Federal Aviation Administration

Memorandum

Date: January 15, 2013

To: Manager, Transport Standards Staff, International Branch, ANM-116

From: Manager, Transport Airplane Directorate, ANM-100

Prepared by: Douglas Bryant, ANM-112

Subject: INFORMATION: Equivalent Level of Safety (ELOS) Finding for Cowling and Nacelle Skin Fireproof Regions on the Airbus Model A350 Airplane, FAA Project Number TC0544IB-T

ELOS Memo #: TC0544IB-T-P-31

Reg. Ref.: §§ 25.1191 and 25.1193

This memorandum informs the certificate management aircraft certification office of an evaluation made by the Transport Airplane Directorate (TAD) on the establishment of an equivalent level of safety (ELOS) finding for the Airbus Model A350 airplane.

Background

Title 14 Code of Federal Regulations (14 CFR) 25.1193(e) requires that the airplane have fireproof skin in areas subject to flame if a fire starts in the engine power or accessory sections. Airbus has proposed that only a portion of the engine nacelle be fireproof while the remaining portion of the engine nacelle is fire resistant during ground operations. The entire engine nacelle will be fireproof in flight. This proposal does not directly comply with the fireproof requirements of § 25.1193(e).

Section 25.1193(e)(3) applies to the cowl and nacelle skin and it is the applicable fire resistance standard for cowls surrounding engine fire zones and any other airplane skin areas subject to flame during engine fire conditions. It prescriptively requires those parts of the airplane be fireproof, regardless of the level of hazard that might be judged to be created by burn through of those areas. The intent of § 25.1193(e)(3) is to prevent a fire from exiting the engine fire zones except as designed through intended ventilation openings, and to thereby allow the behavior of the fire control features (including fire containment, fire detection, and fire extinguishing) to be reliably predicted based on the

assumption that the engine cowls will remain intact and will not burn through. This serves to protect other parts of the airplane from unanticipated impingement of flames and hot gases, and to ensure that the fire detection and extinguishing systems will function as designed so that fire can be detected and controlled.

Historically, the early generations of civil transport airplanes had engine nacelle structures constructed with materials that were inherently fireproof. The more recent use of light alloys and composite materials has led to taking the effect of airflow characteristics data when demonstrating compliance to this requirement. Due to these changes in design construction the FAA tasked the Aviation Rulemaking Advisory Committee (ARAC) Transport Airplane and Engine Issues Group (TAEIG) to recommend specific changes to § 25.1193(e)(3). On October 23, 2000 the Powerplant Installation Harmonization Working Group of the TAEIG submitted their recommendations to the FAA. Those ARAC recommendations have yet to be formally adopted by the FAA. The ARAC recommendations form the basis for alternative standards that provide an ELOS in lieu of direct compliance with the regulations.

Applicable regulation(s)

§ 25.1191 and 25.1193

Regulation requiring an ELOS finding

§ 25.1193(e)(3)

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 alternative standards based on the ARAC recommendation are provided below:

The required ability to withstand the effects of fire varies with the potential hazards associated with different flight and ground operating conditions. Operating conditions that should be considered by Airbus are as follows:

Flight Conditions:

> For approved normal and abnormal flight operations from minimum V1 to minimum touchdown speed, have fireproof skin in areas subject to flame if a fire starts in an engine fire zone. The conditions for demonstrating the fireproof capabilities of the cowling should be consistent with the most critical anticipated operating conditions. Where engine operating conditions can affect the fire resistance of the cowling (including engine power, bleed extraction, ventilation, etc.), these should be examined and the most critical determined. The engine should be assumed to be shutdown at the most critical time during the first 5

minutes, with the engine assumed to be at the most critical windmilling conditions for the remainder of the 15 minutes.

Ground Conditions:

The fire resistance capabilities delineated below must be demonstrated with the engine either operating or not operating, whichever is the more critical.

Those nacelle skins in areas subject to flame if a fire starts in an engine fire zone should be fireproof under any anticipated ground operating conditions where a skin burn-through (or other adverse effects of a fire) could result in a serious injury to crew, passengers or ground personnel. Hazards of concern include, but are not limited to, events such as fuel tank explosion, hazardous spread of fire to flammable fluid sources outside the fire zone, overheating of critical elements outside the fire zone, and fuselage penetration.

The portion of the nacelle skin, which is required to be fireproof on ground, varies by installation. The proposed Model A350 airplane has wing mounted pod type engine installations. For such installations, a design is considered acceptable when it is demonstrated that the fireproof area protects the pylon strut and other portions of the aircraft considered to be put at a serious hazard if burn through occurs. Factors to consider within the analysis and to use when substantiating the design are: the coupling distance of the nacelle to the wing and fuselage, the airflow characteristics, the fluid migration scheme and the fire plume patterns. After the initial analysis, a similarity demonstration may be used when appropriate. Analyses have demonstrated that the typical area of concern ranges from 90° (±45°) to 180° (±90°). This area may increase or decrease depending on the analysis results. For example, most wing mounted engines not closely coupled to the wing have been found acceptable with a ±45° protection while more closely coupled installations and those with other unique design features have required ±90° protection.

All areas within the fire zone that are not fireproof, as proposed by Airbus, shall be fire resistant.

An analysis comparing the proposed design to previously tested designs may be acceptable if sufficient similarity between the designs (or obvious conservative differences) is shown to exist.

Any fire testing should be performed in accordance with Advisory Circular (AC) 20-135, or another method acceptable to the FAA. In accordance with that AC, if credit for backside airflow is proposed, then the test article should also be subjected to pressure differential and vibration conditions representative of fire conditions during and after a severe engine failure event.

Explanation of how design features or alternative standards provide an ELOS to that intended by the regulation

Although noncompliant with the regulation, the alternative standards based on the TAEIG recommendation to the ARAC in October 2000 is considered to provide an equivalent level of safety to demonstrating that the Model A350 airplane complies with § 25.1193(e)(3).

FAA approval and documentation of the ELOS finding

The FAA has approved the aforementioned ELOS finding in the Model A350 project issue paper P-31, titled "Fire Proof Cowlings and Nacelle Skins." This memorandum provides standardized documentation of the ELOS finding that is non-proprietary and can be made available to the public. The TAD has assigned a unique ELOS memorandum number (see front page) to facilitate archiving and retrieval of this ELOS finding. This ELOS memorandum number should be listed in the type certificate data sheet under the Certification Basis section in accordance with the statement below:

An ELOS Finding has been made for the following regulation:
§ 25.1193(e), Cowling and nacelle skin (documented in TAD ELOS Memo TC0544IB-T-P-31)

Original signed by
Victor Wicklund

For Manager, Transport Airplane Directorate,
Aircraft Certification Service

January 28, 2013
Date

ELOS Originated by Transport Standards Staff:	Project Engineer Douglas Bryant	Routing Symbol ANM-112