Exemption No. 11081

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 §§ 25.1305(c)(5) of Title 14, Code of Federal Regulations	**Regulatory Docket No. FAA-2014-0330**

TIME-LIMITED GRANT OF EXEMPTION

By letter no. RA-14-02186, dated May 2, 2014, Mr. Douglas M. Lane, Regulatory Administration Director, The Boeing Company, P.O. Box 3707, Seattle, WA 98124-2207, petitioned for a time-limited exemption from the requirements of Title 14, Code of Federal Regulations (14 CFR) 25.1305(c)(5). This exemption would permit temporary relief from the regulations to allow time for Boeing to upgrade ice-crystal icing indicator software on Boeing Model 787-8 and 787-9 airplanes equipped with GEnx-1B engines.

The petitioner requests relief from the following regulation(s):

> **Section 25.1305(c)(5) at Amendment 25-120** requires that, for turbine-engine powered airplanes, an indicator for the flight crew is required to indicate the functioning of the powerplant ice-protection system for each engine.

The petitioner supports its request with the following information:

The following quotes, in pertinent part, the petitioner's information. The complete petition is available on-line in the Federal Docket Management System at http://www.regulations.gov, docket number FAA-2014-0330.

> The GEnx-1B engines installed on 787-8/-9 airplanes have been shown to be susceptible to operation in Ice Crystal Icing (ICI) conditions in-service. These ICI conditions have resulted in a range of engine responses. Certification Plan 15053, ODA Project Number PS14-0053, will certify a new GEnx-1B engine limitation associated with GEnx-1B Electronic Engine Control (EEC) software version B175 to address the in-service ICI operational issues.
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> GEnx-1B EEC software version B175 certified under ODA Project Number PS13-0989 incorporates logic that eliminates any effects of ICI on engine operation, within the engine limitation envelope certified under ODA Project Number PS14-0053. EEC B175

software detects the presence of ice crystals and cycles the Variable Bleed Valve (VBV) doors, minimizing ice crystal ingestion into the engine core. The ICI VBV system will be substantiated as effective in identifying ICI conditions and eliminating the ICI threat, within the associated GEnx-1B/B175 ICI engine limitation envelope. The Airplane Flight Manual (AFM) limitation for avoidance of ICI conditions will be modified to reflect the new GEnx-1B/B175 engine limitation. The FAA recently clarified that the ICI VBV system used in this capacity constitutes a "powerplant ice protection system," thus invoking the indication requirements of §25.1305(c)(5).

Section 25.1305(c)(5) is a prescriptive regulation that requires a flight deck indicator to indicate the functioning of the powerplant ice protection system for each engine. The 787-8/-9 does not provide a specific flight deck indicator for the functioning of the ICI VBV system.

In future Displays and Crew Alerting System (DCA) software rolls, the EEC monitoring of the ICI VBV system will be used to provide an EICAS [engine indication and crew alerting system] indication to the flight crew, when the ICI VBV system logic is active. However, the ICI VBV EICAS indications will not be active at the time the AFM limitation is modified to reflect the new GEnx-1B/B175 engine ICI limitation. There would be a significant burden if Boeing were required to incorporate an ICI VBV powerplant ice protection system indication for closure of ODA Project Number PS14-0053.

With this petition for exemption, Boeing is requesting relief for a limited period to allow sufficient time to develop, validate, and certify an EEC and DCA software incorporating an ICI VBV indication compliant to §25.1305(c)(5). Following incorporation of the compliant indication in EEC and DCA software, Boeing will issue a service bulletin that recommends all affected airplanes covered by this time limited exemption be retrofitted.

The requested time-limited exemption will provide relief from the ICI VBV powerplant ice protection system indication requirement of §25.1305(c)(5), for new production and in-service Boeing Model 787-8, incorporating EEC B175 software, and upon modification of the AFM to reflect the new GEnx-1B/B175 engine ICI limitation. The relief sought is limited to 787-8/-9 airplanes prior to the incorporation of the DCA software incorporating an ICI VBV indication compliant to §25.1305(c)(5). Certification of the ICI VBV indication will be accomplished by June 30, 2015. A service bulletin will be available no later than August 15, 2015 such that all 787-8 airplanes covered by this exemption can order parts and install a compliant configuration. The Boeing service bulletin will recommend that all airplanes be retrofitted by March 31, 2016. These dates are different than the dates requested by the 747-8/-8F because of the expected 787 program flow times.

Note that Boeing and GE continue to work on a design that will ultimately allow complete lifting of the AFM limitation for avoidance of ICI conditions. This petition for time-limited exemption will apply to this future design.

Effect on safety

The activation of the ice protection feature of the ICI VBV system logic is completely automated with no flight crew input or control. In contrast, ice protection systems for Engine Anti-Ice (EAI) can be manually operated and can include latent faults; hence a

functionality indicator provides necessary pilot feedback. Traditionally flight crews have been trained to independently verify icing conditions based on visual cues and easily available information; this is not the case with ICI conditions.

TAT [total air temperature] less than10 degrees C and the presence of visible moisture or the formation of ice on the windscreen wipers are being used to indicate airplane operation in 14 CFR Part 25 Appendix C icing conditions. Reacting to these visual cues, the flight crew can either manually turn on the EAI system or verify its activation by an automatic ice detection system.

The EEC automatically determines when ICI conditions exist and automatically provides engine ice protection when required. Accurately detecting the conditions that require engine protection for ICI encounters is not possible for the flight crew, as it involves internal engine measurements not available to the flight crew and complicated computations. Visible detection cues associated with ICI are not as consistent as they are with natural icing.

The EEC ICI VBV fault detection and accommodation logic is robust. All logic inputs for the ICI VBV control are monitored continuously to ensure proper engine operation. Each of the engine sensed parameters used in the ICI VBV logic is a dual channel sensor. Failure or loss of any single channel's input is detected and accommodated by the EEC, does not affect ICI VBV system functionality and results in a 10 day time-limited dispatch condition (ENG C1 EICAS latched status message).

Detection of a dual failure by the automatic health checks for any of the critical control signals will result in a non-dispatchable ENGINE CONTROL EICAS latched Status message, requiring resolution prior to the next flight. Hence, there is protection against latent faults to the ICI VBV ice protection feature for each individual engine and the airplane's exposure to that failure would be the remainder of that flight. This type of EEC fault detection logic is common to all GE EECs. The fault detection and accommodation of the sensors used in the ICI VBV logic has not changed, as these parameters were already considered critical parameters required to control the engine.

The AFM was revised in April 2014 to provide information regarding engine parameter effect when the ICI VBV logic is active.

Since the ICI VBV system is automatic with no pilot input, and operational information is provided to the flight crews regarding engine parameter fluctuations when the ICI VBV logic is active, there is no adverse effect on airplane safety awaiting installation of the ICI VBV system EICAS indicator.

Statement of public interest

Granting this petition is in the public's interest because it would allow adequate time for Boeing and its supplier to develop an effective design solution to add a flight deck indication of ICI VBV system operation. Conversely, if the requested relief is not granted the addition of the subject flight deck indication would lead to delay in the modification of the AFM to reflect the new GEnx-1B/B175 engine ICI limitation. Continued adherence to the current AFM limitation with the ICI accommodations provided in EEC B175 software results in unnecessary flight crew workload and burdensome operational planning that can result in otherwise avoidable cancelled and diverted flights.

> Additionally, Boeing has received reports from the airlines that adherence with the AFM limitation is onerous on the airlines and flight crews. The AFM limitation requires new and unique flight operations planning, carrying of additional fuel, increased workload for flight crews and in numerous instances has resulted in extensive diversions resulting in disruptions to the airline operations. Granting of this exemption will diminish the likelihood of future events of this nature.
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> The public interest will be advanced by the grant of exemption as it is in the best economic interest of the United States. Modification of the AFM to reflect the new GEnx-1B/B175 engine ICI limitation for avoidance of ICI conditions makes the 787-8/-9 airplanes more operationally economical and provides a competitive advantage for future airplane sales. As many 787-8/-9 customers are foreign, further delays in the modification of the AFM limitation is 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 the economic health of the United States.

Federal Register publication

A summary notice of the petition was published in the Federal Register on June 17, 2014 (79 FR 34561). One comment was received; the Airline Pilot's Association (ALPA) concurs with Boeing's petition for exemption, adding that:

> … this temporary waiver is a reasonable means to achieve full compliance. ALPA also wants to stress that it is imperative for flight crews to be aware of a functioning powerplant icing protection system. The indication of a working icing protection system is especially important because ICI condition could result in adverse effects on these specific engines.

The FAA's analysis

Section 25.1305(c)(5) at Amendment 25-120 requires that, for turbine-engine powered airplanes, an indicator for the flight crew is required to indicate the functioning of the powerplant ice-protection system for each engine.

The intent of this regulatory requirement is to provide feedback to the flight crew when the powerplant ice-protection system is functioning. Flight crew awareness of the status of the ice-protection system is needed to assure the system has been activated and to annunciate failure of a manual or automated system.

Engine-power fluctuations have occurred during flight testing with modified GEnx engine software. These fluctuations occurred randomly on each engine as the VBV ice-protection system automatically activated. Boeing revised the AFM in April 2014 to provide information to the flight crew regarding engine parameter effects when the ICI VBV logic is active. The applicant has stated,

> Since the ICI VBV system is automatic with no pilot input, and operational information is provided to the flight crews regarding engine parameter fluctuations when the ICI VBV logic is active, there is no adverse effect on airplane safety awaiting installation of the ICI VBV system EICAS indicator.

The FAA has determined that indication to the flight crew of the GEnx-1B ice-protection activation would be in compliance with section 25.1305(c)(5) and provides a tangible safety

benefit. The flight crew needs to be aware of operation of the ICI VBV system so they will understand why engine-power fluctuations are occurring, and that these fluctuations are normal when the system is activated. Without this indication, flight crews might disregard engine-power fluctuations that may be a precursor to an engine power-loss event, thinking that the ICI VBV system has activated when it has not, or flight crews might take inappropriate action when the ICI VBV system is active and the engines and ice-protection system are functioning normally.

The information Boeing has provided to the flight crew in the AFM, regarding engine-parameter effects when the ICI VBV logic is active, effectively precludes any adverse effect on safety in the interim while Boeing develops and incorporates the compliant flight-deck indication.

Specific indication to the flight crew is not provided for ICI conditions. The airworthiness directive in place today relies upon flight crews to monitor weather radar, determine the presence of an ICI environment, and to maintain a minimum distance from ICI conditions. The introduction of the ICI VBV system design improves airplane safety in ICI conditions because the system will automatically activate when icing conditions are present.

The petitioner is continuing to work on a design that will ultimately allow complete lifting of the AFM limitation for avoidance of ICI conditions. They requested that this petition for time-limited exemption apply to any such future design. However, the FAA cannot grant the request to apply this exemption to a future design configuration beyond the scope of VBV ice-protection system changes and AFM changes identified in the petition. If the petitioner plans design changes beyond these changes, they should re-petition identifying any further design changes and identify the impact these changes will have, if any, on meeting the conditions of the exemption.

The FAA agrees with the petitioner's statement of public interest for the reasons the petitioner cites.

The FAA's decision

In consideration of the foregoing, I find that a time-limited grant of exemption is in the public interest regarding 14 CFR 25.1305(c)(5) at Amendment 25-120. Therefore, pursuant to the authority contained in 49 U.S.C. 40113 and 44701, delegated to me by the Administrator, The Boeing Company is granted an exemption until August 15, 2015, from the requirements of § 25.1305(c)(5), as amended by Amendment 25-120, as it pertains to indication of an engine VBV anti-icing system for Boeing Model 787-8/-9 airplanes powered by General Electric GEnx-1B engines, or subsequent variants of the engine with the following conditions:

1. By June 30, 2015, Boeing must complete the design and show compliance to § 25.1305(c)(5), at Amendment 25-120, providing flight-deck annunciation of operation of the engine VBV ice-protection system. On or before August 15, 2015, Boeing must develop and submit for FAA approval service information to incorporate any design changes developed to meet the provision of § 25.1305(c)(5).
2. By January 1, 2015, Boeing must present to the FAA a comprehensive compliance plan and schedule, supporting the deliverables outlined in condition 1 (above). Thereafter, Boeing must submit a status report every three months to the FAA identifying all actions completed to date, as well as those that remain outstanding. The report must demonstrate Boeing's progressive performance and accomplishments indicating its projected success

in meeting the schedule and conditions of the exemption. Boeing must also submit drafts of the service information required by condition 1 (above) to the FAA July 15, 2015.

3. For Model 787-8/-9 airplanes granted a certificate of airworthiness based on this exemption and that do not have the design changes incorporated as identified by condition 1 (above), the "Airworthiness Limitation" section of the Model 787-8/-9 airplane "Instructions for Continued Airworthiness" must state that delivered airplanes cannot be operated after March 31, 2016, unless the design changes submitted in accordance with condition 1 (above) are incorporated by the owner or operator.
4. If an application for an airworthiness certificate is made on or after June 30, 2015, the affected airplanes must incorporate the indication of powerplant ice-protection system operation in compliance with § 25.1305(c)(5).
5. The FAA will not issue original airworthiness-certificate approvals for any Boeing Model 787-8/-9 airplane after June 30, 2015, unless that airplane has incorporated the design changes that Boeing has shown to be fully compliant with § 25.1305(c)(5) and the conditions of this exemption have been met.

Issued in Renton, Washington, on October 10, 2014.

/s/ Michael Kaszycki

Michael Kaszycki
Acting Manager, Transport Airplane Directorate
Aircraft Certification Service