Office of Inspector General

Audit Report

Using the Direct Access Radar Channel During the HOST Replacement Program

Federal Aviation Administration

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Memorandum

U.S. Department of Transportation
Office of the Secretary of Transportation
Office of Inspector General

Subject: ACTION: Report on Using the Direct Access Radar Channel During the HOST Replacement Program
AV-1999-030

Date: November 30, 1998

From: Alexis M. Stefani
Deputy Assistant Inspector General for Aviation

JA-10

To: Steven J. Brown
Acting Associate Administrator for Air Traffic Services

This report presents results from our audit of the HOST and Oceanic Computer System Replacement Program (HOST Replacement). Our objective was to determine whether the Direct Access Radar Channel (DARC) will be capable of serving as the primary air traffic control system during the HOST Replacement. FAA expects to place more reliance on DARC during the next year while transitioning to the new HOST computers. Therefore, DARC must be available while the HOST equipment is shut down during the transition period. A description of our audit scope and methodology is included as Exhibit A to the report.

FAA is replacing HOST equipment at 20 domestic Air Route Traffic Control Centers (centers), 3 oceanic and offshore sites, the Alaska center, and support facilities. The HOST Replacement is structured into four phases to meet funding constraints as well as to reduce the schedule, potential Year-2000, and end-of-service supportability risks. The first phase replaces the mainframe HOST and oceanic computers at the 20 domestic centers by the Year 2000. Subsequent phases replace the computers at the remaining sites, upgrade software, and replace peripherals such as printers and tape drives by mid-2001. Program lifecycle costs are estimated at $607 million through Fiscal Year 2008.

HOST is the heart of the computer system used to control enroute air traffic in the National Airspace System. It processes flight data such as airline identification,

flight plan, and altitude for air traffic controllers at centers, terminal approach facilities, and towers, and radar data on aircraft location for air traffic controllers at the centers. Each center has a primary and secondary HOST processor.

DARC was installed in the early 1980s as the backup for the HOST computer system. FAA relies on DARC to provide radar data to controllers when both HOST processors fail or are not available during maintenance and testing periods. The following chart highlights the key differences in capabilities between HOST and DARC.

Comparison of HOST and DARC Capabilities

Air Traffic Control System Capability	HOST	DARC
Screen Readout of Aircraft Data	X	X[1]
Automated Hand Off From One Controller to Another	X	
Automated Flight Plan Processing	X	
Paper Backup of Flight Information ("Flight Strips")	X	
Route Projection	X	
Warning When Planes Are Too Close/Might Collide	X	
Minimum Safe Altitude Warning	X	

RESULTS-IN-BRIEF

Although it has limitations, DARC is capable of serving as the backup system to control air traffic during the HOST Replacement. DARC is not intended to serve as a primary air traffic control system because it does not have the capability to provide current flight information or controller alerts[2]. FAA analyzed DARC's performance data for the period February 1995 to February 1998 and concluded

[1] DARC, like HOST, provides screen readouts of airline and aircraft identification, assigned and present altitude, ground speed, and the sector the plane will be handed off to. However, unlike HOST, it does not provide a screen readout of the origin and destination of the aircraft.

[2] Controller alerts warn controllers of unsafe separation between aircraft, an aircraft operating below a minimum altitude, or an untracked aircraft operating in the airspace.

that DARC's reliability was better than 99 percent. Reliability is the probability, expressed as a percentage, that a facility/service will perform its mission over a given time period. Our analysis of FAA's data in the National Airspace System Performance Analysis System[3] for the period March 1998 to August 1998 showed that DARC's reliability has remained better than 99 percent. There are, however, some drawbacks associated with relying on DARC during the HOST Replacement period. They are discussed in the following paragraphs.

--The use of DARC reduces controller efficiency because controllers must use manual processes to replace the automated flight data functions the HOST system normally performs. For example, flight progress strips, which provide current information on air traffic and required clearances, are automatically generated by HOST. When DARC is used, these strips must be hand-written by controllers using information they gather during verbal communications. This manual process takes valuable time from the controllers' primary function of watching radar screens and ensuring safe separation of aircraft. National Air Traffic Controllers Association (NATCA) officials estimated that reliance on DARC during peak air traffic operations could reduce air traffic capacity by at least 50 percent because of the need for increased separation of aircraft to ensure safety.

--Some centers will be significantly increasing their reliance on DARC due to planned HOST shutdowns during the replacement and other modernization programs such as the Display System Replacement (DSR). Planned DARC usage at the 5 centers we visited is expected to increase in total from 1,977 to 3,129 hours, or 58 percent during the period July 1998 through December 1999. For example, Chicago center plans to use DARC for 32 hours during the HOST replacement and 24 hours during the DSR transition, in addition to shutdowns planned for normal software and hardware maintenance. Further, unplanned outages of the HOST continue to occur during peak operating hours. From July 1, 1997 through June 30, 1998, air traffic controllers at the 5 centers we visited had to rely on DARC to control air traffic 5 times for 20 hours due to unplanned HOST outages.

-- Air traffic controllers on all shifts need to be proficient in using DARC. However, a large number of air traffic controllers at the five centers we visited have limited experience manually controlling air traffic using DARC. Air traffic management officials and air traffic controllers stated that controllers do not gain actual experience using DARC unless they work the midnight shift when DARC is used for planned HOST shutdowns. Data provided by the 5 centers show that

[3] The National Airspace System Performance Analysis System identifies equipment outages for all centers, the causes of the outages, and measures equipment reliability.

between 21 and 54 percent of the controllers did not work the midnight shift during the period July 1997 through June 1998, and therefore, had very limited or no operational experience controlling air traffic using DARC. While periodic refresher training on DARC is provided to air traffic controllers by computer-based instruction or videotapes, air traffic managers and controllers at the five centers expressed concern that refresher training does not provide the operational experience needed to be proficient in manually controlling air traffic using DARC.

In order to mitigate the risks during the HOST Replacement, we are recommending that FAA ensure that all center air traffic controllers receive increased proficiency training using DARC.

Use of DARC Reduces Air Traffic Controller Efficiency

When air traffic controllers use DARC instead of HOST, air traffic operations are affected. Unlike HOST, DARC does not process flight data, nor does it provide controller alerts. This results in significantly increased manual air traffic control operations, extensive verbal coordination among adjacent centers, and the need for controllers to increase aircraft separation. For example, HOST automatically generates flight progress strips for air traffic controllers to post current data on air traffic and required clearances. When DARC is used without the HOST processors, controllers must hand write flight progress strips from information gathered during verbal communication. Officials at one center visited expressed concern that this time consuming process diverts controller attention from higher priority tasks such as separating aircraft. In addition, the HOST automatically provides adjacent centers with flight information to hand off aircraft. When DARC is used instead of HOST, the controllers must make telephone calls to provide current flight information and perform hand-offs of aircraft responsibility from one controller to another.

To adjust for this time-consuming process and the lack of automatic alerts to controllers of potentially unsafe situations, controllers increase the distance between aircraft to ensure safety. However, the increased separation causes delays in air traffic. For example, on November 6, 1997, an unplanned HOST outage occurred at Indianapolis center at 4:59 a.m. Eastern Standard Time. Software problems with the HOST processors forced the center to transition to DARC, which was used for 14 hours and 31 minutes during peak air traffic operations. Consequently, 287 flights awaiting departure and 17 flights enroute were delayed. Delays were as long as 3 hours and 19 minutes. National Air Traffic Controllers Association officials estimated that reliance on DARC during peak air traffic operations could reduce air traffic capacity by at least 50 percent due to the increased separation requirements when manual procedures are used.

Reliance on DARC Is Expected to Increase

Air traffic controllers will be increasing their reliance on DARC due to planned HOST shutdowns during the HOST Replacement. We compared actual DARC usage for the 18-month period ending June 30, 1998, to planned usage in the subsequent 18-month period for the five centers visited. According to data provided by officials at the five centers, planned DARC usage during the HOST Replacement will increase significantly at some locations.

Comparison of Actual and Planned DARC Usage

	Actual Use[4] 1/1/97-6/30/98	Planned Use[5] 7/1/98-12/31/99	Increase in Planned Use	Percent Increase
Centers	**Hours**	**Hours**	**Hours**	**%**
Washington	197	432	235	119
Cleveland	302	600	298	99
Indianapolis	460	885	425	92
Chicago	569	700	131	23
New York	449	512	63	14
Total	**1,977**	**3,129**	**1152**	**58**

FAA is taking action to minimize the impact on air traffic of the increasing reliance on DARC during the HOST transition period. First, all HOST shutdowns are planned for the midnight shift when air traffic is low. Second, FAA expects to significantly reduce the number of HOST shutdowns required for testing from those projected by its installation contractor. The HOST Replacement installation contractor initially estimated that 24 HOST shutdowns would be required at each center, but FAA Airway Facilities Operational Support staff, through analysis and experience gained at the first test site, project that only 8 shutdowns will be necessary at each site, plus 3 shutdowns for contingencies.

Further, FAA engineers developed a test method, known as Dual-Native NAS, which could further reduce the number of HOST shutdowns needed for the HOST Replacement to six. The use of Dual-Native NAS is expected to minimize the impact on air traffic operations because only one HOST processor is shut down for testing at any one given time, enabling flight data

[4] Actual use does not include the hours when DARC was used for unplanned HOST outages.

[5] Planned use includes HOST shutdowns during the HOST Replacement and other modernization projects such as DSR, as well as normal software and hardware maintenance.

processing through the remaining HOST processor. All 20 centers were briefed on Dual-Native NAS, but the decision to use this method has been left up to each center. At the time of our field work, Washington and Indianapolis centers had decided not to use Dual-Native NAS for the HOST Replacement. However, Indianapolis center officials plan to begin testing Dual-Native NAS to develop procedures and become familiar with its operation for potential use in other modernization programs.

In addition to planned HOST shutdowns, unplanned outages continue to occur and may increase due to aging equipment and diminished supportability. The HOST processor, a key HOST component, is beyond its end-of-service date and spare parts are in short supply. Further, there is a lack of available maintenance expertise to repair the processors. The following chart shows that five HOST components are beyond their end-of-service dates and one other component will reach its end-of-service date by December 31, 1998.

HOST Hardware Units with End-of-Service Dates In 1998

Type of Unit	Number in Use	End-of-Service Date
Keyboard Video Display Terminal	793	06/30/98
Modem	51	06/30/98
Processor Controller	48	09/30/98
Processor (IBM Model 3083BX)	48	09/30/98
Coolant Distribution Unit	48	09/30/98
Display Console	48	12/31/98

Unplanned HOST outages are especially significant when they occur during peak hours. During these outages, air traffic controllers have to use DARC, with its limited capabilities, to control large volumes of air traffic. From July 1, 1997 through June 30, 1998, air traffic controllers at the 5 centers visited used DARC to control air traffic 8 times for approximately 22 hours. Five of these eight HOST outages, which totaled 20 hours, occurred during peak hours. While planned shutdowns during the HOST Replacement will be on the midnight shift, controllers need to be prepared in the event that the HOST is unable to resume operation during the morning peak hours, as well as unplanned outages during other peak times. Consequently, air traffic controllers on all work shifts need to be proficient in using DARC.

Air Traffic Controllers Have Limited Operational Experience Using DARC

Air traffic managers and controllers interviewed at five centers expressed concerns that large numbers of air traffic controllers are not proficient in manually controlling air traffic using DARC. They stated that controllers do not gain actual experience using DARC unless they work the midnight shift, when DARC is used for planned HOST shutdowns. We agree with concerns expressed by the officials and controllers.

We asked air traffic management officials to provide data showing the number of controllers who have controlled air traffic using DARC during July 1997 through June 1998. The officials stated that identifying which air traffic controllers used DARC to control air traffic during the period would involve extensive manual comparisons of time and attendance records to DARC usage records, and some records were no longer available. Therefore, the officials provided us data showing the number of controllers who worked the midnight shift during that period. The data provided were the best available measure to determine whether air traffic controllers may have used DARC to control air traffic. As shown in the following chart, between 21 and 54 percent of the controllers at the 5 centers had not worked the midnight shift and, therefore, are unlikely to have recent experience using DARC to control air traffic.

Air Traffic Controllers[6] Who Did Not Work the Midnight Shift
July 1997 through June 1998

Center	Number of Controllers	Number of Controllers Who Did Not Work the Midnight Shift	Percent of Controllers Who Did Not Work The Midnight Shift
Cleveland	423	227	54%
New York	241	121	50%
Indianapolis	346	171	49%
Washington	321	102	32%
Chicago	365	75	21%
Totals	**1,696**	**696**	**41%**

[6] Includes only full performance level controllers.

Refresher Training Does Not Ensure Controller Proficiency in Using DARC

Air traffic managers and controllers interviewed stated that, although refresher training on DARC is given to all air traffic controllers, it does not provide the operational experience needed to be proficient in manually controlling air traffic using DARC. All centers visited provided refresher training every 6 months as required by FAA Order 3120.4J, "Air Traffic Technical Training," dated June 16, 1998[7], using computer-based instruction, videotapes, or a combination of both. The type and length of training varied by center. However, none of the five centers provided DARC refresher training using dynamic simulation, which creates an operational setting similar to the environment for controlling air traffic. According to FAA officials, a dynamic simulation capability was not developed for DARC. They believe it is not cost effective to develop this capability now, because DARC is nearing the end of its life cycle. Air traffic managers and controllers commented that refresher training is not effective if controllers do not regularly use DARC's unique operating procedures. They stated that FAA does not permit training air traffic controllers on DARC while they are controlling air traffic.

NATCA officials also expressed concerns about the lack of air traffic controller proficiency using DARC. The officials agreed that many controllers are not familiar with the manual operations required when DARC is used to control air traffic and would have difficulty during unexpected outages.

RECOMMENDATION

We recommend that FAA ensure all center air traffic controllers receive increased proficiency training using DARC to minimize the impact of outages during the HOST Replacement.

ACTION REQUIRED

FAA program officials agreed with the audit results and recommendation. They indicated that they had not planned additional DARC training during the HOST Replacement until we brought this matter to their attention. Please provide your written comments within 30 days on the specific actions taken or planned along with target dates for completing planned actions. We appreciate the courtesies and cooperation extended by your staff. If I can answer any

[7] This manual replaced FAA Order 3120.4H, dated June 1, 1995.

questions or be of any further assistance, please call me on (202) 366-0500 or Stuart Metzger, on (202) 366-1981.

SCOPE AND METHODOLOGY

We conducted the audit work from April through October 1998 at FAA Headquarters, centers at Leesburg, Virginia; Ronkonkoma, New York; Aurora, Illinois; Indianapolis, Indiana; and Oberlin, Ohio; and at FAA's Technical Center in Atlantic City, New Jersey. We also held discussions with NATCA Headquarters officials and center union representatives.

To assess DARC's reliability, we reviewed FAA's analysis of DARC's performance data for the 3-year period ended February 1998. In addition, we analyzed records of DARC's reliability for the period March to August 1998 from FAA's National Airspace System Performance Analysis System. We did not verify the accuracy of this system. To address air traffic controller proficiency in using DARC to control air traffic during HOST shutdowns, we discussed air traffic controller proficiency and refresher training on DARC with air traffic managers and controllers at the five centers visited. We reviewed data provided by these centers that identified the percentage of air traffic controllers who had not worked a midnight shift during July 1997 through June 1998. To determine if reliance on DARC is expected to increase or decrease, we compared data on DARC usage for scheduled HOST shutdowns that occurred at the five centers during January 1997 through June 1998 to estimates of planned DARC usage from July 1998 through December 1999. The audit was conducted in accordance with the Government Auditing Standards prescribed by the Comptroller General of the United States.

EXHIBIT B

AUDIT TEAM MEMBERS

The following is a list of major contributors to this report.

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