Exemption No. 10902

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

In the matter of the petition of **Cessna Aircraft Company** for an exemption from § 25.901(c) of Title 14, Code of Federal Regulations	**Regulatory Docket No. FAA-2013-0534**

TIME-LIMITED GRANT OF EXEMPTION

By letter dated June 12, 2013, Mr. Brian Richardet, Manager, Airworthiness, Cessna Aircraft Company, P.O. Box 7704, Wichita, KS, 67277-7704, petitioned the Federal Aviation Administration (FAA), on behalf of Cessna Aircraft Company, for exemption from § 25.90l(c) of Title 14, Code of Federal Regulations (14 CFR). This exemption provides relief from the requirement that no single failure will jeopardize the safe operation of the Model 680 BPC airplane. The exemption requires Cessna to demonstrate that the overall level of safety of the Model 680 BPC engine-control system is not less than that of the current transport-category airplane fleet.

The petitioner requires relief from the following regulations:

> **Section 25.901(c) as amended by Amendments 25-1 through 25-46:**
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> (c) 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.

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-2013-0534.

Cessna Aircraft Company respectfully requests a time-limited partial exemption to 14 CFR 25.90l(c) for certain extremely remote powerplant failures that could affect only a very limited portion of the flight envelope of the Cessna Model 680 Block Point Change (BPC). Section 25.901(c) requires in part that "no single failure will jeopardize the safe operation of the airplane."

This partial exemption will require Cessna to demonstrate that the overall level of safety of the engine control system of Model 680 BPC will not be less than that of the current transport category aircraft fleet. For this purpose, Cessna will analyze the Uncontrollable High Engine Thrust (UHT) failure rate data of the Pratt & Whitney PW306 engine family and perform simulated flights and/or analysis per scenarios specified in FAA Issue Paper P-3 *Uncontrollable High Engine Thrust or Power*.

The exemption will be required for a period of 4 years after FAA issuance of the amended TC for the Model 680 BPC. During this period, Cessna and Pratt & Whitney will develop and make available improved FADEC software for the PW306D engine incorporating logic which will mitigate the effects of an UHT event in some scenarios identified in issue paper P-3. The improvement will be certified as a product improvement prior to the expiration of the time frame specified above and will be implemented in all new production aircraft manufactured after this date. Cessna also intends to make available for retrofit the improved UHT logic to previously fielded Model 680 BPC aircraft (S/N 501 and on).

The nature of this petition for partial exemption is similar to previously granted exemptions for the Airbus Models A340-500, A340-600, the Embraer models EMB-135BJ, EMB-145XR, the Boeing model 757-300 and 777s, and the Gulfstream models G280, G150, G-IV, GV and GV-SP.

Supportive Information:

A committee consisting of representatives from the FAA, the JAA, airplane manufacturers, and engine manufacturers was formed in 1998 to study strategies for providing additional protection from thrust control malfunctions resulting in uncommanded high thrust. The committee found that for the existing in-service airplanes, whose propulsion systems have demonstrated a level of reliability on the order of one uncommanded high thrust 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 uncommanded high thrust 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.

Full compliance with 14 CFR 25.901 (c) requires introduction of complicated and novel engine control system design changes that were not envisioned for the Model 680 BPC Program. It is recognized that UHT logic has been incorporated into engine control

systems of transport category aircraft over the past few years, demonstrating that such a feature can safely and reliably eliminate most of the causes of non-compliant UHT failure conditions. At this time, Cessna and Pratt & Whitney plan to develop and incorporate this feature in the Model 680 BPC aircraft engine control system, thus eliminating the subject non-compliance.

It should be noted that the Model 680 BPC is a derivative of the Model 680, which has maintained a high level of safety and reliability. The PW306D engine on the Model 680 BPC is a derivative of PW306C engine, and there have been no uncontrolled high thrust events reported for the PW306C engine fleet in 1.4 million engine operating hours. There has only been one suspected UHT event for the entire PW306 series. (See the attached Appendix A [available in the Federal Register at docket no. FAA-2013-0534] for an overview of the engine control system.) It is in the public interest to allow prompt certification and introduction of design improvements that enhance aircraft systems reliability and safety and have no direct bearing on the failure modes leading to un-commanded high thrust.

Furthermore, the failure conditions identified in issue paper P-3 for the Model 680 BPC (*Uncontrollable High Engine Thrust or Power*) are almost identical to the conditions defined in JAA CRI B-04 (*Uncontrolled Thrust Increase*) that was applied during the original certification of the Model 680. CRI B-04 did not include scenario b) Takeoff Abort Scenario #2 or the “additional considerations” identified under the FAA Position.

Cessna addressed all requirements of CRI B-04 which included a safety analysis validated by airplane performance and handling qualities assessments, human factors assessments, and flight simulations. The JAA accepted Cessna substantiation and showing of compliance with JAR 25.901 (c). The FAA concurred with the Cessna position on CRI B-04 and with findings of compliance with 14 CFR 25.901 (c).

The petitioner intends to demonstrate that those combinations of failures that could jeopardize safe operation comply with§ 25.90l(c) in that they are not “probable combinations.” Conversely, the petitioner does not always intend to demonstrate that those single failures which could jeopardize safe operation comply with § 25.901(c).

The conditions established by the FAA for granting this partial exemption, when applied to each proposed design change, are intended to take full advantage of each practicable opportunity for improvement while affording the petitioner all warranted flexibility to certificate non-compliant derivative designs.

Issue of Public Interest

A control system that might eliminate all failure modes of concern for the Cessna Model 680 BPC through the introduction of UHT logic would require modifications to the current engine control system. A redesign of previously-approved engine control system architecture would significantly impact the Cessna Model 680 BPC program.

Since this feature is still in development, requiring the Model 680 BPC to fully comply with this rule would prevent Cessna Aircraft Co. from certifying the aircraft on a timely and competitive schedule, putting it in an unfair disadvantage to competing domestic and foreign aircraft manufacturers. This could result in economic disadvantage to the company, its employees and communities who are dependent upon this commerce.

Additionally, Cessna Aircraft Co. is a highly reputable supplier of transport aircraft that serve vital commercial and governmental entities throughout the world. These operators depend on the improved technology in new Cessna models to effectively and safely meet the needs of national and international commerce, governance and charitable missions throughout the world.

Effect of the Exemption on Safety

As stated above, Cessna will demonstrate that the risks due to uncontrollable high thrust failure conditions on Model 680 BPC are consistent with those currently known and accepted for comparable existing transport category airplanes. This means that granting this partial exemption should not adversely affect the average per-flight- hour risk within the current transport airplane fleet.

Preliminary analysis shows that the conditions under which an uncontrollable high thrust failure may jeopardize the safe operation of the airplane are limited to specific aborted takeoff or landing scenarios, and then only when in combination with specific adverse operational and environmental conditions. Preliminary analysis also shows that incorporating UHT logic into the PW306D engine will further minimize the adverse effects and mitigate the hazard classification for these scenarios.

The probability of occurrence of uncontrollable high thrust failure condition on the Model 680 during the relevant flight phases was calculated to be 8.8 E-08, which is less than the known average industry value of one per ten-million airplane operating hours. While these scenarios may occur, there is still a low probability that any serious injury will develop. This limited exposure, in conjunction with the historically low occurrence rates, makes this a relatively low per-flight-hour risk. This assessment is supported by the fact that the 1997 Saudi Arabian Airlines Boeing 737-200 accident is the only one attributed to these types of failures and there were no serious injuries in that accident.

Cessna agrees to demonstrate that all practicable actions have been taken to minimize the adverse effect on safety associated with granting of the exemption from 14 CFR 25.901(c) for the Model 680 BPC aircraft.

Furthermore, the Model 680 BPC incorporates the following features to mitigate UHT:

- The Model 680 BPC aft fuselage mounted engine design (i.e. relative close proximity to A/C centerline) mitigates much of the adverse yaw condition generated during a single engine uncontrollable high thrust event.

- The PW306D engine has been redesigned with an outboard vectored thrust nozzle. This results in a smaller distance between the thrust line and the CG and, thus, a lower minimum control speed on the ground for the Model 680 BPC when compared to the legacy Model 680.

- The Model 680 BPC incorporates a Rudder Bias System which compensates for thrust asymmetry by rudder movement. This feature is automatically actuated when thrust asymmetry occurs and it augments the aircraft controllability when UHT is encountered.

- The PW306D engine control system incorporates an automatic engine shutdown feature, which provides automatic overspeed protection for both N1 and N2 overspeed events. See Appendix A for more details of the engine control system.

There have been no reports of UHT failure condition on the Model 680 or the PWC306C series engine, and service history available for the PWC306 series engine shows that the exposures and failure rates for the engine series are consistent with the known average per-flight-hour risks of comparable existing transport airplanes. Based on this statement, and in combination with the condition to minimize that risk, it can be concluded that granting this exemption should not adversely affect the average per-flight-hour risk within the current transport airplane fleet.

In support of this exemption and prior to customer delivery of any Model 680 BPC aircraft, Cessna will develop and obtain FAA approval of the instructions for continued airworthiness.

Waiver of Notice and Public Procedure

Cessna respectfully requests, and believes that good cause exists to justify, that action on this petition not be delayed by publication and comment procedures. Cessna feels this request is supported by the following reasons:

The petitioner’s request does not set a precedent, because the relief requested herein is very similar to exemptions granted previously.

A delay in acting on the petition caused by publication might have an adverse effect on the operator of the airplanes, who has made substantial plans for the introduction of the airplanes into his fleet.

Conclusion

Cessna believes that the above arguments favor an exemption from 14 CFR 25.901(c) for the aft fuselage mounted installation of the FADEC-controlled Pratt & Whitney PW306D engines onto the Cessna Model 680 BPC aircraft. Additionally, Cessna believes that any risks due to an Uncontrollable High Thrust failure condition on 680 BPC aircraft will not exceed those currently known and accepted for comparable existing transport category airplanes and that the exemption is in the public interest. Cessna requests that the privileges of this exemption apply outside the United States due to the transoceanic capability of the 680 BPC aircraft and the character of mission for many of our operators.

***Federal Register* publication**

A summary notice of the petition was published in the Federal Register on August 1, 2013 [78 FR 46672]. No comments were received.

The FAA's Analysis

Granting this exemption requires the petitioner to show, as required by § 11.81(d), that the request is in the public interest, and, as required by § 11.81(e), that the exemption will not adversely affect safety, or that a level of safety will be provided that is equal to that provided by the rules from which the exemption is sought.

In their petition, Cessna acknowledges that the Model 680 BPC type design currently proposed for certification will not fully comply with the "no single failure" provision of § 25.901(c) as it relates to certain uncontrollable high thrust (UHT) failure conditions. Following the investigation of a 1997 Saudi Arabian Airlines Boeing Model 737-200 airplane accident, it was recognized that this type of noncompliance had long been endemic in the state-of-the-art engine-control architectures of most transport-category airplanes. Furthermore, it was going to be very challenging to develop and validate safe, practical, compliant alternatives to that architecture. Since that time, most type-certification programs have included some sort of exemption for UHT failure conditions. However, one of the conditions for granting each of those exemptions has been that the applicant take all practicable actions to minimize the adverse effects on safety associated with granting the exemption.

In the process of evaluating the proposed Cessna Model 680 BPC airplane type design, the FAA recognized that Cessna had not taken all feasible actions to eliminate or further reduce the risks associated with this noncompliance. Specifically, thrust-malfunction-accommodation type logic was not incorporated. This logic identifies and safely accommodates any sustained, substantial discrepancy between the actual and commanded thrust, as sensed and validated by the engine control. Such thrust-malfunction-accommodation logic, incorporated into some recently approved airplane type designs, has proven itself to be practical and effective at eliminating most noncompliant UHT failures except for those associated with the airplane throttle system (e.g. stuck throttle, disagreement between actual throttle position and that input to the engine control, etc.).

The malfunctioning of something as critical as thrust-malfunction-accommodation logic could have a more adverse impact on safety than would its absence; the FAA considers it critical to safety to allow ample time for proper development and validation of this engine-control logic.

The petitioner will be required, by the conditions for granting this exemption, to demonstrate that the risks due to uncontrollable high-thrust failure conditions on any airplane certificated under this exemption will not exceed those currently known and accepted for comparable existing transport-category airplanes. Making this a condition of this exemption, in combination with the condition that all practical actions be taken to eliminate or further reduce that risk, means that granting this exemption should not adversely affect and, in fact, should improve the average per-flight-hour risk within the current transport-airplane fleet.

For those existing transport airplanes re-evaluated 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 occur, there is still a low probability that a serious injury will result. This limited exposure, in conjunction with the historically low occurrence rates, makes this a relatively low risk per flight hour.

The spectre of this low risk per flight hour accumulating indefinitely on many, if not most, existing and future transport airplanes, is the primary concern driving development of the FAA "Thrust Control Malfunction Airworthiness Program." To date, corrective actions under 14 CFR part 39 have been deemed warranted only when the uncorrected risks for a particular type design were considered significantly greater than those allowed by the conditions and limitations of this exemption. Given that these conditions and limitations require that any airplane certificated under this exemption have a UHT failure rate over three times better than the historical fleet average, the impact of adding these Cessna Model 680 BPC fleet hours to the overall transport fleet exposure should be insignificant.

This exemption allows a somewhat greater hazard than full compliance with § 25.901(c). Nevertheless, the fact that the per-flight-hour risks associated with this noncompliance are low allows the FAA to accomodate well-considered recovery programs like that being proposed by Cessna, helping to assure that the solution does not introduce a problem worse than the one the FAA is trying to solve. Cessna is commiting to implement thrust-malfunction-accommodation logic on all Cessna Model 680 BPC airplanes within 4 years of the date of granting this exemption. This should prevent any significant accumulation of risk on Cessna Model 680 BPC airplanes due to this granting.

The FAA's decision

In consideration of the foregoing, I find that a 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, Cessna Aircraft Company is granted an exemption from § 25.901(c) to the extent necessary to allow type certification of Cessna Model 680 BPC airplanes equipped with Pratt & Whitney PW306D engines, without an exact showing of compliance with the requirements of § 25.901(c) or other applicable regulations as they relate

to single failures resulting in uncontrollable high-thrust conditions. This exemption is subject to the following conditions and limitations:

1. Cessna must demonstrate, for the Model 680 BPC airplanes and in accordance with an FAA-approved "Airworthiness Assessment and Risk Management Plan," that all practicable actions have been taken to minimize the adverse effects on safety associated with granting this exemption. These must include, but are not limited to, practical actions to eliminate or further reduce the risks by improving designs, procedures, training, and Instructions for Continued Airworthiness (ICA).

2. Cessna must demonstrate, in accordance with an FAA-approved "Airworthiness Assessment and Risk Management Plan," that the risks associated with exempting the uncontrollable high-thrust failure condition from the single-failure provisions of § 25.901(c) are no greater for the proposed Model 680 BPC airplanes equipped with Pratt & Whitney PW306D engines than are those risks currently known and accepted for comparable airplanes within the current transport fleet. Acceptable risk for this provision can be characterized as:

    a. The airplane complies with § 25.901(c) for any foreseeable, uncontrollable high-thrust failure conditions in flight, except possibly during approach at low altitude, and for a short duration on the ground during takeoff; and

    b. The expected frequency of occurrence of the uncontrollable high-thrust failure condition is less than once per 10 million airplane operating hours.

3. The following "Note" will be added to the airplane Type Certification Data Sheet for any airplane certificated under this exemption:

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

    In support of this "Note," Cessna must develop and obtain, prior to customer delivery, FAA approval of the Cessna document referenced in the note. This document lists those failures that can contribute to or cause an uncontrollable high-thrust failure condition covered by this exemption. This document will then be made available as part of the ICA. Further, the failures listed within this document will be added to the list of reportables under 14 CFR 21.3 for any airplane certificated under this exemption.

4. No later than 4 years from the date of this granting, Cessna must:

    a. obtain FAA approval of a type design eliminating all noncompliant, uncontrollable high-thrust failure conditions; and

b. show that all new Model 680 BPC production airplanes are equipped with the amended type designs approved to satisfy condition 4a or any subsequently approved thrust-malfunction-accommodation logic.

5. No later than 6 months from the date of this granting, Cessna must obtain FAA approval on a plan and schedule for complying with condition 4.

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

Issued in Renton, Washington, on November 29, 2013.

/s/ Jeffrey E. Duven

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