

Exemption No. 10175

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

In the matter of the petition of

Bombardier Aerospace

for an exemption from § 25.981(a)(3) of Title
14, Code of Federal Regulations

Regulatory Docket No. FAA-2010-0287

GRANT OF EXEMPTION

By letter dated February 25, 2010, and additional information dated May 14, 2010, Mr. C. Nham, Senior Project Manager, Fixed Wing Large Transport Aircraft, National Aircraft Certification, Civil Aviation, Transport Canada, Aircraft Certification Branch (AARDE), 3rd Floor, Tower C, Place De Ville, 300 Sparks Street, Ottawa, Ontario, Canada K1A 0N8, petitioned the FAA, on behalf of Bombardier Aerospace, for a partial exemption from the requirements of § 25.981(a)(3) of Title 14, Code of Federal Regulations (14 CFR). This exemption, if granted, would permit relief from the fault tolerance fuel tank ignition prevention requirements for its Model CL-600-2E 25 (CRJ 1000) series airplanes allowing them to (1) demonstrate that the structural design provides two independent, effective and reliable means of lightning strike protection, and (2) demonstrate compliance with this requirement by 24 months after type certification of the airplane.

The petitioner requests relief from the following regulation:

Section 25.981(a)(3) as amended by Amendment 25-102:

(a) No ignition source may be present at each point in the fuel tank or fuel tank system where catastrophic failure could occur due to ignition of fuel or vapors. This must be shown by:

(3) Demonstrating that an ignition source could not result from each single failure, from each single failure in combination with each latent failure condition not shown to be

extremely remote, and from all combinations of failures not shown to be extremely improbable. The effects of manufacturing variability, aging, wear, corrosion, and likely damage must be considered.

The petitioner supports its request with the following information:

This section quotes, in part, the relevant information from the petitioner's documentation. The complete documentation is available at the Department of Transportation's Federal Docket Management System, on the Internet at <http://regulations.gov>, in Docket No. FAA-2010-0287.

As explained in FAA policy memo ANM-112-08-002, before amendment 25-102, the concept of lightning protection of the fuel tanks was normally applied in preventing ignition of vapors in the tank area. There was no consideration of design failures, aging, wear or maintenance induced errors to the fuel tank structure. As a result, the FAA policy now specifies that compliance with 14 CFR Part 25.981(a)(3) would typically require a design with three highly reliable, independent and redundant protective features to prevent ignition in the event of a lightning strike. The structural elements of the wing tank design of the Bombardier Aerospace (BA) CL-600-2E25 (CRJ1000) do not comply with this requirement.

It was noted in the policy memo that the FAA determined that in certain cases it was in the public interest to grant an exemption for structural related elements provided that certain conditions are met ensuring an acceptable level of safety. In view of this allowance, BA is applying for a two-part exemption for the structural elements of the fuel tank design. Firstly, to demonstrate that the design complies with the requirement even with only two independent, effective and reliable means of lightning strike protection. Secondly, that the demonstration of compliance to this requirement be made after type certification of the CRJ1000.

BA has implemented a compliance plan to meet the requirements of the FAA policy in support of this exemption application, however, it has been concluded that the analyses/assessments, compilation and documentation of the substantiating data cannot be completed in time for CRJ1000 type certification on the basis that some of the test data required to show compliance would not be available prior to this date. A schedule has been included as part of this compliance plan outlining the milestones towards the completion of this deliverable by the middle of September 2012.

Fuel tank ignition prevention is ensured through low fuel tank flammability exposure and the preclusion of ignition sources within the tank. The prevention of ignition sources is substantiated by analysis of all potential ignition sources, using the guidance of AC 25.981-1B (noting that this AC did not address the "structural lightning" aspects) and the development of airworthiness limitations, both fuel system mandatory inspections and by defining critical design configuration control limitations (CDCCLs). As added safety justification, design changes required to show compliance with SCA H2002-03 have been

accomplished. All the resulting mandatory modifications are included as an integral part of the CRJ1000 type design. Low fuel tank flammability exposure has been demonstrated for FAR 26.33 compliance as per FAA guidance AC 25.981-2A and Part 25, Appendix N.

BA considers the design of the CRJ1000 wing a safe design, with good service history and meets authority expectations for an aluminum wing design. BA believes granting this exemption has no impact on safety.

Federal Register Publication

A summary of the petition was published in the *Federal Register* on September 20, 2010 (75 FR 57328). No comments were received.

The FAA's analysis

In May 2001, the FAA issued the "Transport Airplane Fuel Tank System Design Review, Flammability Reduction, and Maintenance & Inspection Requirements" final rule (Docket FAA-1999-6411, effective June 6, 2001) that was adopted as Amendment 25-102. This amendment added specific ignition prevention requirements and a new flammability minimization requirement to § 25.981.

The amended ignition prevention requirements in § 25.981(a)(3) require consideration of factors such as aging, wear, and maintenance errors as well as the existence of single failures, combinations of failures, and latent failures that may be the cause of ignition sources in fuel tanks.

Section 25.981, as amended by Amendment 25-102, requires that airplane designs be protected from the effects of structural lightning with features that are failure tolerant. Prior to this amendment, only § 25.954 had been applied to lightning protection of fuel tanks. That provision requires only that the airplane design prevents ignition of vapors in the tank with no consideration for anticipated design failures, aging, and wear, or maintenance errors.

Systems with potentially catastrophic failure modes would typically meet the requirements of § 25.981(a)(3) by providing at least triple redundancy in their protective features with periodic inspections, or dual redundant features with continuous system monitoring to reduce the latency period. Dual redundant design schemes could only comply with § 25.981(a)(3) when combined with either regular inspections at very short intervals or a monitoring device to verify the functionality of the protective features. Inspection of the various design features may be difficult or impossible if the feature is internal to the fuel tank and part of the wing structure.

When § 25.981 was applied to the structural lightning aspects of new airplane designs, applicants found it was impractical to meet the standard and incorporate additional protective features. We

issued two exemptions and developed new policy. The two exemptions were for the Dassault Falcon 7X, signed on April 20, 2007, and the other was for the Hawker 4000, signed on August 28, 2008. On May 26, 2009, following a public-comment period, we adopted new policy that defined criteria that we would consider regarding granting of exemptions and issuance of special conditions for structural lightning protection.

As discussed in the preamble to Amendment 25-102, conventional, unheated, aluminum wing tanks minimize fuel tank flammability exposure, as required by § 25.981(c). Even if a latent failure of a protective feature occurred for such a tank, the risk of lightning induced fuel tank explosions is relatively low when the tank is fueled with low volatility fuels such as Jet A, as demonstrated by the service experience of these tanks. Because of the impracticality of full compliance with § 25.981(a)(3) for lightning protection and the reduced flammability exposure of these tanks, we believe granting an exemption is in the public interest if applicants can show that their design provides practical dual protective features for fuel-tank structural lightning protection that are both independent and robust, and show the probability of fuel tank ignition to be extremely improbable for any non-fault-tolerant features.

Bombardier provided initial data in support of their exemption request that shows, pending the results of testing and additional analysis, their design should meet the criteria of the FAA policy. Bombardier's request for an exemption states they will demonstrate that the structural design provides two independent, effective and reliable means of lightning strike protection. Such fault tolerant features may be practical for fasteners. However, similar designs have included single failures of structure that could result in a fuel tank ignition source during certain lightning strike events. As stated above, FAA policy allows for accepting single failures when certain criteria in the policy memo have been met. This includes demonstrating the probability of fuel tank ignition to be extremely improbable for any such non-fault-tolerant features. We anticipate after further analysis Bombardier may identify such single failures in the design of the CL-600-2E25 (CRJ 1000). If single failures exist in the design, Bombardier would need to modify their exemption request to expand the scope to include single failures as provided for in this policy and summarized below:

Fault tolerance is not required for any specific design feature if:

- a. providing fault tolerance is shown to be impractical for that feature, and
- b. fuel tank vapor ignition because of that feature and all other non-fault-tolerant features, when their fuel tank vapor ignition event probabilities are summed, is shown to be extremely improbable.

On November 2, 2010, Transport Canada Civil Aviation (TCCA) issued an exemption allowing Bombardier, until October 29, 2012, to complete the necessary certification testing, mitigation, analysis and documentation to show the CL-600-2E25 (CRJ 1000) complies with the TCCA certification requirements for structural lightning protection under AWM 525.981(a)(3). That same data will be used to show the CL-600-2E25 (CRJ 1000) does meet the FAA structural lightning policy.

The CL-600-2E25 (CRJ 1000) airplane type certification program is near completion. Without this exemption, Bombardier would not receive FAA design approval for the aircraft in a timely manner, putting it at an unfair disadvantage with its competitors. This could also cause disruption to several major corporations in the world that are anticipating the imminent delivery of the CL-600-2E25 (CRJ 1000) airplane to meet their business needs. These Bombardier customers may need to find alternatives for their aviation needs if this exemption is not granted. We further note that Bombardier has indicated that no U.S. operators have placed orders for the CL-600-2E25 (CRJ 1000) airplane.

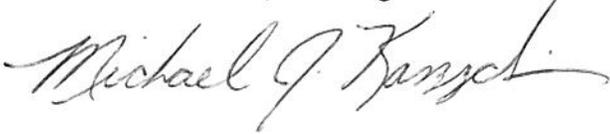
The FAA's Decision

In consideration of the foregoing, I find that a 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, Bombardier is hereby granted an exemption from the requirements of 14 CFR § 25.981(a)(3) as it relates Model CL-600-2E25 (CRJ 1000) series airplane fuel-tank structural lightning protection with the following provisions:

1. Instead of compliance with the requirements of § 25.981(a)(3), Bombardier must show that the design includes at least two independent, effective, and reliable lightning protection features (or sets of features) such that fault tolerance to prevent lightning-related ignition sources is provided for each area of the structural design that they have shown and FAA has determined to be impractical for full compliance.
 - a. Bombardier must identify all features that meet this two-layer protection provision and all features that do not include two-layers..
 - b. If any features do not meet this two-layer protection provision, Bombardier must petition to expand this exemption to include the non-fault tolerant provision described in FAA Policy Memorandum ANM-112-08-002, *Policy on Issuance of Special Conditions and Exemptions Related to Lightning Protection of Fuel Tank Structure*, dated May 26, 2009.
2. Bombardier must perform an analysis to show that the design, manufacturing processes, and airworthiness limitations section of the instructions for continued airworthiness include all practical measures to prevent, and detect and correct, failures of structural lightning protection features because of manufacturing variability, aging, wear, corrosion, and likely damage.

3. Bombardier must demonstrate compliance with provisions 1 and 2 of this exemption within 24 months after type certification of the airplane.
4. If Bombardier is unable to demonstrate compliance with provisions 1 and 2 of this exemption within 24 months after type certification of the airplane, the FAA will not issue further airworthiness certificates until Bombardier shows that the conditions are met.

Issued in Renton, Washington, on DEC 14 2010

A handwritten signature in cursive script, reading "Michael J. Kaszycki".

Michael J. Kaszycki
Acting Manager, Transport Airplane Directorate
Aircraft Certification Service