

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

In the matter of the petition of

**The Boeing Company**

for an exemption from §§ 25.901(c) and  
25.1309(b) of Title 14, Code of Federal  
Regulations

**Regulatory Docket No. FAA-2016-7855**

**GRANT OF TIME-LIMITED EXEMPTION**

By letter dated May 23, 2016, Mr. Douglas M. Lane, Director of Commercial Airplanes, The Boeing Company, PO Box 3707, Seattle, Washington, 98124-2207, petitioned the Federal Aviation Administration (FAA) for a time-limited exemption from the requirements of §§ 25.901(c) and 25.1309(b) of Title 14, Code of Federal Regulations (14 CFR). This exemption, if granted would allow Boeing time to fully develop, certify, and incorporate a design change to correctly accommodate single failures on the thrust control module which can cause uncommanded high thrust (UHT). The design feature that detects and accommodates single failures within the electronic engine control (EEC) is commonly referred to as thrust control malfunction accommodation (TCMA). Boeing intends to correct the design implementing a TCMA feature into the engine software by December 31, 2018, for production 787 airplanes equipped with General Electric GEnx-1B engines, and provide retrofit instructions to the fleet.

**The petitioner requests relief from the following regulations:**

**Section 25.901(c)** states that for each powerplant and auxiliary power unit installation, it must be established that no single failure or malfunction or probable combination of failures will jeopardize the safe operation of the airplane except that the failure of structural elements need not be considered if the probability of such failure is extremely remote.

**Section 25.1309(b)** states that the airplane systems and associated components, considered separately and in relation to other systems, must be designed so that - (1) The occurrence of any failure condition which would prevent the continued safe flight and landing of the airplane is extremely improbable; and (2) the occurrence of any other

failure conditions which would reduce the capability of the airplane or the ability of the crew to cope with adverse operating conditions is improbable.

**Related sections of 14 CFR:**

**Section 25.1301(a)(4)** states that each item of installed equipment must function properly when installed.

**Section 25.1309(a)** states that the equipment, systems, and installations whose functioning is required by this subchapter, must be designed to ensure that they perform their intended functions under any foreseeable operating condition.

**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-2016-7855.

**Description of Issue**

Historically, propulsion control systems on large commercial airplanes have been designed with single elements controlling fuel flow. Industry practice has provided design features to protect the structural integrity of the engine, but it is still possible for single failures or malfunctions of the propulsion control system to result in UHT. Industry design practice provides a means for flight crews to accommodate such failures by shutting down the engine. The effectiveness of this design practice has been demonstrated in today's fleet of large commercial transport airplanes, as there has never been a report of serious injury resulting from a case of UHT.

In the past, compliance to 14 CFR 25.901(c) has been found based on the assertion that the flight crew can recognize and accommodate UHT. However, following a 1997 Saudi Arabian Airlines Boeing 737-200 accident, engineering studies showed that for some airplane designs the traditionally accepted assertion may not always be valid. In response, the FAA has begun to evaluate type designs with far greater scrutiny regarding the flight crew's ability to recognize and safely accommodate single failures that can lead to UHT.

A committee consisting of representatives from the FAA, the Joint Aviation Authorities (JAA), airplane manufacturers, and engine manufacturers was formed in 1998 to study strategies for providing additional protection from thrust control malfunctions resulting in UHT. The committee found that for the existing in-service airplanes whose propulsion systems have demonstrated a level of reliability on the order of one UHT event per 10 million flight hours, it would not be in the public interest to mandate major and novel design changes in an attempt to eliminate the already small potential exposure to UHT malfunctions resulting from single failures. The committee's recommended approach to ensure continued high levels of reliability for all presently certified models is to monitor in-service performance and if any unacceptable failure modes are identified, to take prompt corrective action by introducing focused design improvements using proven technology.

The 787 airplane design minimizes the number of single failures that can lead to UHT, and has a design feature which is intended to detect UHT and automatically accommodate it when the failure is detected while the airplane is on the ground. Engineering simulations have shown that the 787 airplane is controllable for detected failures that cause UHT, when such failures are correctly accommodated; however, it was recently found that some failures of the thrust control module are not correctly accommodated for the GENx-1B engine installation. The Rolls Royce Trent 1000 installation correctly accommodates these failures and is not the subject of this exemption request. Given the low rate of thrust control module failures and the very limited exposure time on the ground when the failure is potentially uncontrollable, a catastrophic event caused by a UHT due to unaccommodated thrust module failures is not anticipated during the next 2 ½ years. Boeing proposes to address single failures of the thrust control module on the GENx-1B engine installation with a software modification by December 31, 2018, for production 787-8 and 787-9 airplanes. A service bulletin will be issued to the 787-8 and 787-9 fleet to allow retrofit of the change. The 787-10 airplane model, which is scheduled to be certified in mid-2018, will correctly accommodate thrust control module failures at the time of certification.

### **Statement of Public Interest**

There are upcoming design changes to the 787 for which compliance to §§ 25.901(c) and 25.1309(b) are relevant. These upcoming changes include corrective actions for known design deficiencies, including revised logic which will prevent a potential personal safety risk during airplane maintenance, and the elimination of unintended crew alerts that unnecessarily distract the crew. The approach of taking action to correct specific problems as they are identified has been used for many years on the 787 and other Boeing models, allowing the Boeing fleet to maintain a high level of safety and reliability. It is in the public interest to allow prompt certification and introduction of upcoming design changes that enhance propulsion system reliability and safety, as well as other improvements that have no direct bearing on the failure modes leading to UHT. In addition, there is planned introduction of a new thrust rating that will expand the mission capability of the 787-9, thus providing more efficient point-to-point operation than is currently available on the 787-9. Preventing certification of airplane mission-related changes would only result in less economical routes or service by less efficient airplanes which are no safer than the 787. Therefore, it is in the public interest for the FAA to grant a partial, time-limited exemption to 14 CFR 25.901(c) and 25.1309(b) to allow near-term type design changes on the 787 to proceed.

### **Statement of No Adverse Effect on Safety**

The time-limited exemption, if granted, would not significantly affect the safety of the 787 fleet. The 787 already has significantly less exposure to UHT failures which could jeopardize safe operation compared with other airplane models which have been certified without design features to automatically accommodate UHT failures, and operating under exemption to 14 CFR 25.901(c). A Thrust Control Malfunction Airworthiness Program will be implemented on the 787 model, requiring airlines to report thrust control malfunctions, and it will be incumbent upon engine manufacturers and Boeing to

maintain vigilance to investigate and correct each relevant event. To date, no such events have occurred on the 787.

### **Request to Waive Publication and Comment**

Boeing requests a waiver of public comment. The nature of the requested exemption is identical to exemptions already granted for many similar large commercial airplanes, and for which there were no public comments received. Similar partial exemptions to 14 CFR 25.901(c) have been granted for UHT failures on Airbus A318-100, A340-500, A340-600 airplanes; Embraer EMB-135BJ, EMB-145XR, ERJ 170-100, ERJ 170-200, ERJ 190-100, ERJ 190-200 airplanes; Boeing Model 717, 737, 747, 757, 767, 777, DC-9, MD-90, MD-88, MD-11 airplanes; and Gulfstream GIV-X, G280, GV, GV-SP, and GVI airplanes.

### **Privileges of the Exemption Outside the United States**

Per 14 CFR 11.81(h), Boeing requests that the privileges of this exemption be extended outside the United States. This extension of privileges is necessary for operations based in countries having bilateral agreements with the United States accepting FAA 14 CFR part 25 as their airworthiness standards for transport category aircraft. The Boeing 787 is operated throughout the global market place.

### **Conclusion**

Boeing requests that the FAA grant prompt relief to 14 CFR 25.901(c) and 25.1309(b) by granting a time-limited exemption for single failures causing UHT for the 787. The same relief has been granted for many other large commercial transport airplanes. Boeing has taken measures on the 787 to minimize exposure to such single failures, and to minimize their effects, and the 787 has demonstrated a high level of reliability. Boeing intends to correct the design by December 31, 2018, for production 787 airplanes, and provide retrofit instructions to the fleet.

### **Federal Register publication**

Although the petitioner requested that action on its petition not be delayed for publication in the Federal Register, the FAA found that the petition, if granted, would set a precedent. Therefore, to allow an opportunity for the public to comment on the petition, a summary of it was published in the Federal Register on August 19, 2016 (81 FR 55519). One comment was received from the Air Line Pilots Association, International (ALPA).

ALPA believes that the temporary nature, including the timeframe of this exemption, is appropriate but encourages the FAA to clearly define the requirements to comply with § 25.901(c) with regard to high crosswind conditions and the improbability of adverse operating conditions as they relate to § 25.1309(b). However in the exemption request, Boeing does not include a discussion about high crosswind simulations or improbability of adverse operating conditions and their effect on compliance with §§ 25.901(c) and 25.1309(b). Boeing requested a time-limited exemption to the requirements of §§ 25.901(c) and 25.1309(b) that will allow them time to make design changes to the propulsion control system and give them additional time to modify the EEC software and eliminate the non-compliance with respect to single failures within

the thrust control module that could result in UHT. In a separate exemption request (Docket No. FAA-2016-8059), Boeing requested a permanent exemption to the requirements of § 25.901(c) as they relate to single failures that could result in UHT, which in combination with high crosswinds on or close to the ground during landing, could result in a loss of control of the airplane. The FAA will address that exemption request and associated comments in Docket No. FAA-2016-8059.

## **The FAA's analysis**

### Introduction

Boeing has requested a time-limited exemption from the requirements of §§ 25.901(c) and 25.1309(b) as they apply to UHT for 787 airplanes equipped with General Electric GENx-1B engines. Boeing recently discovered that a design feature (TCMA) intended to detect and accommodate UHT resulting from a single failure of the thrust control module does not function properly. Boeing proposes to address the TCMA logic error with a modification to the GENx-1B EEC software for the 787-8 and 787-9 production airplanes and by providing retrofit instructions for the existing fleet. This time-limited exemption would allow Boeing the time necessary to certify upcoming propulsion control system design changes prior to developing and certifying the software modification that would appropriately accommodate single failures that could result in UHT.

Boeing has design changes that will require approval prior to the date when the EEC software can be revised to address the TCMA logic errors. These design changes require compliance with §§ 25.901(c) and 25.1309(b) as well as related regulations §§ 25.1301(a)(4) and 25.1309(a). Boeing did not include §§ 25.1301(a)(4) and 25.1309(a) in their petition; however, without a temporary exemption from these regulations, the necessary design changes cannot be approved. Therefore, the FAA is adding these additional regulations to the exemption.

### Public Interest and Effect on Safety

According to § 11.81, Boeing must show that granting this request is in the public interest and will not adversely affect safety. Boeing contends that the nature of this exemption request is identical to exemptions already granted for similar large commercial airplanes. However, this request is unique because it involves an airplane that had previously been found compliant without an exemption for single failures that could result in UHT. The exemption would allow Boeing to certify propulsion control system design changes while they develop and certify new engine software that will eliminate the noncompliance specific to the detection and accommodation of UHT caused by the thrust control module. Also, Boeing is requesting relief from § 25.1309(b) which has not been included in previously granted exemptions.

Boeing states that there are upcoming propulsion control design changes to the Model 787 airplane that require compliance with §§ 25.901(c) and 25.1309(b) and a time-limited exemption will allow Boeing the time to incorporate these related changes prior to developing and certifying a new design that accommodates the single failures of the thrust control module that could result in UHT. The design changes that will be certified during the time-limited exemption period are intended to enhance propulsion system reliability and safety and have no

direct bearing on failures leading to UHT. Additionally, there is a planned introduction of a new thrust rating that will result in a more economical flight operation.

The FAA has determined that granting this time-limited exemption is in the interest of public safety because it allows certification of the airplane design changes that increase airplane propulsion system reliability and safety while the level of safety with respect to UHT remains unchanged.

This exemption allows a slightly greater hazard than full compliance with §§ 25.901(c) and 25.1309(b). However, for those existing transport airplanes re-evaluated after the 1997 Saudia Arabian Airlines accident to date, the conditions under which a UHT failure may jeopardize the safe operation of the airplane are limited to specific aborted takeoff or approach-and-landing scenarios. Given that these scenarios may occur, there is a low probability that a serious injury would result. This limited exposure, in conjunction with the historically low occurrence rates, makes this a relatively low risk per-flight-hour. In addition, the loss of TCMA protection is limited to a certain single failure within the thrust control module that can result in UHT; other failure scenarios that can result in UHT still have the TCMA protection. Therefore, the FAA concludes that the requested time-limited exemption provides a level of safety equivalent to that of the existing fleet of similar transport category airplanes that do not have features to automatically detect and accommodate UHT failures.

### **The FAA's decision**

In consideration of the foregoing, I find that a grant of time-limited 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 The Boeing Company temporary relief from the requirements of 14 CFR 25.901(c), 25.1301(a)(4), 25.1309(a), and 25.1309(b) as they relate to single failures of the thrust control module that could result in UHT conditions and to the extent necessary to allow type certification of new propulsion control system designs for Model 787-8 and 787-9 airplanes equipped with General Electric GENx-1B engines. This exemption expires on December 31, 2018, and is subject to the following conditions:

1. The following "Note" will be added to the airplane type certificate data sheet (TCDS) for any airplane certificated under this exemption:

**The FAA has concluded that the occurrence of any uncommanded high-thrust failure condition, or any of the associated causal failures listed within Boeing Document [reference TBD], may endanger the safe operation of an airplane. Consequently, the FAA recommends that operators report any such failures in accordance with Title 14, Code of Federal Regulations 121.703(c), 125.409(c), and 135.415(c).**

2. In support of the "Note" in condition 1 above, Boeing must develop and obtain FAA approval of the document referenced in the "Note" prior to issuance of a standard airworthiness certificate for airplanes covered under the terms of this exemption. That document will list the failures that can contribute to or cause a UHT failure condition covered under this exemption. For any airplane certificated under this exemption, failures of the type listed within that document

must be reported to the FAA using the same method and report timeliness requirements as for reporting events under 14 CFR 21.3.

3. No later than December 31, 2018, for all airplanes to which this exemption applies, Boeing must:
  - a. Obtain FAA approval of amended type designs and related service instructions incorporating fully compliant TCMA logic that accommodates all UHT failures associated with the thrust control module.
  - b. Show that all new Boeing Model 787-8 and 787-9 production airplanes are equipped with the amended type designs approved to satisfy condition 3a or any subsequently approved TCMA logic.
4. The Airworthiness Limitations section of the Instructions for Continued Airworthiness for Boeing Model 787-8 and 787-9 airplanes delivered under the conditions of this exemption must state that the GENx-1B-powered 787-8 and 787-9 airplanes produced before December 31, 2018, cannot be operated after December 31, 2020, unless all design changes and limitations developed in accordance with condition 3a above are incorporated by the owner or operator.
5. The FAA will not issue original airworthiness approvals for GENx-1B-powered Model 787-8 and 787-9 airplanes after December 31, 2018, unless those airplanes have the type design changes referenced in condition 3 of this exemption.

The granting of this exemption does not relieve any regulatory obligation to identify and correct unsafe conditions related to UHT failure conditions.

Issued in Renton, Washington, on September 23, 2016.

/s/

Michael Kaszycki  
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