

UNITED STATES OF AMERICA
DEPARTMENT OF TRANSPORTATION
FEDERAL AVIATION ADMINISTRATION
RENTON, WASHINGTON 98057-3356

In the matter of the petition of

Airbus

for an exemption from § 25.981(a)(3) of
Title 14, Code of Federal Regulations

Regulatory Docket No. FAA-2016-8799

GRANT OF EXEMPTION

By letter dated June 22, 2016, Mr. François Duclos, A330/A340 Chief Airworthiness Engineer, Airbus, D2202, 1 Rond-Point Maurice Bellonte, 31707 Blagnac Cedex, France, petitioned the Federal Aviation Administration (FAA) for an exemption from the requirements of § 25.981(a)(3) of Title 14, Code of Federal Regulations (14 CFR). This exemption, if granted, would allow Airbus to use the requirements of FAA Policy Statement PS-ANM-25.981-02, *Policy on Issuance of Special Conditions and Exemptions Related to Lightning Protection of Fuel Tank Structure and Systems* as an alternative to full compliance to § 25.981(a)(3) for horizontal fuel trim tank structural lightning protection for the Model A330-200 and A330-300 airplanes.

The petitioner requests relief from the following regulation:

Section 25.981(a)(3), at Amendment 25-102, states that no ignition source may be present at each point in the fuel tank or fuel tank system where catastrophic failure could occur due to ignition of fuel or vapors. This must be shown by 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 from all combinations of failures not shown to be extremely improbable. The effects of manufacturing variability, aging, wear, corrosion, and likely damage must be considered.

The petitioner supports its request with the following information:

This section quotes the relevant information from the petitioner's request with minor edits for clarity. The complete petition is available at the Department of Transportation's Federal Docket Management System, on the Internet at <http://regulations.gov>, in Docket No. FAA-2016-8799.

Extent of Relief Sought

In the frame of the A330 horizontal stabilizer composite structure modification, an exemption to 14 CFR 25.981(a)(3) is sought for the fuel trim tank structural lightning protection.

More precisely, as noted in FAA Policy Statement PS-ANM-25.981-02, dated June 24, 2014, Airbus has concluded that compliance to § 25.981(a)(3) is impractical for fuel tank structural joints. Indeed, this would require either three independent layers of protection which cannot practically be built into the aircraft design with the current state-of-the-art technologies, or very frequent in-tank inspection of the fasteners' health. With hundreds of fasteners on the horizontal stabilizer of an A330, this option is impractical for the operators and could, in addition, have a potential for unintended damages to other tank ignition protection features. As far as dual fault tolerant design features are concerned, Airbus considered, in the frame of the A350 aircraft design, a number of potential alternatives which are all described in detail in the Airbus proprietary compliance documentation submitted to the FAA for that program (reference document 00V391J0003/P01). There were no practical alternatives identified. This assessment of possible design alternatives and its conclusions equally apply to the design of the A330 horizontal stabilizer modification.

The original A330 horizontal tail plane (HTP) design avoided the use of directly struck fasteners in the fuel tank. All design features of the post-modification A330 horizontal stabilizer fuel trim tank have been demonstrated (either by test or by similarity to previous A350 design features) to be fault tolerant with regard to lightning induced ignition sources, taking into account manufacturing variability, likely errors, and the effects of aging. Some design features have been demonstrated to be inherently safe by test with regard to lightning induced ignition sources. The only case where fault tolerance to lightning induced ignition sources has not been demonstrated is the fuel tank skins, where the protection from puncture or hot spots due to lightning attachment is afforded by the inherent material properties, and is not considered to be subject to failures (similar to the A350 certification case). Details of the demonstration were presented to the FAA and will be available in proprietary certification compliance documents.

Finally, inspections and limitations necessary to preserve the fault tolerant design will be defined and made available in the appropriate instructions for continued airworthiness (ICA).

Public Interest

The proposed A330 horizontal stabilizer modification will help to improve the efficiency of the A330 aircraft. For fuel tank lightning protection, Airbus has used all available practical measures in the design of the modified structure. A comprehensive and thorough compliance demonstration, heavily relying on tests, has been conducted to show that the design is fault tolerant to a fuel tank ignition source caused by a lightning strike on the structure. Granting the exemption and approving the modification therefore

represents a tangible consolidation of the acceptable level of safety of the A330 fuel trim tank with regards to lightning ignition threat. It is therefore in the public interest.

On another hand, requiring additional steps to attempt to fully comply with § 25.981(a)(3) would have prohibitive cost, weight, and maintenance consequences with no commensurate increase in safety. It would therefore negate the business case for the modification and thus deprive the airlines and their customers from the benefits of flying a more efficient aircraft.

For these reasons, Airbus believes that it is in the public interest for the FAA to grant this exemption.

Reasons Why Granting the Exemption would not Adversely Affect Safety

The A330 modified horizontal stabilizer fuel tank structure design will be demonstrated to be fault tolerant to a lightning strike. This demonstration is made with due consideration of manufacturing variables and aging conditions. Inspections and limitations necessary to preserve the fault tolerant design will be defined and made available in the appropriate ICA. The fuel trim tank located in this structure is demonstrated to have a flammability exposure below the 7% fleet-wide criteria per 14 CFR 26.33(c). For all these reasons, the conditions delineated in Policy Statement PS-ANM-25.981-02, dated June 24, 2014, to ensure an acceptable level of safety are met and it is therefore considered that a catastrophic fuel vapor ignition resulting from a lightning strike on the horizontal stabilizer structure is extremely improbable.

In addition, the safety record of the Airbus fleet for the fuel trim tank structure design, upon which the modified A330 structure is based, is satisfactory with regard to the lightning strike threats. The concerned Airbus aircraft have collectively accumulated in excess of 237 million revenue service flight hours as of March 2016, with no reported issues related to a fuel trim tank lightning strike.

Request to Waive Publication and Comment Period

Airbus requests that the FAA waive the publication and comment step in the exemption process. Airbus considers this petition as similar in intention and safety implications to exemptions previously granted by the FAA to other applicants for § 25.981(a)(3) as it relates to fuel tank structure lightning protection. The requested exemption would therefore not set a precedent. Unnecessary delays in the treatment of this petition could be detrimental to the timely certification of the A330 horizontal stabilizer modifications by the FAA as currently scheduled for end of October 2016.

Federal Register publication

The FAA has determined that good cause exists for waiving the requirement for *Federal Register* publication for public comment because the request is identical in all material respects to previously granted exemptions; the exemption, if granted, would not set a precedent; and any delay in acting on this petition would be detrimental to Airbus.

The FAA's analysis

In May 2001, the FAA issued the “Transport Airplane Fuel Tank System Design Review, Flammability Reduction, and Maintenance & Inspection Requirements” final rule (Docket No. FAA-1999-6411, effective June 6, 2001) that was adopted as Amendment 25-102. This amendment added specific ignition-prevention requirements and a new flammability-minimization requirement to § 25.981.

The amended ignition-prevention requirements in § 25.981(a)(3) require consideration of factors such as aging, wear, and maintenance errors, as well as the existence of single failures, combinations of failures, and latent failures that may be the cause of ignition sources in fuel tanks. Section 25.981, as amended by Amendment 25-102, requires that the structural aspects of airplane designs be protected from the effects of lightning with features that are failure tolerant. Prior to this amendment, only § 25.954 had been applied to lightning protection of fuel tanks. That provision requires only that the airplane design prevents ignition of vapors in the tank with no consideration for anticipated design failures, aging, wear, or maintenance errors.

Systems aspects of the fuel tank system with potentially catastrophic failure modes would typically meet the requirements of § 25.981(a)(3) by providing at least triple redundancy in their protective features with periodic inspections, or dual-redundant features with continuous system monitoring to reduce the latency period. Dual-redundant design schemes could only comply with § 25.981(a)(3) when combined with either regular inspections at very short intervals or a monitoring device to verify the functionality of the protective features. Inspection of the various design features may be difficult or impossible if the feature is internal to the fuel tank and part of the wing structure.

When § 25.981 became applicable to the structural lightning protection aspects of new airplane designs (Amendment 25-102), applicants found that it was impractical to meet the standard and to incorporate the additional protective features. The FAA agreed that it can be impractical to meet the specific requirements of § 25.981(a)(3) for certain areas of structural design. As a result, the FAA issued two exemptions and developed a new policy related to lightning protection of fuel tank structure. One exemption was for the Dassault Falcon 7X (Exemption No. 9148, issued April 20, 2007) and the other was for the Hawker Beechcraft Model 4000 (Exemption No. 8761A, issued August 28, 2008). On May 26, 2009, following a public-comment period, the FAA issued a policy (ANM-112-08-002) that defined criteria for the granting of exemptions and issuance of special conditions for structural lightning protection. The FAA issued additional special conditions and exemptions based upon that policy from 2009.

In 2014, the FAA superseded Policy No. ANM-112-08-002 with Policy No. PS-ANM-25.981-02, *Policy on Issuance of Special Conditions and Exemptions Related to Lightning Protection of Fuel Tank Structure and Systems* (issued June 24, 2014). This new policy provides a standard approach to applying alternatives to direct compliance with § 25.981(a)(3). It contains the criteria the FAA will consider when applicants need to request an exemption to § 25.981(a)(3) because they find it impractical to directly comply with the ignition-prevention requirements relating to lightning protection of structure and systems. The primary differences between the latest policy statement and the previous one are:

- a) The additional applicability of the policy to fuel tank systems in addition to structure for areas of systems design where the applicant shows that compliance with § 25.981(a)(3) is impractical;
- b) Additional criteria for evaluating the practicality of direct compliance to § 25.981(a)(3);
- c) Additional criteria for establishing inspection requirements for structural failures that could result in an ignition source.

As it applies to fuel tank lightning protection for basic airframe structure (airplane skins, joints, ribs, spars, stringers, and associated fasteners, brackets, and coatings), Airbus contends that both the addition of a third, independent, ignition-source protective feature, and providing sufficient monitoring to detect latent failures in a dual-protective feature, are impractical for certain areas of composite airplane-wing structure. Airbus evaluated possible means of providing additional protective features as a condition of this exemption, as discussed in the policy statement, and found it was impractical to incorporate those features into the Airbus A330 HTP.

Airbus states that the only case where fault tolerance to lightning induced ignition sources has not been demonstrated is the fuel tank skins. Airbus also states that the protection from puncture or hot spots due to lightning attachment is afforded by the inherent material properties, and is not considered to be subject to failures (similar to the A350 certification case). Airbus will need to show that the probability of fuel-vapor ignition, due to these non-fault-tolerant features, is extremely improbable, in order to satisfy the criteria in the policy statement.

The FAA agrees with Airbus that compliance with § 25.981(a)(3) for fuel tank structure would require a combination of redundant protective features, and a high level of reliability of those features, that are excessively expensive to produce and maintain using available technology. Lightning energy can be transferred to fuel tanks installed in wings through the many fasteners and other structural elements. It is impractical to provide either continuous monitoring of the “health” of the protective features for these structures or to inspect them frequently enough to detect latent failures. These features are typically integral to the fuel tank structure or internal to the fuel tank, requiring access into the tank to verify the integrity of the feature. Inspections of the airplane structure requiring fuel tank entry may be scheduled only once or twice during the life of the airplane.

The Airbus petition states that the A330 HTP has been demonstrated to comply with § 26.33(c) at Amendment 26-2. The original certification basis of the A330 did not include Amendment 25-102. This amendment was incorporated into the certification basis of the A330 HTP design change and therefore, paragraph 5.c.(2), *Exemptions for type design change programs and STCs on pre-Amendment 25-102 airplanes*, of Policy No. PS-ANM-25.981-02, applies. That paragraph states that for pre-Amendment 25-125 airplanes, the fuel tank flammability standards for the design change will be those required under the applicable provisions of §§ 26.33 and 26.35 at Amendment 26-2. Airbus states the A330 fuel trim tank located in the changed structure has demonstrated to have a flammability exposure below the 7% fleet-wide criteria per 14 CFR 26.33(c). Therefore, Airbus has met the flammability exposure requirement of the policy memo for pre-Amendment 25-125 airplanes.

In addition to validating independent and effective design means of lightning protection for certification on new production airplanes, § 25.981(b) at Amendment 25-102 requires establishing critical design configuration control limitations (CDCCLs), inspections, and other procedures to prevent the development of ignition sources within the fuel tank system as the airplane progresses through its service life. These limitations, inspections, and procedures must be included in the Airworthiness Limitations section (ALS) of the ICA as required by § 25.1529. Airbus states that it will define inspections and limitations necessary to preserve the fault tolerant design and will include them in the appropriate ICA in accordance with §§ 25.981(b) and 25.1529.

Fuel Tank Systems

With regard to fuel tank systems on the Model A330, Airbus did not request relief from the requirements of § 25.981(a)(3) for lightning protection of systems elements in its petition for exemption. Therefore, fuel tank systems are not included in this exemption.

Conclusion

The FAA considers the Airbus request to be in the public interest because the Model A330 horizontal stabilizer fuel tank design provides an acceptable level of safety, and full compliance to § 25.981(a)(3) is impractical. Full compliance would require significant modifications to the fuel tank design; introduce additional complexity into the manufacturing and quality process, as well as into maintenance procedures that have not been shown to be completely effective; and add significant cost and schedule impact to the Model A330 airplane program.

The petition states that Airbus will follow Policy Statement No. PS-ANM-25.981-02 related to fuel trim tank structural lightning protection for the certification of the Model A330-200 and A330-300 airplanes. The company will provide fault tolerant structural lightning protection features for the fuel tank structure, except for the fuel tank skins. In those areas, it will need to meet the conditions stated in the grant of exemption.

Condition No. 5 of this exemption requires that Airbus prevent the development of lightning-related ignition sources within the fuel tank structure by establishing inspections or other procedures. Such prevention may necessitate one or more of the following actions, or others:

- a) The identification of airworthiness limitations, including mandatory maintenance actions (i.e., inspections) or CDCCLs necessary to preclude the development of unsafe conditions due to non-fault-tolerant lightning protection features;
- b) The inclusion of sampling programs, maintenance, or inspections for fault-tolerant lightning protection features in the Airbus recommended airplane maintenance program;

Note: If inspections from non-mandatory programs such as Baseline Zonal inspection program, Corrosion Prevention and Control Program (CPCP), etc., are going to be used to support the robustness of the overall inspection program, these programs must become mandatory and be included in the Airworthiness Limitations section of the airplane's Instructions for Continued Airworthiness.

- c) The incorporation into applicable airplane maintenance documents, including the structural repair manual, of caution information that identifies the lightning protection features of the fuel system design to minimize the potential for inadvertent damage or disruption of these features.

The FAA's decision

In consideration of the foregoing, I find that a grant of exemption is in the public interest. Therefore, pursuant to the authority contained in 49 U.S.C. 40113 and 44701 delegated to me by the Administrator, I grant Airbus an exemption from 14 CFR 25.981(a)(3) as it relates to the Model A330-200 and A330-300 fuel trim tank structural lightning protection. This grant of exemption and the following conditions are consistent with the alternatives to direct compliance with § 25.981(a)(3) as set forth in Policy Statement PS-ANM-25.981-02.

This exemption is subject to the following conditions:

- (1) The fuel tank flammability exposure must comply with the applicable provisions of §§ 26.33 and 26.35 at Amendment 26-2.
- (2) The fuel tank structure must be designed and installed to prevent catastrophic fuel vapor ignition due to lightning.
- (3) The fuel tank structure lightning protection design must be fault-tolerant for failures that result in lightning-related ignition sources.
- (4) Fault-tolerance is not required for any specific design feature if:
 - a) Airbus provides substantiating documentation showing fault-tolerance is impractical for that feature; and
 - b) Airbus shows that fuel tank vapor ignition is extremely improbable (i.e., so unlikely that it is not anticipated to occur during the entire operational life of all Model A330-200 and A330-300 airplanes) when the airplane's fuel tank vapor ignition event probabilities are combined with that feature and all other non-fault-tolerant features.
- (5) Airbus must establish inspections or other procedures to prevent development of lightning-related ignition sources within the fuel tank structure.
- (6) Airbus must perform an analysis showing that the airplane's design, manufacturing processes, and the Airworthiness Limitations section of the Instructions for Continued Airworthiness include all practical measures to prevent, detect, and correct failures of the lightning protection features of fuel tank structure due to manufacturing variability, aging, wear, corrosion, and likely damage.

Issued in Renton, Washington, on October 26, 2016.

/s/

Dionne Palermo
Acting Manager, Transport Airplane Directorate
Aircraft Certification Service