Exemption No. 11002

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 §§ 25.671(d), 25.1301(a)(1), 25.1301(a)(4), 25.1309(a), and 25.1309(b)(2) of Title 14, Code of Federal Regulations	**Regulatory Docket No. FAA-2014-0373**

TIME-LIMITED PARTIAL GRANT OF EXEMPTION

By letter dated June 4, 2014, Douglas Lane, Director of Regulatory Administration, The Boeing Company, P.O. Box 3707, MC 03-52, Seattle, Washington 98124-2207, petitioned the Federal Aviation Administration (FAA), on behalf of The Boeing Company, for a time-limited exemption. The petition seeks relief from §§ 25.671(d), 25.1301(a)(1), 25.1301(a)(4), 25.1309(a), and 25.1309(b)(2) of Title 14, Code of Federal Regulations (14 CFR), as they relate to reliability in the ram-air turbine generator control unit (RAT GCU), and a recently observed anomaly in the function of the altitude-select knob on the autopilot mode-control panel (MCP) installed in Boeing Model 787-9 series airplanes. The proposed time-limited exemption, if granted, would permit type certification of the new airplane model with the anomalies present in the non-compliant components, and as applies to the MCP, with a procedural mitigation to ensure that the flightcrew will detect and correct the anomaly if it occurs. The exemption would allow type certification and airplane deliveries to proceed, followed by design changes that will bring the affected airplanes back into full compliance as quickly as possible after the changes are available.

The petitioner requests relief from the following regulations:

> **Section 25.671(d)** – requires that the airplane must be designed so that it is controllable if all engines fail. Compliance with this requirement may be shown by analysis where that method has been shown to be reliable.

Section 25.1301(a)(1) and (4) – requires that each item of installed equipment must be of a kind and design appropriate to its intended function, and must function properly when installed.

Section 25.1309 (a) and (b)(2) – requires that the equipment, systems, and installations the functioning of which is required by this subchapter, must be designed to ensure that they perform their intended functions under any foreseeable operating condition; and that the airplane systems and associated components, considered separately and in relation to other systems, must be designed so that the occurrence of any other failure condition, which would reduce the capability of the airplane or the ability of the crew to cope with adverse operating conditions, is improbable.

The petitioner supports its request with the following information:

This section quotes, in pertinent part, 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-2014-0373.

Description of Issue: Ram Air Turbine (RAT) Generator Control Unit (GCU)

The 787-9 demonstrated compliance to 25.671(d) during flight tests and through analysis. However, during a non-certification flight test, one RAT GCU failed to produce electrical power due to a failed capacitor within the GCU. Review of the design found that this capacitor did not have the Boeing standard recommended voltage de-rating. Boeing considers this condition to be non-compliant to §§ 25.671(d) and 25.1301(a)(1) as the RAT GCU is not designed with adequate reliability. The effect of insufficient de-rating may result in early capacitor failure. The GCU is powered only when the RAT is operating during ground test or in-flight deployment. The design will be made compliant by design change to the GCU implementing a different capacitor.

The development, validation, certification and production incorporation of the design change is to be completed by end of February, 2015. A service bulletin to allow fleet retrofit with the new GCU will be released after production delivery. This will allow all 787-9 airplanes delivered under this exemption to order parts and install a compliant configuration. The Boeing service bulletin will recommend that all airplanes delivered under this exemption be retrofitted.

Description of Issue: Autoflight Mode-Control Panel (MCP)

The Altitude-Select knob on the 787-9 MCP supports two functions: Setting the air-traffic-control cleared altitude via knob rotation, and requesting altitude intervention via pressing the knob axially during vertical navigation use. When the altitude-intervention function is used by pressing the knob axially, the knob may rotate through one or two detents due to low resistance torque which results in changes to the selected altitude. The crew may note the change in the selected altitude prior to violating the air traffic control clearance but the limited time available to detect the error causes a large reduction in safety margins which is classified as "hazardous" by the System Safety Assessment.

The 787-9 Mode Control Panel Altitude-Select knob does not directly comply with §§ 25.1301(a)(4), and 25.1309(a) and (b)(2), as described above. As an interim corrective action, a Flight Crew Operations Manual Bulletin is to be released to all 787 operators prior to delivery of the first 787-9 airplane. There is insufficient time to incorporate an appropriate change to rectify this issue prior to 787-9 certification, it will be corrected after certification of the 787-9. The final solution will be a revised part number MCP with updated software. The development, validation, certification and production incorporation of the revised MCP is to be completed by end of May, 2015. A service bulletin, to allow fleet retrofit with the new MCP, will be released after production delivery. This will allow all 787-9 airplanes delivered under this exemption to order parts and install a compliant configuration.

The Boeing service bulletin will recommend that all airplanes delivered under this exemption be retrofitted.

Statement of Public Interest

Granting this petition is in the public's interest because it would allow adequate time for Boeing and its suppliers to develop effective design solutions to the non-compliances addressed by this petition. Availability of the 787-9 airplanes with the Rolls Royce Trent 1000 engines will reduce fuel burn and hence reduce emissions of carbon dioxide, reduce global emissions of NOx, and reduce operating costs of airlines from current in-service airplanes.

The public interest will also be served by grant of exemption as it is in the economic interest of the United States. Many 787-9 customers, including the launch customer, are overseas. Delivery delays of the 787-9 are not in the interest of the public due to the potential negative impact to export sales, the balance of trade, the gross domestic product, and economic health of the United States.

Statement of No Adverse Effect on Safety

RAT GCU

Boeing has recently discovered and reported this non-compliance and determined that this issue is not an immediate safety issue. This is based upon the unlikelihood of the need of the RAT combined with failure of the capacitor. In addition, even if the RAT is required, there is a reasonable likelihood that the RAT GCU will operate as intended with the incorrectly de-rated capacitor. By using a quantitative risk analysis, the probability of the RAT GCU failure and dual engine failure during one flight is currently assessed to be extremely improbable. The grant of the relief sought does not adversely affect safety because of the unlikely occurrence of a RAT GCU failure when needed during the limited fleet exposure.

MCP

This issue has no adverse effect on safety. This is considering:

- The condition involves the flightcrew inadvertently changing the selected altitude when the MCP altitude-select knob is pressed to initiate an altitude intervention without observing the inadvertent input, and

- As an interim corrective action, a Flight Crew Operations Manual Bulletin is to be released to all 787 operators prior to delivery of the first 787-9 airplane. The bulletin will highlight to flight crews the sensitivity of the MCP knob and to confirm selected altitude when using the knob, the confirmation of which is an advisable practice on all aircraft.

Need to Exercise 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 within foreign countries having bilateral agreements with the United States accepting 14 CFR Part 25 as their airworthiness standards for transport-category aircraft. The 787-9 is intended for the global marketplace with a launch customer based in a country utilizing the United States airworthiness standards.

Conclusion

The relief sought is limited to the two systems/components (RAT GCU, Autoflight MCP) for the area of non-compliance to the applicable requirements for those 787-9 aircraft completed prior to the production incorporation of the design changes bringing those systems into full compliance and recommending retrofit of the airplanes delivered under the exemption. The preceding discussion has shown that grant of exemption for the relief being sought presents no adverse impact on safety. It has also been shown that grant of exemption is in the public's interest as it facilitates the replacement of older aircraft with the environmental and safety enhancements and improved economic performance of the 787-9. The public's interest is further served through the economic benefit that the scheduled production and deliveries bring to the US and local economies. Due to imminent delivery of the airplane, The Boeing Company requests that the FAA waive public comment and grant this petition.

***Federal Register* publication**

The FAA has determined that good cause exists for waiving the requirement for *Federal Register* publication for public comment because delivery of the airplane is imminent, and any delay in acting on this petition would be detrimental to The Boeing Company.

The FAA's analysis

RAT GCU

The petitioner has requested relief from § 25.671(d) for the RAT GCU. The petitioner has demonstrated compliance to this regulation by test and analysis. Based on those test and analysis results, the FAA finds that, with a properly operating RAT GCU, the 787-9 is compliant with this regulation and an exemption to this regulation is not required. While the design is capable of performing this function, the reliability of the RAT GCU is not of a "design appropriate to its intended function" as required by § 25.1301(a)(1).

During a flight test, one RAT GCU failed to produce electrical power due to a failed capacitor within the GCU. Additionally, this same failure mode occurred three times during acceptance test procedures on other RAT GCUs. Review of the design found that a capacitor did not have the Boeing standard recommended voltage de-rating. This condition has been determined to be non-compliant to § 25.1301(a)(1) as the design does not provide adequate reliability to ensure

that the airplane is controllable if all engines fail for an extended period of time and if the APU is also unavailable. The effect of insufficient de-rating may result in premature capacitor failure. Note that the GCU is powered only when the RAT is operating during ground test or in-flight deployment. Boeing will make this design compliant by design change to the RAT GCU.

Boeing will complete the development, validation, certification and production incorporation of the design change by the end of February 2015. Boeing will release a service bulletin to allow fleet retrofit with the new GCU after production delivery. This exemption requires all airplanes delivered under this exemption to be retrofitted to be compliant.

Effect on safety

A dual-engine shutdown combined with a failed RAT GCU has no immediate effect on safety as flight control is maintained for 10 minutes using battery power. Additionally, there is no adverse effect on safety if the flightcrew is operating or starts operating the auxiliary power unit (APU) as it, too, provides electrical power to maintain flight control after a dual-engine shutdown. Failure of the RAT GCU is of concern only in the event of non-restartable, dual-engine, in-flight shutdown where the APU is also unavailable. The non-compliant RAT GCU poses a hazard only if the capacitor is failed during this condition. Under this condition, the airplane will be controllable for approximately 10 minutes using battery power. However, the RAT GCU is tested at least four times after manufacture, including during an airplane-production flight test and, based on actual failure data, the failure probability of the component is low. Therefore, encountering a non-restartable, dual-engine shutdown, where the APU is also unavailable, and having the RAT GCU also experience a capacitor failure, is considered extremely improbable during the time-limited exemption period.

In consideration of the above, the FAA concludes that granting this exemption does not adversely affect safety.

MCP

The altitude-select knob on the 787 mode control panel (MCP) supports two functions:

1. Setting the air-traffic control-cleared altitude as a target for the airplane's guidance system via knob rotation through detents that provide a tactile feel to the pilot, and
2. Requesting altitude intervention via pressing the knob axially during vertical navigation use.

Altitude intervention is a function to permit making a temporary change to an altitude clearance provided by air-traffic control, which is provided during a climb or descent with the intent of retaining the previously loaded vertical path in memory so that the flightcrew can resume that vertical path after air-traffic control releases the intervention request. When the flightcrew uses the altitude-intervention function by pressing the knob axially, the knob may inadvertently rotate through one or two detents due to low-resistance torque. This is rare, and was only recently detected. When it occurs, the result is a change to the selected altitude which, if not detected and corrected, may cause the airplane to deviate from its assigned altitude. An unintended altitude deviation can be hazardous if not detected and corrected. In the FAA's analysis, this is an infrequent functional error in an airplane component (the altitude-select knob) that is sensitive to the manner in which the flightcrew uses the component. The error occurs in response to

foreseeable, but previously unnoticed, variations in the way the flightcrew touches the knob. The error is not a typical system failure in the sense of a knob becoming defective due to wear.

The selected altitude, and any change to it made by rotating the knob, are visible in the MCP display window and, if inadvertently confirmed as a change, the new target appears in the primary flight display. Both target-altitude displays are within the pilots' primary fields of view. The flightcrew should note the change in the selected altitude to prevent violating their air-traffic control clearance, but the limited time available to detect the error causes a large reduction in safety margins which is, by itself, classified as "hazardous" in the System Safety Assessment Boeing is using to certify the airplane.

The 787-9 MCP altitude-select knob with this anomaly does not directly comply with §§ 25.1301(a)(4), and 25.1309(a) and (b)(2), as described above. As an interim corrective action, a Flight Crew Operations Manual Bulletin is being released to all 787 operators prior to delivery of the first 787-9 airplane. The bulletin mentions the specific vulnerability: the possibility of inadvertently making two inputs to the altitude-select knob (altitude intervention and a new altitude) while trying to make just one (altitude intervention only), due to the sensitivity of the rotary knob, and reminds crewmembers to visually verify the MCP altitude selection whenever taking action on the MCP altitude-select knob or button. The FAA notes that verification of autopilot commands and operations is a standard and proper flightcrew practice.

The complete solution to the non-compliance will be a revised MCP with updated software and a new part number. The software will ensure that inadvertent additional inputs will not be accepted by the autopilot system. Boeing has insufficient time to incorporate an appropriate change to rectify this issue prior to 787-9 certification. The anomaly will be corrected after certification of the 787-9. The development, validation, and certification of the revised MCP, followed by production incorporation, and a service bulletin to allow retrofit onto delivered airplanes, are expected to be complete by November 30, 2015.

Effect on safety

Boeing's non-compliance has no adverse effect on safety when it is mitigated by adherence to the Flight Crew Operations Manual Bulletin, which highlights the anomaly and reinforces proper flightcrew resource-management practices that prevent the anomaly from having an effect on the airplane. The non-compliant condition poses a hazard only when it results in a crewmember inadvertently changing the selected altitude when pressing the MCP altitude-select knob to initiate an altitude intervention, and then only if both crewmembers do not detect the error. The non-compliant condition will only exist for a limited period of time sufficient for Boeing to provide a compliant solution.

In consideration of the above, the FAA concludes that granting this exemption does not adversely affect safety.

Public interest

If the FAA were to deny this exemption, it would disrupt air commerce by preventing operators from implementing planned airplane deployments that are necessary to accommodate customer demand, and it would adversely impact the economic interests and trade balance of the United States by denying deliveries of airplanes to customers in foreign nations; and of increasing global fuel consumption with resulting increased costs and gas emissions from causing older, less-

efficient airplanes to remain in service longer while awaiting deliveries, while providing adequate time to safely design and test design changes for the RAT GCU and MCP.

In consideration of the above, the FAA concludes that granting this exemption is in the public interest.

The FAA's decision

In consideration of the foregoing, I find that a partial grant of exemption is in the public interest and will not adversely affect safety. Therefore, pursuant to the authority contained in 49 U.S.C. 40113 and 44701, delegated to me by the Administrator, The Boeing Company is hereby granted an exemption from §§ 25.1301(a)(1), 25.1301(a)(4), 25.1309(a), and 25.1309(b)(2) for all Boeing Model 787-9 series airplanes in accordance with the conditions and limitations described below.

The petition is granted to the extent necessary to allow type certification of the Boeing Model 787-9 series airplanes after the date of this granting, without a showing of compliance with the stipulated regulations as they relate to the existence of functional anomalies in the ram-air turbine generator control unit, and the altitude-select knob on the autopilot mode-control panel. This partial time-limited grant of exemption is subject to the following conditions and limitations:

Conditions and limitations

1. On or before July 31, 2014, the petitioner will provide a compliance plan that supports findings of compliance to § 25.1301(a)(1) for the ram-air turbine generator control unit (RAT GCU), and on or before July 31, 2014, the petitioner will provide a compliance plan to §§ 25.1301(a)(4), and 25.1309(a) and (b)(2) for the autopilot mode-control panel (MCP) altitude-select knob.

2. On or before July 31, 2014, the petitioner will propose to the FAA a schedule identifying all major milestones for meeting the compliance dates identified in condition 1.

3. All design data and substantiation data must be submitted for approval to the FAA on or before December 30, 2014 for the RAT GCU, and March 31, 2015 for the MCP altitude-select knob. For purposes of this paragraph and paragraph 4, the data submitted must show compliance with the applicable regulations specified in paragraph 1.

4. Service instructions that provide a method to incorporate the design changes to existing delivered aircraft must be submitted to the FAA for approval on or before February 28, 2015 for the RAT GCU, and May 31, 2015 for the MCP altitude-select knob, and made available to airplane owners and operators no later than March 31, 2015 for the RAT GCU, and June 30, 2015 for the MCP altitude-select knob.

5. For 787-9 airplanes granted a certificate of airworthiness on or before February 28, 2015 for the RAT GCU, and May 31, 2015 for the MCP altitude-select knob, the Airworthiness Limitations section of the 787-9 airplane's *Instructions for Continued Airworthiness* must state that the airplanes cannot be operated after August 31, 2015 for the RAT GCU, and November 30, 2015 for the MCP altitude-select knob, unless the design changes submitted to and approved by the FAA, in accordance with this exemption, are incorporated by the airplane owner or operator.

6. Airplanes for which the application for an airworthiness certificate is made after February 28, 2015 for the RAT GCU, and May 31, 2015 for the MCP altitude-select knob, must incorporate the design changes that are submitted to and approved by the FAA per condition 3.

7. The FAA will not issue original airworthiness approvals for the 787-9 after February 28, 2015 for the RAT GCU and May 31, 2015 for the MCP altitude-select knob, unless the petitioner has shown full compliance with the provisions of this exemption by that date.

This exemption will remain in effect until August 31, 2015 for the RAT GCU, and November 30, 2015 for the MCP altitude-select knob, from the date of issuance, or until Boeing complies with each of the conditions specified in this exemption, whichever occurs later, unless superseded or rescinded.

Issued in Renton, Washington, on June 12, 2014.

/s/ Michael Kaszycki

Michael Kaszycki
Acting Manager, Transport Airplane Directorate
Aircraft Certification Service