U.S. Department of Transportation

Federal Aviation Administration

Memorandum

Subject:	Action: Review and Concurrence, Equivalent Level of Safety Finding for the Alcoa-SIE Cargo Conversions Passenger to Freighter Conversion of a Boeing Model 757-200 FAA Project Number ST7269LA-T	Date:	4/11/06
		Reg Ref:	§§ 25.855, 25.857
From:	Manager, Propulsion/Mechanical Systems Branch, ANM-112	Reply to Attn of :	David Rathfelder, ANM-120L
To:	Manager, Los Angeles Aircraft Certification Office, ANM-100L	ELOS Memo #:	ST7269LA-T-S-1

Background

The Alcoa-SIE Cargo Conversions (ASCC) passenger to freighter conversion is a supplemental type certificate (STC) project for the Boeing 757-200. In this STC, the aft lower cargo compartment is classified as a Class C cargo compartment requiring, among other things, a smoke detector system.

If an aft lower lobe cargo compartment smoke detection alarm occurs after a main deck cargo compartment smoke detection alarm due to smoke leakage from the upper deck, the flight crew would not know if the second alarm represents a real cargo fire or a false alarm. There is a concern that the pilots' response to this (likely erroneous) alarm of a fire in the lower lobe Class C cargo compartment could result in a higher degree of risk than that of no indication at all. Therefore, the proposed system causes the aft lower lobe cargo compartment smoke detector system alarm output to be inhibited when the crew is fighting a fire in the main deck cargo compartment. During the time the smoke detector system alarm output is inhibited, the aft lower lobe cargo compartment does not strictly comply with the requirements of § 25.857(c)(1). However, the applicant's design and operational procedures do provide sufficient mitigating factors that lead to an equivalent level of safety.

The primary benefit of inhibiting the smoke detector system alarm output during this time is that the pilots will not receive an erroneous indication of a fire in the aft lower cargo compartment that could cause them to take unnecessary and drastic actions. There are two features that compensate for the inhibiting of the smoke detector system alarm output in the aft lower cargo compartment. The first is the likelihood of having a fire. While the FAA does not accept the use of the probability of a fire as sole means of compliance for any of the requirements regarding fire protection; the FAA does acknowledge that cargo compartment fires are rare events. The FAA has done sufficient analysis to understand that the likelihood of having two independent cargo compartment fires during the same flight is sufficiently remote as to not require certification for such an occurrence (hence the reason why two lower lobe Class C cargo compartments are

permitted to share fire extinguishment/suppression agent with a quantity sufficient for one cargo compartment fire). The second is that during any time that the smoke detector system alarm output is inhibited, the ventilation airflow is shut off in both the main deck and aft lower cargo compartments. During this time, the procedure in the proposed airplane flight manual (AFM) cargo fire procedure for the main deck Class E cargo compartment requires the flight crew to climb or descend, as necessary, to depressurize the airplane to a cabin altitude between 20,000 ft and 25,000 ft if they cannot make an immediate landing. Fire growth in a compartment with a reduced partial pressure of oxygen (i.e., pressure altitude above 20,000 ft) and lacking a supplemental oxygen source, is negligible. Although it is unlikely that an independent fire would occur during the time that fire fighting on the main deck is being conducted, FAA is concerned that if an independent fire in the lower aft Class C cargo compartment were to exist, during those times the compartment had sufficient oxygen, rapid fire growth could occur (e.g., during descent at altitudes lower than 20,000 ft). However current FAA data indicate that there is a false alarm rate on the order of 200 to one in the fire detection system. As a result, concern about the number of false alarms and the associated maintenance and degradation of the fire suppression system outweigh any benefit that might be gained from preventatively discharging the fire prevention system in the lower aft Class C cargo system on descent. Because of these compensating features, all the benefits of the Class C cargo compartment fire suppression system are retained while eliminating the consequences of an erroneous signal.

Applicable regulation(s)
§§ 25.855, 25.857

Regulation(s) requiring an ELOS
§ 25.857(c)(1)

Description of compensating design features or alternative standards which allow the granting of the ELOS (including design changes, limitations or equipment need for equivalency)

The following conditions must be met:

a. Smoke from a cargo fire in the main deck Class E cargo compartment must not result in an inadvertent smoke detection in the forward lower lobe Class C cargo compartment.

b. Occurrence of a main deck fire combined with a failure to inhibit a false alarm is considered a major hazard. The system must be shown acceptable via a Systems Safety Analysis.

c. Any time during flight that the Class C cargo compartment smoke detector system alarm output is inhibited, the ventilating airflow is shut off in both the main deck and aft lower cargo compartments.

d. AFM must specify that in the event of a fire in the main deck Class E cargo compartment, the flight crew should land the airplane at the nearest suitable airport after following Class E cargo compartment fire fighting procedures.

e. An acceptable functional or flight test, as appropriate, must be performed to demonstrate that:

(1) When smoke is detected in the main deck Class E cargo compartment, ventilating airflow shuts off to both the main deck Class E cargo compartment and aft lower lobe Class C cargo compartment.
(2) The system properly inhibits the aft lower lobe Class C cargo compartment smoke detector system alarm output during the appropriate time.

Explanation of how design features or alternative standards provide an equivalent level of safety to the level of safety intended by the regulation

Compliance with the conditions stated above will result in a product in which all the benefits of the Class C cargo compartment fire suppression system are retained while eliminating the consequences of an erroneous signal.

FAA approval and documentation of the ELOS

The FAA has approved the aforementioned Equivalent Level of Safety Finding in issue paper S-1. This memorandum provides standardized documentation of the ELOS that is non-proprietary and can be made available to the public. The Transport Directorate has assigned a unique ELOS Memorandum number (see front page) to facilitate archiving and retrival of this ELOS. This ELOS Memorandum number should be listed in the Type Certificate Data Sheet under the Certification Basis section (TC's & ATC's) or on page 3 of the STC Certificate. [E.g. Equivalent Safety Findings have been made for the following regulations:
§25.857(c)(1) Cargo Compartment Classification (documented in TAD ELOS Memo ST4018SE-T-ES-2)]

Original signed by Neil D. Schalekamp	*4/11/06*
Manager, Propulsion/Mechanical Systems Branch, ANM-112	Date