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THE AIRBUS A-380:
RESCUE & FIRE PROTECTION

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The A380-800 is an all-new twin-aisle, twin-deck four-engined aircraft having a baseline seating capacity of 555 passengers in a three-class configuration. First flight is expected in the first quarter of 2005, while it is scheduled to enter service with Singapore Airlines in the second quarter of 2006. Total orders and commitments to date (December '04) stand at 139 for both the passenger and freighter versions as received from 13 airlines (122 passenger aircraft and 17 freighters). The freighter version (A380-800F) is scheduled to enter service in 2008. Although the payload capacity of the A380-800 in terms of seats is 35% more than Boeing 747, it is only 7 feet longer having a total length of 238.6ft, while compared to the B777-300 and A340-600 it is actually 4 and 9 feet shorter respectively. Its total wingspan is 261.6ft.

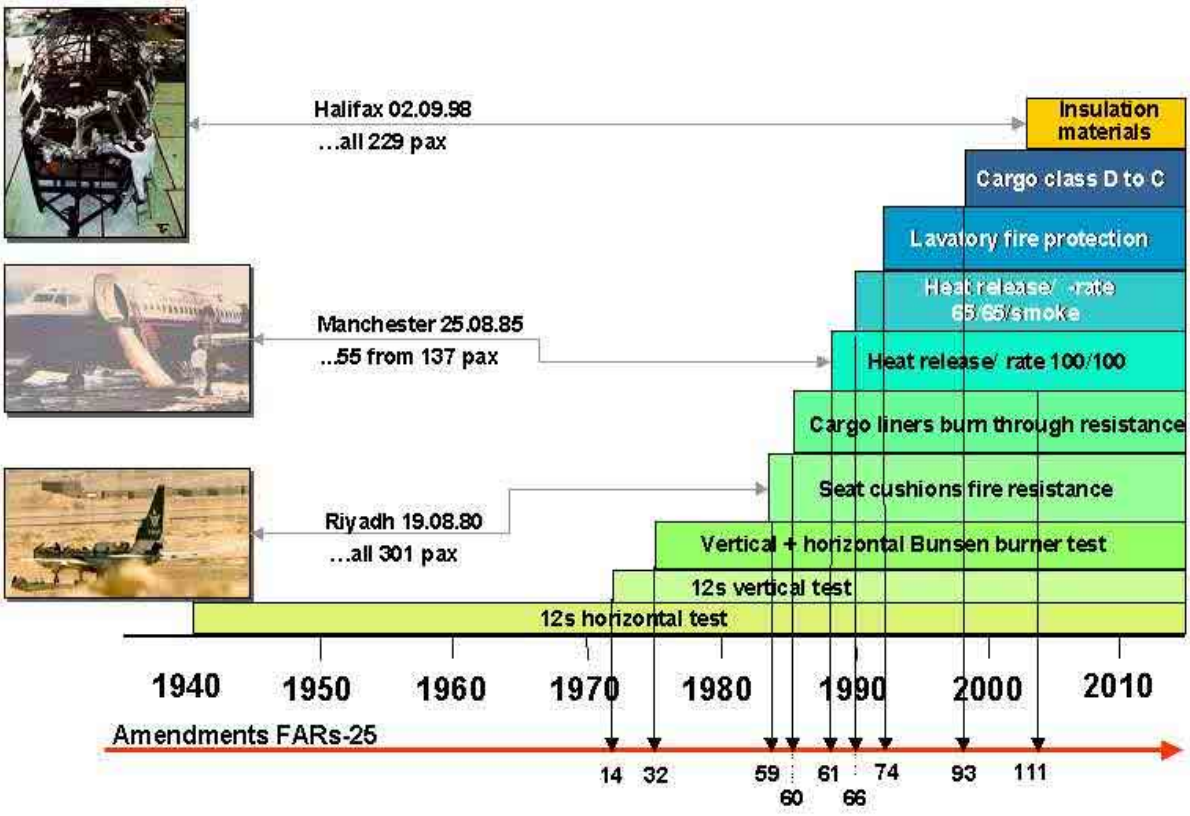
FIRE SAFETY

The progress made in aircraft fire safety technology and the evolution of regulations over the past 35 years is noteworthy. This evolution, as illustrated below, contributes to passenger confidence that today's commercial aircraft is safer than ever.

Airbus' task as an aircraft manufacturer is to enhance the safety of the traveling public and the confidence of the aviation community by applying the highest safety standards to its products. The all-new A380 was an opportunity to apply state-of the-art technology that also has benefits in terms of fire safety.

In general, the fire safety standards set by Airbus for its aircraft, including the A380, not only meet but in most cases exceed the existing JAA and FAA requirements. For example, some of the stringent Airbus requirements with which the A380 complies include:

i) Higher smoke density standards for "major interior parts" requiring lower smoke concentration (Dm 150 compared to 200 set by the authorities)
ii) Defined specific toxicity limits for aircraft, something not yet addressed by the authorities



iii) Rigorous heat release/rate requirements which call for 55/55 Kw/m^2 compared to 65/65 Kw/m^2 set by the authorities, significantly decreasing the flash-over probabilities of the cabin
iv) Smoke emission and toxicity tests for air ducts, thermal insulation, sidewall panels, hat rack covers, fasteners, electrical wiring, etc.

In addition, the A380 will comply with the new FAA 25.856 (a) & (b) requirements for "Flame Propagation" (effective September 2005) and "Flame Penetration/Burn-through" (effective September 2007). The A380 will inherently have better burn-through characteristics on its upper fuselage due to the use of a new hybrid material called GLARE – a sandwich of alternate layers of aluminum foils and unidirectional glass fibres - which has considerably higher burn-through resistance than conventional aluminum alloys. Hence, with the combination of GLARE on the upper fuselage and insulation blankets on the inside lower fuselage, complying with FAA 25.856(b), the A380 will be better protected against burn-through during a post crash fuel fire.

The A380 incorporates several Carbon Fibre Reinforced Plastic composites (CFRP) into primary and secondary structures such as the central wing box, the tail cone, vertical and horizontal stabilisers, etc.. It may not be widely known that CFRPs also have increased burn-though resistance compared to conventional aluminum alloys, even if the "resin" used for their manufacturing in aviation applications is responsible for denser external smoke when the CFRP is exposed for a prolonged time period to large fuel fires.

ARFF OPERATIONS

From the very early stages of the A380's development, Airbus established a team to manage all possible airport compatibility issues including ARFF. The outcome of multiple studies performed on many major international airports and their existing infrastructure was fed back to the design parameters of the A380 in order to produce an aircraft capable of safely operating from ICAO Code E or FAA Group V airports, even though its corresponding airport design category is ICAO Code F or FAA Group VI. As a result, the A380 has been designed to operate:

a) Under current ICAO ARFF requirements,
b) With existing ARFF equipment already in use at major airports and
c) According to established ARFF practices

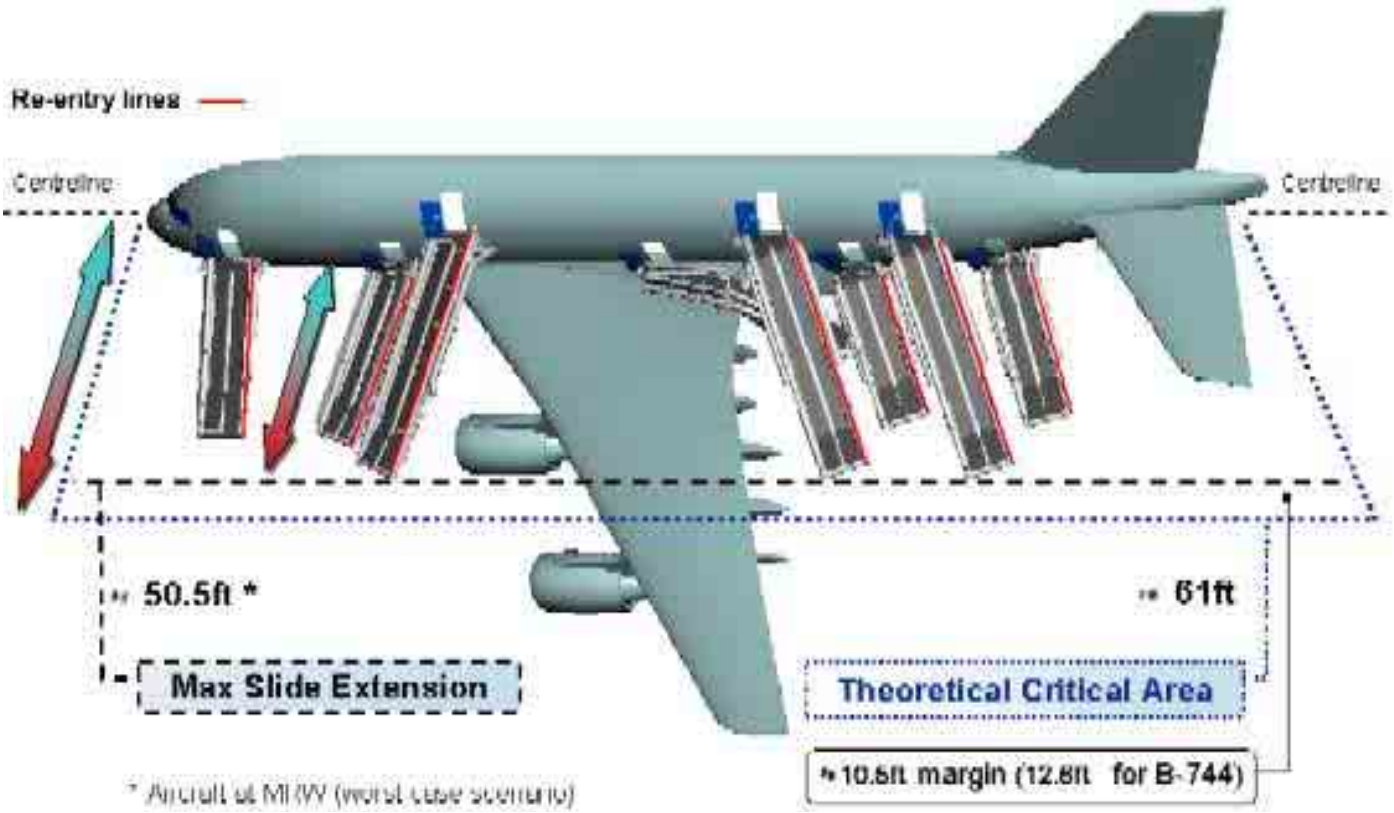
The A380 is classified under ICAO ARFF Category 10 due to its cabin width of 23.4ft. ICAO Cat. 10 calls for 8,500 gallons of minimum water/extinguishing agent on scene, which is 33% above ICAO Category 9 requirements (corresponding to B747) and 42% more than FAA Index E. We know that the methodology for determining minimum usable amounts of extinguishing agents (water) is based on the TCA/PCA principle developed more than 30 years ago, which is driven by fuselage length. Comparing, however, the minimum water requirements of the various ICAO ARFF categories, we see a certain logical pattern derived which relates to the quantity of fuel carried. For example, considering the revolution to commercial aircraft size during the 1970's brought on by the B747 over the existing B707 and comparing the fuel quantities of these two aircraft, it becomes apparent that the increase in ARFF water requirements corresponds to the increase in the associated fuel quantities. A 103% fuel increase of B747 over B707 is analogous to the 101% increase in ARFF minimum water requirements between ARFF Categories 7 (B707) and Cat. 9 (B747). The same holds for the A380 and B747; a 29% fuel increase of the A380 over B747-400 is analogous to the 33% increase of minimum water requirements between ARFF Categories 9 and

ARFF upper deck access vehicles used by Frankfurt ARFF for B747 operations, while other portable stairs capable of reaching 8m height (same as B747 upper deck doors) are also illustrated.

10. It should also be noted that based on the current methodology for calculating minimum ARFF water quantities (ICAO Doc 9137 Part 1), the A380 has an actual requirement of 7,344 gallons of water, achieving a 14% margin with current minimum requirements of Cat. 10 (8,500 gallons). This is not the case for other wide body jets flying today, as some of them actually require more than the minima set by ICAO.

Although the full upper deck existence might require some operating RFF procedures to be fine tuned, the operational approach remains the same as with B747, while all ARFF equipment already exists today for rescue operations on the upper deck. The picture above depicts

Tests have also been carried out on fuselage piercing with "snozzle" ARFF equipment which confirmed that GLARE piercing for ARFF purposes is feasible with existing equipment, requiring 600psi compared to 500psi for conventional aluminum alloy panels (available "snozzle" vehicles may have as much as 2800psi piercing capability). The emergency slides of the A380 comply with the latest FAA TSO C69c requirements, and among others, incorporate lighting on their



vertical holds and at tip for night evacuation, as well as "re-entry" lines for access of ARFF crews to both decks in case of absence of other means (illustrated below). The slides extend 50.5ft from the longitudinal centerline of the fuselage, which is only 3.2ft more than B747 upper deck slides. The clearance obtained between the far end toe of upper deck slides and the TCA perimeter is 10.5ft (aircraft at Maximum Ramp Weight).

The A380 will have to meet the 90 sec. evacuation time requirements at its highest density configuration as per FAA/JAA 25.803. Furthermore, a separate "migration" scenario will be run to investigate possible migration of upper deck passengers to main deck, thus exceeding even the stringent certification requirements.

CONCLUSION

The A380 has been designed to operate under existing ICAO ARFF requirements, according to current practices and with existing equipment. After 35 years of development and progress in commercial aviation safety, we can say that fire safety regulations have evolved to cover all aspects of modern aircraft systems & evacuation means, and the A380 design fully took account of that. For instance:

- *Materials with improved standards in terms of burn-through & fire propagation,*
- *Stricter requirements which apply to aircraft manufacturing & Certifications and Airports, consulted throughout by the Airbus teams, are better organized and equipped in terms of RFF & crisis management success to fully address large aircraft operations.*

ABOUT THE AUTHOR - *MR. YORGOS SAOUNATSOS* is employed with Airbus in the A380 Programme. In his capacity as a senior engineer for ground operations, he is the functional integration team manager for the associated validation & verification process and also responsible for ARFF of the A380. In the past, he worked for the new Athens Int'l Airport, where in his capacity as a senior operations supervisor he managed the airport operation center and also served as the on-scene commander for aircraft and airport related emergencies. Before that, he was responsible for the elaboration of the Aerodrome Operations Manual and emergency response procedures. He holds a BSc in Aerospace Engineering, MSc in Air Transport Management, MSc in Logistics and a FAA commercial pilot license & flight Instructor rating.