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Accounting and Information
Management Division

B-279744

May 1, 1998

The Honorable Stephen Horn
Chairman
Subcommittee on Government
    Management, Information and Technology
Committee on Government
    Reform and Oversight
House of Representatives

Subject: Air Traffic Control: FAA Plans to Replace Its Host Computer System
            Because Future Availability Cannot Be Assured

Dear Mr. Chairman:

During the February 4, 1998, Joint Hearing of the House Government Reform
and Oversight Committee's Subcommittee on Government Management,
Information and Technology and the House Science Committee's Subcommittee
on Technology on the "Federal Aviation Administration at Risk: Year 2000
Impacts on the Air Traffic Control System," you requested that we provide, for
the record, an assessment of FAA's Host Computer System (HCS). Our review
objectives were to determine (1) whether HCS has been meeting availability
requirements and (2) what issues affect FAA's ability to ensure HCS' availability
in the future.[1]

To address these objectives, we analyzed HCS performance and outage data for
the past 3 calendar years and the 5-year Host hardware maintenance and
sustainment assessment by Lockheed Martin, FAA's HCS sustainment
contractor. We also analyzed documents supporting FAA's Host and Oceanic
Computer System Replacement program. In addition, we interviewed officials
from FAA, Lockheed Martin, and International Business Machines (IBM)
Corporation. IBM provided the HCS hardware in the mid-1980s, and its
subsidiary currently provides HCS maintenance for Lockheed Martin. We did

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[1]System availability is defined as the time that a system is operating
satisfactorily, expressed as a percentage of the time the system is required to be
operational.

GAO/AIMD-98-138R FAA's Host Computer System

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not independently verify the performance data provided by FAA. We conducted our work from February 1998 through April 1998 in accordance with generally accepted government auditing standards.

OVERVIEW OF FAA's
HOST COMPUTER SYSTEM

Air traffic controllers in FAA's 20 en route centers control aircraft over the continental United States in transit and during approaches to some airports. HCS is the key information processing system in FAA's en route environment. It processes radar surveillance data, processes flight plans, links filed flight plans with actual aircraft flight tracks, provides alerts of projected aircraft separation violations (i.e., conflicts), and processes weather data.

HCS consists of hardware, a unique operating system, and application software. HCS hardware components are divided into three major categories of equipment: (1) the processor subsystem, which consists of a main processor (IBM 3083), a processor controller (IBM 3082) that checks the temperature and status of the main processor, a coolant distribution unit, and a power distribution unit, (2) the direct access storage subsystem, which consists of disk control units and disk drives, and (3) the peripheral subsystem, which includes modems and printers.

FAA uses two processor subsystems in each of its en route centers to mitigate the impact of system failures. If the primary HCS processor fails, processing is automatically switched to the support processor. When both HCS systems are unavailable, FAA's Direct Access Radar Channel (DARC) system provides backup radar data processing functionality; however, it does so with a degradation in flight data processing capabilities. Specifically, DARC provides basic data pertinent to an aircraft's identification, position, altitude, and speed, but it does not provide automated flight plan processing, controller hand-offs, or a safety alert processing capability, which alerts controllers to impending conflicts between aircraft.

From 1986 to 1988, IBM installed HCS hardware in FAA's 20 en route centers as well as its training and technical support centers. At that time, IBM projected that this equipment would have a service life of 10 years. Since HCS was installed, FAA contracted with Lockheed Martin for HCS hardware maintenance. Lockheed Martin, in turn, subcontracted the work to an IBM subsidiary.

HCS HAS NOT BEEN MEETING
AVAILABILITY REQUIREMENTS

For the last 3 years, HCS has not met its availability requirements. FAA has specified an HCS system availability requirement of 99.998 percent. HCS did not meet this requirement in 1995, 1996, and 1997, with average availabilities of 99.972 percent, 99.984 percent, and 99.982 percent, respectively. It also did not meet it in the first 2 months of 1998, with an average availability of 99.992 percent.

HCS' availability rate is driven by unscheduled outages. Unscheduled outages occur for a variety of reasons, including equipment failures, loss of power, software problems, and weather effects. Of the 29 unscheduled outages in 1997, FAA data show that 34.5 percent were due to software, 27.6 percent were due to hardware, and 37.9 percent were due to an assortment of other reasons, such as loss of power, weather effects, and unknown causes.

SPARE PARTS SHORTAGE AND
YEAR 2000 ISSUE AFFECT HCS'
FUTURE AVAILABILITY

One key issue affecting HCS' future availability is the shortage of critical spare parts. Given that HCS hardware is approaching the end of its expected life cycle, IBM calculated end-of-service dates for each HCS subsystem based on failure rates, available spares, engineering support, plant maintenance, and projected demand. IBM stated that after the end-of-service date, it will maintain the system on a "best effort" basis and the government will be responsible for furnishing any spare parts that become unavailable. Under this scenario, FAA predicts it will encounter longer system outage times—thereby reducing the availability of en route automation systems and threatening air traffic services.

IBM identified eight key hardware units, including the main processor, that will reach their end-of-service dates on or before December 31, 1999. FAA is most concerned about the main processor, which is projected to reach its end-of-service date by September 30, 1998. One key component, the Thermal Conduction Modules (TCM), drives this end-of-service date.[2] Even more specifically, one module of TCM, known as CLVM,[3] is projected to be depleted

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[2]TCM is an IBM-patented technology for packaging electronic circuits for efficient heat dissipation.

[3]According to FAA officials, the meaning of the "CLVM" acronym has been forgotten over time, though it may stand for Cache Link Volatile Memory.

first. TCM technology was discontinued by IBM in the late 1980s and the manufacturing and refurbishing facilities were dismantled. IBM holds all patents on TCM technology and no other manufacturers or vendors are licensed to make or repair them.

In June 1997, Lockheed Martin conducted a worldwide search to identify alternative sources of these parts and reported it could not locate a shelf inventory of TCMs and found no way to guarantee the availability of parts for the HCS main processors (IBM 3083).

Given the six spare CLVM parts it had in inventory on March 4, 1998, and worst-case usage projections,[4] FAA estimated that the inventory of this part will be depleted early in 1999. Using best-case usage projections, the inventory will be depleted in late 1999.[5]

To prolong the life of the current inventory of spare parts, in December 1997, FAA implemented a more conservative replacement policy for TCM parts. Under this new policy, TCM parts are not automatically replaced after experiencing two minor problems, as they were under the prior policy. Instead, each minor problem is reported and analyzed, and each part is evaluated to determine its ability to continue operations. Additionally, once the current inventory of spares is depleted, FAA plans to cannibalize parts from HCS processors located at its training and technical support centers. FAA estimated that it would be able to obtain 26 CLVMs through this cannibalization effort. However, even with cannibalization, FAA states that HCS cannot be maintained beyond 2001.

A second key issue that could affect HCS' availability is the Year 2000 computer problem. While FAA officials expressed confidence that they have resolved date dependencies in HCS' operating system and application software, IBM

Basically, CLVM is the module that provides memory storage for the other TCM modules.

[4]Worst-case usage projections assume that actual part usage rates over the past 3 years will increase by 50 percent each year in the future.

[5]In the past, parts were replaced after experiencing 1 serious or 2 minor problems. Best-case usage projections assume that in the future, parts will not be replaced to correct mi or problems, and that the replacement rate for serious problems over the past 3 years will increase by 50 percent each year.

reported that it has no confidence in the ability of the HCS processor's microcode (low-level machine instructions used to service the IBM 3083) to survive the millennium date change because it no longer has the skills or tools to properly assess this code. If there are date dependencies in the processor's microcode, HCS could malfunction or shut down, thereby forcing FAA to operate with the degraded flight processing capabilities provided by its backup system and potentially reducing air traffic capacity. IBM has therefore recommended that FAA purchase new HCS hardware.

FAA PLANS TO REPLACE HCS

Because of concerns about the availability of spare parts and the Year 2000 issue, FAA initiated the Host and Oceanic Computer System Replacement program to replace all HCS processors in its 20 en route centers and training and technical support centers by October 1999.[6] Software and peripheral equipment replacements, which will occur in the later phases of this program, are scheduled for completion by mid-2001. FAA believes this phased approach, with a total system life-cycle cost estimate of about $607 million through 2008, will provide the lowest risk for fast processor replacement and will provide for replacement of other hardware components prior to their end-of-service dates.

While we agree that FAA must act quickly to resolve its HCS spare parts and Year 2000 issues, this acquisition does not come without risks--risks that FAA must mitigate in a short time. In our February 4, 1998, testimony, we reported on several HCS hardware acquisition risks. One of these is the risk of delays and problems resulting from deploying HCS concurrently with FAA's new Display System Replacement (DSR). When upgrading parts of a safety-critical system such as HCS and DSR, it is simpler and safer to upgrade one part at a time. Another risk lies in the difficulty associated with deploying new hardware to 20 en route centers in less than 2 years. In commenting on a draft of this report, FAA officials concurred that this is a risk but stated that they are mitigating it by using a phased approach that will allow them to deploy the hardware first and the software and peripheral equipment replacements later.

The Department of Transportation's Inspector General is initiating two assignments that will address FAA's progress in mitigating these risks. The first is a review of the Host and Oceanic Computer System Replacement's cost, schedule, and risks. The second is a review of FAA's plans for concurrently deploying systems, including HCS and DSR, in 1999 and 2000. Additionally, we have initiated a review of FAA's plans for assuring business continuity should

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[6]FAA also plans to replace non-HCS equipment in four Oceanic en route centers.

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its systems not be replaced, renovated, or working correctly in time for the year 2000.
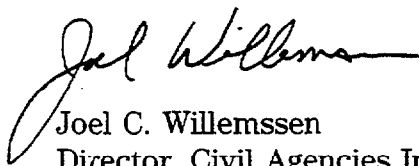
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On April 24, 1998, we obtained agency comments on a draft of this letter from officials at FAA and the Department of Transportation (DOT), including the director of FAA's Year 2000 program office, FAA's en route integrated product team lead, and DOT's information technology division manager. These officials generally agreed with the facts presented. FAA officials also commented on particular language in the draft letter, and these comments have been incorporated into the letter as appropriate.

We are sending copies of this letter to the Ranking Minority Member of your Subcommittee and the Chairwoman and Ranking Minority Member of the Subcommittee on Technology, House Committee on Science; the Secretary of Transportation; the Administrator of the Federal Aviation Administration; the Department of Transportation Inspector General; the Director of the Office of Management and Budget; and other interested parties. Copies will also be made available to others upon request.

If you have any questions on the material in this letter, please contact me at (202) 512-6253 or Colleen Phillips, Assistant Director, at (202) 512-6326. We can also be reached by e-mail at *willemssenj.aimd@gao.gov* and *phillipsc.aimd@gao.gov*, respectively.

Sincerely yours,

Joel C. Willemssen
Director, Civil Agencies Information Systems

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