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Delays in Critical Air Traffic Control Modernization Projects Require Increased FAA Attention to Existing Systems

Statement for the record by
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Subcommittee on Transportation and Related Agencies
Committee on Appropriations
United States Senate

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Mr. Chairman and Members of the Subcommittee:

My testimony today will cover the delays and problems in two of the Federal Aviation Administration's (FAA) most critical air traffic control modernization projects--the Voice Switching and Control System and the Advanced Automation System. Delays in these two major systems will lead to FAA operating existing automated systems longer than originally anticipated. Because these aging systems have already experienced problems, my testimony will also address the need for FAA to devote increased management attention to them.

Voice Switching and Control System Problems and Delays Continue

The Voice Switching and Control System, or VSCS, is a highly complex system intended to improve ground-to-ground and air-to-ground voice communications at air traffic control facilities. It is to be deployed at 24 air traffic control centers and is expected to serve up to 430 controller positions at each center. VSCS is critical to FAA's plans to modernize the air traffic control system because it is to provide communications for new controller workstations, currently being developed under the Advanced Automation System. Because the new workstations are designed to work with VSCS, they cannot be fully tested or used until VSCS' essential capabilities are operational.

In October 1986, FAA awarded two VSCS prototype development contracts to AT&T Technologies, Incorporated, and to Harris Corporation to design, develop, and install prototype systems. As we reported to you in 1989,[1] both prototype contractors began experiencing unanticipated technical difficulties in meeting VSCS requirements soon after beginning work on the project. FAA officials told us in 1989 that the contractors had resolved most of these development problems and therefore FAA planned to award a contract to one of the two contractors for the production of VSCS in November 1989. However, subsequent testing in 1989 and again in 1990 showed that neither contractor was able to produce a prototype system that satisfied FAA's requirements.

Because of these continuing problems, the severe cost increases and schedule delays already encountered in VSCS continue to escalate dramatically. In 1989 we reported that the total estimated cost to design, develop, produce, and install the system had tripled from $258 million in 1982 to over $786 million. Since 1989, the total cost has almost doubled to $1.5 billion. The schedule for VSCS has been delayed 8 years. In 1982 FAA projected that the system would be operational at the first site in 1986. Now, FAA estimates that the first site will be operational in 1994.

Because of the VSCS problems, FAA recently decided to restructure

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[1]Air Traffic Control: Voice Communications System Continues to Encounter Difficulties (GAO/IMTEC-89-39, June 1, 1989).

the acquisition of the system by extending the prototype development phase until December 1991, when it plans to award the production contract. This restructuring is responsive to our previously reported concerns on the need for FAA to complete key testing before awarding a production contract.[2] Under the revised strategy, acceptance and operational controller testing of the prototypes are scheduled to be conducted before awarding the production contract. Such testing will provide FAA with added assurance that the system it eventually selects will meet functional and performance requirements in an operationally realistic environment.

In addition, FAA's revised acquisition strategy involves exploring two alternative interim voice systems with communication capabilities that could be used with the Advanced Automation System workstations. This exploration will impose additional short-term costs on the government. However, by providing additional communications options, this initiative may allow FAA to proceed with AAS workstation implementation without risking further delays attributable to VSCS problems.

Although FAA has made progress in ensuring that it has a well-designed acquisition, risks remain that VSCS will not be successfully developed in the near future because (1) some requirements remain difficult to attain, and (2) contractors have

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[2]GAO/IMTEC-89-39, June 1, 1989.

little time to incorporate recent FAA requirements changes into their prototypes before testing begins next month.

One demanding VSCS requirement is system availability. FAA requires the system to be available for use by controllers 99.99999 percent of the time, which is less than 4 seconds of down time per year. Because the primary way to achieve this system availability is through built-in redundancy, contractors have had to develop a large amount of software and hardware in their VSCS prototypes.

Another difficult VSCS requirement is the automated system reconfiguration function. FAA intends the Advanced Automation System to allow the amount of airspace a controller handles to be reapportioned several times a day to reflect changes in staffing, amount of air traffic, and availability of equipment. Therefore, the new workstations need to reconfigure their maps and displays to match these changes in airspace. To accommodate these workstation changes, VSCS must be able to automatically reassign radio frequencies and reroute incoming calls--a complex task. While some manual reconfiguration can be done on the current system, it does not meet the Advanced Automation System requirements because such changes can only be done manually.

In addition to difficult requirements, the contractors have had little time to modify their prototypes to incorporate recent FAA

requirements changes. Although testing of prototypes begins next month, FAA and the contractors did not resolve open technical issues on the requirements changes until March 1991. Both contractors expressed concern about their ability to incorporate these changes into their prototypes in time for testing. This testing will be critical in assessing the contractors' progress in overcoming past problems and their ability to deliver a system that meets all requirements.

Mr. Chairman, I would like to point out that the problems and risks with VSCS that I have just discussed will be described in more detail in a report that we will be issuing to you shortly.

Advanced Automation System Delayed

Let me now briefly discuss the Advanced Automation System, or AAS, the centerpiece of FAA's plans to modernize the air traffic control system. AAS is intended to replace aging air traffic control computer systems with new hardware, software, and controller workstations. FAA believes that implementation of AAS will increase controller productivity, reduce operating costs, save fuel and passenger time, and allow controllers to handle anticipated traffic increases more safely and efficiently. FAA is now in the third year of its contract with IBM, currently valued at about $3.8 billion, to complete the design and production of AAS.

FAA plans to implement the AAS program in five phases. The first phase is the Peripheral Adapter Module Replacement Item, which is to permit more data from additional radars to be received at the en route air traffic control centers that handle air traffic between airports. The second phase is the Initial Sector Suite System. This system constitutes the largest portion of AAS, and is to replace controller workstations at en route air traffic control facilities and automate some processes that are now done manually. The third phase, the Terminal Advanced Automation System, is to provide additional hardware and software to support terminal capabilities and allow the consolidation of smaller terminal facilities into en route centers. The Area Control Computer Complexes, the fourth phase, are to provide software to perform en route functions in area control facilities, and install additional hardware to enable the conversion of en route traffic control centers into area control facilities. Finally, the fifth phase, Tower Control Computer Complexes, are to provide additional automation support in selected airport traffic control towers.

Much of IBM's effort to date has been on the phase one Peripheral Adapter Module Replacement Item. FAA recently sent this component to the en route traffic control center in Seattle for installation and integration testing. All FAA centers in the continental United States are expected to have the replacement item operational by July 1993.

Implementation of the remaining four phases of AAS will not occur for several more years. In December 1990, FAA and IBM agreed to a 19-month delay covering these phases. As a result, workstations under the Initial Sector Suite phase are not scheduled to be operational at the first center until August 1995, with the last center being operational in May 1997. The remaining three phases of AAS are scheduled to be operational at air traffic control facilities between January 1997 and November 2002.

We previously reported to you that the 19-month delay occurred because (1) not all requirements issues were resolved when the IBM contract was awarded, (2) FAA and IBM underestimated the time it would take to develop and test software, and (3) FAA added some new requirements.[3] For example, one added requirement was the need for sector by sector transition, which would allow new workstations to be deployed at an en route center one sector at a time, rather than a total one-time change from the old control room to the new one.

Aging Systems Will Be Operated Longer Than Anticipated

Delays in AAS and VSCS will lead to FAA operating aging computer systems at its air traffic control facilities for several more years. Currently, FAA maintains about 180 terminal radar approach

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[3]Air Traffic Control: Continuing Delays Anticipated for the Advanced Automation System (GAO/IMTEC-90-63, July 18, 1990).

control facilities, or TRACONs, which control aircraft arriving at or departing from airports, and 20 en route traffic control centers in the continental United States. Each of these facilities is supported by an automated system to help controllers maintain aircraft separation.

At its 63 largest TRACONs, FAA relies on outdated computer technology in its automated systems to provide essential aircraft position and flight plan information to controllers. The main computer processors for these systems are 1960s-vintage low capability UNIVAC computers. This computer can store up to 256,000 characters in main memory and process up to about 500,000 instructions per second. By contrast, a typical desktop computer can store 4 million characters and process between 2 and 3.5 million instructions per second. In addition, the old UNIVAC processors can perform only one task at a time, whereas modern processors are multitask. Furthermore, the system software that runs the old processors, Ultra, is a UNISYS-proprietary, assembly-language product that is antiquated and difficult to maintain.

Mr. Chairman, we have previously reported to you on the severe problems that these aging, outdated TRACON systems have experienced.[4] Specifically, computer capacity shortfalls were impairing controllers' ability to maintain safe separation of

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[4]Air Traffic Control: Computer Capacity Shortfalls May Impair Flight Safety (GAO/IMTEC-89-63, July 6, 1989).

aircraft. Many TRACONs reported instances of aircraft position and identification information disappearing from controllers' displays, data flickering on the displays, and computer responses to controllers' attempts to update or request data being delayed.

By contrast, at its en route traffic control centers, FAA has implemented newer hardware technology that provides additional computer capacity. Specifically, in the late 1980s, FAA implemented new IBM 3083 computers to replace IBM 9020 computers that were installed in the 1960s. To accommodate this new hardware, FAA modified, rather than replaced, the existing system software.

Since implementation of these new computers, the overall reliability of the en route system has improved. However, the number of problems with the modified software has steadily increased. The number of unresolved software problems has now grown to over 1500 nationwide. Further, FAA classifies over 70 percent of these problems as having the potential to either adversely impact or seriously degrade the air traffic system.

Problems with en route software have led to a number of interruptions in the primary computer system--most lasting only seconds but others continuing for several minutes or more. When these interruptions occur, the recovery features of the en route system allow controllers to resume most air traffic control

functions within seconds. Nevertheless, such outages impact the air traffic control system. For example, last year the Los Angeles Center experienced a 77-minute outage of the primary system. FAA estimated that 57 airplanes were delayed an average of 22 minutes each due to this software-caused outage.

Management Attention Needed to Address Capacity and Software Problems

The problems experienced at large TRACONs and en route centers require FAA management attention. To address the problems at larger TRACONs, we previously recommended that FAA take necessary actions to ensure that critical air traffic control functions were not interrupted by existing capacity shortfalls and institute a computer capacity and performance management program for TRACON systems.[5] In response to our recommendations, FAA has taken several steps to prevent continuing capacity shortfalls from occurring in the near-term. For example, to increase capacity, FAA is replacing existing computer memories with high-speed solid state memories and procuring additional processors. FAA also recently began monitoring the performance of its systems by capturing data on track utilization, processor utilization, and aircraft targets. This data provides FAA with information on the ability of current systems to meet existing processing needs.

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[5]GAO/IMTEC-89-63, July 6, 1989.

Although FAA has taken steps to prevent capacity shortfalls from occurring in the near-term, it has not yet identified future TRACON computer capacity requirements. Without adequate information on future requirements, FAA does not know if its actions to provide additional capacity will continue to be sufficient until AAS is implemented. Therefore, we reiterate our previous recommendation to the Secretary of Transportation that he direct the FAA Administrator to implement a capacity management program that includes analysis of future work loads.[6]

At en route centers, timely and effective resolution of software problems would reduce the risk that the air traffic control system will be impaired. Correcting software problems to ensure the system performs as originally intended is one of the major activities needed to maintain the integrity of a computer system. The primary ways to correct software problems are either temporary fixes to the operational program known as patches, or permanent solutions to the software's source code. In correcting its software problems, FAA has been primarily relying on patches. However, undue reliance on these temporary fixes may exacerbate the risk of future problems to the air traffic system by causing software code and logic to deteriorate or become difficult to maintain.

FAA officials attribute both their reliance on patches and their

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[6]GAO/IMTEC-89-63, July 6, 1989.

inability to make appropriate corrections and adequately resolve software problems to a lack of available resources. However, FAA has not developed a plan that identifies its resource needs for correcting and maintaining center software until AAS is implemented. In a report we plan to issue to you shortly, we intend to recommend that FAA make improvements in its management of software.

Mr. Chairman, this concludes my statement on the increasing need for FAA to assure existing systems are effectively managed due to delays in critical modernization projects.