# KEYNOTE ADDRESS

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The 4th Triennial International Cabin and Fire Safety Research Conference
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Welcome to the Fourth Triennial International Aircraft Fire and Cabin Safety Research Conference. Since 1995 researchers and test personnel, and stakeholders, have convened every three years to present their recent and ongoing program findings, and opine on fire and cabin safety concerns and the direction that future R&D should take. As you are aware, the conference will cover the broad areas of materials and systems fire safety, evacuation, crash dynamics and operation issues. It is designed to address both engineering and cabin crew concerns, and requirements. To my knowledge it is the only technical conference devoted exclusively to fire and cabin safety R&D in civil transport aircraft.

I want to acknowledge the Cabin Safety Research Technical Group that organized this and the previous three conferences. Comprised of representatives from the major aviation authorities throughout the world, this group strives to cooperate in fire and cabin safety research. This conference is one of its major undertakings. I want to also thank our gracious Portuguese hosts who arranged for such a beautiful setting for this important conference.

It is noteworthy that this is the first triennial conference held in Europe. The three prior conferences were hosted by the FAA near its Technical Center outside of Atlantic City. The European venue highlights what is obvious to all of us – aviation efficiently connects the international community, and since safety is critical to the vitality of commercial aviation, we all benefit if we cooperate in its advancement. Incidentally, information on the Cabin Safety Research Technical Group and the proceedings of the three prior conferences is available on the FAA's Fire Safety Branch website at www.fire.tc.faa.gov

In my viewpoint, the importance of this conference cannot be overstated. All of us are interested and devoted to maintaining and improving aircraft fire and cabin safety. However, we often have divergent viewpoints on what the problems are, their relative importance, and what the best solutions are. Our perspective most often depends on whether we are a manufacturer, airline, supplier, crew member, accident investigator or regulator. We tend to form "camps" where we reinforce each other's common position. This conference provides the opportunity for all stakeholders to make their case on some particular subject or provide findings from research and/or testing. We will hear and learn of different problems, different viewpoints and different solutions. Based on this information and data, we should be better able to form a more objective opinion or make a more objective decision. Being knowledgeable and informed is critical to advancing aircraft fire and cabin safety.

Another point I wish to make is about the importance of working together. Each of us has certain assets and deficiencies. We each specialize in some facet of aircraft cabin and fire safety but are less knowledgeable about other aspects. For example, a researcher's expertise may be in the application of scientific principles, modeling, testing or advanced technology, but may be lacking in basic, if not in-depth, understanding of the design and operation of an airplane. In particular, how new technology would impact the aircraft design and operation is critically important. Conversely, a manufacturer is intimately knowledgeable about the design and operation of an airplane, but may be less familiar

with new safety technology, or may not have the facilities and instrumentation to evaluate or further develop, when necessary, new safety systems, materials or procedures. I believe that only by working together can we develop practical and cost-effective safety improvements.

The need for practical and cost effective safety improvements deserves repeating. The aviation industry has an excellent safety record, which is due, in part, to mandated, sometimes costly improvements based upon R&D products. Many believe that most of the "big problems" have been addressed and that the remaining smaller improvements must be achieved at a commensurate smaller cost. Improvements must also be practical and not burdensome to the manufacturers, operators and crew. For example, practicality and cost effectiveness was a guiding light behind FAA's development of an on-board inert gas generation system, or OBIGGS, to safeguard against fuel tank explosions. Nevertheless, it took three iterations – from ground-based inerting to on-board ground inerting to OBIGGS – before an acceptable solution was developed. In this case practicality, or low maintenance and weight, was achieved through simplicity. Also, throughout the program we examined other potential safety applications for the inert gas, such as cargo fire suppression, in an attempt to lower costs.

An important goal of the regulatory authorities is to harmonize aircraft safety requirements to the highest level attainable. The aviation community and all its constituents benefit when all aircraft are designed to and operated at a consistent and high standard. Aviation commerce will certainly be served when higher safety standards are reflected by an excellent safety record. This conference also helps to promote the harmonization, as well as advancement, of aviation safety standards, design and operation.

The primary drivers for aircraft safety research are accidents and incidents, new aircraft designs and the implementation of advanced technology into aircraft. All of these factors are important although accidents receive the most significant attention, especially if there are fatalities. New aircraft designs always raise safety concerns, as is the case with both the high passenger capacity A380 and the 7E7 with its composite fuselage and wings.

The double-decked A380 will become the world's largest transport aircraft with up to over 850 passengers. In the event of a fire, will the fire spread more quickly to the upper deck, making the passengers seated in this area more vulnerable to the effects of the fire? Will there be any impact on the speed of evacuation from a height of 8 meters? Reduced situational awareness of other exits or the other deck may inhibit the ability of the crew to effectively manage the evacuation. If passengers use the stairs, will this disrupt the evacuation process?

Replacing aluminum structure with composite materials in the 7E7 raises fire safety concerns regarding in-flight fire prevention and postcrash fire survivability. In general, aluminum is non-combustible and a good conductor of heat, whereas composites may be flammable and are good insulators. With this dramatic change in fire behavior, will composites provide the same level of safety as aluminum structure? In particular, during

a hidden in-flight fire, will a composite fuselage ignite and propagate flames, or tend to trap the heat from a fire, creating a worst situation than with aluminum structure? During a postcrash fire will smoke and toxic gases emitted by the burnthrough resistant composite fuselage inhibit passenger evacuation? Or, if a composite wing is subjected to a postcrash fuel fire, will the wing collapse or even possible explode, causing fatalities that may not have otherwise occurred with a metallic wing?

The Fire Sessions will be dominated by papers on fuel tank inerting, fuel flammability, thermal acoustic insulation flammability and hidden fire safety. This research is driven by past accidents, such as TWA 800 in 1996 and Swiss Air MD-11 in 1998, incidents and subsequent recommendations issued by the accident investigation boards. Additional areas of research include halon replacement agents (halon production was banned because of ozone depletion), smoke/fire detectors (current cargo detectors exhibit very high false alarm rates), hazardous materials such as lithium batteries and oxygen containers (fire dangers exhibited in past accident/incidents) and ultra-fire resistant materials (Congressional mandate to conduct long range research to create a "fireproof" cabin).

Future fire safety research will support the implementation of a planned Notice of Proposed Rulemaking (NPRM), requiring a fuel tank inerting system in aircraft with heated center wing tanks. Research will continue on fuel vapor flammability to upgrade and validate models that may be used during the approval process for inerting systems. Hidden fire safety research will include upgrading all hidden area materials to a level of fire resistance now required for insulation, improving the effectiveness of hand-held extinguishers against hidden fires, and developing and evaluating on-board detection and extinguishing systems. As previously stated fire safety research is needed for very large transport aircraft and composite transport aircraft. Long range research will continue to develop the enabling technology for ultra-fire resistant materials.

The Evacuation Sessions will cover a broad range of research activities related to emergency evacuation. A major concern is evacuation form the high capacity, new A380, which will have an equal number of passengers on the upper and lower decks. Will greater passenger hesitation at the higher exit elevation (8 meters) affect the evacuation rate? It appears that computer simulation and modeling of evacuation is finding greater application, judging by the large number of papers. Models of course, offer advantages over experiments, including greater flexibility of conditions, innumerable trials, low cost, and no injuries. However, models must be validated in order to ensure confidence in the results. Another common theme is the management of an emergency evacuation by the cabin crew, including crew/passenger interaction, crew cooperation and workload.

Passenger performance and awareness has always been an underlying concern which is now receiving much more attention. A full morning under the Operational Issues Session is being devoted to this subject. It is generally believed that the vast majority of passengers are totally unprepared for an emergency evacuation. What can be done to

improve passenger awareness and preparedness for an event as unlikely as winning a lottery?

Future research will undoubtedly continue on very large transport aircraft and new designs such as a blended wing aircraft. With 5 or 6 bays that are each similar to a 737, the blended wing design presents unprecedented emergency evacuation challenges. The blended wing design raises a more general concern. We have to be more proactive in conducting research on future technology and not fall behind the industry. The downside to this is that the advanced technology may not come to past, running the risk of misdirecting precious resources.

Another point needs to be made regarding proactive research on new technology. We have to also examine whether the assumptions we have used to set standards are still valid, and develops new standards when needed. Current regulations may not apply to new technology, and we should anticipate this and conduct the needed research so that we are better prepared when the new technology is implemented. Unfortunately, this is usually not the case.

The Crash Dynamics Session is a mix of modeling and crash testing. There is a need for human neck injury criteria for occupants in side facing seats. Methods are being developed for simplifying the aircraft seat dynamic test requirements. Models are employed for special applications, such as the crashworthiness of conformable auxiliary fuel tanks and hot air balloon landing and protection. There are several papers on dynamic testing of commuter aircraft and helicopters. Passenger protection is also a common topic. Future research will include further development and application of analytical modeling, determining the generic design requirements for a crash resistant fuel system, and possibly defining the seat dynamic performance standards for commuter aircraft.

Passenger awareness and education will be the primary topic of the Operational Issues Session, as was previously discussed. Additional topics address in-flight turbulence, direct view for cabin crew members, and cabin simulators for research and training. A number of additional areas of concern have been raised by cabin safety specialists. Cabin/cockpit crew communication during emergencies has become more difficult with the advent of locked cabin doors and the development of very large aircraft. Joint training when possible is advocated. Realistic training is also needed for the cabin crew in dealing with hidden in-flight fires. Some of the issues are the lack of specific hidden fire fighting procedures and crew concern about the safe use of halon. FAA recently issued an advisory circular that provides general guidance for fighting in-flight fires. Problems with emergency equipment sometimes occur during incidents and accidents. Passengers often have trouble using the equipment property during high stress situations. Other concerns raised include medical issues with elderly passengers and long flights, fire hazards of carry-on electrical devices and batteries and safety in budget airline operations.

A final important point is that we have made improvements in aircraft safety, as bourne out in real world data. However, we must never be satisfied or become complacement. More improvements are needed to improve or even maintain the current level of safety because more accidents could occur as traffic increases, even if the accident rate decreases. We must continually address areas where improvement is possible.

In closing, commercial aviation is an exciting, highly technical and very complex business. Safety - and now security – are critical to its prosperity. Safety includes both design and operation. It also is complex because of technology, stakeholder divergent views and the excellent safety record. To make further improvements in aircraft safety, it is essential that stakeholders work together to seek practical and cost effective solutions. One must be informed of the issues and technology in order to be able to participate and make meaningful contributions. This conference provides the opportunity to gain some of that essential knowledge.