STATEMENT OF THE HONORABLE JAMES B. BUSEY, FEDERAL AVIATION ADMINISTRATOR, BEFORE THE SENATE COMMITTEE ON COMMERCE, SCIENCE, AND TRANSPORTATION, SUBCOMMITTEE ON AVIATION, CONCERNING THE DC-10. SEPTEMBER 19, 1989.

Mr. Chairman and Members of the Subcommittee:

I welcome the opportunity to appear before the Subcommittee to discuss with you actions the FAA has taken previously to respond to problems which have arisen with the DC-10, as well as steps we are taking to address concerns arising out of the recent Sioux City accident. At the outset I believe it is important that I assure you and the public that the FAA considers the DC-10 to be a safe aircraft. I would stress that we have no safety information which would cause us to consider grounding the aircraft, as some have asked.

The DC-10 has been operating since 1971. During that time, the DC-10 fleet, of which 446 were built, has logged over 5 million landings and more than 15.6 million flight hours. Eight versions of the DC-10 have been approved by FAA, but one model (the DC-10-40F) was never built. Today, approximately 428 DC-10's/KC-10's, the military version, remain in service worldwide.

Of the seventeen DC-10 aircraft which have been destroyed in accidents prior to the Sioux City accident, only one accident--the crash of a Turkish Airlines DC-10 near Paris in 1974--appeared to

the FAA to involve a design deficiency that clearly played a significant part in the loss of the airplane. The Turkish Airlines tragedy involved the loss of a cargo door and subsequent loss of aircraft controls. Of the remaining accidents, three airplanes were destroyed on the ground undergoing maintenance or servicing; four airplanes were destroyed as the result of aborted takeoffs due to tire failure, bird ingestion in an engine, and taking off on the wrong runway into another airplane; seven airplanes were destroyed during landing where significant factors were pilot error and weather; one airplane was flown into a mountain; and another crashed on takeoff due to a maintenance-induced engine pylon failure.

The 1974 Turkish Airlines accident near Paris involved a cargo door latching failure. The separation of the cargo door from the aircraft resulted in depressurization which collapsed the aircraft floor impacting control cables which ran under the floor. Following the Turkish Airlines accident, the FAA issued an airworthiness directive (AD) to resolve the cargo door latching problem. The FAA also issued another AD for all wide body aircraft (DC-10, Lockheed L-1011, and Boeing 747) to improve the capability of the passenger and crew compartment floors to withstand, without collapse, an in-flight depressurization caused by the sudden opening of a large hole in the lower deck cargo compartment. Later, the Federal Aviation Regulations were amended

to incorporate new design requirements to correct this potential problem.

A number of other corrective actions were also taken after a DC-10 crashed on takeoff at O'Hare Airport in 1979. The accident was precipitated by the separation of the left engine and pylon from the aircraft near takeoff rotation. The structural and systems damage to the aircraft resulted in retraction of the left wing outboard slats, loss of stall warning, and loss of slat "disagreement" annunciation, which allowed an asymmetrical stall and uncontrolled, leftward roll of the aircraft. We subsequently found that the pylon separation was caused by major structural damage which had resulted from maintenance abuse nearly two months earlier.

During the course of the safety investigation, the FAA issued a series of AD's requiring inspection of the DC-10 pylons. At one point, the DC-10 fleet was grounded for over a month while the FAA conducted a comprehensive investigation. Reinstatement of the DC-10 type certificate was accompanied by issuance of three airworthiness directives. Briefly, the airworthiness directives required: strict adherence to a rigorous, repetitive inspection program for the DC-10 wing pylon assembly; inspection, periodic reinspection, and replacement of certain cables in the DC-10 slat

system; and proper operation, before any revenue DC-10 flights, of certain stall or takeoff warning systems.

In the case of the Sioux City accident, the investigation continues by the National Transportation Safety Board with FAA involvement so the probable cause has not been established by the Board. Preliminary data calls attention to both engine and hydraulics issues, in particular concerns exist with regard to the vulnerability of the hydraulics system and about catastrophic engine failure. We have instituted action in both of these areas to address these concerns.

With regard to the DC-10 hydraulic systems which provide control over the aircraft, much work has been done in the past to protect the hydraulics from catastrophic failures. For example, the DC-10 has triple redundant hydraulic systems in the aft section. Each control surface is operated by two different systems. The hydraulic lines of those systems are separated as far as possible and run along structural members in the aft fuselage and empennage. Each hydraulic system is powered by a separate engine, with two engine-driven pumps providing hydraulic pressure. Two electrically powered auxiliary pumps and two reversible motor pumps provide backup pressure for the various systems.

Priority was given to mutual spatial separation of the three systems. Where redundant power sources for a function required that one system be routed near another, the third system was kept as far away as possible from that area. Where geometric confines of the airplane restricted such separation, examination of high-energy parts trajectories guided the installation and location of equipment.

Prior to the Paris DC-10 accident in 1974, Douglas undertook a complete review of the DC-10 hydraulic system. Several changes to the hydraulic system were made, and FAA issued an AD to prevent hydraulic fluid loss in the rudder standby power hydraulic system from inducing an additional failure in an adjacent second hydraulic system, thereby maintaining flight control system capability. Additionally, approximately 18-20 design improvements in the DC- 10 hydraulic system were made by the manufacturer. Subsequent to the Paris DC-10 accident, the DC-10 hydraulic-powered flight controls were evaluated to assure they were adequately separated in light of new FAA requirements.

Turning now to engines, with the advent of the jets, significant changes occurred in engine technology. And as turbine engines evolved, thrust capabilities increased and the forces generated on engine components grew exponentially to provide that increased thrust. FAA's certification processes and the manufacturers'

engine testing processes are both exhaustive and demanding necessitating thousands of hours of testing, and, to the extent feasible, are designed to ensure that, if engine components fail, they will do so in a way that will not affect the safety of the aircraft. As engine rotor disks become larger and kinetic energy forces increase, it becomes increasingly difficult to ensure the containment of a failed rotor disk. Consider, for example, the General Electric CF6-6 first stage fan system weighs 750 pounds and generates kinetic energy of approximately 10 million foot pounds. The rotor disk alone weighs more than 270 pounds. Therefore, the FAA has sought to minimize rotor failure effects, using design techniques of redundancy, separation and isolation, and damage tolerance to contain and minimize damage from rotor shrapnel. One of the lessons learned, from what we know thus far of the Sioux City accident, is that further means must be more fully explored to determine if there are ways using today's new technologies to better protect airplanes against this newly experienced type of engine failure or other types of external damage. And we are doing that in two initiatives currently underway.

One McDonnell Douglas team is concentrating its effort on a study to generate design changes which would allow continued safe flight and landing in the event of failures of the Number 2 engine similar to the Sioux City accident with the resulting damage to

the hydraulic systems. A second team is evaluating all systems vulnerability resulting from a multi-fragment, high energy failure of any engine or auxiliary power unit (APU) and/or the explosion of a landing gear tire in the wheel well. The team is also looking at these issues in the context of the MD-11 type design. Both teams are meeting weekly with FAA on these matters. I should add that McDonnell Douglas is actively assessing possible design changes to meet the teams' objectives.

I have also asked for a broader look at the issue of redundant systems for power operated flight controls for large aircraft. The Sioux City accident and the 1987 Japan Air Lines B-747 accident suggest to me the need for more stringent regulations governing the reserve capability of large aircraft with powered controls under emergency conditions. An industry-FAA task force will examine this issue under the auspices of our recently established R&D advisory committee. This is a complicated issue, which will take some time for the task force to deal with, but I will be expecting to have available initial findings after several months of effort on their part.

Unrelated to the Sioux City tragedy, we and industry have been actively examining the DC-10, as one part of our overall aging aircraft program, since the International Conference on Aging Aircraft in June 1988. This has led us to propose a number of

structural changes to the DC-10, along with modifications or additions to current inspections designed to ensure continued structural integrity. The DC-10 is, of course, only one of many aircraft types that we are addressing in our aging aircraft program. We also expect to have developed a corrosion inspection program for the DC-10 by this October, and to initiate rulemaking to require the institution of such a program by DC-10 operators.

Mr. Chairman, I would like to disgress a moment to let you know of our latest steps to insure safety of this airplane. Though we have not, as I indicated previously, found the missing fan disk, our engineers indicate that one possible scenario which might have led to the uncontained engine failure or rotor disk burst is the development of a crack in the fan disk as the result of an internal flaw in the disk material itself. Since the accident, we have been working almost literally around the clock with the manufacturers and suppliers to understand how such a flaw might arise and develop. While we do not have all the answers yet, we have been able to isolate one particular material process in which the likelihood of such flaw development is highest. We have been able to design and field test an inspection process which should give us assurance that there are no such flaws in engines in use. Final field proof tests of the procedures were concluded this weekend, and I have ordered today that these tests be applied to all CF6-6 engines of a certain material specification--those which

used the so-called "double vacuum" melt process during the formation of the titanium material from which the rotor disks are forged.

Briefly, the tests we have required use ultrasonic technology, and will be required in two stages: off the wing, in a test called "immersion ultrasonic inspection," and--for engines which cannot immediately be tested off the wing--on the wing, using "contact ultrasonic" inspections. We have prioritized the inspection process into three lots, and require inspection of the first two lots--a total of 55 engines--by November 21; the remaining 165 engines will be inspected over the following 2 months, so as to complete inspection of all 220 double vacuum fan disks by February 4. These inspections will add further assurance that the Sioux City tragedy will never happen again.

In short, the FAA has worked closely with McDonnell Douglas and DC-10 operators over the years to make refinements and improvements to the DC-10 to ensure that the travelling public receives safe transportation. I am confident that these efforts have given us safe and reliable aircraft, and that on-going efforts to examine engine and control system issues will not only improve our understanding of these complicated issues but will enable us to enhance safety requirements for wide body aircraft generally.

In closing, Mr. Chairman, I would like to acknowledge my appreciation of the Subcommittee's commitment to aviation safety and support of the FAA. We look forward to working closely with you as we work to improve the safety of our air transportation system.

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