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Hazardous Weather Detection and Dissemination Systems

Statement of
Kenneth M. Mead, Associate Director
Resources, Community, and Economic
Development Division

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Mr. Chairman and Members of the Subcommittee:

We appreciate this opportunity to comment on the Federal Aviation Administration's (FAA's) existing and planned hazardous weather detection and dissemination systems for major airports. At your request, we reported last year on FAA's existing system for communicating severe weather warnings to pilots and are today releasing a report on the planned systems for detecting and communicating hazardous weather.[1]

Our earlier report disclosed that limitations in the existing aviation weather detection and dissemination system can often result in insufficient weather information being available to pilots during the critical takeoff and landing phases of flight. Specifically, we found that existing FAA airport radars have limited real-time[2] weather detection capability and are designed primarily for keeping aircraft separate. They cannot discern the types and severity of weather. Further, FAA's ground-based system of sensors for detecting wind shear (a rapid change in wind speed or direction) was found to be unreliable and plagued by false alarms. We also found that hazardous weather warnings are frequently not provided to pilots as soon as they are available

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[1]See Aviation Weather Hazards: FAA System for Disseminating Severe Weather Warnings to Pilots (GAO/RCED-86-152BR, Apr. 22, 1986); and Aviation Weather Hazards: Status of FAA's New Hazardous Weather Detection and Dissemination Systems (GAO/RCED-87-208, Sept. 29, 1987)

[2]Real time is the period in which the occurrence and reporting of weather are almost simultaneous.

because air traffic controllers are too busy separating aircraft during peak traffic periods.

Over the past year, we reviewed FAA's planned investment of $1.5 billion in new weather projects to see if they will provide more accurate hazardous weather detection and improve the timeliness of weather warnings to pilots. What we found is encouraging in that FAA's new systems will provide better hazardous weather detection than is presently available. There are, however, some unresolved issues that could reduce these systems' anticipated effectiveness and/or increase their cost. Moreover, while one of FAA's objectives is to improve the timeliness of weather information dissemination, the National Airspace System (NAS) plan indicates that hazardous weather information from the new detection systems will not be sent directly and automatically to pilots for nearly a decade. Until this is done, busy controllers will continue to disseminate the information, and FAA is not likely to be able to provide more timely hazardous weather information to pilots.

FAA's NEW SYSTEMS TO DETECT WIND SHEAR AND THUNDERSTORMS

Essentially, there are two hazardous weather phenomena that can crash an aircraft during takeoff and landing: wind shear and thunderstorms and the lightning, hail, and turbulence that accompany them. Wind shear alone has been identified as a cause or factor in 18 accidents since 1970, involving the loss of 575 lives.

Three of FAA's new systems--the enhanced low-level wind-shear alert system (enhanced LLWAS), the terminal next-generation weather radar (terminal NEXRAD), and the terminal Doppler weather radar--are for detecting wind shear. Another--a new airport surveillance radar (ASR-9)--is for detecting phenomena associated with thunderstorms around airports. The objective of these new systems is to improve weather detection.

Enhanced LLWAS

The enhanced LLWAS is an improvement to FAA's existing ground-based system of sensors for detecting wind shear. It is to be installed at 110 airports by August 1992. The number of wind sensors will be increased from 6 to 11, and an improved computer processor will be added. The objective of enhanced LLWAS is to increase the number and density of sensors, thereby reducing the likelihood that wind shears will hit between the sensors without being detected.

Although an improvement, the enhanced LLWAS is not viewed by FAA as the optimal solution to the wind-shear detection problem because, for the most part, the sensors are located on the airport and cannot detect wind shears that occur above the ground-based sensors or beyond the airport's boundaries. For example, Delta Air Lines flight 191, which crashed at Dallas/Ft. Worth International Airport on August 2, 1985, encountered a microburst beyond the airport's LLWAS sensors. This microburst was not detected by LLWAS until some 10 to 12 minutes after the crash, when the microburst came closer to the airport and within range of the LLWAS sensors.

Enhanced LLWAS, however, will remain a part of the total FAA wind-shear program to supplement the new Doppler radar systems.

Terminal NEXRAD and Terminal

Doppler Weather Radars

The terminal NEXRAD and terminal Doppler weather radars will change the method of detecting wind shear from ground-based sensors to radars. These radars will use state-of-the-art Doppler technology to measure the intensity of winds. Existing FAA and National Weather Service radars do not have this capability.

FAA is procuring 16 NEXRADs to provide weather information to enroute air traffic in Alaska, Hawaii, and the Caribbean. However, before installing them at their enroute locations, FAA plans to install these radars near 19 of the nation's busiest airports between 1990 and 1992 and call them terminal NEXRADs.

The terminal NEXRADs will be sited away from the airports and will improve wind-shear detection by extending coverage beyond the area covered by the enhanced LLWAS system. They will provide interim wind-shear coverage while the terminal Doppler weather radar is being developed.

The terminal Doppler weather radar is FAA's optimal ground-based wind-shear detection system. FAA plans to award a procurement contract in late fiscal year 1988, and the terminal Doppler weather radar is to be installed at 100 airports between 1992 and 1995.

Research on Terminal Doppler Weather Radar's Performance Objectives May Not Be Completed Before Planned Production Contract Date

FAA and its wind-shear researchers have identified performance objectives that they believe an optimal ground-based wind-shear detection system should meet. They include (1) accurately measuring wind-shear severity, (2) forecasting development of wind shears, (3) scanning all airport runways and flight paths, (4) having at least a 90-percent probability of detecting all wind shears while having a 10-percent or less false alarm rate, and (5) being fully automated whereby radar signals are automatically translated into useful information. The purpose of these objectives is to assure accurate detection and useful information to pilots.

Although FAA is planning to award a procurement contract for 102 terminal Doppler weather radars in 1988, research on how to meet certain performance objectives will still be continuing. Thus, if the current schedule holds, FAA will contract to buy the radar before it knows whether the radar can meet all performance objectives.

In this regard, FAA researchers have identified several weather features that are believed to be indicators of developing wind shears; but it is not known whether a reliable detection technique is possible. Similarly, FAA has indicated that the 90-percent detection and 10-percent false alarm rates may be difficult to achieve. Research and testing of various aspects of the terminal Doppler weather radar is to continue in 1987 and 1988.

Competing Performance Objectives May Require Different Siting and Scanning Strategies

When FAA's research on all the performance objectives is completed, certain trade-offs among the various performance objectives may have to be made. Different system siting and scanning strategies may meet some performance objectives while reducing the effectiveness of others.

For example, FAA is considering the alternative of a full-circle scan in which the radar antenna rotates 360 degrees, as distinguished from a sector scan in which the antenna rotates back and forth to cover 120 degrees. The advantage of the sector scan is that it can make more scans and produce more data quicker than the 360-degree scan, thereby increasing the probability and accuracy of wind-shear detection. The advantage of the 360-degree scan is that the entire airport area can be observed. This could include the identification and location of incoming wind shears that have not yet reached the airport runways and flight paths.

FAA also is considering various radar siting strategies. For example, to best measure a wind shear's severity, FAA researchers believe the radar probably should look straight down a runway to detect the speed of wind moving toward and away from the radar. Conversely, a radar sited in this way may miss aloft weather movements that can quickly develop into wind shears.

UNCERTAINTY EXISTS ABOUT HOW TO USE THE AIRPORT SURVEILLANCE RADAR's WEATHER DATA

In addition to its wind-shear detection systems, FAA is procuring the ASR-9 radar which is to be installed at 101 airports between 1988 and 1991. The ASR-9 will provide improved weather detection by distinguishing between six levels of precipitation. The higher the rate of precipitation, the more likely that it is associated with hazardous phenomena such as lightning, hail, or turbulence. FAA and the National Weather Service have determined that each of the six levels can contain phenomena strong enough to crash an aircraft.

FAA has decided to disseminate the ASR-9 weather information directly to air traffic controllers, who will relay the information to pilots. It may be difficult for controllers, however, to explain to pilots the airspace covered by the different levels of precipitation. Only two of the six precipitation levels can be displayed on a controller's radar screen at one time. All higher levels of precipitation will be included as one of the two levels displayed on the controller's screen. For example, if levels 1 and 3 are displayed, all level 4 through 6 precipitation will be as level 3-type weather. A controller who wishes to provide a pilot with all six levels, therefore, will have to switch channels three times. FAA has not yet developed guidance for controllers on how the levels of weather are to be monitored and what information is to be disseminated to pilots.

STATUS OF FAA's EFFORTS TO SEND HAZARDOUS WEATHER DATA DIRECTLY TO PILOTS

According to the Air Line Pilots Association, its highest weather priority is for real-time information on wind shear, thunderstorms, and runway conditions at airports. To provide more timely weather information to pilots and reduce the work load of controllers, FAA is developing a ground-to-air communication system that will give pilots direct access to some weather data.

In a March 1987 hearing before this Subcommittee, FAA stated that wind-shear information will be disseminated directly to pilots. However, current NAS plan projections indicate that automatic dissemination of hazardous weather data, such as wind shear, may not occur for another 10 years. FAA recently began research and development on how to send terminal NEXRAD wind-shear data directly to pilots.

In October 1985 hearings before the Subcommittee on Aviation, House Committee on Public Works and Transportation, FAA officials said that ASR-9 precipitation data would be available in the cockpit by the early 1990s. This does not comport with FAA's current intentions, which are to rely on controllers to provide pilots with ASR-9 data. FAA officials recently told us that the agency does not plan for in-flight aircraft to directly access ASR-9's precipitation data. Instead, program officials told us that controllers will monitor the ASR-9 and relay the information to pilots.

CONTROLLERS OFTEN LACK TIME TO DISSEMINATE WEATHER INFORMATION

Switching from channel to channel to monitor and disseminate ASR-9 data as well as providing pilots with wind-shear information from FAA's enhanced LLWAS, terminal NEXRAD, and/or terminal Doppler weather radar takes time. On the basis of past GAO reviews of controller activities, there will be times when controllers will not be able to monitor the radar displays or disseminate hazardous weather information to pilots.

In our April 22, 1986, report on FAA's current system for disseminating hazardous weather information,[3] we found that two-thirds of the controllers at the nation's five busiest airports occasionally delay or do not give weather information to pilots. In addition, when weather information is given, it may not be given as soon as possible because controllers are too busy performing their primary duty of separating aircraft. For example, we found that 19 percent of controllers responding to our 1985 air traffic control work force survey reported that they often decline to provide weather advisories while working daily traffic peak periods.[4] Another 34 percent said they occasionally decline to give weather advisories. We believe these findings underscore the

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[3]See GAO/RCED-86-152BR, Apr. 22, 1986.

[4]See Aviation Safety: Serious Problems Concerning the Air Traffic Control Work Force (GAO/RCED-86-121, Mar. 6, 1986)

importance of FAA's efforts to develop a system for automatically disseminating hazardous weather data to pilots.

CONCLUSIONS

In summary, the terminal Doppler weather radar will improve wind-shear detection, but all research on the radar's scanning and siting strategies, detection accuracy and reliability, automation, and wind-shear forecasting will not be completed by FAA's planned fiscal year 1988 production contract date. While it is important for FAA to proceed as quickly as possible in developing and deploying an optimal ground-based wind-shear detection system, we believe it also is important that the system perform effectively, that the effects of unmet performance objectives be clearly assessed, and that the Congress be apprised of the radar's performance prior to FAA's awarding of a production contract. Therefore, we are recommending that FAA inform the Department and the Congress of any performance objectives that the terminal Doppler weather radar cannot meet and their impact on safety and cost before committing funds for a procurement contract.

Further, the new airport surveillance radar presents significant improvements in detecting airport-area weather hazards, but FAA has not determined how the ASR-9 information is to be monitored by controllers or what weather information is to be disseminated to pilots. On this point, our report recommends that FAA develop guidance on how air traffic controllers are to monitor the ASR-9 weather display and what hazardous weather information they are to disseminate to pilots.

Finally, until FAA can send information from its new ground-based hazardous weather detection systems directly to pilots, it will not be in a position to meet its objective of providing more timely hazardous weather information to pilots. Controllers will continue being the primary source of hazardous weather information.

This concludes my testimony, Mr. Chairman. I will be happy to answer any questions you or the other Subcommittee Members may have at this time.