card-assembly level to determine whether the SPY-1 radar system processed dates or contained a date function. Specifically, our review focused on 10 SPY-1 components; the input output buffer, the electronic counter measurements processor, the wave form generator, the detection burn through module, the intermediate frequency processor, the search-and-track processor, the auxiliary wave form generator, the track initiation processor, the signal processor interface, and the antenna. We determined that these components and the SPY-1 radar system do not process dates. Therefore, the SPY-1 radar system should not be impacted by Y2K issues.

Vertical Launching System

The vertical launching system is a general purpose system capable of launching missiles for air, surface, and subsurface engagements. We obtained the engineering schematics, circuit-card-assembly drawings, system specifications, and vendor documents to determine whether the system had a potential Y2K issue. The review of vertical launching system included the launch sequencer, the launch control unit, the motor control panel, and the power supply. We determined that these components and the vertical launching system do not process dates. Therefore, the vertical launching system of the Aegis weapon system should not be affected by the Y2K issue.

Aegis Clock

The Aegis clock is a binary counter that synchronizes up to 25 computers in the Aegis combat system. The Aegis clock resets itself to zero after 6 days. Our review showed that the Aegis clock does not have a date function and, therefore, should not be affected in the year 2000 and beyond.

Conclusion

Our review of the three major components of the Aegis weapon system did not disclose any Y2K effects on the operation of the system. We determined that the SPY-1 radar system, the vertical launching system, and the Aegis clock do not process dates. Our analysis was based on reviews of system schematics, circuit-card-assembly drawings, system specifications, and vendor documents.

Appendix C. Report Distribution

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