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Hazardous Weather Detection and Warning Systems

Statement of
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Subcommittee on Investigations and Oversight
House Committee on Public Works and Transportation

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Mr. Chairman and Members of the Subcommittee:

We are happy to be here to comment on the Federal Aviation Administration's (FAA's) development of wind shear and hazardous weather detection and warning systems for major airports. We are working in this area for the House Science, Space, and Technology Committee, and we are grateful to Chairman McCurdy and Members of the Transportation, Aviation and Materials Subcommittee for this opportunity to share our findings with you. My statement today will focus on some of the difficulties FAA faces in developing its new hazardous weather systems.

More than half of all fatal air carrier accidents are in some way attributable to weather. According to FAA, there are two main problems with its existing aviation weather system: Inadequate weather detection systems, and the lack of a quick way to communicate weather information to pilots.

To correct these problems, FAA's National Airspace System (NAS) plan calls for $1.5 billion worth of new weather systems. I would like to discuss FAA's plans in three areas:

-- wind shear detection,

-- precipitation and thunderstorm detection, and

-- communicating hazardous weather information to pilots.

WIND SHEAR DETECTION

Wind shear--an abrupt change in wind speed or direction--has been identified as a cause or factor in 18 accidents since 1970, which involved the loss of 575 lives. The need for more accurate wind shear detection and more timely weather warnings to pilots, particularly during the critical takeoff and landing phases of flight, continues to be a concern for aviation safety.

FAA is developing three new ground-based wind shear detection systems, but all three have either detection limitations or unresolved technical problems.

The first new wind shear detection system FAA plans to install is the enhanced low level wind shear alert system. The system will be installed at 110 airports by August 1992, and consists of 11 ground sensors placed primarily on the airport, twice the number of sensors the existing low level wind shear alert system has.

Although an improvement, FAA does not view the enhanced low level wind shear alert system as the optimal solution to the wind shear detection problem because the sensors for the most part still cannot detect wind shears that occur above ground level or outside the physical boundaries of the airport. This problem was illustrated by the 1985 Delta Airlines crash at Dallas/Ft. Worth International Airport where a microburst--the most dangerous form of wind shear--occurred away from the airport, beyond the low level wind shear alert system. This microburst did not come within the range of the sensors until some 10-12 minutes after it caused the crash.

The second wind shear detection system in FAA's plans is called the terminal NEXRAD radar. It will be capable of "seeing" wind shears and microbursts as much as 30 miles away from the airport. The radar will be located away from the airports and will scan air movements occurring above ground in all directions. While terminal NEXRAD will supplement the enhanced low level wind shear alert system and make up for some of its limitations, FAA views it as a temporary system, only to be installed at 19 airports, and to be replaced as soon as FAA's optimal system, the terminal Doppler weather radar, is ready.

FAA's third wind shear detection system, the terminal Doppler weather radar, is to be installed at 100 airports. It is currently in research and development and has a number of unresolved technical problems that could reduce its operational performance or delay its procurement schedule. FAA and its researchers have stated that some of the radar's important performance objectives will be difficult to achieve, and FAA has testified that its procurement schedule is optimistic.

The terminal Doppler weather radar is intended to: (1) accurately forecast, detect, and measure wind shears, (2) have at least a 90 percent probability of detecting all microbursts and only a 10 percent or less false alarm rate, and (3) be fully automated whereby radar signals are automatically translated by computers into information that can be used by controllers and pilots.

FAA is sure the radar can detect wind shears. But FAA is not sure the radars and computers together can (1) forecast a microburst early enough to give controllers and pilots adequate warning and accurately measure its strength along the flight path; (2) meet the 90 percent detection/10 percent false alarm objective; or (3) deliver information in a form pilots and controllers can use as quickly as it is needed. FAA also must decide whether the radar can best perform its mission by being on or off the airport, and whether its antenna should have a full circle or a more limited scan. The radar siting and scanning issues bear directly on the radar's ability to forecast wind shears, accurately detect their occurrence, and measure their severity or strength.

FAA's schedule calls for awarding a procurement contract for the 100 terminal Doppler weather radars in 1988, but it is not likely that all the research needed to determine whether FAA's objectives can be met will be completed by then. Since research on these problems is to continue this year and in 1988, FAA will likely once again have to decide whether to delay its procurement schedule or take a chance that what it buys will need further development after it is purchased in order to meet its performance objectives.

PRECIPITATION AND THUNDERSTORM DETECTION

In addition to wind shear detection, FAA has another weather detection system in its plans, a new airport surveillance radar, called ASR-9. ASR-9 can distinguish among six levels of precipitation, five of which have been determined by FAA and the National Weather Service to contain phenomena strong enough to crash an aircraft.

Although the ASR-9 is a significant improvement over existing airport surveillance radars, FAA has not yet developed guidance for how controllers are to monitor and report the additional weather information to pilots. On the basis of our reviews of controller work load and methods for disseminating weather information,[1] we think it is probable that some of the weather information available from the ASR-9 will never be received by pilots because controllers are often too busy directing traffic to give weather warnings.

According to Air Traffic Control, FAA's controller handbook (FAA 7110.65D), the controllers' first priority is separating aircraft. The handbook instructs controllers to issue "pertinent information" on observed weather, and to provide radar guidance around weather areas when requested to do so by pilots. FAA plans to provide ASR-9 precipitation intensity information on air traffic controllers' radar displays; individual controllers will be responsible for deciding which "pertinent information" on levels of precipitation intensity to report to pilots.

Only two of the six precipitation intensity levels can be displayed on the controller's radar screen at one time, and to view all five hazardous weather levels controllers will have to adjust their display three separate times. We believe there will be times when controllers' work load will not allow them time to monitor the radar displays in this manner or provide the information to pilots.

Even in those instances when controllers do have time, we believe there is a substantial risk that the complexity of the weather might result in important information being miscommunicated

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[1] Aviation Weather Hazards: FAA System for Disseminating Severe Weather Warnings to Pilots (GAO/RCED-86-152BR, April 22, 1986) and Aviation Safety: Serious Problems Concerning the Air Traffic Control Work Force (GAO/RCED-86-121, March 6, 1986).

to pilots. For example, in a large, multi-celled storm, it will be difficult for controllers to explain to pilots the difference between potentially hazardous areas covered by weaker storm cells and certainly hazardous areas included in the strongest storm cells.

COMMUNICATION OF WEATHER WARNINGS TO PILOTS

FAA knows that it needs to provide more timely weather information to pilots to improve air traffic control system safety. For example, in February 1984, the Air Line Pilots Association notified FAA that its highest weather priority was for real-time information on wind shear, thunderstorms, and runway conditions at airports. FAA has included the Mode S Data Link in the NAS plan to send weather information to in-flight aircraft equipped to receive it, without involving air traffic controllers. FAA's intention is to relieve busy controllers of much of their weather dissemination responsibilities, thereby enhancing productivity and safety.

It is unlikely, however, that the controllers' role in hazardous weather dissemination will be lessened in the near future. First, FAA's NAS plan does not now include uplinking wind shear and thunderstorm-related data. Instead, FAA proposes to use Mode S to send mostly routine weather information that is already available to commercial aircraft over a private data link service and that general aviation pilots can currently access from FAA. We understand FAA is sponsoring research and development which might allow wind shear data to be directly conveyed to pilots some time in the future, but FAA has not made this a part of the NAS plan.

Second, few general aviation pilots, the group FAA believes will benefit most, are expected to install the Mode S avionics necessary to receive weather information over the data link before the end of the century. To receive hazardous weather information over Mode S, an aircraft will have to be equipped with an avionics package including a Mode S transponder, a computer, and a printer or display. Although FAA has recently mandated that any transponder installed after January 1, 1992, must be Mode S, aircraft presently equipped with today's predominant transponder, that is not capable of receiving Mode S data, are not required to reequip and FAA expects many aircraft to continue using the existing transponder rather than installing Mode S. A November 1986 FAA study estimated that only 18 percent of all aircraft will have a Mode S transponder by 1995. While the study did not estimate how many of the aircraft will have the additional computer and printer or display necessary to request and receive Mode S weather messages, FAA recognizes that the number of aircraft capable of receiving data link information is likely to be less than the 18 percent having a Mode S transponder in 1995. Consequently, controllers will continue to be the primary source of hazardous weather information for most pilots.

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In summary, it will take FAA several more years to achieve its objectives of more accurate hazardous weather detection and more timely communication of weather warnings to pilots. A number of unresolved technical issues about the performance of terminal Doppler weather radar are unlikely to be resolved before FAA's planned procurement of the system in 1988. This could result in procurement delay, continued development following procurement, or reductions in the radar's planned capabilities. ASR-9 thunderstorm related detection capabilities will depend on already busy controllers to monitor and report weather problems to pilots, an additional duty they may not always be able to perform. And present FAA plans do not call for the Mode S data link to automatically communicate radar detected wind shear or thunderstorm related information from airports to pilots. Until such a system is developed, controllers will continue to provide weather information to pilots.

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