STATEMENT OF NEAL A. BLAKE, DEPUTY ASSOCIATE ADMINISTRATOR FOR ENGINEERING, FEDERAL AVIATION ADMINISTRATION, BEFORE THE HOUSE COMMITTEE ON PUBLIC WORKS AND TRANSPORTATION, SUBCOMMITTEE ON AVIATION, CONCERNING WEATHER RADAR. OCTOBER 30, 1985.

Mr. Chairman and Members of the Subcommittee:

I appreciate the opportunity to appear before the Subcommittee today to discuss FAA programs on wind shear. We have a number of programs which are designed to help us better understand, detect, and respond to the threat of wind shear. Wind shear has posed a very real threat to aviation safety and has presented a significant challenge to all of us in the aviation and scientific communities to find a way to deal with that threat. I would like to outline for the Subcommittee today our efforts in this area and the solutions I see before us.

Since the early 1970's, when wind shear was identified as a significant cause of aircraft accidents, the FAA has conducted an active program on wind shear. To better understand and combat this meteorological phenomenon, FAA undertook a variety of steps: it established a wind shear office; entered into research agreements with the Wave Propagation Laboratory of the National Oceanic and Atmospheric Administration (NOAA) to conduct research studies and experiments in wind shear sensing technologies; sponsored research at the National Severe Storms Laboratory of NOAA on the use of Doppler radar for severe weather detection and at Lincoln Laboratory on improvements in radar for storm detection; and established sensor test beds for wind shear at Dulles Airport and Chicago, Illinois. As an outgrowth of the activities carried on under this early program, there were a number of positive achievements in the late 1970's time period. These included: an R&D report on flight guidance systems designed to enhance the pilot's capability to achieve the best performance from an aircraft in a wind shear encounter; an advisory circular providing guidance on the certification of airborne wind shear systems; an advisory circular providing information on the wind shear phenomena and piloting techniques designed to achieve best aircraft performance in wind shear encounters; a wind shear training film; wind shear profiles for use in pilot training in aircraft simulators; improved National Weather Service forecasting of wind shear accompanying weather fronts; and implementation of Low Level Wind Shear Alert Systems (which we refer to as LLWAS) at 59 airports, which will have increased to 110 airports by the middle of next year.

LLWAS was designed to detect gust fronts which were originally believed to represent the primary wind shear hazard. The system, however, has also been effective in detecting some microbursts that have occurred on airports. LLWAS alerts the controller whenever the wind at the approach or departure end of a runway differs by 15 knots or more from the centerfield wind. These alerts are then given to the pilots by the controller.

A number of research activities have been conducted to investigate and define the nature of the wind shear hazard. I have included a brief description of these research efforts as an appendix to my prepared statement. In parallel with these research programs, the FAA, working in conjunction with other agencies, has been conducting development programs to take the research results and provide needed improvements in the FAA weather system. I would like to summarize briefly some of the pertinent activities.

LLWAS Enhancements. One of the activities conducted as a follow-on to the 1982 Joint Airport Weather Studies (JAWS) research effort was the definition of enhancements to the Low Level Wind Shear Alert System. These enhancements include increasing the number of sensors from 6 to 11 to provide better coverage of the airport and enhance the system capability to detect gust fronts and microbursts. Enhanced LLWAS's have been installed at New Orleans (1984) and Denver (1985), and data from these sites are being used to develop the enhancement package for the remaining sites. In addition, the FAA Technical Center and the National Center for Atmospheric Research are working on improved methods of presenting the processed information to the controller. Implementation of the enhancements is planned for the 1987-1988 time period. The enhanced system, however, is limited to detecting hazards within the airport boundary. Doppler radar appears far more promising in predicting hazards further from the airport with the potential for advance warning to pilots.

NEXRAD. Development of the Next Generation Weather Radar is a joint program involving FAA, the Department of Defense, and the National Weather Service. This radar was initially conceived to be one that could meet simultaneously the enroute weather needs of the three agencies and the FAA terminal weather needs. When the data on microbursts became available from JAWS, it was clear that the NEXRAD radar could not meet both requirements simultaneously. Accordingly, FAA initiated development activities to establish the feasibility of utilizing modified NEXRAD capabilities to meet the higher update rate and wind shear detection requirements of the terminal area.

System testing of the enroute NEXRAD will start at the contractors' facilities in December 1985. Independent operational test and evaluation will be conducted through July 1986 and selection of the production contractor is scheduled to occur in mid-summer. Contract award is currently scheduled for November 1986. A study was conducted by the National Bureau of Standards to review the NEXRAD specification and the availability of commercial equipment to meet the NEXRAD requirement. The results of that study are now available and support the NEXRAD specifications as well as indicate that no commercial off-the-shelf alternatives are available to NEXRAD.

Terminal Doppler Weather Radar. The FAA has established a test bed at Memphis, Tennessee, to take data on microbursts in the humid southeast portion of the United States as recommended by the National Academy of Sciences. The test bed is also being used to determine the best siting and scanning strategies for terminal Doppler weather radar. It is currently planned to move the test bed to Huntsville, Alabama, next year to participate in the National Science Foundation project MIST (for Microburst Severe Thunderstorm). During 1986, the FAA, assisted by Lincoln Laboratory, National Center for Atmospheric Research, and others, will develop and test automatic detection and warning algorithms for wind shear. In 1987, the FAA plans to conduct an operational test using the automatic detection and warning system. The site for the test has not been selected; however, Denver is one candidate being considered.

Development of designs for a terminal Doppler weather radar is being initiated. Terminal Doppler radar would be a major system acquisition and we are currently looking at alternative ways in which to make the appropriate acquisition.

Airborne Doppler Weather Radars. The National Academy of Sciences report recommended that "Research should continue on the use of airborne Doppler light detection and ranging systems (lidars) and airborne microwave Doppler radars as a means for detecting low-altitude wind shear." The advantage of having a suitable airborne device is, of course, that the equipped aircraft would receive wind shear warnings at all airports at which it would operate. Considerable technical problems with regard to airborne Doppler weather radars which must be overcome include the ability to provide the needed sensitivities, clutter rejection, and automatic signal processing on an aircraft, where antenna size is limited and antenna look angles required for low level wind shear detection accentuate the clutter removal task. Current airborne radar systems simply do not possess the needed capabilities. NASA Langley has proposed to initiate a research program to determine the level of improvement that could be achieved in airborne Doppler weather radar technology. The FAA is supporting this activity, but there is no assurance that an airborne unit capable of detecting both wet and dry microbursts can be achieved. Hence, we are also examining other technologies, particularly for the detection of dry microbursts.

Central Weather Processor. Outputs from the NEXRAD, Terminal Doppler Weather Radar, and the weather channel of the ASR-9 radar will be transmitted to the central weather processor located at the future area control facilities. This processor will process radar, satellite and mesonet inputs, and prepare displays for the center weather service unit meteorologist. The meteorologist will annotate severe weather hazard charts prepared by the system processors and will prepare center weather advisories and short-term forecasts on severe weather events. The annotated severe weather contours will then be made available for display on controller scopes. The same information will be available in the cockpit via the Mode S data link. Implementation of this advanced processing and dissemination system is scheduled for the early 1990's.

Wind Shear Training for Pilots. The FAA plans to award a contract to a consortium of aircraft manufacturers, airlines, and scientists for the development of an improved pilot training program on wind shear. This program will be conducted over a 2-year period and will provide a training program suitable for all categories of pilots. The improved pilot training package to be generated through this effort will consist both of written materials and video tapes that support the written materials. Included in this program will be materials on the nature of the wind shear threat; lessons that have been learned from prior wind shear encounters; what aircraft crews should be aware of; and what crews can do when wind shear is encountered. Part of this package will consist of materials to be used by others in providing training on wind shear to pilots. A detailed instructor's manual will be prepared along with a variety of information on training scenarios and situations. The supporting video to be used by pilot instructors will provide a pre-simulator briefing and will emphasize specific operational techniques to be used in the wind shear environment. The simulator exercises themselves will incorporate wind shear models that are based on the most recent wind shear data including microburst generated shears. In short, we expect to have a comprehensive program which can readily be used throughout the aviation industry to improve pilots' understanding of wind shear as well as basic piloting skills when wind shear is encountered.

To summarize, Mr. Chairman, the FAA has a comprehensive program in the wind shear area. Our program addresses both improved pilot training and the development of improved ground and airborne detection systems. In my view, we are well on our way toward making significant improvements in wind shear detection and avoidance. We believe that successful completion of the development and implementation of the systems I have described will enable us to provide accurate, timely warnings to pilots of potential wind shear.

That completes my prepared statement, Mr. Chairman. I would be pleased to respond to questions you may have at this time.

RESEARCH EFFORTS TO DEFINE THE NATURE OF WIND SHEAR

- Starting in the early 1970's, the National Severe Storms Laboratory conducted a program to use Doppler radars to study storm systems. Pilots flying specially reinforced aircraft provided real-time data on storm turbulence, precipitation intensity, and lightning to permit correlation of radar returns with the actual conditions in the storm system.

- Dr. T. Theodore Fujita, Professor of Meteorology at the University of Chicago, has been one of the researchers that has been instrumental in the identification and classification of wind shear phenomena including gust fronts, microbursts, and macrobursts. Much of this work has been summarized in his recent report "The Downburst."

- Project NIMROD (for Northern Illinois Meteorological Research on Downburst) was conducted in 1978, and provided early data on the characteristics of downbursts occurring in northern Illinois. The data showed that 50 percent of the microburst-downburst activity occurred in thunderstorms and were characterized as being "wet" with the other 50 percent occurring in conditions where rain evaporated before reaching the ground. The latter microbursts are called "dry" microbursts.

- Dr. John McCarthy, Chief of the Research Applications Program, National Center for Atmospheric Research, has been a key member of the technical group that obtained, interpreted, and disseminated data on the wind shear hazard.

- Project JAWS (for Joint Airport Weather Studies) involved many agencies including the National Science Foundation, National Center for Atmospheric Research, Federal Aviation Administration, National Aeronautics and Space Administration, Royal Aircraft Establishment, Environmental Research Laboratory, Wave Propagation Laboratory, and National Severe Storms Laboratory. This program, conducted in the vicinity of Denver during 1982, produced a wealth of data on microbursts. These data include rate of formation and decay, lifetime, severity, movement, and some information on precursors, meteorological events that may lead to the formation of microbursts in the next several minutes. The research results have already been used in an updated pilot training film as improved profiles for pilot training, recommendations for enhancing the Low Level Wind Shear Alert System, and inputs for Doppler Weather Radar wind shear algorithm development.

- Project CLAWS (for Classify, Locate, and Avoid Wind Shear) involved NOAA and FAA personnel. This program, which was conducted at Denver's Stapleton Airport in 1984, provided operational experience with pilot use of microburst advisories. A National Science Foundation research Doppler Weather Radar located near the airport was staffed with an experienced radar meteorologist who detected the occurrence of microbursts. The microburst advisories were relayed to a second meteorologist in the tower, and then passed on to pilots by the controllers. This operational demonstration provided much information which will be used in the design of the automatic detection and warning algorithm and controller displays. Some of the pilots' reactions included: verification that microbursts existed in areas covered by the advisories; departing aircraft delaying their departures until the microburst had dissipated; and, arriving aircraft adding additional speed on approach, executed missed approaches, or elected to wait until the microburst had dissipated. Significantly, one pilot indicated that the advisory he received probably prevented his being involved in an accident.