Exemption No. 8622

UNITED STATES OF AMERICA
DEPARTMENT OF TRANSPORTATION
FEDERAL AVIATION ADMINISTRATION
RENTON, WASHINGTON 98055-4056

In the matter of the petition of **GULFSTREAM AEROSPACE LP (GALP)** for an exemption from § 25.901(c) of Title 14, Code of Federal Regulations	**Regulatory Docket No. FAA-2005-22150**

PARTIAL GRANT OF EXEMPTION

By letter dated August 7, 2005, Mr. Baruch Marom, Airworthiness Manager, Gulfstream Aerospace LP (GALP), c/o IAI Dept. 4199, Ben Gurion International Airport 70100, Israel, petitioned for an exemption from the "no single failure criteria" of § 25.901(c) of Title 14, Code of Federal Regulations (14 CFR) as it relates to "uncontrollable high thrust failure conditions." Recent studies and service experience indicate that some existing transport category airplanes do not strictly comply with § 25.901(c) for certain uncontrollable high thrust failure conditions. The proposed, if granted, would permit type certification of the Gulfstream Model G150 airplane.

The petitioner requires relief from the following regulation:

> **Section 25.901(c)** requires, in part, that "no single failure will jeopardize the safe operation of the airplane."

ANM-05-481-E

The petitioner's supportive information is as follows:

In 1998 a committee consisting of representatives from the FAA, the Joint Aviation Authorities (JAA), airplane manufacturers, and engine manufacturers was formed 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 un-commanded 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 un-commanded 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.

The GALP Model G150 is a derivative of the Model G100. The Model G100 has maintained a high level of safety and reliability. 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. Full compliance with 14 CFR 25.901(c) would require costly, complicated, and novel design changes to the G150 Program. Mandating such compliance whenever an incremental change is made to a presently certified type design would discourage voluntary changes intended to improve the reliability and safety of the fleet. Therefore, it is in the public interest for the FAA to grant a partial exemption to 14 CFR 25.901(c), as described above.

The petitioner intends to demonstrate that those combinations of failures that could jeopardize safe operation comply with § 25.901(c) in that they are not "probable combinations [1]." Conversely, the petitioner does not always intend to demonstrate that those single failures, which could jeopardize safe operation, comply with § 25.901(c). Compliance with § 25.901(c) requires each identified single failure be assumed to occur under all anticipated combinations of airplane operating and environmental conditions. While the single failures themselves must be assumed to occur regardless of their probability[2], probability can be considered when determining what combinations of operating and environmental conditions are anticipated to occur in the fleet life of the airplane type. Single failures do not need to be assumed to occur under conditions that are in and of themselves not expected to occur.

The engine control system for the GALP Model G150 is a digital electronic engine control (DEEC) based system. Future design changes to this control system should provide opportunities to significantly reduce or even eliminate the subject non-compliance. 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 noncompliant derivative designs.

Federal Register Publication

The FAA has determined that good cause exists for waiving the requirement for Federal Register publication because the partial exemption, if granted, would not set a precedent. Any delay in acting on this petition would be detrimental to Gulfstream Aerospace LP.

The FAA's analysis/summary is as follows:

Background

Uncontrollable High Thrust Failure Conditions

Numerous single and anticipated combinations of failures within traditional turbojet engine control systems result in losing the normal means to control thrust (i.e., control via the throttle lever, autothrottle, etc.). A subset of the resulting failure conditions may include actual thrust either increasing to higher than commanded and/or remaining high when low thrust is commanded. These "Uncontrollable High Thrust Failure Conditions" and the hazards they pose have long been inherent in transport airplane designs. In fact, the "fail-safe" states for engine controls have traditionally been chosen to protect high thrust capability and allow the flightcrew to decide when an engine shutdown is appropriate.

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1. The term "probable," as used in § 25.901(c) has a very different meaning than the same term as subsequently used in association with § 25.1309(b) compliance. As used in §25.901(c), "probable" means "foreseeable". In §25.1309(b) terms, this means the subject failure conditions are "anticipated to occur" (i.e. aren't "extremely improbable").

2. While probability has been an acceptable means of supporting a finding that a particular "combination" of failures are not "probable", any single failure where the physics of the failure can be identified is typically "anticipated to occur" unless that occurrence within the relevant exposure can be clearly and acceptably ruled out, as is the case for those structural failures specifically excepted by the rule itself.

An initial estimate indicates that over the last 20 years, the average rate of occurrence for the uncontrollable high thrust failure condition on turbofan-powered large transport category airplanes has remained relatively constant at around one every 2.5 million flight hours. This would indicate that to date an "Uncontrollable High Thrust Failure Condition" has occurred hundreds of times without resulting in a single reported serious injury.

When these failure conditions were identified during past certifications, compliance was typically based on accepting an assertion that the flightcrew will recognize and safely accommodate the loss of the normal means to control engine thrust, including shutting down the affected engine via an independent fuel shutoff as required. However, recent engineering studies and service experience, including a 1997 Saudi Arabian Airlines Boeing 737-200 accident, indicate that this traditionally accepted assertion is not always valid. For those airplanes re-evaluated to date, the FAA has determined that the available failure recognition and accommodation time under certain anticipated operating conditions is so short and the required corrective actions sufficiently unnatural that the flightcrew cannot be relied upon to reliably and completely perform those actions before the safe operation of the airplane is jeopardized.

The FAA is responding to the full scope of this determination by developing a "Thrust Control Malfunction Airworthiness Program" to consistently and objectively assess and manage the existing and future transport airplane fleet risks associated with this non-compliance and potential for unsafe conditions. The ultimate goal of this program will be to bring the transport airplane fleet into compliance as quickly as practicable. The interim goal of this program will be to manage the risk associated with each instance of non-compliance so that it does not represent an unsafe condition.

In the interim, for type certification the FAA has begun requesting more effective validation of any assertion that the flightcrew will recognize and safely accommodate the loss of the normal means to control engine thrust. Until practicable design solutions can be identified, validated, and safely integrated into turbine engine control system type designs, it is clearly in the public interest to continue to certificate type design improvements, even if they don't strictly comply with the reference standard.

Gulfstream Model G150

The petitioner intends to demonstrate that those combinations of failures that could jeopardize safe operation comply with § 25.901(c) in that they are not "probable combinations.[3]" Conversely, the petitioner does not always intend to demonstrate that those single failures which could jeopardize safe operation comply with § 25.901(c).

Compliance with § 25.901(c) requires that each identified single failure be assumed to occur under all anticipated combinations of airplane operating and environmental conditions. While the single failures themselves must be assumed to occur regardless of their probability[4], probability can be considered when determining what combinations of operating and environmental conditions are anticipated to occur in the fleet life of the airplane type. Single failures do not need to be assumed to occur under conditions that are in and of themselves not expected to occur.

In order to certificate the GALP G150 airplane, the petitioner must either obtain this exemption or substantially modify the type design before any derivative designs, including obvious product improvements, can be approved. As delineated in the petitioner's supporting information, the petitioner contends that having the exemption available as a certification option when design changes don't increase the risks associated with the subject non-compliance is in the best interest of the public.

The engine control system on the Honeywell TFE731-40AR engine for the GALP G150 is a single channel digital electronic engine control (DEEC) based system with a back-up hydromechanical control mode, and, as such, future design changes to this control system should provide opportunities to significantly reduce or even eliminate the subject non-compliance.

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3. The term "probable," as used in § 25.901(c) has a very different meaning from the same term as subsequently used in association with § 25.1309(b) compliance. As used in §25.901(c), "probable" means "foreseeable." In §25.1309(b) terms, this means the subject failure conditions are "anticipated to occur" (i.e., are not "extremely improbable").

4. While probability has been an acceptable means of supporting a finding that a particular "combination" of failures is not "probable," any single failure where the physics of the failure can be identified is typically "anticipated to occur," unless that occurrence within the relevant exposure can be clearly and acceptably ruled out, as is the case for those structural failures specifically excepted by the rule itself.

The conditions established by the FAA for granting this 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.

Introduction

To obtain this exemption, the petitioner must show, as required by § 11.81(d), that granting 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.

Effect on Safety

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 to minimize 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 an uncontrollable high thrust 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 any serious injury will result. 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.

It is the spectre of this low per flight hour risk accumulating indefinitely on many, if not most, existing and future transport airplanes that 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 required by the conditions and limitations of this exemption. Given that these conditions and limitations require that any airplane certificated under this exemption be expected to have an uncontrollable high thrust failure rate over three times better than the current fleet average, the impact of adding these GALP Model G150 fleet hours to the overall transport fleet exposure should be insignificant. Furthermore, if as part of the "Thrust Control Malfunction Airworthiness Program," the FAA determines that

additional generally applicable precautions must be taken, including perhaps some future introduction of a compliant design, these will further minimize any cumulative risk impact of granting this exemption.

This exemption allows a somewhat greater hazard than full compliance with § 25.901(c). This is why the FAA intends to bring the transport fleet into full compliance as soon as practicable. Nevertheless, the fact that the per flight hour risks associated with this non-compliance are low allows us to develop a well considered recovery program to assure that we don't introduce a problem which is worse than the one we are trying to solve and that this recovery program is clearly in the public interest.

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

Public Interest

If the FAA were to deny this petition, that would have the effect of preventing certain product improvements from being voluntarily proposed. The petitioner will be required by the conditions for granting this exemption to demonstrate that all practicable actions have been taken to minimize the adverse effect on safety associated with granting this exemption from § 25.901(c) for each applicable design change. This condition assures that granting the exemption will be in the public interest. That is, any risks associated with a known non-compliance must be eliminated or further reduced wherever the FAA finds that to do so is technologically feasible and cost beneficial for the public. This has traditionally been accepted as the level of safety, which is "in the public interest." Furthermore, if bringing the airplane into compliance is found to be a "practicable action," then this exemption would in effect be self-eliminating.

The FAA's decision

In consideration of the foregoing, I find that a partial 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, Gulfstream Aerospace LP (GALP) is granted an exemption from § 25.901(c) to the extent necessary to allow type certification of the GALP Model G150 type design 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. GALP must demonstrate, 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 petition. 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.

2. GALP 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 GALP Model G150 type design than those currently known and accepted for comparable existing transport category airplanes. 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 aborted takeoff or approach and landing below 100 feet; and

   b. The expected frequency of occurrence of the uncontrollable high thrust failure condition is less than once per ten 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 the FAA-approved 'Airworthiness Assessment and Risk Management Plan,' may endanger the safe operation of an airplane. Consequently, the FAA recommends that operators be encouraged to report instances of uncommanded high thrust in accordance with §§ 121.703 (c), 125.409 (c), and 135.415(c)."

   This exemption includes a requirement to develop an 'Airworthiness Assessment and Risk Management Plan' concerning uncommanded high thrust. The document must list failures that may cause uncommanded high thrust. This document is required by the exemption to be included in the Instructions for Continued Airworthiness for the applicable airplane and must be made available by the type certificate holder to operators of airplanes that have this exemption. Further, the failures listed within the FAA-approved 'Airworthiness Assessment and Risk Management Plan' must be added to the list of reportables under § 21.3 for any airplane certificated under this exemption."

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.

Note: Additional background and guidance regarding these provisions are provided in FAA Letter 02-112-02, dated October 19, 2001.

Issued in Renton Washington on October 13, 2005.

Signed by Kalene C. Yanamura
Kalene C. Yanamura
Acting Manager
Transport Airplane Directorate
Aircraft Certification Service