



Federal Aviation Administration

Memorandum

Date: August 2, 2011

To: Acting Manager, Seattle Aircraft Certification Office, ANM-100S

From: Manager, Transport Airplane Directorate, ANM-100

Prepared by: Jon Regimbal, ANM-140S

Subject: INFORMATION: Equivalent Level of Safety (ELOS) Finding for Ground Fault Interrupter Relays on Boeing Models 707, 727, 737CL, 737NG, 747CL, 747-400, 747-8/-8F, 757, 767, and 777

ELOS Memo #: PS-05-0123-P-1, Revision 1

Regulatory Ref: § 25.981(a)(3)

The purpose of this memorandum is to inform 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 Boeing Puget Sound ground fault interrupter relay design on Boeing Models 707, 727, 737CL, 737NG, 747CL, 747-400, 757, 767, and 777 series airplanes.

This memo is being revised to extend this ELOS to the Boeing Model 747-8/-8F, and also include the override and jettison pumps for the 747-8/-8F.

Background

Boeing Puget Sound has applied for amendment to their type certificates to modify Models 707, 727, 737CL, 737NG, 747CL, 747-400, 747-8/-8F, 757, 767, and 777 series airplanes by installing a ground fault interrupter relay (GFI).

In this application, Boeing Puget Sound has proposed the use of a GFI which does not meet some of the requirements of § 25.981(a)(3) at Amendment 25-102. Boeing Puget Sound has proposed that compensating features of the design exist to provide an equivalent level of safety.

The applicable parts of Amendment 25-102 of § 25.981(a)(3) state:

“..... (a) No ignition source may be present ... This must be shown by ...
(3) ... Demonstrating that an ignition source could not result from each single failure, from each single failure in combination with each latent failure condition not shown to be extremely remote, and ...

The Boeing GFI design addresses the § 25.981(a)(3) single failure requirement only. However the probability of the GFI having a latent failure condition which would prevent it from detecting a fault current and removing power from the fuel pump is not shown to be extremely remote. The GFI does not have the ability to verify that fault protection is operational prior to application of power to the pump. Potential latent failures in the GFI function will be detected via a manual built-in test (BIT) which will be performed by operators at minimum 4,000 flight-hour maintenance intervals. Boeing notes that the failure rate for loss of fault current detection is 2.26E-07. The FAA has therefore concluded that Boeing has not shown the GFI design, in combination with a minimum 4,000 flight-hour maintenance interval inspection, meets the § 25.981(a)(3), Amendment 25-102, requirement that for each single failure in combination with each latent failure condition not shown to be extremely remote.

However, the FAA accepts Boeing’s position that incorporation of this GFI provides an increased level of protection over those aircraft without the GFI installed. There are compensating features that together provide an equivalent level of safety to that which would be provided if the aircraft was directly compliant to § 25.981(a)(3), Amendment 25-102.

Applicable regulation(s)

§ 25.981(a)(3)

Regulation(s) requiring an ELOS finding

§ 25.981(a)(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)

Boeing Puget Sound’s proposed GFI has the following compensating design features:

1. The extensive service history at the initial release of this finding in 2007 on the Boeing 707, 727, 737CL, 737NG, 747CL, 747-400, 757, 767, and 777 series airplanes includes 478,123,000 hours of electric motor fuel pump operation that show limited exposure to pump failure modes that could result in an ignition source. Failure rates associated with

potential ignition source problems of fuel pump phase-to-phase and phase-to-ground shorts are relatively low. The fleet has continued to accumulate service experience with similar findings.

2. Service experience has resulted in design improvements to prevent certain failures so there are limited numbers of foreseeable failures for which the GFI would be needed to provide additional protection. On-going design improvements in the affected fuel pump housing electrical connectors further reduce the ignition source risk.
3. Periodic inspections will be performed to check functionality of the GFI. Due to the potential latent failures of the GFI functions, a maximum 4,000 flight-hour maintenance interval for checking the functionality of the GFI is required. The 737NG airplanes will be inspected annually, not to exceed 4,000 flight- hours, as required by Section 9 of the 737NG Maintenance Procedures Document. This inspection interval corresponds to the inspection interval for the 737NG fuel pump auto-shutoff and power-on relays. GFIs that fail a functional check must be replaced prior to further flight or the affected fuel pump(s) deactivated per the master minimum equipment list (MMEL). The GFI is an airworthiness limitation, critical design configuration control limitation (CDCCL) item, and must be checked accordingly, as an airworthiness limitation item in the special compliance item/airworthiness limitation document.

The 747-8/-8F series airplanes have similar CDCCL and annual functional check requirements listed in the airworthiness limitations instructions of the maintenance planning document.

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

The Model 747-8 is a derivative airplane based on the Model 747-400. The fuel boost and override / jettison pumps and GFI circuitry are the same or functionally similar as had been previously certified on the Model 747-400 series airplanes.

The compensating design features described in the previous section constitute a design that meet the level of safety intended by the regulation.

FAA approval and documentation of the ELOS finding

The FAA has approved the aforementioned ELOS in Issue Papers P-1 and P-24. This memorandum provides standardized documentation of the ELOS 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. This ELOS memorandum number should be listed in the Type Certificate Data Sheet under the Certification Basis section. An example of an appropriate statement is provided below.

Equivalent Level of Safety Findings have been made for the following regulation(s):
§ 25.981(a)(3) Fuel tank ignition prevention (documented in TAD ELOS Memo No.
PS-05-0123-P-1)

Original Signed by

Victor Wicklund

August 4, 2011

Transport Airplane Directorate,
Aircraft Certification Service

Date

ELOS Originated by: Seattle ACO	Project Engineer: Jon Regimbal	Routing Symbol: ANM-140S
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