TURBULENCE INJURY REDUCTION -- A SYSTEMS APPROACH

BY

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Good morning ladies and gentlemen, I am Bob Frantz from the Air Line Pilots Association. I would like to present to you this afternoon, an overview of *current activities* within the government, *the* industry, and our organization to find solutions for mitigating turbulence injuries.

Our Association has always been active in trying to solve the continuing problem of turbulence injuries. Several years ago our efforts were instrumental in establishing the regulation for the placards found *today* on the back of every passenger seat which states, "**FASTEN SEAT BELT WHILE SEATED".** Unfortunately, that has proven to be insufficient in ensuring all passengers actually do fasten their seatbelts and, as a result, turbulence remains one of the leading causes of airline passenger injuries. Additionally, flight attendants continue to suffer similar debilitating injuries. According to NASA, passenger and flight attendant *injuries* combined have resulted in a cost to *the* industry of $100 million dollars *per* year. Today, ALPA continues to be involved in all aspects of solving this problem. We *have* served on many NTSB turbulence accident investigations, and participate in all FAA and NASA conferences and committees regarding this subject. Today I would like to report what is occurring in *some* of these areas.

From an accident investigation viewpoint, a number of relevant facts *are apparent.* During the period April 1980 to December 1997, the NTSB reported a total of 423 injuries to passengers and 186 injuries to flight attendants. There *were* three *passenger fatalities* in that period. There *was* only one injury to a belted passenger, an elderly lady who broke her ankle *against* the seat in front of her.

A further review of NTSB reports indicates that approximately half of *turbulence* accidents/incidents occur in convective weather. That is weather that contains storm cells that may or may not be detected visually or by radar (and occur at all altitudes). *The remaining accidents/incidents* occur in clear air turbulence. *This phenomena,* usually found at high altitudes and not apparent visually, is difficult to *predict* with current forecasting technology. The *NTSB* reports further indicate that most injuries occur behind the mid-point of the aircraft.

Flight Data Recorder (FDR) readouts from these accidents indicate *several pertinent facts.* With clear air turbulence there is often only minutes or even seconds *available for flight crews* to warn the cabin *with* a PA announcement and the seatbelt sign. A typical FDR readout shows an initial small vertical positive acceleration, followed by a severe negative drop. The initial positive G may act as a springboard *for the following negative G* to propel individuals out of their seats or off the floor. There will be several subsequent cycles, which then gradually dissipate. Investigative recording during the post accident investigation reveals that during severe turbulence, passengers propelled out of their seats *may* impact the overhead bins or ceiling. Some *head* injuries *occur* at

this time, but the most severe injuries occur when individuals come back down and strike the non-frangible arm rests on the seats and *suffer* major bone fractures. This is clearly indicated by the arm rests at seats of occupants with serious injuries being bent downwards from 10 to 15 degrees. Additionally, many passengers are *burned by* hot coffee, *or struck by* significant objects of mass such as the serving carts, *as loose articles are tossed about* unrestrained. You could characterize these severe accident scenes as "terrifying mayhem!"

There are several ongoing programs designed to mitigate this problem. ALPA participates *in one program* called "Partners In Cabin Safety." The *group* is a fast track committee designated by the FAA Administrator to reduce injuries through passenger seat belt awareness and flight attendant education. During the course of this program, ALPA facilitated the work being done by George Washington University in simulation. Their turbulence simulation, which you will see later in the program, depicts *how* unbelted passengers and unsecured objects of mass *react* during severe turbulence. It is hoped that *video excerpts of* this simulation will be incorporated into a passenger awareness campaign, reinforced with posters in all airport jetways. This approach was successfully used in the "Buckle-up America" *automobile seatbelt* campaign, despite the vigorous attempts by the auto industry to prevent it. I believe that our positive attitude toward seatbelt usage in our country is due to that campaign. The simulation, because it is so graphic, also speaks in a universal language, and may help foreign passengers who may come from countries *that do not share our* seatbelt culture, *understand the message*. ALPA believes that cabin safety is a team effort and passengers are an important part of that team. If *passengers realize the consequences of turbulence* through a visual presentation (a picture is worth a thousand words - a video may be worth 15,000 words) they will more than likely comply with what is required--that is fasten their seatbelts. The Partners in Cabin Safety program concludes its work next month.

ALPA also participates in the NASA Airline Safety Program on turbulence injury reduction. So far, *this research program* has concentrated strictly on technology methods of injury mitigation through better forecasting and detection of turbulence. There are several excellent products that *could* be developed out of this program. These include:

*AVIATION WEATHER INFORMATION (***AWIN) --** *This research program brings* real time *graphic and alphanumeric* weather into the cockpit via satellite and ground station *request-reply* data-link *technology*. This *information* will be important initially for avoiding convective turbulence, as well as for long range flight planning under the "Free Flight" program.

IN SITU DETECTION -- This *airborne detection* program incorporates new *sensors* on aircraft for initially collecting *turbulence* data *such as acceleration, true air speed, and temperature,* to determine a turbulence baseline. Later the *sensors* will be modified *to distinguish differences from baseline data* so that real-time turbulence information will be relayed to ATC via data-link. Eventually every aircraft will act as a meteorology station giving worldwide coverage.

ADS-B -- (AIRBORNE DEPENDENT SURVEILLANCE-BROADCAST) This *broadcast-only* communications system or a similar one will use data-link technology to provide graphic and alphanumeric meteorological information between aircraft.

INFRARED – A *sensing* beam is projected forward of the aircraft to measure the velocity of air molecules and *the data is used to develop a computed* turbulence display for the cockpit. At this time the technology has limited range and limited high altitude detection due to lower air density and fewer particulate molecules at altitude.

FLIGHT CONTROL DAMPENING – *More responsive* flight control actuators will compensate for turbulence and dampen out vertical forces. This *technology* is presently used in some military aircraft.

Because some of the technologies described above are still several years from development and certification, ALPA decided to also address the operational issues involved in order to derive short-range solutions to injury mitigation. *ALPA is assembling representatives of several of its national technical committees to study the turbulence issues under one joint project. Our group will provide technical input to any industry efforts dealing with turbulence detection, and mitigation of injuries*. *Specific ALPA interests* include:

IMPROVED AIRCREW TRAINING -- in areas of meteorology and aircraft performance.

IMPROVED CRM BETWEEN PILOTS AND DISPATCH WEATHER FORECASTERS -- An example of an already successful program in this area will be briefed by the representative from NorthWest Airlines.

PILOT/FLIGHT ATTENDANT COMMUNICATIONS -- how to warn flight attendants to prepare the cabin for turbulence, given the short warning time.

PROFESSIONAL SURVEYS -- ALPA is providing pilots and facilitating surveys that are in support of the NASA Airline Safety Program. Surveys of pilots, flight attendants, dispatchers and even passengers will identify weak procedures that need refinement.

IMPROVEMENT IN CABIN SAFETY DESIGN -- We have raised the point that some cabin design improvements could help reduce injuries. These include: inset hand holds in strategic locations for flight attendants to help secure themselves; safety lids for coffee pots; secondary retaining *devices* for luggage in the overhead bins; seatbelt monitoring system (the technology currently exists in hospitals and automobiles); light signaling method to warn flight attendants of impending turbulence *and its severity*; and a method for securing the service carts to the floor.

NASA and the FAA have recognized that the ALPA program outlined above complements the actions and outcomes expected from their work. Our first conference in early 1999 will *compliment NASA work and may fall under the RTCA umbrella*. RTCA is working to form a special committee on turbulence, which will include short-range operational considerations. On October 20th, 1998 they established Terms of Reference (TOR) outlining three areas: (1) Hazard Assessment; (2) User's Needs Analysis and Operations Concept (Operational Requirements); and (3) Recommendations for Program Elements that would develop and implement turbulence

service improvements, including R&D, training, procedures, rulemaking, and aircraft systems development, certification and implementation.

With RTCA joining this program we now have a complete holistic approach to finding optimal solutions at the least cost. RTCA *could* also provide an avenue in which cabin safety design improvements could be submitted for certification preparation. We hope that our ALPA conference after the first of the year, hosted at the George Washington University, Ashburn, Virginia campus, will also serve as a benchmark for measuring success in a team effort to significantly reduce turbulence injuries.