Air Transport Association

DEPT. OF TRANSPORTATION
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Ref: 99nm18

March 27,200

U.S. Department of Transportation Dockets,
Docket No. FAA- 1999-64 11,
400 Seventh Street, SW.,
Room Plaza 401,
Washington, DC 20590.

Ladies and Gentlemen:

Subject: Fuel Tank System Design Review, Flammability Reduction, and Maintenance and Inspection Requirements. - Notice of Proposed Rulemaking

FAA has issued an Notice of Proposed Rulemaking [NPRM] which if adopted, would require manufacturers of specified transport category airplanes, to submit substantiation to the FAA that the current designs of the fuel tank systems on existing airplanes precludes the existence of ignition sources within the airplane fuel tanks. It would also require the affected manufacturers to develop specific fuel tank system maintenance and inspection instructions for any items in the fuel tank system that are determined to require repetitive inspections or maintenance, to assure the safety of the fuel tank system. In addition, the proposed rule would require operators of these specified airplanes to incorporate FAA approved fuel tank system maintenance and inspection instructions into their current maintenance or inspection programs. The rule also contains enhanced requirements for future design of fuel tank systems to minimize development of flammable vapors in tanks or to mitigate the hazard of such vapors.

The attached document is submitted in response to the FAA's request for comments on the NPRM. The document represents the consolidated comments of the worldwide aviation industry as represented by:

ATA [Air Transport Association of America]
AEA [Association of European Airlines]
AAPA [Association of Asia Pacific Airlines]
AECMA [Association of European Airplane Manufacturers]
AIA [Aerospace Industries Association]

This single document is submitted as an indication of the industry's solidarity regarding the proposals in the NPRM. As such, we request that the FAA treat the document as a response from each and every member of the associations noted above,

We thank you for the opportunity to provide information on this very important aviation safety issue.

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Singapore Airlines
Thai Airways International

Aerospace Industries Association

AAI Corporation
The Aerostructure Corporation
Alliant Techsystems Inc.
American Pacific Corporation
Analytical Graphics Inc.
Argo-Tech Corporation
B.H.Aircraft Company, Inc.
BAE SYSTEMS North America Inc.
Barnes Aerospace
The Boeing Company
Cordant Technologies, Inc.
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The European Association of Aerospace Industries

AECMA

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BAE SYSTEMS Regional Aircraft
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CASA
DaimlerChrysler Aerospace **Airbus**
Dassault Aviation
Fairchild **Dornier**
Fokker Services
MTU
Rolls-Royce
Rolls Royce **Deutschland**
SNECMA
Saab
and consolidated with
AAI **(Austrian** Aeronautics Industries group)
GEBECOMA (Belgian Aerospace Industries **Association)**
AAM CR (Association of **the** Aviation **Manufacturers** of the Czech Republic)
FDAI **(Foreningen** for **Dansk** Aerospace **Industri)**
FAI **(Finnish** Aerospace Industries)
GIFAS (Groupement des Industries **Françaises Aéronautiques** et **Spatiales)**
HAIG (Hellenic Aerospace Industries Group)
BDLI (Bundesverband der **Deutschen** Lug- **und Raumfahrtindustrie)**
FAEI (Federation of Aerospace Enterprises in Ireland)
AIAD **(Associazione** Industrie per **l'Aerospazio** i **Sistemi e** la **Difesa)**
LAI (Luxembourg Aerospace Industries)
NAI (Netherlands Aerospace Industries)
ADAP (Associação do Desenvolvimento **Aeronáutico** de Portugal)
ATECMA **(Agrupación Tecnica Española de Constructores** de **Material Aerospacial)**
SAI **(Swedish** Aerospace Industries)
SBAC (Society of British Aerospace Companies)

Also

Bombardier Aerospace

Aviation Industry Response
to
FAA NPRM 99-18

Transport Airplane Fuel Tank System Design Review,
Flammability Reduction, and
Maintenance and Inspection Requirements

March 27, 2000

Executive Summary

Industry Comments to NPRM 99-18

Overview

On October 29, 1999, the Federal Aviation Administration (FAA) issued Notice of Proposed Rulemaking (NPRM) 99-l 8, titled *Transport Airplane Fuel Tank System Design Review, Flammability Reduction, and Maintenance and Inspection Requirements.*

Included in this proposed rulemaking is a *special federal aviation regulation* (SFAR) requiring the design-approval holders of certain turbine-powered transport-category airplanes to submit substantiation to the FAA that the design of the fuel tank systems of previously certificated airplanes precludes the existence of ignition sources within the airplane fuel tanks. This SFAR would also require the affected design-approval holders to develop specific fuel tank system maintenance-and-inspection instructions for any items in the airplane fuel tank system that are determined to require repetitive inspections or maintenance to ensure the safety of the fuel tank system. In addition, the SFAR would require certain operators of those airplanes to incorporate FAA-approved fuel tank system maintenance-and-inspection instructions into their current maintenance or inspection program.

NPRM 99-l 8 also proposes three amendments to the airworthiness standards for transport-category airplanes. The first would define new requirements, based on existing requirements, for demonstrating that ignition sources could not be present in fuel tanks when failure conditionsare considered. The second would require future applicants for type certification to identify any safety-critical maintenance actions and develop limitations to be placed in the Instructions for Continued Airworthiness (ICA) for the fuel tank system. The third would require means to minimize development of flammable vapors in fuel tanks, or means to prevent catastrophic damage if ignition does occur.

This document presents the combined comments of aviation manufacturers and operators worldwide to NPRM 99- 18.

Safety record

Air travel far surpasses any other transportation mode in terms of safety. At present, the accident rate in the United States is approximately one jetliner hull loss per 2 million departures. Accidents involving fuel tank explosions are extremely rare events that account for a very small number of these hull-loss accidents.

Safety record (cont'd)

Over the past four years, extensive efforts have been initiated to further enhance the excellent safety record of jet transport fuel systems, including worldwide inspection programs of the fuel systems of essentially all types of airplanes affected by this proposed rulemaking. These efforts have resulted in enhancements to the design and installation of fuel system wiring and fuel pumps. Concentrated efforts are continuing in fuel system safety.

Industry comments

The industry (airplane manufacturers and operators) is committed to aviation safety and agrees *in principle* with the proposed FAA rulemaking. Drawing from our collective expertise and experience around the world, the industry has developed and offers in this document comments intended to make the proposed rulemaking more effective and practical. Specific comments to the NPRM are summarized below and discussed at length within this document.

Harmonization

The industry believes that rather than implement this rulemaking unilaterally, the FAA should pursue harmonization with other nations' aviation regulatory authorities. This would simplify operations, reduce the cost of compliance without compromising safety, and extend the latest safety benefits more broadly in the world fleet.

Design review

The FAA is essentially proposing to recertify the fuel systems of all previously certified commercial turbine-powered transports of the past 40 years to new certification standards with respect to avoidance of fuel tank fires and explo-sions. The industry believes that this approach is unnecessarily excessive and could potentially create an insurmountable task burden. While more than 450 million hours of service experience have indeed identified valuable lessons learned, this same service experience also demonstrates the largely successful outcome of the previously certified design practices.

The industry proposes a more practical and efficient means of accomplishing this design review that would be equally effective in enhancing fuel system safety. This alternative method is to apply experience and knowledge gained through service history as well as the special inspection program of the industry's Fuel Systems Safety Program, complemented by analytical means where necessary (e.g., performance of system-level FTAs). This alternative approach would be implemented in the form of a prescriptive-type rule (i.e., one that defines and prescribes actions to be taken).

The industry believes deriving design and maintenance enhancements from information gained from service experience with airplanes of all type designs,

Design review (cont'd)

in all types of service, will yield more effective safety enhancements. This approach also allows safety enhancements to be introduced sooner because the method proposed by the industry builds on current efforts and activity rather than on initiating new ones. Another benefit of this alternative approach is that it uses a broader pool of resources to accomplish the task, allowing fuel system specialists to be utilized more effectively.

Simply stated, the industry's approach of using real-world data, supported by analysis as required, would provide effective enhancements sooner and at less cost than the analytical design reviews proposed by the FAA in NPRM 99- 18.

Ignition risk

The NPRM states that, "*no* ignition source may be present." The industry accepts the intent of this statement within the context of ensuring that any residual ignition risk is satisfactorily reduced within the probability of certainty as is commonly applied to fail-safe design (FAR 25.1309).

The NPRM addresses latent failures for fuel systems in a more conservative manner than other flight-critical systems of an airplane. Based on a relative assessment to other systems, the industry believes that this approach is not warranted. We instead recommend that the FAA apply FAR 25.1309 to the certification of new fuel system designs rather than create a unique new rule.

Flammability reduction

The NPRM proposes that newly certified fuel tank installations must include a means to minimize the development of flammable vapors in fuel tanks. There is currently not an agreed-to, definitive industry standard for assessing flammability of aircraft fuel tanks. Thus, the industry proposes that a rule based on flammability be delayed until such time as a standard is defined. In its place, the industry recommends a more meaningful rule that would accomplish some degree of flammability reduction even though a definitive flammability standard does not exist. The industry suggests the current proposed rule be redefined to require *practical* measures to reduce heat transfer from adjacent heat sources into fuel tanks.

Maintenance and inspection requirements

The industry agrees with the FAA that maintenance of the fuel tank systems of the world fleet can be improved. The industry strongly recommends existing processes, such as the Certification Maintenance Coordination Committee (CMCC), be utilized for the development of enhanced scheduled maintenance tasks and inspections. Finally, the industry recommends the FAA avail itself of activities currently ongoing within the industry, notably the work of the

Maintenance and inspection requirements (cont'd)

ATSRAC Task 3 Subcommittee and the ATA working group that is updating Maintenance Steering Group 3 (MSG-3) guidelines.

The proposed method for establishing critical design configuration control limitations needs to be revised. As written, it places design holders at risk of having their proprietary design features made public to compensate for inadequacies in the current procedures for design modification approval. Additionally, the proposed rule potentially makes the original equipment manufacturer (OEM) liable for changes made to the aircraft, even when the OEM is not involved in the change.

Compliance time

The industry strongly disagrees with the compliance time proposed by the FAA in this NPRM. The SFAR proposes a total of 12 months to conduct the required design reviews, develop all corrective design changes, and develop or modify maintenance and inspection programs for fuel systems *essentially for all commercial turbine-powered airplanes built since* 1958. This includes all models, all derivatives of models, all options and combinations of options available, as well as all supplemental type certifications (STC).

In light of the massive scope of this SFAR, the proposed time frame is simply unrealistic. If the SFAR were adopted in its current form, the industry would recommend a minimum compliance time of 54 months. If the industry recommendations contained within this commentary were adopted, the SFAR compliance time could be reduced to 36 months. By comparison, the FAA required 22 months to release NPRM 99-l 8 after the commitment was made to do so in December of 1997.

The NPRM also requires operators to implement a maintenance program 18 months after the effective date of the rule. Operator compliance time should begin after the FAA has approved the OEMs' maintenance and inspection program.

Development and implementation of specific design changes deriving from the SFAR design review should be accomplished outside the scope of SFAR compliance and administered using existing airworthiness directive (AD) processes. This approach offers the benefit of allowing the industry and the FAA to mutually develop and agree on prioritization of the associated work.

Cost

Based on its review of the rulemaking as proposed by the FAA, the industry is concerned that the true cost of these proposed rules may have been grossly underestimated. Given the complexity of NPRM 99- 18, the industry has not attempted to conduct a detailed cost analysis. However, aspects of the FAA's cost analysis have been identified that may be inaccurate because of erroneous or incomplete assumptions. Therefore, the industry recommends that the FAA reevaluate its cost estimate to take into account the observations made within this commentary.

Conclusion

The industry urges the FAA to consider and incorporate into its rulemaking the comments summarized above and discussed in detail in the body of this document. The alternative methodologies herewith proposed meet the intent behind NPRM 99-18 and achieve its goals by making this proposed rule as effective and practical as possible.

This alternative approach is explained in detail in the following pages, and is summarized below:

- Base SFAR No. XX on a *prescriptive* rule (i.e., develop checklists derived from lessons learned) rather than on FAR 25 changes.
- Develop and implement maintenance and inspection instructions after completion and approval of the SFAR design reviews.
- Accomplish any necessary redesign activities using existing airworthiness procedures and processes.
- Evaluate ignition risk in new type designs using the accepted definitions and proven methods of FAR 25.1309 and the fail-safe design concept embedded in its associated AC, rather than creating new, more conservative requirements.
- Pursue *practical* measures in new type designs to reduce heat transfer from adjacent heat sources into fuel tanks.
- Replace FAR Ops requirements with individual airworthiness directives based on aircraft type and issued upon completion and approval of the SFAR No. XX.

Furthermore, the industry recommends that this rulemaking be harmonized with other nations' regulatory authorities, rather than remain a unilateral FAA initiative.

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Contents

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Section 1 Introduction

Industry Comments to NPRM 99-18

About this document

This document provides a collective industry response to FAA NPRM 99-l 8, titled *Transport Airplane Fuel Tank System Design Review, Flammability Reduction, and Maintenance and Inspection Requirements.* The following organizations formulated this response and agree with its contents:

- Aerospace Industries Association (AIA)
- Air Transport Association of America (ATA)
- Association of Asia Pacific Airlines (AAPA)
- Association of European Airlines (AEA)
- European Association of Aerospace Industries (AECMA)

The above organizations are referred to as "the industry" in this document.

About NPRM 99-18

FAA Notice of Proposed Rulemaking (NPRM) 99- 18 seeks to enhance fuel tank safety. This NPRM has four parts, the first being a *specialfederal aviation regulation* (SFAR) that applies retroactively to all turbine-powered transport aircraft built since 1958:

- **FAR Part 21 SFAR** XX--proposes design reviews to substantiate that ignition sources are precluded in the fuel tanks of these affected airplanes, and calls for the design-approval holders to develop maintenance and inspection instructions for use by their operators.

NPRM 99-l 8 also includes three amendments to the airworthiness standards that guide the development of subsequent transport-category aircraft:

- **Rule change to FAR** 25.981(a)-proposes new requirements for demonstrating that ignition sources could not be present in fuel tanks when failure conditions are considered.
- **Rule change to FAR** 25981(b)-proposes that future type certificate applicants identify any safety-critical maintenance actions and develop limitations to be placed in the Instructions for Continued Airworthiness of the fuel tank system.
- **Rule change to FAR** 25.981(c)-proposes that means be developed to minimize flammable vapors in fuel tanks or to prevent catastrophic damage if ignition does occur.

About NPRM 99-18 (cont'd)

NPRM 99-l 8 also includes an amendment to Appendix H of the airworthiness standards that applies to instructions for continued airworthiness:

- **Rule change to H25.4 of Appendix** H-proposes a new requirement to identify airworthiness limitations applied to the fuel tank system in the Instructions for Continued Airworthiness.

NPRM 99-l 8 also includes four amendments to the airworthiness standards that apply to maintenance operations:

- **Rule change to** FAR **91.410,** FAR **121.370,** FAR 125.248, **and FAR 129.14—proposes** that operators revisit and revise, as necessary, the fuel tank system maintenance and inspection programs.

Historical background

Jetliner hull-loss accidents are rare events. In the world fleet, 1.5 hull losses occur for every million jetliner departures (in the U.S. fleet, which is subject to NPRM 99-l 8, one hull loss occurs for every 2 million departures). Fuel tank explosions account for 0.3 percent of total hull losses in the world fleet since 1958. Thus, they occur 300 times less frequently than the overall hull-loss accident rate, or about once in every 160 million departures.

Since 1958, nine hull losses related to fuel tank explosions have occurred in the world fleet. Two were the result of engine separations, two involved ground maintenance, and one each involved lightning strike, disintegration, and sabotage. The remaining two events remain unexplained, including the loss of Flight 800, a 747-l 00, which exploded in July 1996.

Although fuel tank safety has been excellent overall, the FAA observes that, "service history has shown that ignition sources have developed in airplane fuel tanks due to external ignition sources, and internal ignition sources resulting from unforeseen failure modes or factors that were not considered at the time of original certification of the airplane."[1]

FAR Part 25—which governs the certification of transport aircraft-requires that ignition sources not be present in fuel tanks. For design purposes, the industry has always assumed that fuel tanks are flammable at all times even though jet fuel vapors become flammable only under certain combinations of temperature, pressure, mass volume, and other factors.

In 1967, Amendment 25-l 1 introduced section § 25.98 1, which addresses fuel tank temperatures with the intent of precluding hot surfaces from igniting

[1] FAA Advisory Circular AC 25.981-2X, l/12/2000 (Draft), p. 4.

Historical background (cont'd)

fuel vapors in the tanks. As adopted, §25.981 required certification applicants to determine the highest allowable temperature in the fuel tank that reserves a safe margin to the lowest temperature at which autoignition, or spontaneous ignition, might be expected to occur. Advisory Circular 25.98 1 - 1 A followed in 1972 with specific guidance, including failure modes, for complying with the above temperature requirements.

Another section, $25.901, states that, "no single failure or malfunction or probable combination of failures will jeopardize the safe operation of the airplane." A closely related section, $25.1309, applies this philosophy broadly to the entire airplane and its systems. Yet another section, §25.954, requires the prevention of fuel tank vapor ignition from lightning strikes.

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Section 2 Harmonization and Coordination

Overview

The purpose of this section is to document the industry's views concerning the harmonization of NPRM 99- 18 and delegation of compliance findings in the presence of bilateral agreements.

Industry request

The industry requests that the FAA:

- Harmonize this initiative with, at a minimum, the European Joint Aviation Authorities (JAA) and Transport Canada.
- Delegate SFAR compliance findings to the Prime Certification Authority with which the FAA has a signed bilateral agreement (see below this section).

Reasons to harmonize regulation

The industry strongly supports harmonization of NPRM 99- 18 for the same reasons that it supports regulatory harmonization in general. Harmonization simplifies operations, reduces the cost of compliance without compromising safety, and extends the latest safety benefits more broadly in the world fleet.

NPRM 99-l 8 presents precedents in the certification and operational upkeep (maintainability and continued airworthiness) of the fuel systems of transport-category airplanes. This NPRM affects original equipment manufacturers (OEM), supplemental type certificate (STC) holders, and the operators of U.S.-registered aircraft. It also affects all future U.S.-registered aircraft. In short, from an OEM's point of view, its world fleet is affected.

This NPRM potentially affects the certification codes and policies established or enforced by other airworthiness authorities. Because the FAA is regarded as a leader in aviation safety, the initiatives it puts forward-although directed just at aircraft under its jurisdiction—are scrutinized and implemented in one form or another by the airworthiness authorities of a great many nations.

Although this global regulatory reconciliation trend is not reflected in the FAA's economic analysis, it is a fact of life and presents a significant cost issue that must be addressed by each OEM as well as each operator looking to change its fleet composition. OEMs and operators alike have found through experience that worldwide harmonization of large and important issues improves the quality, oversight, and implementation time of safety initiatives.

Reasons to harmonize regulation (cont'd)

Harmonization reduces the cost of compliance and provides the traveling public with confidence that identified safety issues are being treated on all aircraft worldwide, not just on jetliners that wear U.S. N-numbers or other regions' registration numbers.

If the FAA does not pursue harmonization of this NPRM, it will undermine the ongoing effort by OEMs, the FAA, the JAA, and Transport Canada to harmonize their Part 25 Codes. Should the FAA proceed unilaterally, it may be contributing to the divergence of Part 25 Codes in the future.

Specific benefits

Significant benefits of harmonization of NPRM 99- 18 include:

- **Minimization of burden to the industry, including avoidance of duplication of work.** If harmonization is not sought, the OEMs are put at the mercy of each authority's policy. Cost is increased for both the OEM and the operator. The time scale of the safety initiative becomes unmanageable. Practically speaking, the number of times an OEM must show its fuel system is safe is directly proportional to the number of rules and safety initiatives that affect its aircraft. The rules and safety initiatives may disagree with the definition and method of judging an "unsafe condition." Operators will be penalized by having more mandates whose periods of embodiment are not compatible.
- **Creation of a unified course of action for the review of the existing fleet and the certification of new aircraft (an unambiguous set of requirements).** This harmonization benefit is especially important in light of recent bilateral agreements that call for the FAA to delegate compliance findings to the primary type certificating authority.
- **A consistent level of safety worldwide.** A harmonized approach promotes consistent use of safety-assessment methodology to judge airplane designs for "fuel tank ignition source" failure conditions.
- **Creation of superior regulation.** ARAC groups governed by good terms of reference and a set schedule have produced comprehensive, usable rules and advisory material by using the expertise and policies of the industry and the authorities. The final rule of this NPRM may be slightly delayed because of harmonization, but the end result will be better, and there will be far fewer comments to disposition.
- **Less effort in the long run.** If the regulatory proposals in NPRM 99- 18 are not harmonized now, the industry is convinced, based on past experience, that a request will be made in the future to harmonize. The work and the effort currently being expended will have to be duplicated, wasting many organizations' already limited resources.

True harmonization

The creation of superior regulation requires that regulatory authorities work together to develop the rulemaking. Were other regulatory authorities simply to adopt, as is, regulation that has been unilaterally developed by the FM, this adoption process would not constitute true harmonization, and many of the above benefits would not be realized.

Delegation of SFAR compliance

OEMs for whom the FAA is the validating authority request that the FAA delegate SFAR compliance findings to the prime certification authority in accordance with the approved bilateral agreement. The OEMs in this situation believe that FAA delegation of responsibility will facilitate the overall SFAR compliance process and still achieve the safety objectives.

To date, the industry does not believe that the FAA has contacted any other prime certification authority to discuss compliance protocol.

Importance of industry comments

If the FAA determines that harmonization of NPRM 99- 18 is not practical from a time standpoint, additional consideration might well be given to the comments presented in this document, which reflect the views of the industry worldwide.

About the ARAC process

It is further suggested that the FAA use the fast-track Aviation Rulemaking Advisory Committee (ARAC) process. Using the ARAC process, a forum of the world aviation industry and certification authorities could address the comments and concerns of the industry and review its alternative proposal for a practical, harmonized program to enhance fuel tank system safety.

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Section 3 Design Review

FAR Part 21, SFAR No. XX

Overview

This section addresses proposed FAA SFAR No. XX, which requires a design review of the fuel tank systems of the existing turbine-powered commercial airliner fleet. Additional comments regarding maintenance and inspection instructions associated with this SFAR are presented in Sections 6 and 7 of this document.

In NPRM 99-l 8, the FAA proposes the following rule text:

> Compliance: No later than [12 months after the effective date of the final rule], or within 12 months after the issuance of a certificate for which application was filed before [effective date of the final rule], whichever is later, each type certificate holder, or supplemental type certificate holder of a modification affecting the airplane fuel tank system, must accomplish the following:
>
> (a) Conduct a safety review of the airplane fuel tank system to determine that the design meets the requirements of §§ 25.901 and 25.981(a) and (b) of this Chapter. If the current design does not meet these requirements, develop all design changes necessary to the fuel tank system to meet these requirements.
>
> (b) Develop all maintenance and inspection instructions necessary to maintain the design features required to preclude the existence or development of an ignition source within the fuel tank system of the airplane.
>
> (c) Submit a report for approval of the Administrator that:
>
> (1) Provides substantiation that the airplane fuel tank system design, including all necessary design changes, meets the requirements of §§ 25.901 and 25.981(a) and (b) of this Chapter; and
>
> (2) Contains all maintenance and inspection instructions necessary to maintain the design features required to preclude the existence or development of an ignition source within the fuel tank system throughout the full operational life of the airplane.

About the proposed SFAR

The FAA makes these observations within the preamble of NPRM 99-l 8 that help summarize the reason for the proposed SFAR:

> . ..[a]ccident investigations and adverse service experience [have] shown that unforeseen failure modes and lack of specific maintenance procedures on certain airplane fuel tank systems may result in degradation of design safety features intended to preclude ignition of vapors within the fuel tank (lines 24-27).

About the proposed SFAR (cont'd)

> Many of the design practices used on airplanes in the existing fleet are similar. Therefore, anomalies that have developed on specific airplane models within the fleet could develop on other airplane models. (lines 565467)
>
> . ..[f]uel tank systems [are required to] be designed to ensure fail-safe operation between normal maintenance and inspection intervals. (lines 107-107)
>
> The FAA determined that during original certification of the fuel tank system, the degree of tank contamination and the significance of certain failure modes of the fuel tank system components had not been considered to the degree that more recent service experience indicates is needed. (lines 380-383)

Overall intent of this SFAR

The preamble of NPRM 99-18 goes on to state that a design review is considered necessary and what the intent of this review would be:

> As a result, the FAA considers that a one-time design review of the fuel tank system for transport airplane models in the current fleet is needed. (lines 567-568)
>
> The intent of the design review proposed in this notice is to assure that each fuel tank system design that is affected by this action will be fully assessed and that the design approval holder identifies any required modifications, added flight deck or maintenance indications, and/or maintenance actions necessary to meet the fail-safe criteria. (lines 620-623)

The industry agrees *in principle* with FAA intent

The industry agrees with the FAA objective of enhanced fuel system safety and is already engaged in an industrywide initiative in this area. We concur *in principle* with this FAA initiative to "perform a one-time design review of the fuel tank system for transport airplane models in the current fleet."

The following discussion highlights concerns that the industry has with the proposed SFAR design review methodology, and then presents a practical alternative that will effectively achieve the objectives of the design review.

0 bjective of design review

The industry believes firmly that the objective of this design review should be to *enhance* the level of safety that already exists in the stated applicability of transport-category airplanes. This design review should:

- Utilize the lessons learned identified from service experience to examine the integrity of the existing designs and determine if changes to these designs are warranted.
- Support the development of improved maintenance instructions and general-practice guidelines to maintain the level of safety intended in these designs.

About the FAA's proposed design review methodology

The design review methodology proposed by NPRM 99-l 8 is summarized below using excerpts from the NPRM (lines 595[illegible]6 10):

> The proposed SFAR would require the design approval holder to perform a safety review of the fuel tank system to show that fuel tank fires or explosions will not occur on airplanes of the approved design. In conducting the review, the design approval holder would be required to demonstrate compliance with the standards proposed in this notice for (paragraphs) 25.981 (a) and (b) . ..and the existing standards of (paragraph) 25.901. As part of this review, the design approval holder would be required to submit a report to the cognizant FAA Aircraft Certification Office (ACO) that substantiates that the fuel system is fail-safe.
>
> The FAA intends that those failure conditions listed previously in this notice, and any other foreseeable failures, should be assumed when performing the system safety analysis needed to substantiate that the fuel tank system design is fail-safe. The system safety analysis should be prepared considering all airplane inflight, ground, service, and maintenance conditions, assuming that an explosive fuel air mixture is present in the fuel tanks at all times, unless the fuel tank has been purged of fuel vapor for maintenance. The design approval holder would be expected to develop a failure modes and effects analysis (FMEA) for all components in the fuel tank system. Analysis of the FMEA would then be used to determine whether single failures, alone or in combination with foreseeable latent failures, could cause an ignition source to exist in a fuel tank. A subsequent quantitative fault tree analysis should then be developed to determine whether combinations of failures expected to occur in the life of the affect fleet could cause an ignition source to exist in a fuel tank system.

The proposed methodology is excessive

The FAA is essentially proposing to recertify the fuel systems of all previously certified turbine-powered commercial transports of the past 40 years to new certification standards with respect to avoiding fuel tank fires and explosions. The industry believes that this approach is unnecessarily excessive. While more than 450 million hours of service experience have indeed identified valuable lessons learned, this same service experience also demonstrates the largely successful outcome of the previously certified design practices.

About enhancing safety through lessons learned

Rather than recertify the fuel system in its entirety, the industry believes that the major safety-enhancement benefit of a design review can be derived from utilizing these lessons learned to examine the integrity of the existing designs. The following observations support this view:

- The years of knowledge that went into designing and certifying the original systems far exceeds any reasonable effort that can be expended for the proposed design review. The effectiveness of these original efforts should be acknowledged and given credit for. The proposed SFAR design review should focus on the service-

About enhancing safety through lessons learned (cont'd)

experience lessons learned as a means of adding value to what has already been accomplished.

- More than 450 million hours of service experience have demonstrated the largely successful outcome of the previously certified designs. Concentrating attention on the service-experience lessons learned would bring focus to a design review.
- Many of the aircraft types that are required to comply with this SFAR are approaching the end of their fleet lives. When determining if design changes are warranted, the consideration should be based upon a risk assessment associated with the *remaining* fleet life.
- Imposition of new certification requirements is not necessary, as discussed in Section 4, Ignition Risk.

The proposed methodology creates an unnecessary task burden

Recertification of the world fleet would be an unmanageable task. The precedents and resource-management issues included within NPRM 99- 18 are very complex and would have both short- and long-term effects on the aviation industry. The SFAR design review proposal, as written, goes well beyond a lessons learned focus. This additional task burden would actually interfere with realizing the benefits of lessons learned:

- Recertification adhering to the guidelines of AC 25.1309- 1 A would be extremely labor intensive. For example, FAR 25.1309 compliance was not required for aircraft whose certification basis was before FAR Amendment 25-23. The analysis methods outlined in AC 25.1309- 1 A were not adopted by the FAA until June 21, 1988, and were therefore not necessarily applied to aircraft certified before this date. Thus, the certification documentation and technical archives of pre-Amendment 25-23 aircraft may be limited in their usefulness to support a formalized AC 25.1309-1A analysis. Note that the majority of aircraft types affected by this SFAR are pre-Amendment 25-23.
- Availability of qualified personnel to conduct the level of design analysis implied by the proposed FAA approach is limited. Formalized analysis of the type outlined in AC 25.1309- 1 A requires specialists with extensive knowledge of the system architecture, component details, and service history as well as the analysis methodology. Such specialists would be required to support not only the SFAR tasks, but also the ongoing work responsibilities for which they are normally employed.
- Flow time required to perform the proposed design review would exceed the proposed compliance time. The industry believes that the proposed design review methodology would require two to four

The proposed methodology creates an unnecessary task burden (cont'd)

labor-years of effort per major model for large transport aircraft. Some manufacturers have as many as 15 major models with numerous minor model variations. These minor model variations would add significant additional review effort. Availability of qualified engineers does not allow these reviews to be conducted in a completely parallel fashion. Assuming a nine-month flow time to accomplish each review and the capability to conduct up to three reviews simultaneously, some manufacturers would require well in excess of 45 months to complete the proposed reviews. In other instances, the resources available to some TC or STC holders may limit their capability to one design review at a time. Note that these estimates take into account work already accomplished by the industry over the past four years.

- The SFAR, as written, requires all necessary design changes to be identified, developed, evaluated, and shown to comply with the proposed new certification requirements. The industry strongly believes that if the design review identifies the need to change the design, the design change activities should be treated separately from the SFAR activity. Existing airworthiness procedures should be utilized to process mandatory design changes (including appropriate NPRMs and ADs on a case-by-case basis). The FAA's own SFAR cost assessment is in agreement with the industry position. Lines 1003–1007 of NPRM 99-l 8 state: "The assessment may identify conditions that would be addressed by specific service bulletins or unsafe conditions that would result in FAA issuance of an airworthiness directive (AD). However, those future costs would be the result of compliance with the service bulletin or the AD and are not costs of compliance with the proposed rulemaking. Those costs would be estimated for each individual AD, when proposed."

- The SFAR, as written, requires "all maintenance and inspection instructions necessary" to be submitted as part of the design review report. Effective maintenance program development cannot practically start until the design review is completed. The OEM maintenance program must be developed in coordination with the operators and regulatory agencies. Therefore, submittal of the maintenance and inspection instructions as part of the design review report is not feasible. Development of these instructions will require six to eight months of effort once the FAA has approved the design review report. See Section 7, Maintenance Operations, for further discussion of this issue.

The proposed methodology creates an unnecessary task burden (cont'd)

- The industry believes the FAA has grossly underestimated its own flow times regarding coordination and approval of the SFAR-mandated design reviews and resulting compliance substantiation documents. Experience shows that 60 to 90 FAA flow days are to be expected for the review and approval of documents of this kind. Multiplied by 100 reports or more, it would appear that the FAA itself would require more than the proposed 12 months compliance time to complete its review and approval cycle once the reports are submitted by the industry.

Result: an excessive compliance burden

In light of these concerns, the industry must conclude that the SFAR No. XX design review methodology proposed by the FAA is impracticable because it:

- Creates new certification requirements when application of an alternative approach will meet the same objective.
- Does not consider the substantial level of effort and general effectiveness of the original design and certification activities as demonstrated by more than 450 million hours of service experience.
- Does not provide a risk assessment over the *remaining* fleet life of each aircraft type.
- Does not provide a simple design-assessment method that is compatible with the technical information available to the TC and STC holders.
- Is impracticable to perform for pre-Amendment 25-23 aircraft.
- Is labor intensive, time-consuming, and so specialized in nature that the pool of people who could actually perform such a design assessment is highly constrained within the industry.
- Grossly underestimates the amount of flow time required by both the industry and the FAA to complete the proposed task.
- Proposes to include any redesign activity as part of the SFAR compliance task rather than use existing airworthiness procedures for these kinds of activities.
- Does not allow the maintenance and inspection instructions to be developed in a feasible manner.

A practical alternative

The industry believes that an alternative design review method would better achieve the overall objective of enhancing fuel system safety. This alternative method would be based on service experience (lessons learned) and regulated as a prescriptive-type rule (i.e., one that defines actions to be taken).

For example, in the NPRM 99- 18 preamble, the FAA lists examples of service experience that may not have been adequately considered in the original fuel system design. Areas of the fuel system covered by these examples include:

- Pumps.
- Wiring to pumps in conduits located inside fuel tanks.
- Fuel pump connectors.
- Fuel quantity indicating system wiring.
- Fuel quantity indicating system probes.
- Component bonding.

If a comprehensive listing of these in-service experiences were defined (e.g., in proposed FAA AC 25.98 1-1X), fuel system designs could be evaluated to determine if adequate consideration had been made regarding the potential effects of each item listed. The information gathered by the special inspection program of the industry's Fuel Systems Safety Program would be a useful source of information.

Single failures shown to cause an ignition source in the fuel tank system would warrant a design change. A quantitative fault tree analysis could be developed for combinations of failures shown to cause ignition sources to determine if such failure combinations could be expected to occur in the *remaining* fleet life of the affected aircraft type.

Benefits of a prescriptive approach

The benefits of this prescriptive design review approach would be:

- A common evaluation criterion for each aircraft type regardless of its certification basis.
- A more objective evaluation process that simplifies delegating the compliance-finding task by the FAA and ensures equal treatment for each manufacturer and its operators.
- Faster task completion and report submittal, and thus a quicker resolution to any deficiencies in the existing fleet.
- Separation from the FAA program to enhance fuel tank certification requirements for future aircraft (the FAR 25 rule change proposals could proceed on a different time frame).

Benefits of a prescriptive approach (cont'd)

- The ability to use analytical methods as a complementary means of showing compliance.
- Development of a standardized report or checklist to ease the compliance-finding process.
- A far greater pool of people able to accomplish the task, because a prescriptive design review method does not demand engineers with detailed expertise in fuel systems and FAR $25.1309 analysis.

About the industry's proposed SFAR alternative

The FAA and the industry goal of preventing fuel tank system ignition sources in the existing fleet can be better met through the alternative prescriptive approach being proposed here by the industry. Such an approach is practical and effective. It will facilitate a safety-enhancing review of the world fleet.

The industry's alternative design review process

As proposed by the industry, the references to §25.90 1 and §25.98 1 (a) and (b), as described in the NPRM 99-18 revised version, are removed and replaced
by a prescriptive rule that may take the form of a checklist as described above. A service experience-based listing of lessons learned would be provided in a document such as the proposed AC 25.981-1X.

Under this industry proposal, FAA SFAR No. XX Compliance text would be modified to read:

(a) Conduct a safety review of the airplane fuel tank syste m to be evaluated against the defined listing of service experience "lessons learned." Identify if design deficiencies exist for which redesign is warranted by determining if ignition sources may exist caused by single failures or combinations of failures expected to occur in the remaining operational fleet life of the aircraft type.

(b) Develop all maintenance and inspection instructions necessary to maintain the design features required to preclude the existence or development of an ignition source within the fuel tank system of the airplane throughout the remaining operational fleet life of the aircraft.

(c) Submit a report for approval of the Administrator that:

(1) Provides substantiation that the airplane fuel tank system design has been evaluated against the defined listing of "lessons learned" and determination made if ignition sources may exist caused by:

i. Single failures.

ii. Combinations of failures expected to occur in the remaining operational fleet life of the aircraft type.

(2) Identifies design deficiencies for which redesign is warranted.

The industry's alternative design review process (cont'd)

This rule text makes it clear that any design deficiency for which redesign is warranted shall be identified, but modifications need not be developed at the time of report submission.

The rule text also makes it clear that development of the maintenance and inspection instructions associated with the results of the design review will occur *after* the design review has been completed and approved by the FAA (see Section 7, Maintenance Operations, for a detailed discussion of this industry proposal). The text of the design review report will directly reflect what was determined in the airplane assessment.

Compliance time

The compliance time proposed by the FAA is insufficient for the industry, as explained above in this section. It would not be possible to meet the suggested compliance time even using the industry's proposed design review method. If the FAA accepts the industry's alternative approach, the industry proposes the following text revision:

Compliance time:

(a) All design review reports must be submitted to the Administrator no later than 36 months after the effective date of this rule or within 18 months of the issuance of a certificate for which application was filed before [effective date of the rule], whichever is later.

(b) Maintenance and inspection instructions must be submitted to the Administrator no later than 8 months after the FAA has approved the design review report for the applicable aircraft type.

If the FAA does not accept the industry's alternative approach, then the compliance time for completion of the design review should be extended to 54 months.

Applicability

The industry agrees with the FAA's applicability statement except for use of the word "affecting" with respect to STC holders. Substitution of the word "modifying" is recommended because the reference is only to STCs that result in direct ATA 28 modifications and not STCs that are adjacent to the fuel system and may indirectly affect them (see the below discussion of STCs for more information).

Applicability (cont'd)

The following text revision is accordingly proposed:

Applicability:

This SFAR applies to the holders of type certificates, and supplemental type certificates modifying the airplane fuel tank system, for turbine-powered transport category airplanes, provided the type certificate was issued after January 1, 1958, and the airplane has a maximum type certificated passenger capacity of 30 or more, or a maximum type certificated payload capacity of 7500 pounds or more. This SFAR also applies to applicants for type certificates, amendments to a type certificate, and supplemental type certificates modifying the fuel tank systems for those airplanes identified above, if the application was filed before the effective date of this SFAR and the certificate was not issued before the effective date of this SFAR.

About STCs and field approvals

The rest of this section addresses:

- The applicability of NPRM 99- 18 to ATA 28 STC approvals, non-ATA 28 Supplemental Type Certificate (STC) approvals and field approvals whose installation(s) may affect the airplane fuel tank system.
- The feasibility of conducting a design review on the above-mentioned approvals.

NPRM 99-18 applicability

Part 21 SFAR No. XX's applicability statement reads in part:

...This SFAR also applies to applicants for type certificates, amendments to a type certificate, and supplemental type certificates affecting the fuel tank systems for those airplanes identified above, if the application was filed before the effective date of this SFAR and the certificate was not issued before the effective date of this SFAR.. .

FAR 91, 121, 125, and 129 applicability statements read:

. . . no certificate holder may operate a turbine-powered transport category airplane with a type certificate issued after January 1, 1958, and a maximum type certificated passenger capacity of 30 or more, or a maximum type certificated payload capacity of 7500 pounds or more.. .

Within these two applicability statements, the FAA implicates:

- STCs that affect changes to fuel tank systems (ATA 28 STCs).
- STCs that modify systems or components outside the fuel tank system, but that may be inappropriately associated to the fuel tank system installation (non-ATA 28 STCs).
- Field approvals of systems that affect the fuel tank systems.

NPRM 99-18 applicability (cont'd)

The FAA states that the "objectives of this proposed rule would not be achieved unless these systems are also reviewed and their safety ensured."

Industry observations

The industry agrees that the design review should be as complete as necessary, bearing in mind that:

- There must be a balance between cost and benefit.
- There must be technical information available at the airline or principal maintenance inspector (PMI) level to effectively carry out NPRM 99-l 8's objective.

About ATA 28 STCs

The industry agrees that STC holders who have made major changes to the fuel system should be held responsible to complete SFAR No. XX's design review in the same fashion and time scale as proposed above by the industry.

In cases where the ATA 28 STC holder is out of business and the technical data is not readily available, the operator and FAA should define a method to ensure themselves that the design meets the SFAR objectives.

About non-ATA 28 STCs

The industry has concerns about rendering a mandatory design review of the non-ATA 28 STCs and field approvals.

The FAA says each STC must be evaluated for any effect on the fuel system, which means that an STC that affects the configuration of the cabin with its associated wiring (e.g., power ports, in-flight video) must be included.

Operator challenges

For a large number of operators, the design review process for ATA 28 and non-ATA 28 STCs may present an insurmountable burden because:

- A full review of modifications accomplished by the operators over the decades that some of these airplanes have been operated is impracticable.
- Where operators have sold aircraft to another party, it is possible that the current owner of the airplane may come back to the operator and require such an evaluation. This situation is unmanageable.
- Operators will have difficulty performing any type of quantitative analysis due to lack of intensive familiarity with these types of rules.

Operator challenges (cont'd)

- The technical information required to perform a quantitative or qualitative analysis may not be available or may not pertain to the specific aircraft model.
- OEM involvement in providing airlines with assistance is viewed by the operators as being minimal for several reasons. First, the OEMs are probably not familiar with many of the STCs that are incorporated on the aircraft. Second, the chance of obtaining an assistance contract with the OEMs is slim because they will be stretched for manpower supporting OEM responsibilities relating to this SFAR. It should be noted that the compliance responsibility is with the operator, the STC holder, and the FAA.
- Technical assistance from the FAA fuel system specialists is not ensured for the operators. The FAA may be prepared to work with the affected type certificate holders to assist them in complying with the requirements of the proposed SFAR, but such assistance may not be possible for operators in this situation due to a lack of manpower. Even though the guidelines will be in AC 25.98 1-1X, operators believe that a PMI will not have the expertise to be able to evaluate whether an alternative truly satisfies the SFAR.

NPRM 99-l 8 does not account for any of the above.

About field approvals and approved repairs and modifications

In the preamble section of the operational rule changes (lines 801–807), the FAA implicates field approvals. For the record, the industry defines "field approvals" as those alterations signed off by the PMI on the FAA 337 form.

Based on the context of SFAR No. XX text and the FAR Ops text, the industry does not agree that field approvals are implicated. Thus, any reference to field approvals should be removed from NPRM 99- 18.

The industry does not consider that other forms of repairs or modifications permitted on in-service aircraft and not specifically mentioned in the SFAR (e.g., approvals used by airlines via SFAR 36 repairs) have to be considered within the context of NPRM 99-l 8.

If the FAA disagrees with the industry position, the industry proposes that field approvals, approved repairs, and so on be considered in the same fashion as non-ATA 28 STCs (see below).

Assessment of non-ATA 28 STCs

For the reasons stated in the discussion of non-ATA 28 STCs (see above in this section), the industry strongly suggests that the FAA consider a separate requirement within SFAR No. XX for assessing the effect of non-ATA 28 STCs (as well as ATA 28 STCs where the manufacturer and design data no longer exist) on the airplane's fuel system.

The industry believes that airplanes that fall into this category can only be assessed qualitatively and/or by inspection. In such situations, two key areas need to be examined to achieve a safety enhancement:

- The modification of wiring next to or near wiring that enters the fuel tank.
- The effect of ECS modifications and other system modifications capable of generating autoignition temperature into the tank structure.

The effects of non-ATA 28 STCs on wiring that enters the fuel tank can be assessed by a one-time inspection performed on each aircraft model at the next heavy-maintenance interval where the area or zone is opened and accessed, or if possible in conjunction with any required modification program downtime resulting from the OEM/STC design review per SFAR No. XX.

The objective of the inspection would be to examine wiring that enters the fuel tank to record any nonconformities introduced by modifications. The nonconformity would be established based on a listing of specific inspection guidelines issued by either the FAA (possible inclusion in AC 25.98 1-1X) or the OEMs for each aircraft model type.

As with the SFAR design review, any nonconformities would be identified and reported to the design approval holder. A qualitative design review can be performed as an alternative to a one-time inspection if sufficient technical information is available regarding the installation of STCs. Finally, alternate methods that would ensure the continued airworthiness of the aircraft (with respect to wiring that enters the fuel tank) should be considered. For example, installation of a transient suppression device should eliminate the need to inspect and/or conduct design reviews of modifications that might otherwise affect FQIS wiring.

Effects of environmental control system (ECS) and other systems capable of generating autoignition temperatures into the tank structure can be covered by reviewing whether the approved configuration has been altered. This review will reveal whether the OEM design is unaffected, or whether the operator needs to follow up with the design approval holder of the design modification.

Development of a one-time inspection program

The industry believes that a one-time inspection process, as described above, would need to be developed using:

- The OEM's or STC holder's list of general design practices and precautions obtained during their SFAR design reviews.
- The revised maintenance program (e.g., tasks, procedures, intervals).

This information will provide operators with guidelines on what to inspect, how to inspect, and what the pass/fail criteria are (see Section 7).

This inspection should also not repeat the inspections that have been performed to date by the airline. For instance, the operator should receive credit for any inspections performed because of an AD or the FSSP.

Industry proposal

Based on the above, the industry requests that the FAA:

- Revise SFAR No. XX for non-ATA 28 STCs as suggested above.
- Make clear the applicability or category of changes that are being investigated (i.e., non-ATA 28 STCs, field approvals).
- Take into account the work that has already been performed and standard wiring practices or the equivalent.
- Amend the compliance time to be compatible with accomplishing an inspection during heavy maintenance, together with any major fuel system modification resulting from the design review.

The following text revision is accordingly proposed:

Applicability:

[Same as SFAR except that it applies to non ATA 28 (fuel system) STCs which may affect the fuel tank system.]

Compliance time:

- Wring Inspection compliance to be associated to the AD mandating that the operators incorporate the maintenance program.
- Within 36 months of the effective date of NPRM 99-l 8, the ECS and / or wiring qualitative analysis shall be submitted to the FAA

Industry proposal (cont'd)

Rule:

1. Wiring

   Conduct a one time inspection of wiring that enters the fuel tank to assess whether any STC modifications compromise the fail-safe design concept and are as such a possible fuel tank ignition source. For the purpose of this rule, only the wiring *external* to the tank need be inspected, OR

   a) Perform a qualitative design review to determine that no STCs are installed such that an ignition risk is induced due to its proximity to wiring that enters the fuel tank.

2. Autoignition

   Perform a qualitative review of the ECS and other system capable of generating auto ignition temperatures, into the tank structure. This review should determine whether the approved manufacturer's configuration has been altered. If altered, the operator shall identify the alteration and report it to the person responsible.

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Section 4 Ignition Risk

Rule Change Proposed to FAR 25.981(a)

Overview

This section addresses the proposed FAR Part 25.98 1 (a) rule change, which retains the existing requirements of the FAR relating to determination of a safe margin below the temperature expected for autoignition of fuel and precluding the temperature in the fuel tank from exceeding that temperature.

The proposed rule also adds a new requirement that requires a safety analysis to evaluate the potential for the development of ignition sources in a fuel tank system resulting from single, single and latent, or multiple failure conditions.

In NPRM 99-l 8, the FAA has proposed the following rule text:

§ 25.981 Fuel Tank Ignition Prevention

(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:

(1) Determining the highest temperature allowing a safe margin below the lowest expected autoignition temperature of the fuel in the fuel tanks.

(2) Demonstrating that no temperature at each place inside each fuel tank where fuel ignition is possible will exceed the temperature determined under paragraph (a)(l) of this section. This must be verified under all probable operating, failure and malfunction conditions of each component whose operation, failure or malfunction could increase the temperature inside the tank.

(3) Demonstrating that an ignition source could not result from each single failure, from each single failure in combination with a 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.

Summary of FAA viewpoint

The FAA makes these observations within the preamble of NPRM 99-l 8 with regard to the application of the existing regulations and the use of the fail-safe design concept in the prevention of ignition sources in fuel tank systems:

[T] he regulatory authorities and aviation industry have always presumed that a flammable fuel air mixture exists in the fuel tanks at all times and have adopted the philosophy that the best way to ensure airplane fuel tank safety is to preclude ignition sources within fuel tanks. This philosophy has

Summary of FAA viewpoint (cont'd)

been based on the application of fail-safe design requirements to the airplane fuel tank system to preclude ignition sources from being present in fuel tanks when component failures, malfunctions, or lightning encounters occur. (lines 88-92)

Section 25.901 . ..requires, in part, that the propulsion and fuel tank systems be designed to ensure fail-safe operation between normal maintenance and inspection intervals, and that the major components be electrically bonded to the other parts of the airplane. (lines 105-l 08)

Compliance with § 25.1309 requires an analysis, and testing where appropriate, considering possible modes of failure, including malfunctions and damage from external sources, the probability of multiple failures and undetected failures, the resulting effects on the airplane and occupants, considering the stage of flight and operating conditions, and the crew warning cues, corrective action required, and the capability of detecting faults. (lines 117-l 21)

This provision [referring to lines 109-l 21] has the effect of mandating the use of "fail-safe" design methods which require that the effect of failures and combinations of failures be considered in defining a safe design. (lines 122-l 23)

These regulations, when applied to typical airplane fuel tank systems, lead to a requirement for prevention of ignition sources inside fuel tanks. (lines 154-l 55)

About the intent of 25.981 (a)(3)

In the preamble, the FAA goes on to redefine the existing FAR 25.981, which since 1967 has specified requirements for the prevention of fuel tank ignition due to autoignition temperature. This proposed redefinition of FAR 25.98 1 adds requirements that define failure scenarios that must be addressed for fuel tank ignition prevention. As the reason for this added rule, the FAA states:

The second area of concern encompasses the need to require the design of future transport category airplanes to address more completely potential failures in the fuel tank system that could result in an ignition source in the fuel tank system. (lines 569-571).

This proposal would also add a new paragraph (a)(3) to require that a safety analysis be performed to demonstrate that the presence of an ignition source in the fuel tank system could not result from any single failure, from any single failure in combination with any latent failure condition not shown to be extremely remote, or from any combination of failures not shown to be extremely improbable. (lines 830-833)

This proposal is needed because the general requirements of §§ 25.901 and 25.1309 have not been consistently applied and documented when showing

About the intent of 25.981 (a)(3) (cont'd)

that ignition sources are precluded from transport category airplane fuel tanks. Compliance with the proposed revision to § 25.981 would require analysis of the airplane fuel tank system using analytical methods and documentation currently used by the aviation industry in demonstrating compliance with §§ 25.901 and 25.1309. (lines 854-858)

Overview of industry comments

With respect to ignition-source prevention as proposed in NPRM 99- 18, the industry:

- Agrees that a specific paragraph should be added to FAR 25.98 1 to address failure modes that affect fuel tank ignition source prevention.
- Believes that so doing will ensure a consistent application of the rule for new designs.
- Does not believe that the new requirement to address conditions not shown to be extremely remote is consistent with the existing FAR.
- Recommends that the language of the proposed harmonized version of FAR 25.901 (c), referencing FAR 25.1309, be similarly adopted for the proposed FAR 25.98 1 (c).

About the fail-safe design concept

When comparing NPRM 99-l 8's identified failure condition of "fuel tank ignition source" against the requirements of §25.901 (c) and 25.1309(b), rule §25.90 1 (c) requires the applicant to show that:

- No single failure or malfunction, which will jeopardize the safe operation of the airplane, can occur.
- No probable combinations of failures will jeopardize the safe operation of the airplane (a combination being two or more failures, whether evident or latent).

And §25.1309(b) requires the applicant to show:

- The occurrence of any failure condition that would prevent the continued safe flight and landing of the airplane is extremely improbable.
- Compliance [to the above]... must consider . . . the probability of failures and undetected failures . . . [and] crew warning cues, corrective action required, and the capability of detecting faults.

FAR 25.901 (c) is intended to provide an overall safety assessment of the powerplant installation that is consistent with the requirement of $25.1309. FAR 25.1309 applies to all aircraft equipment, systems, and installations, and

About the fail-safe design concept (cont'd)

in fact envelops the intent of §25.901(c). The purpose of 925.1309 is to determine the effect of a functional failure or malfunction on the airplane using qualitative and quantitative analytical tools in conjunction with engineering and operational judgment. It is noted that within the European JAR, the JAR 25.901(c) rule text refers directly to JAR 25.1309.

The industry favors the continued use of the fail-safe design concept, as defined in AC 25.1309-1A and the forthcoming AC/AMJ 25.1309, which utilizes design and analysis methods to ensure within known probability bounds that a hazardous or catastrophic event will not occur. This industry approach would provide a design objective that is achievable, certifiable, and within the boundaries of industry practice for the design of safe aircraft.

About latent failures and the fail-safe design concept

With regards to latent failures, the proposed rule states:

> . ..an ignition source could not result...from each single failure in combination with each latent failure condition not shown to be extremely remote.. . .

The industry considers the proposed §(a)(3) rule text too severe because it presents requirements that are outside the scope of both $25.1309 and $25.90 1 (c) standards-the same standards that the FAA states in its preamble are the baseline rules for the ignition source prevention assessment. These regulations provide a defined method for treating latent failures.

In §25.901 and $25.1309 and their associated ACs, latent failures are assigned a failure rate and an associated latency period, both of which are substantiated by manufacturer experience. This is formalized within the AC 25.1309-l A description of the fail-safe design concept as, "Subsequent failures.. .whether detected or latent, and combinations thereof should also be assumed, unless their joint probability with the first failure is shown to be extremely improbable." To comply with these criteria, it is necessary to apply the fail-safe design concept as embodied in the FARs and defined in AC 25.1309-1A.

The new wording proposed by the FAA imposes a requirement on latent failure conditions that are just part of the larger set of combinations leading to the hazard of "ignition sources present in fuel tanks." It is the larger set that $25.1309 imposes a requirement on, thus taking into account the complete set of all combinations. This FAA wording adversely penalizes the resulting outcome of the analysis, in particular as regards the definition of maintenance intervals and the means for determining whether an added safety feature is required to mitigate or prevent the event.

About latent failures and the fail-safe design concept (cont'd)

Proposed AC 25.98 1-1X provides a more detailed explanation of the reason for the latent-failure *extremely remote* requirement proposed in the NPRM:

> In order to eliminate any ambiguity as to the restrictions on latent failures, § 25.981 (a)(3) explicitly requires that any anticipated latent failure condition not leave the airplane one failure away from a catastrophic fuel tank ignition. In addition to this § 25981(a)(3) limitation on latency, § 251309(c) limits latent failure conditions to those that do not create an "unsafe system operating condition." Consequently, if a latent failure condition is not extremely remote (i.e., it is anticipated to occur) and it creates an "unsafe system operating condition," then "warning information must be provided to alert the crew" and "to enable them to take appropriate corrective action." These applicable regulatory restrictions on latency notwithstanding, there are practical limitations on the available means of compliance. For example, detecting a failure condition requires a finite period of time and there are not always "appropriate corrective actions" that can be taken during the flight. Consequently, for the purposes of compliance with § 25981(a)(3), the period of latency for any anticipated significant latent failure condition should be minimized and not allowed to exceed one flight cycle. For the purposes of § 25.1309(c) compliance, any time the airplane is operating one failure away from a catastrophic fuel tank ignition should be considered an "unsafe system operating condition," recognizing that sometimes the only "appropriate corrective action" is to continue on to your destination but not re-dispatch the airplane.

The industry recognizes that the FAA has been arguing this philosophy on latent failures in different industry and regulatory forums over the last several years without resolution. The industry recommends that because this is a controversial and unresolved subject, that this issue on latent failures be removed from this NPRM. A request by the industry, through TAEIG, has been formally submitted to the FAA that requests a separate project be established to address, and come to a consensus on, the issue of latent failures.

In the NPRM preamble, it is stated:

> In order to eliminate any ambiguity as to the necessary methods of compliance, the proposed rule explicitly requires that the existence of latent failures be assumed unless they are extremely remote, which is currently required under § 25.901, but not under § 25.1309. (lines 858-860)

The industry does not believe that the new requirement to address latent failures that are extremely remote is required under §25.90 1. FAR 25.90 1 (c) does contain the term "extremely remote," but it is used within the context of structural design integrity and has never been assigned a probability. Within Amendment 25-40, the FAA comments, "[Extremely remote] has been used in other sections of the regulations...to establish a consideration that must be given to the failure of *structural components* during the evaluation of

About latent failures and the fail-safe design concept (cont'd)

the type design" (e.g., pylons, engine mounts, and engine rotors). The FM also states in that amendment that, "FAR 25.1309 would continue to apply to powerplant and APU installations." The industry agrees with this final statement and believes that it is not appropriate to attribute the "extremely remote" definition to systems and equipment for which FAR 25.1309 has proved to be sufficient.

The FAA is also aware that the requirements of FAR 25.901 (c) have been under active review for harmonization with the JAR 25.90 1 (c) requirements. The current harmonized proposal for §25.90 1 (c) resides with the FAA for final action (publication of the NPRM). The new requirement states that for powerplant installations (which include fuel system), compliance must be shown to the requirements of $25.1309, except for certain specific structural failure conditions such as engine rotor failure, propeller blade release, and case rupture. It would seem logical for the proposed revision to §25.981(a)(3) to match the new §25.901(c) and invoke the requirements of $25.1309, rather than attempt a match to the terminology in the current but obsolete $25.901 (c) requirement.

In summary, the industry agrees that a specific paragraph should be added to FAR 25.981 to address failure modes that address fuel tank ignition source prevention and to ensure a consistent application of the rule for new designs. However, the industry believes the new requirement to address latent failures is overly conservative and proposes retaining the accepted definitions and proven methods of FAR 25.1309 and the fail-safe design concept embedded in its associated AC.

The industry proposes revisions to §25.981 (a)(3)

Based on the information above in this section, the industry requests that the proposed §25.98 1 (a)(3) wording be replaced with the following:

Alternative 1:

§ 25.981 Fuel Tank Ignition Prevention

(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 vapors. This must be shown by:

(3) Assessment of ignition risk under the provisions of $25.1309.

The industry proposes revisions to 925.981 (a)(3) (cont'd)

The industry prefers Alternative 1 as it would ensure that fuel tank ignition risk is assessed according to the current §25.1309, utilizing the corresponding AC 25.1309-1A as guidance. This proposed alternative would not introduce any new requirements or regulations.

If the above, industry-preferred text is not deemed acceptable and a specific requirement must be defined, the industry instead proposes the following:

Alternative 2:

25.981 Fuel Tank Ignition Prevention

(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 vapors. This must be shown by:

(3) Analyses and/or tests that demonstrate that:

(i) There are no single failures that result in an ignition source in the fuel tank system.

(ii) Any combination of failures, including latent failures, that result in an ignition source within the fuel tank system are extremely improbable.

This second text represents the current and harmonized version of $25.1309 and envelops the concept of §25.901(c). It is unambiguous and uses wording that reflects current (and future) industry standards.

About 25.981(a) and the proposed SFAR XX design review

In Section 3, Design Review, the industry presented comments addressing the proposed FAA SFAR No. XX. This SFAR would require a design review of the fuel tank systems of the existing turbine-powered commercial airliner fleet. In lines 597-598 of the preamble to NPRM 99-l 8, the FAA states that, "In conducting the review, the design-approval holder would be required to demonstrate compliance with the standards proposed in this notice for (paragraph) 25.981(a)...."

Industry conclusion

Based on the discussions above and the commentary presented in Section 3, the industry disagrees that the proposed rule should be applied to the existing commercial airliner fleet.

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Section 5 Flammability Reduction

Rule Change Proposed to FAR 25.981(c)

Overview

This section offers industry comments on the proposed FAR 25.981(c) rule change within NPRM 99- 18. In this rule change, the FAA proposes that means be developed to minimize flammable vapors in fuel tanks, or prevent catastrophic damage if ignition does occur.

This proposed rulemaking responded to NTSB recommendations for reducing exposure to operation with flammable vapors in fuel tanks. Subsequent FAA and industry activity included the establishment of an Aviation Rulemaking Advisory Committee (ARAC) working group, the Fuel Tank Harmonization Working Group (FTHWG). The FTHWG recommended that the FAA initiate rulemaking action to amend §25.98 1, applicable to new type designs, to include a requirement to limit the time transport airplane fuel tanks could operate with flammable vapors in the vapor space of the tank.

The FTHWG proposed, "Limiting the development of flammable conditions in the fuel tanks, based on the intended fuel types, to less than 7 percent of the expected fleet operational time, or providing means to mitigate the effects of an ignition of fuel vapors within the fuel tanks such that any damage caused by an ignition will not prevent continued safe flight and landing." The group indicated that the intent of this requirement was "to address flammability mitigation as a new layer of protection to the fuel system."

In NPRM 99-18, the FAA proposes the following rule text:

§ 25.981 — Fuel Tank Ignition Prevention

(c) The fuel tank installation must include—

(1) Means to minimize the development of flammable vapors in the fuel tanks; or

(2) Means to mitigate the effects of an ignition of fuel vapors within fuel tanks such that no damage caused by an ignition will prevent continued safe flight and landing.

About the intent of 525.981 (c)

In the preamble of NPRM 99-l 8, the FAA discusses its intent in proposing the new 25.98 1 (c) rule. A number of different statements are made including:

The FAA agrees with the intent of the recommended regulatory text recommended by the ARAC. (line 880)

About the intent of §25.981 (c) (cont'd)

. ..the FAA is proposing a more objective regulation that is intended to minimize exposure to operation with flammable conditions in the fuel tanks. (lines 886-887)

. . .certain design methods.. .increase the likelihood that flammable vapors will develop in the fuel tanks (lines 891–893).... Therefore, in order to preclude the future use of such design practices, this proposal would revise 25.981 to add a requirement that fuel tank installations be designed to minimize the development of vapors in the fuel tanks. (lines 896-898)

This proposal is not intended to prevent the development of flammable vapors in fuel tanks because total prevention has currently not been found to be feasible. Rather, it is intended as an interim measure to preclude, in new designs, the use of design methods that result in a relatively high likelihood that flammable vapors will develop in fuel tanks when other practicable design methods are available that can reduce the likelihood of such development. (lines 901-905)

The intent of the proposal is to require that fuel tanks are not heated, and cool at a rate equivalent to that of a wing tank in the transport airplane being evaluated. (lines 910-911)

The industry agrees *in principle*

The industry agrees *in principle* with the FAA's overall intent to enhance the fuel system safety of future aircraft designs through measures to reduce fuel tank flammability exposure. The industry agrees that action should be taken, as identified by the ARAC FTHWG, "to address flammability mitigation as a new layer of protection to the fuel system." The industry further agrees that §25.98 1 (c) should not be retroactively applied to existing type certifications, as that has not been shown to be practical.

The following discussion highlights concerns that the industry has with the proposed 25.98 1 (c) regulation, and then presents several practical alternatives that should be considered.

About the NPRM and ARAC proposals

As previously stated, the intent of the ARAC FTHWG proposed regulation was "to address flammability mitigation as a new layer of protection to the fuel system." Requiring that fuel tank flammability be limited "to less than 7 percent of the expected fleet operational time" would allow compliance to be demonstrated in a quantifiable manner. However, ongoing studies of fuel tank flammability have demonstrated that means to reliably quantify exposure to flammable fuel vapors do not currently exist. The FAA's Fuel Flammability Task Group, coordinated through the FAA Technical Center in Atlantic City, stated in its final report (DOT/FAA/AR-98/26), "Th[is] report cannot offer a single definitive answer to the question of when fuel tanks contain flammable

About the NPRM and ARAC proposals (cont'd)

vapor, but it does identify the research necessary for a better understanding of fuel flammability in aircraft fuel tanks."

The FAA's proposed rule to require "means to minimize the development of flammable fuel vapors in fuel tanks" is also problematic. The use of the term *minimize*, coupled with the uncertainty of when fuel tanks contain flammable vapor, would result in a highly ambiguous rule. Findings of compliance with such a rule would be highly subjective, creating considerable uncertainty for the applicant. The FAA observes in the preamble of NPRM 99-l 8 that, it having been recommended by the ARAC FTHWG to "continue to evaluate means for minimizing the development of flammable vapors within the fuel tanks," the "[d]evelopment of a definitive standard to address this recommendation will require a significant research effort that will likely take some time to complete." (line 888-891)

The industry recommends...

Therefore, if the proposed rule is to be based upon the flammability of jet fuel, the industry believes that this rule should be postponed until a definitive, industry-recognized standard for assessing flammability is available.

The industry recommends that the FAA continue research to define practical standards by which to evaluate fuel tank flammability. This research should include evaluating the benefits of further flammability reduction as well as the potential costs of achieving such a reduction.

This research could be performed in alliance with the industry through an ARAC committee. The desired outcome would be the definition of standards for assessing flammability. The availability of quantifiable flammability limits would in turn allow the development of practical, beneficial regulation.

In addition to recommending that implementation of a flammability rule be delayed until the supporting studies are complete, we recommend that the FAA harmonize this rule with non-U.S. regulatory authorities before it is proposed (see Section 2 for a discussion of the benefits of harmonization).

A practical alternative

In the near term, a more meaningful rule could be proposed that would accomplish some degree of flammability reduction even though a definitive flammability standard does not exist. The industry suggests the current proposed rule be redefined to require *practical* measures to reduce heat transfer from adjacent heat sources into fuel tanks.

A practical alternative (cont'd)

This approach is consistent with the FAA's NPRM preamble statement that the proposed rule ". ..is not intended to prevent the development of flammable vapors in fuel tanks because total prevention has currently not been found to be feasible. Rather, it is intended as an interim measure to preclude, in new designs, the use of design methods that result in a relatively high likelihood that flammable vapors will develop in fuel tanks when other practicable design methods are available that can reduce the likelihood of such development." (line 90 l-905)

The industry believes that this approach can be accomplished under the following proposed rule:

§25.981 (c):

If systems adjacent to fuel tanks could cause significant heat transfer to the tanks:

1) Means to reduce heating of fuel tanks by adjacent systems shall be provided; or...
2) Equivalent flammability reduction means shall be provided to offset flammability increases that would otherwise result from heating; or.. .
3) Means to mitigate the effects of an ignition of fuel vapors within fuel tanks shall be provided such that no damage caused by an ignition will prevent continued safe flight and landing.

About the industry's proposal

The industry's proposed rule avoids the current difficulties of assessing the level of fuel tank flammability and, at the same time, is responsive to the issue of fuel tank heating resulting from adjacent heat sources such as air-conditioning packs. The ARAC FTHWG evaluated various means of reducing fuel tank heating and concluded that approaches such as directed ventilation could provide a meaningful reduction in the fleet average exposure to flammable fuel vapors.

This approach is consistent with the NPRM statement that "[t] he proposal would, however, require that practical means, such as transferring heat from the fuel tank (e.g., use of ventilation or cooling air), be incorporated into the airplane design if heat sources were placed in or near the fuel tanks that significantly increased the formation of flammable fuel vapors in the tank. . .." (line 906-909).

The industry does not, however, agree with the FAA statement that "[t]he intent of the proposal is to require that fuel tanks are not heated, and cool at a rate equivalent to that of a wing tank in the transport airplane being evaluated"

About the industry's proposal (cont'd)

(line 9 1 O-9 11). For example, directed ventilation systems may *reduce* heating of adjacent fuel tanks, but they do not *eliminate* heating. Furthermore, there should be no requirement to "cool at a rate equivalent to that of a wing tank." The studies conducted by the ARAC FTHWG did not conclude that such a requirement was necessary or achievable.

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Section 6 Maintenance/Continued Airworthiness

Rule Change Proposed to FAR 25.981(b) and Appendix H25.4

Overview

This section addresses the proposed FAR 25 rule change as it affects the maintainability and continued airworthiness of the aircraft fuel system.

In NPRM 99-18, the FAA proposes the following rule text, which the industry has classified under the Maintenance/Continued Airworthiness heading:

§ 25.981 — Fuel Tank Ignition Prevention

(b) Based on the evaluations required by this section, critical design configuration control limitations, inspections or other procedures must be established as **necessary** to prevent development of ignition sources within the fuel tank system and must be included in the Airworthiness Limitations section of the ICA required by § 25.1529. Placards, decals or other visible means must be placed in areas of the airplane where maintenance, repairs or alterations may violate the critical design configuration limitations.

H25.4 — *Airworthiness Limitations* section

(a) The Instructions for Continued Airworthiness must contain a section titled Airworthiness Limitations that is segregated and clearly distinguishable from the rest of the document. This section must set forth—

(1) Each mandatory replacement time, structural inspection interval, and related structural inspection procedures approved under §25.571; and

(2) Each mandatory replacement time, inspection interval, related inspection procedure, and all critical design configuration control limitations approved under § 25.981 for the fuel tank system.

(b) If the Instructions for Continued Airworthiness consist of multiple documents, the section required by this paragraph must be included in the principle manual. This section must contain a legible statement in a prominent location that reads: "The Airworthiness Limitations section is FAA-approved and specifies maintenance required under §§ 43.16 and 91.403 of the Federal Aviation Regulations, unless an alternative program has been FAA approved."

Overall intent of §25.981(b) and Appendix H25.4

The FAA states (lines 277-278) that "the development of an ignition source inside the fuel tank may be related to both the design and maintenance of the fuel tank systems." The FAA goes on to state (lines 63 l-634) that, "The proposed SFAR would require that the design-approval holder develop any

Overall intent of §25.981(b) and Appendix H25.4 (cont'd)

specific maintenance and inspection instructions necessary to maintain the design features required to preclude the existence or development of an ignition source within the fuel tank. These instructions would have to be established to ensure that an ignition source will not develop throughout the remaining operational life of the airplane."

The industry agrees in principle

The industry agrees that the maintainability requirements of FAR 25 that are applicable to fuel tank systems need to be examined. We further agree that specific maintenance and inspection instruction enhancements should be developed such that they are valid over the operational life of the aircraft.

Specific areas of industry concern

However, the industry disagrees with many terms proposed by NPRM 99-l 8 to accomplish these objectives. Specifically, the industry feels that:

- The proposed methodology is impractical.
- Industry practices are at times ignored.
- Efforts by other related working groups are not coordinated.
- Proprietary design features incorporated by the design holders are put at risk of being made public to protect inadequacies in current modification approval procedures.
- The rule ultimately makes the original equipment manufacturer (OEM) liable for the change done to the aircraft, even if the OEM is not involved in the change (e.g., STC modifications performed by outside firms or airlines).

The rest of this document section presents an examination of the components of the FAA maintenance/continued airworthiness proposals and the practical alternatives proposed by the industry to achieve the same goals.

About maintenance program development and approval

The industry has significant reservations about the process for maintenance program development and approval as proposed by the FAA. To this end, the following subjects are addressed:

- The concepts of *check, inspection, overhaul,* and *fail-safe.*
- The current processes.
- Ongoing industry work.

About *check, inspection, overhaul,* and *fail-safe*

The maintenance program development and approval process, as delineated in NPRM 99- 18 (lines 248–259), contains inaccuracies. The industry offers the following corrections to help the FAA with definitions and principles that are central to this proposed process.

For example, the concepts of *check, inspection, overhaul,* and *fail-safe* are incorrectly portrayed in the statement:

> Historically, for fuel tank systems these required programs include operational checks (e.g., pre-flight and en-route), functional checks following maintenance actions (e.g., component replacement), overhaul of certain components to prevent dispatch delays, and general zonal visual inspections conducted concurrently with other maintenance actions, such as structural inspections.

The following clarifications are based on the FAA-accepted definitions[2] of the above terms as relates to maintenance programs:

Operational checks-tasks that are performed by maintenance personnel to confirm that a function works; these are not tasks that are performed by the flight crew during preflight checks or when en route.

Functional checks-tasks that are performed by maintenance personnel to check *how well* a function works. These are quantifiable checks and can include data measurement. It is true that these checks may also be performed after component replacement (although an operational check is more likely), but in this case, they have nothing to do with the scheduled maintenance program.

Components in relationship to the word overhaul--components are *not* overhauled to prevent dispatch delays; a restoration may be considered applicable and effective to maintain a function (see MSG-3 guidelines). This function may or may not be associated with the minimum equipment list (MEL). Other maintenance tasks may also contribute to the reduction of dispatch delays.

General zonal visual inspection (GZVI)—this term and its meaning are incorrect. The proper industry term is *general visual inspections* (GVI). In Maintenance Review Board (MRB) report development, credit may be taken for GVIs performed as part of the *Zonal Inspection Program* to satisfy certain structural (and systems) inspections. A GVI may be scheduled concurrently with a structural inspection if the latter occurs before the GVI interval is reached (thus avoiding needing access twice).

Lines 258-260 go on to state the FAA's interpretation of the role of specific maintenance instructions: "However, specific maintenance instructions to

[2] As formalized in AC 12 1-22A and MSG-3.

About *check, inspection, overhaul,* and *fail-safe* (cont'd)

detect and correct conditions that degrade fail-safe capabilities have not been deemed necessary because it has been assumed that the original fail-safe capabilities would not be degraded in-service."

Manufacturers design to ensure that sufficient capability remains to ensure the continued airworthiness of fail-safe designs. However, it is recognized that situations may exist where this is not practical or service experience reveals unforeseen conditions. In such situations, specific maintenance instructions to detect and correct degrading conditions may be necessary.

About current processes

Today, each manufacturer develops an initial aircraft-system maintenance program via:

- The MRB process by means of an MSG-3 analysis.
- Certification Maintenance Requirements (CMR) process by means of, for example, System Safety Assessment (SSA).

The MRB process is defined by AC 12 1-22A. The outcome of this process is the MRB report, which "outlines the initial scheduled maintenance/inspection requirements to be used in the development of an approved continuous air-worthiness maintenance program for the airframe, engines (on-wing engine only), systems, and components.. . . These MRB requirements are a basis from which each air carrier develops its own continuous airworthiness maintenance program."[3] This process yields maintenance tasks performed for safety, operational, or economic reasons, involving both preventative maintenance tasks, which are performed before failure occurs (and are intended to prevent failures), as well as failure-finding tasks." The FAA (AEG branch) directly participates in the MRB report development and approval process.

The CMR process is defined in AC 25-19. CMRs are developed in the type certification process within the realm of the 525.1309 analysis (quantitative or qualitative). The "CMRs usually result from a formal, numerical analysis conducted to show compliance with catastrophic or hazardous failure conditions as defined in paragraph 6b of AC 25- 19." CMRs are "designed to verify that a certain failure has or has not occurred and *do not* provide any preventative maintenance function." They "exist solely to limit the exposure to otherwise hidden failures."

[3] AC 121-22A, page 11, g (1).

About current processes (cont'd)

The Certification Maintenance Coordination Committee (CMCC), a joint authority/operator/manufacturer committee, is formed to jointly decide if the identified item should be a CMR task or whether it is adequately controlled as an existing MRB report task. Provisions to have an alternative to a given CMR that would satisfy the intent of the CMR while allowing reduced operational impact are allowed via AC 25-19 guidelines. The final list of CMRs is added as an appendix in the MRB report.

The flow chart below is repeated from FAA AC 25- 19 to illustrate the inter-relationship between the MRB and CMR processes.

Figure 1: SCHEDULED MAINTENANCE TASK DEVELOPMENT

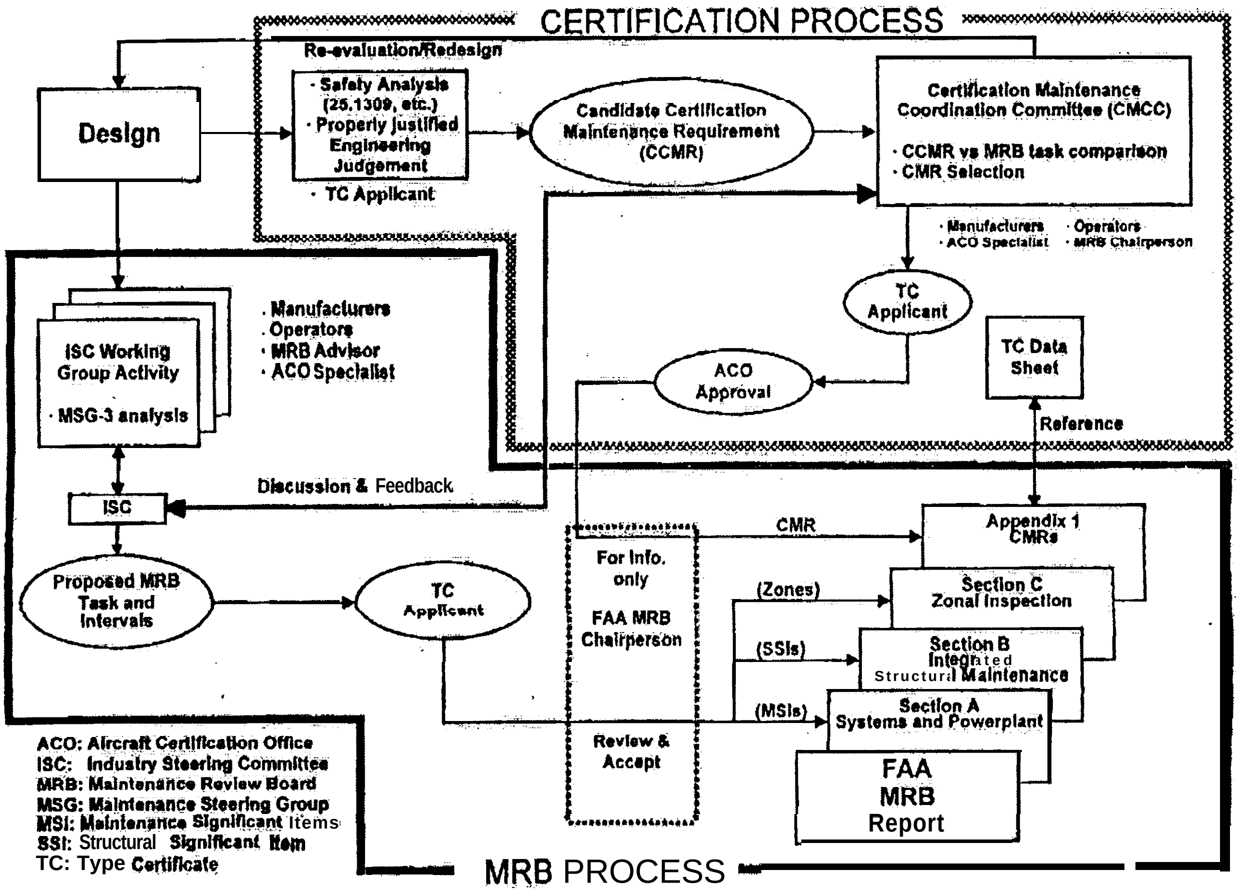

Figure 1

About current processes (cont'd)

Manufacturer-recommended standard practices must also be considered in the development of the maintenance program. These practices, which cover such elements as wiring installation, are the method whereby the manufacturers ensure that essential information will be evident to those who may perform maintenance, repairs, or alterations.

Thus, the manufacturer-recommended standard practices process provides a proven mechanism that already exists to address the FAA concern that, "...essential information will be evident to those that may perform and approve such repairs and alterations" (lines 874-875). Operators use manufacturer-recommended standard practices information when planning or performing maintenance tasks. These practices are usually documented in the Aircraft Maintenance Manual.

About ongoing industry work

NPRM 99-18 appears to overlook efforts currently being performed within the industry, notably the work of the:

- **ATSRAC Task 3 subcommittee-this** subcommittee is charged with addressing maintenance criteria; its initial focus is on wiring and bonding, but its subsequent recommendations will be applicable to all aircraft zones including fuel tanks.
- **ATA working group that is updating MSG-3 guidelines—** this group is actively defining an appropriate logic with which to address aging systems and lightning/HIRF; they are also clarifying the definition of GVI and will propose guidance on what should be found and addressed during a GVI. This group is supporting the work of ATSRAC Task 3.

The need is self-evident for the NPRM 99-l 8 FAA development team to work in the same direction. This evident need applies particularly to the logic used to identify applicable tasks and intervals, and the means to promulgate these new requirements.

Valuable knowledge and processes already exist

The FAA states (lines 561-562) that its review, ". . .indicates that aging of fuel tank system components and unforeseen fuel tank system failures and mal-functions have become a safety issue.. . ." It adds that this "indication" can be reversed by four actions, one being to "impose operational requirements so that any maintenance or inspection actions will be included in each operator's FAA-approved program" (lines 577-578).

Valuable knowledge and processes already exist (cont'd)

The industry agrees with the FAA that maintenance of the fuel tank systems of the world fleet can be improved. This improvement may be gained by:

- Using the MRB process as defined in AC 12 1-22A and the CMR process defined in AC 25- 19.
- Taking advantage of work performed by the FAA's ATSRAC (aging systems) Task 3 subcommittee and ATA's MSG-3 review group.
- Using findings of the industry Fuel Systems Safety Program (FSSP).
- Creating regulations that improve the visibility and accountability of the existing process.

Consequent industry beliefs

The industry does not believe that the overall safety record of fuel systems warrants a unique method of maintenance-program definition.

Instead, we believe that the FAA should merge all of the industry's efforts dealing with how to improve the way in which maintenance programs are developed and implemented.

We further believe that the FAA and the industry should work together to define a unified treatment for *all* critical airplane systems.

Alternative maintenance-program development method

The previous sections have explained how the existing systems and processes can provide the safety enhancement sought by both the FAA and the industry. Various sections of this document have also shown that important benefits await the FAA if it elects to avail itself of

- Work that has already been performed via the MRB process.
- Lessons learned from inspections performed over the last few years, either through ADs or through the Fuel Systems Safety Program.
- Recommendations made by other working groups (e.g., ATSRAC).
- Extensive expertise within the industry (operators and OEMs) as well as within the FAA itself (ACO and AEG).

Considering the above, the industry believes that the only way to produce a fuel tank maintenance program that enhances safety and remains economically feasible is to use the Certification Maintenance Coordination Committee (CMCC) as defined in the AC 25-19 diagram titled *Scheduled Maintenance Task Development (see* figure 1).

Alternative maintenance-program development method (cont'd)

The industry suggests that a CMCC be held for each aircraft model under investigation within the SFAR. Some general guidelines are as follows:

- Once the OEM has completed and reviewed its technical findings with the FAA ACO (or equivalent), the OEM or the FAA should organize the CMCC.
- The CMCC is convened with participants including the FAA ACO, the FAA AEG, the OEM (or STC), and the operators.
- Upon completion of the CMCC, the OEM should prepare the final maintenance program for submittal to the FAA as part of SFAR No. XX compliance.

The OEMs estimate that this process, which occurs after completion of the design review, should take 6 to 8 months and should be included in the overall compliance plan for SFAR No. XX. See Section 7, Maintenance Operations, for further discussion of this topic.

Industry comments on 525.981 (b)

The industry herewith presents its comments on the proposed §25.98 1 (b) rule change and associated preamble material, which introduce three concepts:

- The notion of "critical design configuration control limitations."
- Creation of a new part in the Airworthiness Limitation section of the ICA ($25.1529) addressing the prevention of development of ignition sources within the fuel tank system.
- Mandatory placement of placards, decalsm or other visible means in areas of the airplane where maintenance, repairs, or alterations may violate the critical design configuration limitations.

Critical design configuration control limitations

NPRM 99-l 8, lines 869-872, define critical design configuration control limitations as follows:

> Critical design configuration control limitations include any information necessary to maintain those design features that have been defined in the original type design as needed to preclude development of ignition sources. This information is essential to ensure that maintenance, repairs or alterations do not unintentionally violate the integrity of the original fuel **tank system type design.**

Within this definition, the industry interprets "any information necessary" as being not only the provision of maintenance and inspection instructions, but also the provision of the fuel tank design features itself, including material specifications, specific manufacturing process, dimensions, and so on (those features that are presented and substantiated in the type certification process).

Critical design configuration control limitations (cont'd)

NPRM 99- 18 (lines 866467) further says that the §25.98 1 (b) "...requirement would be similar to that contained in §25.57 1 for airplane structure." When examining §25.571, the industry notes that just "inspections or other procedures must be established, as necessary, to prevent catastrophic failure and must be included in the Airworthiness Limitations Section of the Instructions for Continued Airworthiness required by §25.1529."

Specifics as to how to establish these inspections are then provided. §25.571 does not use general terms like "any information" or "design features," and it does not put in question the approved airplane configuration by making the OEM list parts or features of those parts that contribute to the defined limits.

The industry finds that it cannot agree with the definition of *configuration control limitations* as proposed by the FAA because it:

- Requires the type certificate holder to list its proprietary design approach; this requirement leads to a loss of competitive edge and an infringement on proprietary intellectual property.
- Puts an unprecedented liability risk on the type certificate holder if it omits some features, either through error or because it did not realize a supplementary function provided by the features.
- Goes beyond the notion of inspection and maintenance and does not imply the same compliance requirement as §25.57 1, which is the FAA's stated precedent for this new rule.
- Goes against standard industry practice regarding what should be provided to the user.
- Attempts to cover deficiencies in the STC and the airline modification approval process by indirectly implicating the OEM in changes to the certified configuration that the OEM did not perform, and of which the OEM has no knowledge.

About proprietary knowledge

NPRM 99-l 8 proposes that the OEMs make public proprietary knowledge. The industry rejects this requirement because it would sacrifice the hard-earned competitive advantage that the OEMs derive through their expertise and continuing investment in research and development.

Specifically, the industry *does not agree* that it is appropriate or necessary to define in the public domain any proprietary features of fuel tank design. The same concern would apply to the listing of features of its approved parts. For

About proprietary knowledge (cont'd)

example, if a certain pump is qualified on the airplane, the industry does not believe it is appropriate or necessary to list all of the features inherent to that pump itself that were qualified as part of the unit's approval. This approved parts list and the associated installation and maintenance manuals suffice for maintaining the airworthiness of this pump.

If any operator wishes to install an alternative part or installation, then it is the approving authority's responsibility to ensure that the proposed replacement is equivalent in safety to that already-approved, OEM-installed part.

The industry's proposed alternative approach

However, the industry would consider:

- Requiring that inspections or other procedures be established, as necessary, to maintain the conventional design features that inherently prevent an ignition source from developing.
- Removing the notion of critical design configuration limitations.
- Using existing processes to define, document, and manage the inspection and maintenance program.
- Improving the zonal and general visual inspections as necessary.

As the above suggests, the industry believes that safety can be enhanced via existing processes according to §25.1529 and AC 25-19 (CMR or AD) and by an improvement in the definition of a general visual inspection (GVI), such as is now being pursued by the FAA's ATSRAC (aging systems) Task 3 sub-committee. This alternative industry approach would eliminate the need for the §25.98 1 (b) text currently proposed by the FAA. See below in this section for further discussion of the industry's Appendix H proposal.

Because safety can be enhanced using existing processes, as described above, the industry further believes strongly that no new document needs to be created to identify and list Airworthiness Limitations associated with the fuel system. Today the FAA ACO approves Airworthiness Limitation sections that typically comprise three documents:

- The Airworthiness Limitation Items document (for repetitive structural inspections).
- The AMM 05- 10 (for mandatory structural-replacement times).
- The CMR document (for repetitive systems tasks).

The industry's proposed alternative approach (cont'd)

A review of these documents with respect to NPRM 99- 18 confirms that a new document is not required for comprehensive fuel system maintenance or inspection tasks. Mandatory maintenance tasks can instead be introduced using current industry practices:

- For any aircraft with an existing CMR document, the CMR document may be used to transmit any new mandatory task arising from reevaluation of fuel system design.
- For any aircraft not having a CMR document, an inspection service bulletin covered by an AD may be used to transmit any new mandatory task.

Therefore, the industry reiterates its recommendation to remove §25.981(b) from the proposed rule text.

About placards and decals

The preamble of NPRM 99-18 states (lines 874-878) that:

> The original design approval holder must define a method of ensuring that this essential information will be evident to those that perform and approve such repairs and alterations. Placards, decals, or other visible means must be placed in areas of the airplane where these repair or alteration actions may degrade the integrity of the design configuration. In addition, this information should be communicated by statements in appropriate manuals, such as Wiring Diagram Manuals.

The industry agrees that adequate information regarding general design practices and precautions must be available to those who perform and approve repairs and alterations to the airplane. However, placards and decals may not be practical considering that that they might not remain in place or be readable over time.

The industry believes a more effective way to convey fuel system general practices information to operators is via the standard-practices section of the Aircraft Maintenance Manual (or a similar section of another manual). The ideal concept would be to assimilate all fuel system general practices into one place that anyone modifying any ATA system would consult to determine the manufacturer's recommended practices. Existing procedures to document approved parts (e.g., the Illustrated Parts Catalog or Component Maintenance Manual), as well as their proper use, will suffice in most instances to ensure aircraft configuration.

The industry agrees that fuel quantity indicating system (FQIS) wiring might be better identified. Operators have suggested that the OEMs work with the appropriate agencies to develop

About placards and decals (cont'd)

a standardized system to identify critical fuel systems wiring on aircraft. This identification system would be used in future designs. A precedent for this type of identification is provided by oxygen lines.

In summary, the industry believes that the above actions will enhance safety in a much more practical way than that proposed by the FAA. Therefore, we take exception with the FAA proposal to use placards, decals, or other visible means inside or outside the fuel system to notify operators of design guidelines, design precautions, wire routes, and so on.

Accordingly, the industry recommends that:

- §25.981(b) be deleted from the proposed rule text.
- Consideration be given to specially identifying FQIS wiring, following the precedent set by oxygen lines.

Industry comments on Appendix H25.4

Paragraphs (a), (a)(1) and (b) of the proposed revision to Appendix H25.4, Airworthiness Limitation section, are identical to the existing regulations. The industry considers them adequate and has no comments about them. However, in NPRM 99-18, the FAA also proposes adding a new paragraph, this being §(a)(2).

> (a) The Instructions for Continued Airworthiness must contain a section titled Airworthiness Limitations that is segregated and clearly distinguishable from the rest of the document. This section must set forth-
>
> (2) Each mandatory replacement time, inspection interval, related inspection procedure, and all critical design configuration control limitations approved under § 25.981 for the fuel tank system.

The industry disagrees with proposed paragraph §(a)(2) because:

- Singling out just the fuel system is not justified because all systems have their own criticalities that must be documented.
- It fails to recognize that equivalent systems-related tasks are already defined under Certification Maintenance Requirements (CMR), a process that has been in place since the early 1980s and formalized in 1994. The CMR is considered the systems equivalent of the structural airworthiness limitation and is part of today's certification process even though it is not included in the FAR/JAR 25 (the FAA ACO and other prime certifying authorities regularly approve CMRs, and all operators' maintenance programs use these same CMRs).

Industry comments on Appendix H25.4 (cont'd)

- It indirectly regroups all maintenance tasks associated with the prevention of fuel tank ignition sources under the responsibility of the ACO and undermines the MRB process and the FAA AEG's responsibility in approving maintenance programs.

In light of the above, the industry does not fully understand why the FAA is proposing Appendix H25.4 §(a)(2). Rather than regulate the CMR concept system by system, the industry feels that it would make far more sense for the FAA to pursue a separate regulatory initiative leading to official recognition of the CMR. Doing so would fix a long-standing regulatory deficiency.

The advantages of such an alternative rulemaking approach is that it would:

- Keep current procedures and processes in place and avoid the creation of another bureaucratic approval process.
- Accomplish the FAA objective of requiring manufacturers to create an Airworthiness Limitation section in the ICA similar to that approved under §25.571 for structure (lines 202-206).
- Eliminate the need to enforce mandatory inspection or other procedures via §25.98 1 (b).

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Section 7 Maintenance Operations

Rule Change Proposed to FAR 91.410, FAR 121.370, FAR 125.248, and FAR 129.14

Overview

This section provides industry comments on the maintenance operations rule changes proposed in NPRM 99-18. These comments specifically address:

- The intent of the proposed rule.
- Development or modification of a maintenance and inspection program.
- Approval of the revised maintenance and inspection program.
- Compliance time.
- Application of the program.

About the proposed rule changes

NPRM 99-18 includes three FARs (91.410, 121.370, and 125.248) that all share the title "Fuel Tank System Maintenance and Inspection Instructions." These proposed new FARs state:

> After [18 months after the effective date of the final rule], no certificate holder may operate a turbine-powered transport category airplane with a type certificate issued after January 1, 1958, and a maximum type certificated passenger capacity of 30 or more, or a maximum type certificated payload capacity of 7500 pounds or more, unless instructions for maintenance and inspection of the fuel tank system are incorporated in its maintenance program. Those instructions must be approved by the Administrator. Thereafter, the approved instructions can be revised only with the Approval of the Administrator.

In contrast, FAR 129.14 (c), titled "Maintenance Program and Minimum Equipment List Requirements for U.S.-Registered Airplanes," reads slightly differently, as shown below, although the actual requirement is identical:

> (c) For turbine-powered transport category airplanes with a type certificate issued after January 1, 1958, a maximum type certificated passenger capacity of 30 or more, or a maximum type certificated payload capacity of 7500 pounds or more, no later than [18 months after the effective date of the final rule], the program required by paragraph (a) of this section must include instructions for maintenance and inspection of the fuel tank systems. Those instructions must be approved by the Administrator. Thereafter, the approved instructions can be revised only with the Approval of the Administrator.

Intent of these proposed rule changes

The overall intent of the proposed FAR 9 1, 12 1, 125, and 129 rule changes is to require that operators revisit and revise, as necessary, the fuel tank system maintenance and inspection program.

The FAA states that the revised maintenance and inspection program should be developed, approved, and implemented by the operators within 18 months after the effective date of the final rule.

The preamble section, "Proposed Operating Requirements" (lines 729–806), details the FAA's perception of how the revised maintenance program should be established, approved, and implemented.

The industry agrees *in principle*

The industry agrees *in principle* with the intent behind these proposed rule changes. We support the concept of reviewing and revising, as necessary, the fuel tank system maintenance and inspection program.

However, the industry disagrees with the FAA's proposed methodology and time frame for fulfilling this intent. Therefore, an alternative approach for implementing the new or revised maintenance program is presented below.

Maintenance and inspection program development and modification

Today, all airplanes effected by NPRM 99- 18 have an associated FAA-approved maintenance and inspection program.

The specific procedure used to develop each manufacturer's recommended maintenance and inspection program varies due to the evolution of the FAR 25 type certification basis of the aircraft as well as of the MRB process and MSG guidelines. Nevertheless, every procedure has elements in common:

- The manufacturers' recommended maintenance and inspection programs serve as the basis for developing operators' individual maintenance and inspection programs.
- Safety issues are identified and addressed at both the type certification and continued-airworthiness levels.
- The FAA has internal processes for managing the approval of manufacturer-developed maintenance and inspections programs, safety tasks, and the final individual-operator maintenance and inspection programs.

See Section 6, Maintenance/Continued Airworthiness, for more information.

About the existing process

As described above, existing maintenance and inspection programs approved under FAR Parts 91, 12 1, 125, and 129 are based on a foundation of factual information derived from various sources using a defined process.

It appears to the industry that dissolution of this existing process to meet a calendar deadline will *not* lead to a safety enhancement. Instead, we believe that for safety to be enhanced:

- FAR 25 and AC 121-22A/MSG-3 maintenance-program development processes must be followed. The technical concerns and information obtained in recent years need to be examined by all experts so as to properly define any additional maintenance tasks and their intervals (see the FAR 25 maintenance/continued airworthiness discussion).
- Any changes in OEM maintenance and inspection programs must be communicated to operators in an approved format that is compatible with the aircraft certification basis (e.g., AD, CMR, MRB).
- OEM maintenance and inspection changes should be evaluated using, as a minimum, the CMCC process as defined in AC 25-19. The purpose of this process is to ensure that tasks do not conflict and that the task classification and interval are both compatible with the overall maintenance program. This process is required in the final maintenance program. The design review will not provide sufficient time for its inclusion (FAA NPRM 99-l 8 proposes 12 months).
- Tank entries, with their potential for damage, must be minimized.
- The PMI must not be put in the position of judging whether any alternative truly satisfies the SFAR, even if the guidelines exist in AC 25.981 because the PMI will in all likelihood lack the expertise to perform the required technical evaluation.

Revision suggestions

Therefore, the industry suggests that the FAA revise its "Proposed Operating Requirements" preamble text (lines 742-783) to state that:

- Fuel tank system maintenance programs should be reexamined in context with the results of the OEM design review and the existing MRB and other mandated programs, such as the Corrosion Protection Control Program (CPCP) and the supplemental structural inspection document (SSID).
- AC 25-19 approval processes, in particular the CMCC, should be used as appropriate to determine the task classification, interval, and method of task transmission (e.g., service bulletin, existing program update).

Revision suggestions (cont'd)

It is also suggested that this "Proposed Operating Requirements" preamble text (lines 748-790) be expanded to include a description of the maintenance-program approval process as it is ultimately envisioned by the FAA.

About inspection-program approval

To obtain an approval for an operational maintenance and inspection program, the industry today interacts with the following authority organizations:

Development of the OEM maintenance and inspection program

- FAA ACO responsible for the type certification of the aircraft.
- FAAAEG.
- Non-U.S. airworthiness authority, if the FAA ACO has delegated its authority via a bilateral agreement.

Approval of the individual operator's maintenance program

- PMI.

Definition of *Administrator*

The industry defines the authorities listed above to be *the Administrator* of the aircraft maintenance and inspection programs, including the fuel system portion. This industry understanding is consistent with the FAR 1 (§ 1.1) definition: "*Administrator* means the Federal Aviation Administrator or any person to whom he has delegated his authority in the matter concerned."

The roles of the MRB process and PMI-as defined by FAR 25 AC 25-19— are specified in the various FARs with respect to maintenance and inspection program development. Therefore, the industry objects to the inconsistent definition proposed by NPRM 99- 18 (lines 740-74 1), which identifies "the Administrator" as "the manager of the cognizant FAA ACO." Instead, the industry requests that the FAA revise its proposed rulemaking to reflect the formalized, industry-recognized roles of the above-named authority entities.

Along with the revision of the definition, the industry also recommends that the FAR 9 1, 12 1, 125, and 129 rule texts be revised to remove the sentence, "Thereafter, the approved instructions can be revised only with the Approval of the Administrator." This recommendation is offered because the sentence is redundant with respect to the information provided in FAR 25. Once the maintenance program is identified, including task classification, the guidelines for program revision are self-explanatory.

The sentence, "These instructions must be approved by the Administrator," should remain as is.

About the compliance time frame

The industry takes exception to NPRM 99-l 8's proposed compliance time frame for incorporating any new instructions into maintenance and inspection programs. Specifically, the industry disagrees with the proposed:

- Criteria used to start the clock (the effective date of the final rule).
- Time allotted to accomplish the rule (18 months).

Criteria for starting the clock

Fuel tank system maintenance programs already exist, as previously stated. The maintenance-operations initiative proposed by NPRM 99-l 8 is seeking enhancements to these extant programs, which are based on known technical information. Without the additional insights that will be gained through the SFAR design review assessment process (see Section 3), any generalized attempt to accurately revise the existing maintenance and inspection programs will be suboptimal or counterproductive with respect to NPRM 99-l 8's goals.

It is a fact that each entry into a fuel tank creates the risk of collateral damage. Going in to look for something without a certainty of what it is and why it is being looked at is not an effective safety enhancement.

It must also be recognized that completion of the design reviews and development of the manufacturers' maintenance programs must be sequenced.

For these two reasons, the industry proposes that the clock start running once the design review and manufacturers' maintenance program for the specific airplane model are completed and approved by the FAA. This completion date is subject to negotiation between the FAA ACO and the OEM. It should be noted that if this industry proposal is not accepted, then operators will be put in jeopardy of penalties for a situation that is beyond their control.

Time allotted to accomplish this rule

The FAA should consider that effective maintenance program development cannot practically start until completion of the SFAR No. XX design review. Once the design review is completed, the OEM must develop the OEM maintenance program (in coordination with the operators and regulatory agencies, using the processes that have been discussed herein). The OEM maintenance program must then be approved. The operator must then take this approved maintenance program and develop his specific maintenance program that in turn must be approved by his PMT. Upon approval by the PMI, the operator must then develop the necessary work documents. If one accepts that completion and approval of a design review for any one aircraft type will require approximately 12 months (see Section 3), the remaining six months (18 months – 12 months) is simply inadequate to develop the

Time allotted to accomplish this rule (cont'd)

maintenance program through its necessary steps. When one considers the applicability of the proposed SFAR No. XX, the situation becomes totally unmanageable.

The FAA establishes compliance times to ensure that industry organizations act within a given period of time to achieve stated goals. With this in mind, the industry proposes that individual time frames be associated with each step in the NPRM process. In this way, the NPRM objective can be accomplished in a timely manner without unduly penalizing any entity or organization.

The tables below illustrate the industry's proposed time frames for structuring and controlling the development and implementation of the fuel tank system maintenance and inspection program for each affected TC or STC included in the current FAA rule proposals:

***a. OEM* actions**

Step	Estimated time for completion
Design review completion and approval	End date set by the FAA ACO and the OEM or STC holder
Maintenance program review / revision and submittal to the FAA	6 to 8 months after SFAR No. XX is completed
Approval of the revised program by the FAA (ACO and AEG)	Completion time unknown

b. Operator actions

Step	Estimated time for completion
Individual operator maintenance program development	Approval of OEM program starts clock of individual operator maintenance program, then 4 to 6 months
Approval of the maintenance program by the PMI	2 to 3 months
Develop necessary work documents based on the PMI-approved maintenance program information	6 months

Time allotted to accomplish this rule (cont'd)

Other factors further support this industry proposal, as outlined above, for extending the compliance times, these being:

- An inspection procedure may need to be developed for a newly identified task (e.g., NDT, bond testing, fault current).
- Any tooling for these items may be difficult to obtain because all operators will need to incorporate the inspections into their programs.

Alternative proposal for maintenance-program application

The industry strongly recommends that the requirements to incorporate a new or revised fuel system maintenance program be uncoupled from the OEM and STC design review process also called for in NPRM 99-l 8.

The arguments presented herewith clearly illustrate that to achieve the safety-initiative objective, input is needed from the OEMs and the STC holders.

The FAA states that, "The FAA intends that any additional fuel tank system inspection and maintenance actions resulting from the SFAR review would occur during an airplane's regularly scheduled major maintenance checks" (lines 1041-1042). However, the industry feels that this statement is merely an expression of intent, and that if the design review were to determine that an inspection were needed more often, then this statement would become irrelevant.

Of course, negation of the statement would change the FAA's cost estimate. For example, operators would need significant additional airplane downtime to accomplish the maintenance and inspection program if the application date or the repeated inspection tasks did not coincide with the airplane's scheduled major overhauls. It should be noted that any tank entry requires a minimum of 24 hours of downtime to open, purge, and close the fuel tanks. Therefore, mandating tank entries between major overhauls would significantly increase cost for operators by disrupting maintenance planning and reducing the time that airplanes are available for revenue service.

If the FAA wishes to implement a *practical* maintenance program, including:

- Formulation of individual operators' programs.
- Approval of the programs by the PMT.
- Plan implementation (including provision for a bridge program in case the new program does not line up with major layups).

Alternative proposal for maintenance-program application (cont'd)

. ..then the industry recommends that:

- The FAA cancel its FAR Parts 91, 12 1, 125, and 129 rule-change initiative.

. . .and, as previously discussed in Section 6 of this document:

- For existing aircraft, the OEMs issue service bulletins or documents similar to SID documents, to be mandated by FAA ADs.
- For new aircraft designs, the standard AC 25- 19 procedures, and MRB report developed from MSG-3 and the certification process (systems safety assessment), be used.

The AD should be issued after completion and approval of the OEM's or the STC holder's SFAR design and maintenance program review and should contain the approved program, a cost associated with this program, and a realistic implementation timetable. The industry recommends that the AD should be issued per aircraft type.

The AD will allow both the FAA and the industry to:

- Assess the actual impact of the maintenance program (cost versus benefit).
- Ensure that the appropriate compliance time scale is mandated versus the effective date of the rule and the resources available.
- Ensure that foreign authorities and operators are notified of the mandatory continuing-airworthiness information via a recognized document (ICAO obligation, annex 8, paragraph 4.2.2).

Finally, it is noted here that the FAA used ADs to implement its Corrosion Protection Control Program (CPCP). The industry believes that this program offers a sound procedural precedent that the FAA might again follow to implement the fuel system safety initiatives proposed in NPRM 99- 18.

Section 8 Cost

NPRM 99-18

Overview

The proposed rulemaking encompassed by NPRM 99-l 8 is complex and far reaching. The FAA has conducted a cost/benefit assessment associated with the effects of implementing the proposals of NPRM 99-l 8.

The FAA estimates that the ***benefit*** associated with this proposed rulemaking would be "between $260 million and $520 million" (lines 990-991) in U.S. dollars. Within the framework of the FAA's benefit estimating methodology, the industry agrees with this conclusion.

In contrast, the industry has not agreed with the specifics of the proposed rulemaking and strongly disagrees with the associated costs as estimated in the NPRM. As already discussed at length in this document, the industry further believes that practical alternatives exist that would more effectively achieve the intent of this proposed rulemaking.

About the FAA cost estimate

In NPRM 99-l 8, the FAA provides its estimate of the proposed rulemaking's cost to the industry. It breaks these costs down among the following three categories and lists them as:

	Category	Estimated cost
1.	Fuel Tank System Design Assessments-New SFAR	$14.40 million
2.	Fuel Tank System Inspections-Operational Rule Changes	$154.16 million
3.	Future Fuel Tank System Design Changes-Revised Part 25	"minimal"

These costs appear to be underestimated

Based on its review of the rulemaking as proposed by the FAA, the industry is concerned that the true cost of these proposed rules may have been grossly underestimated. Given the complexity of NPRM 99- 18, the industry has not attempted to conduct a detailed cost analysis. However, aspects of the FAA's cost analysis have been identified that may be inaccurate because of erroneous or incomplete assumptions. Therefore, the industry recommends that the FAA reevaluate its cost estimate to take into account the observations made below.

General observations

The FAA is obligated to evaluate the potential cost impact of its rulemaking relative to the U.S.-registered fleet. In conducting this cost analysis, the FAA has assumed a fleet size of 6,006 airplanes as of 1996. By the time the final rulemaking is completed, the actual U.S.-registered fleet size will exceed 7,000 airplanes. More importantly, the FAA must be cognizant of the worldwide impact its rulemaking will have as other regulatory agencies adopt identical or similar rules. Thus, the true cost of this activity will far exceed the cost associated with the U.S.-registered fleet.

The industry has observed that the number of affected TCs and STCs counted by the FAA is too low. For example, neither the Fokker F 50 nor the Boeing 717 appears on the FAA's list. It would also appear that the FAA's listing of ATA 28 STCs is incomplete. For example, there are no ATA 28 STCs listed for any Airbus, Fokker, Bombardier, or Aerospatiale models.

The industry agrees with the FAA that just a small number of non-fuel-system STCs will require a system assessment. However, the FAA analysis does not account for the significant effort and associated cost that would be required to determine whether or not these non-ATA 28 STCs affect the fuel system and thus merit further attention.

In the "Regulatory Evaluation" section of NPRM 99-18, the FAA states, "Many STC holders would be able to incorporate a large portion of a TC holder's fuel tank system assessment into its assessment." In fact, the release of such proprietary information to a third party would need to occur under a technical assistance contract, the cost of which should be added to the FAA cost analysis.

About SFAR design review costs

The first category of estimated costs identified by the FAA is the "Cost of Fuel Tank System Design Assessments-New SFAR." As illustrated above, the FAA estimates a cost of $14.4 million for this area of industry effort. The work and associated costs required by the SFAR are described below, along with the associated industry concerns.

The FAA estimated 0.5 to 2 engineering years of effort per aircraft type. As discussed in Section 3, Design Review, the industry believes the actual level of effort required would be on the order of 2 to 4 engineering years for each major model. Minor model variation will add additional effort that is difficult to quantify but could easily increase the total effort by 30 to 50 percent. In addition, systems do evolve with time, leading to additional permutations that must be considered.

About SFAR design review costs (cont'd)

Therefore, the industry believes that the basic design reviews will require two *to three times more effort and cost than identified by the FAA.* The cost of the basic design review may thus be in the range of $28 million to $52 million plus an additional $14 million to account for variation within models.

Section 3, Design Review, also discusses the difficulties of assessing STCs. In particular, reviewing non-ATA 28 STCs and field approvals could be unmanageable for airplanes with a long service life and with multiple owners. The FAA does not appear to have made any accounting for the cost of addressing these modifications.

The industry has proposed that, as an alternative approach, a one-time inspection be performed to verify that wiring entering the fuel tank, and systems capable of generating autoignition temperature into fuel tank structure, have not been compromised by such modifications. If one reasonably assumes that such an inspection would require about 50 to 100 labor-hours to perform, then the resultant inspection labor costs alone could amount to $28 million to $52 million depending upon the number of airplanes to be inspected (e.g., 7,000 airplanes x 100 hours per airplane x $70 per labor-hour).

The simple estimate above does not include the cost of the downtime-and resultant revenue loss-required to accomplish such an inspection, yet the currently proposed compliance time of 12 months would require airplanes to be pulled from revenue service for special inspection. The FAA has estimated that an increase in out-of-service time of between 11.5 hours and 32 hours would result in lost net revenues of $6.4 million for a 12-month period (lines 1089-l 096). The inspections described above would require approximately this much downtime.

About developing design changes

The above paragraphs have addressed the cost of conducting the SFAR design reviews. Additional costs would be associated with developing the warranted design changes identified by the SFAR design reviews.

The FAA observes in the preamble to NPRM 99- 18 that the design review, "may identify conditions that would be addressed by specific service bulletins or unsafe conditions that would result in FAA issuance of an airworthiness directive (AD). However, those future costs would be the result of compliance with the service bulletin or the AD and are not costs of compliance with the proposed rulemaking. Those costs would be estimated for each individual AD, when proposed" (lines 1004-l 007).

About developing design changes (cont'd)

The industry accepts this FAA position, agreeing in general that design changes should be handled outside the scope of the SFAR (see discussion in Section 3, Design Review). However, the industry does not believe that it is correct for the FAA to assert that none of these costs are attributable to the proposed rulemaking of NPRM 99-l 8. In those instances where new rules are created that go beyond existing rules, essentially raising the bar, the cost of any design change driven by these new rules should be considered as part of the total cost of this rulemaking.

A specific example of such a new rule is §25.98 1 (a)(3), which proposes new, more-stringent requirements associated with evaluating the effects of latent failures (see discussion in Section 4, Ignition Risk). Should compliance with this specific rule require design changes broadly across the fleet, the costs would be substantial. For example, if this rule were to impact half the U.S. fleet (about 3,500 airplanes), and modification costs averaged $40,000 per airplane, the total cost would be $140 million.

It is not possible to predict what effect this new rule would actually have on the fleet, but the potential obviously exists for costs that range between $100 million and $200 million, or more.

About OEM maintenance and inspection instructions

The FAA has assumed in its cost analysis that the development of these OEM maintenance and inspection instructions would simply be part of the design review. In fact, this work must be done after completion of the design review, as discussed in Section 3, Design Review, and Section 7, Maintenance Operations.

The industry has not calculated the cost associated with this activity. However, if one assumes that this effort represents 20 to 30 percent of the effort associated with the basic design review, then the cost could be on the order of $10 million.

The SFAR cost estimate is much too low

As the above has shown, the FAA estimate of $14.4 million for the fuel tank system design assessment substantially underestimates the potential cost of industry compliance with the proposed SFAR. As explained, the potential cost to the industry may actually be on the order of $180 million to $330 million.

About the cost of operational rule changes

The second category of estimated costs identified by the FAA is the "Cost of Fuel Tank System Inspections-Operational Rule Changes." NPRM 99- 18 observes (lines 104 l-l 045) that:

> The FAA intends that any additional fuel tank system inspection and maintenance actions resulting from the SFAR review would occur during an airplane's regularly scheduled major maintenance checks. From a safety standpoint, repeated entry increases the risk of damage to the airplane. Thus, the proposal would not require air carriers to alter their maintenance schedules, and the FAA anticipates that few or no airplanes would be taken out of service solely to comply with the proposal unless an immediate safety concern is identified.

The industry not only agrees with this FAA intent, but strongly recommends that the FAA ensure that final rulemaking associated with NPRM 99- 18 does not penalize the industry by requiring inspection intervals more frequent than truly necessary, or lead to unnecessary hard-timing of components.

The potential cost of inspections is enormous

This industry concern is very real given the current content of proposed rule §25.981(a)(3) and its new treatment of latent failures (see the discussion in Section 4, Ignition Risk). A requirement to maintain the probability of occurrence of a given latent failure to less than 1×10^{-7} would dictate onerous inspection intervals and component hard-timing requirements.

For example, a component with a latent failure rate of 1×10^{-9} per flight-hour would have to be inspected (or hard-timed) every 100 hours (or 200 hours if an average exposure time is assumed: T/2) to keep the probability of failure under 1×10^{-7}. A component failure rate of 1×10^{-8} per flight-hour would require inspection every day (10 hours). The benefit derived from performing such inspections or hard-timing is nil. The implications of such a rule are self-evident.

Thus, if compliance with the final rulemaking associated with NPRM 99-l 8 leads to situations such as described above, the resulting costs would be huge with no attendant benefit. The FAA's cost estimate for the Operational Rule Changes is $154 million over 10 years. It is based upon the assumption that the required maintenance and inspection programs will coincide with an airplane's *regularly scheduled major maintenance checks.* The situation described above would result in numerous inspections that would not align with these regularly scheduled checks. In addition, it could lead to widespread hard-timing of components (e.g., pumps). No consideration of either of these possibilities was made in the FAA cost analysis. ***The*** *magnitude of the cost impact could extend into the billions of dollars.*

About the cost of future design changes

The third category of estimated costs identified by the FAA is the "Cost of Future Fuel Tank System Design Changes-Revised Part 25 ." NPRM 99- 18 states that, "The FAA anticipates that the proposed Part 25 change would have minimal effect on the cost of future type certificated airplanes because compliance with the proposed change would be done during the design phase of the airplane model before any new airplanes would be manufactured" (lines 10 15-l 0 17).

The industry believes that the above FAA assumption is incorrect. Proposed rule §25.98 l(c)(l) requires that the fuel tank installation include, "means to minimize the development of flammable vapors in the fuel tanks." Moreover, the FAA states that it intends that the body tanks, "cool at a rate equivalent to that of a wing tank" (lines 9 1 O-9 11). The industry's technical and regulatory concerns on this front have already been discussed in Section 5, Flammability Reduction.

If the FAA proceeds with this rulemaking, the cost impacts to future airplane designs could be substantial. For example, the ARAC FTHWG conducted preliminary cost assessments of a directed ventilation system (see Section 9.6 of the Task Group 5 report). Presented below, these fuel tank cooling cost estimates are divided into the categories indicated. It should be noted that directed ventilation systems of the type evaluated by the ARAC FTHWG would not cool a center wing tank at a rate equivalent to that of a wing tank.

About the ARAC FTHWG assessment

The ARAC FTHWG analysis considered the costs associated with small, medium, and large airplane designs.

- Development costs per airplane design: $2.8 million.
- Installation costs per production airplane: $2 1,200.
- Additional airplane operational costs per airplane per year:
  - Small $30,408.
  - Medium $39,295.
  - Large $50,5 18.

The cost of future changes is not "minimal"

Using these numbers, a simple calculation may be performed to estimate the recurring costs associated with such a system over a IO-year time period. These costs would consist of the installation costs per production airplane and the additional operational costs per airplane per year, applied to a fleet of a new airplane design with an assumed production rate. The following table presents the results of this simple estimate for a 1 O-year period (ignoring inflation, cost of capital, and so on).

Size	Annual production rate	Production cost	Operational cost	Total Cost
Small	180	$38,160,000	$301,039,200	$339,199,200
Medium	72	$15,264,000	$155,608,200	$170,872,200
Large	60	$15,264,000	$129,673,500	$144,937,500

Although the above example is simplistic in nature, the conclusion may be drawn that the overall potential costs are indeed substantial, even if the initial developmental costs are not.

Cost conclusions

This section has shown that the cost side of the cost/benefit analysis included in NPRM 99-l 8 is inaccurate. Costs to the industry for complying with this rulemaking, as currently proposed, have been significantly underestimated as a result of erroneous or incomplete assumptions.

Therefore, the industry:

- Recommends that the FAA reevaluate its cost estimate to take into account the observations made above.
- Believes the practical alternatives it proposes in this document will more effectively achieve the intent behind the proposed rulemaking.

INTENTIONALLY LEFT BLANK

Section 9 Conclusions

The industry concludes...

The industry agrees with the intent behind NPRM 99-l 8, which is to further enhance the safety of fuel tank systems in airplanes already in service as well as in newly type certificated designs. However, the industry believes that this NPRM, as written, is excessive and creates an unnecessary compliance burden. The proposed alternatives presented in this industry commentary would make NPRM 99- 18 more effective and practical. These comments have been cooperatively developed based on collective industry expertise and experience worldwide.

The industry recommends that the FAA pursue harmonization with other regulatory authorities rather than continue unilateral development of this proposed rulemaking. The industry's recommendations should form a foundation for the harmonization process. Harmonization benefits would include superior rulemaking, simpler operations, reduced compliance cost without compromising safety, and a broader extension of the latest safety benefits in the world fleet.

The industry's recommended changes to the proposed rulemaking of NPRM 99-l 8 are presented below in their entirety (highlighted by italicized type).

The industry's proposed rewording of SFAR XX

SFAR No. XX-Fuel Tank System Fault Tolerance Evaluation Requirements

1. Applicability. This SFAR applies to the holders of type certificates, and supplemental type certificates ***modifying*** the airplane fuel tank system, for turbine-powered transport category airplanes, provided the type certificate was issued after January 1, 1958, and the airplane has a maximum type certificated passenger capacity of 30 or more, or a maximum type certificated payload capacity of 7500 pounds or more. This SFAR also applies to applicants for type certificates, amendments to a type certificate, and supplemental type certificates ***modifying*** the fuel tank systems for those airplanes identified above, if the application was filed before the effective date of this SFAR and the certificate was not issued before the effective date of this SFAR.

2. Compliance: No later than [*36* months after the effective date of the final rule], or within 18 months after the issuance of a certificate for which application was filed before [effective date of the final rule], whichever is later, each type certificate holder, or supplemental type certificate holder of a modification affecting the airplane fuel tank system, must accomplish **paragraphs (a) and *(c) of this section. Maintenance and inspection***

The industry's proposed rewording of SFAR XX (cont'd)

instructions identified in paragraph (b) of this section must be submitted to the Administrator no later than 8 months after the FAA has approved the design review report for the applicable aircraft type.

(a) Conduct a safety review of the airplane fuel tank system *to be evaluated against the defined listing of service experience lessons learned. Identify if design deficiencies exist for which redesign is warranted by determining if ignition sources may exist caused by single failures or combinations of failures expected to occur in the remaining operational fleet life of the aircraft type.*

(b) Develop all maintenance and inspection instructions necessary to maintain the design features required to preclude the existence or development of an ignition source within the fuel tank system of the *airplane throughout the remaining operational fleet life of the aircraft type.*

(c) Submit a report for approval of the Administrator that:

1) Provides substantiation that the airplane fuel tank system design has been evaluated against the *defined listing of lessons learned and determination made if ignition sources may exist caused by:*

i. *Single failures.*

ii. *Combinations of failures expected to occur in the remaining operational fleet life of the aircraft type.*

2) Identifies design deficiencies for which redesign is warranted.

The industry's proposed Part 25 changes

§ 25.981 Fuel Tank Ignition Prevention

(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 vapors. This must be shown by:

(1) Determining the highest temperature allowing a safe margin below the lowest expected autoignition temperature of the fuel in the fuel tanks.

(2) Demonstrating that no temperature at each place inside each fuel tank where fuel ignition is possible will exceed the temperature determined under paragraph (a)(l) of this section. This must be verified under all probable operating, failure and malfunction conditions of each component whose operation, failure or malfunction could increase the temperature inside the tank.

Alternative 1: *(3) Assessment of ignition risk under the provisions of $25.1309.*

Alterna five 2: *(3) Analyses and/or tests that demonstrate that:*

(i) There are no single failures that result in an ignition source in the fuel tank system.

(ii) Assessment of ignition risk under the provisions of $25.1309.

Delete: ~~(b)~~

(c) If systems adjacent to fuel tanks could cause significant heat transfer to the tanks:

(1) Means to reduce heating of fuel tanks by adjacent systems shall be provided; or.. .

(2) Equivalent flammability reduction means shall be provided to offset flammability increases that would otherwise result from heating; or...

(3) Means to mitigate the effects of an ignition of fuel vapors within fuel tanks *shall be provided* such that no damage caused by an ignition will prevent continued safe flight and landing.

Industry proposes Appendix H unchanged

The industry considers the existing Appendix H25.4, Airworthiness Limitation section, to be adequate. The fuel system is not more critical than other systems to warrant it being singled out. The existing Certification Maintenance Requirements process should be utilized rather than creating new rulemaking.

Industry proposes Parts 91,121, 125, and 129 unchanged

As outlined in the Maintenance/Continued Airworthiness section, the industry believes that the existing processes should be utilized. A Certification Maintenance Coordination Committee should be formed and its recommendations then mandated by FAA ADs for existing aircraft or revised CMRs for new aircraft.

Summary

Air travel surpasses any other transportation mode in terms of safety. This record reflects the industry commitment to safety, which is enhanced through the ongoing efforts of manufacturers, operators, regulatory authorities, and other interested parties working together.

AIRBORNE EXPRESS.

145 HUNTER DRIVE-WILMINGTON, OHIO 45177 (937) 382-5591

March 23, 2000

Mr. Robert Peel
Air Transport Association of America
1301 Pennsylvania Ave., NW
Suite 1100
Washington, DC 20004-1701

Dear Mr. Peel:

We, Airborne Express, acknowledge and endorse the industries comments on NPRM #99-1 8 which will be submitted to the FAA under a joint cover letter entitled 'Subject: Fuel Tank System Design Review, Flammability Reduction, and Maintenance and Inspection Requirements", dated March 27, 2000.

Regards,

Dennis Manibusan
Senior Vice-President
Maintenance & Engineering

U·S AIRWAYS

DEPT. OF TRANSPORTATION
00 MAR 29 PM 2:15

March 27, 2000

PJK-00-004
Sent VIA E-Mail

Mr. Robert Peel
Aircraft Systems Engineering
Air Transportation Association
1301 Pennsylvania Ave. N.W.
Suite 1100
Washington, DC 20004- 1707

Subject: NPRM 99- 18 - Fuel Tank System Design Review, Flammability Reduction and Maintenance and Inspection Requirements

Reference: (a) FAA NPRM 99- 18

Dear Mr. Peel:

The FAA has issued Reference (a) which, if adopted, would require a design review to substantiate that the current fuel system designs on the specified aircraft preclude the existence of ignition sources within the fuel tanks. It would also require the development and incorporation of specific fuel tank maintenance and inspection instructions required to assure the safety of the fuel tank system.

In order to address the proposed Reference (a), the worldwide aviation industry formed the Fuel Systems Safety Team (FSST). The FSST produced a single document which provides the collective industry response to the fuel systems NPRM. US Airways actively participated in the formulation of the industry response by the FSST and agrees with its contents. In addition, US Airways has the following comments:

- The industry response proposes accomplishing inspections in lieu of the design reviews in instances where design reviews would not achieve the objective of enhancing fuel system safety. A specific example would be external fuel system wiring such as the FQIS wiring. Design analysis would not be able to verify that the FQIS wiring was separated from all other wiring. Thus, an inspection was proposed as a way to verify adherence to separation requirements.

- US Airways wants the FAA to consider compliance options for the proposed rule, other than design reviews or inspections. Transient suppression devices (TSDs) would provide the same level of safety enhancement to the fuel system external tank wiring. The TSD would alleviate the need for labor intensive inspections and/or wire separation of the fuel tank external wiring.

2000 Commerce Drive, RIDC Park Building 2 Pittsburgh, PA 15275 (412) 747-3882 Fax (412) 747-3688

The operators should be allowed to choose which compliance option (design review, inspection, TSD) makes the most sense considering their particular situation.

Your representation of US Airways is greatly appreciated as always.

Sincerely,

Gordon G. Kemp
Senior Director, Technical Services

GK/PJK/bjw
ata/ad/fuel tank system NPRM 99-18

Department Number
C8020
Northwest Airlines, Inc.
5 10 1 Northwest Drive
St. Paul, MN 55 11 l-3034

NORTHWEST AIRLINES

March 27, 2000

Mr. Robert Peel
Director, Airworthiness & Technical Standards
Air Transport Association of America
130 1 Pennsylvania Avenue NW – Suite 1100
Washington, DC 20004- 1707

Subject: Transport Airplane Fuel Tank System Design Review, Flammability Reduction, and Maintenance and Inspection Requirements

References: FAA Docket No. FAA- 1999-64 11
ATA Memo No. 00-AE-011

Dear Mr. Peel:

The subject NPRM proposes that within 12 months, airplane manufacturers and STC holders perform safety reviews of fuel tank systems to determine whether or not they meet the requirements of FAR 25.90 1 and 25.98 1 (a) and (b). The manufacturers and STC holders must also recommend maintenance and inspection instructions necessary to maintain the design features required to preclude an ignition source within the fuel tank system throughout the life of the airplane.

Within 18 months, operators must incorporate instructions for maintenance and inspection of the fuel tank system into their maintenance program as approved by the administrator.

The ATA has sponsored meetings of the operators and manufacturers to discuss this issue and write an industry response.

NWA supports the ATA industry response but would like to highlight the following issues of concern to the FAA.

Design Review

Paragraphs 1 and 2 of proposed changes to Part 21 states that all "... supplemental type certificates affecting the fuel tanks systems.. ." require a safety review and recommended inspections to maintain the system. Since it cannot be consistently interpreted whether a particular STC affects the fuel tank system, we request that the wording be changed to state "... supplemental type certificates *modifying* the fuel tank systems. . ." This will more clearly narrow the scope of the STC design review to those STCs of most concern, NWA would also like to point out that for operators of aircraft that have had multiple owners, it is not always possible to determine whether modifications not initiated by the TC holder were performed on the fuel system. Operators also do not typically have the ability to perform STC design reviews if the design data is not available. NWA would request that as an alternative to the design review, operators be given the option to perform a one-time inspection to determine whether or not significant changes have been made to the fuel system.

Maintenance Program Requirements

NWA requests that the existing MRB process be used along with any necessary working groups such that they must submit to the FAA a recommended plan, by aircraft type, within 36 months of the SFAR issuance. The fuel tank maintenance program should not be treated any differently than other aircraft systems. Operators should have 12 months, after approval by the administrator, to incorporate the maintenance changes into their maintenance programs.

Cost

The FAA cost analysis to comply with the NPRM as written is underestimated. The proposed rule uses the following estimates to determine cost:

1. Five engineering days to incorporate recommendations into “inspection manual.”
2. Extra labor to perform inspections range from 19 hours to 110 hours.
3. Out of service time to perform inspection range from 11.5 hours to 32 hours.
4. Annual documentation costs of one hour per eight hours inspection labor.

It is difficult to accurately estimate costs when it is not known what tasks will become mandated after performing the TC and STC design reviews/inspections or if they will be mandated during scheduled major maintenance checks. However, we believe that incorporating the recommendations into our maintenance program will require 30 engineering days per aircraft model. Inspection labor should be at least doubled. For example, Boeing SB 747-28-2205 requires approximately 100 manhours to inspect the center wing tank. We estimate that another 100 manhours would be required to inspect outer tanks.

If the proposed review requirements cause operators to remove components for overhaul or modify fuel system components, the cost of complying with the NPRM will be significantly higher. The FAA should take this into consideration when calculating costs.

Summary

NWA requests the FAA to seriously consider the above comments and the ATA Industry response to this NPRM. We recommend the FAA work with industry experts to come up with recommended modification and inspection requirements by aircraft model. The recommendations would then be subject to review and more accurate cost analysis. This process would avoid much of the paper chasing and more effectively determine what safety enhancements are needed.

Respectfully,

Mark Millam
Chief Engineer

cc: Greg Budinger
Doug Hill

[4910-13]

DEPARTMENT OF TRANSPORTATION

Federal Aviation Administration

14 CFR Parts 21, 25, 91, 121, 125, and 129

(Docket No. FAA-1999—, Notice No. 99—18]

RTN 2120-AG62

Transport Airplane Fuel Tank System Design Review, Flammability Reduction, and Maintenance and Inspection Requirements

AGENCY: Federal Aviation Administration (FAA), DOT.

ACTION: Notice of proposed rulemaking (NPRM).

SUMMARY: This proposed rulemaking would- require design approval holders of certain turbine-powered transport category airplanes to submit substantiation to the FAA that the design of the fuel tank system of previously certificated airplanes precludes the existence of ignition sources within the airplane fuel tanks. It would also require the affected design approval holders to develop specific fuel tank system maintenance and inspection instructions for any items in the fuel tank system that are determined to require repetitive inspections or maintenance, to assure the safety of the fuel tank system. In addition, the proposed rule would require certain operators of those airplanes to incorporate FAA-approved fuel tank system maintenance and inspection instructions into their current maintenance or inspection program. Three amendments to the airworthiness standards for transport category airplanes are also proposed. The first would define new requirements, based on existing requirements, for demonstrating that ignition sources could not be present in fuel tanks when failure conditions are considered. The second would require future applicants for type certification to identify any safety critical maintenance actions and develop limitations to be placed in the instructions for continued airworthiness for the fuel tank system, The third would require means to minimize development of flammable vapors in fuel tanks, or means to prevent catastrophic damage if ignition does occur. These actions are the result of information gathered from accident investigations and adverse service experience, which has shown that unforeseen failure modes and lack of specific maintenance procedures on certain airplane fuel tank systems may result in degradation of design safety features intended to preclude ignition of vapors within the fuel tank.

DATES: Comments must be received on or before ~~[insert date 90 days after date of publication in the Federal Register]~~ January 37, 3000.

ADDRESSES: Comments on this proposed rulemaking should be mailed or delivered, in duplicate, to: U.S. Department of Transportation, Dockets, Docket No. FAA- 1999—6411, 400 Seventh Street SW., Room Plaza 401, Washington DC 20590. Comments may also be sent electronically to the following Internet address: 9-NPRM-CMTS@faa.gov. Comments may be filed and/or examined in Room Plaza 401 between 10 a.m. and 5 p.m. weekdays, except Federal holidays, In addition, the FAA is maintaining an information docket of comments in the Transport Airplane Directorate (ANM- 100), Federal Aviation Administration, Northwest Mountain Region, 160 1

Lind Avenue SW., Renton, WA 980554056. Comments in the information docket may be examined between 7:30 a.m. and 4:00 p.m. weekdays, except Federal holidays.

FOR FURTHER INFORMATION CONTACT: Michael E. Dostert, FAA, Propulsion/Mechanical/Crashworthiness Branch (ANM- 112), Transport Airplane Directorate, Aircraft Certification Service, 160 1 Lind Avenue SW., Renton, Washington 98055-4056; telephone (425) 227-2 132, facsimile (425) 227-1320; e-mail: mike.dostert@faa.gov.

SUPPLEMENTARY INFORMATION:

Comments Invited

Tnterested persons are invited to participate in this proposed rulemaking by submitting such written data, views, or arguments as they may desire. Comments relating to the environmental, energy, federalism, or economic impact that might result from adopting the proposals in this notice are also invited. Substantive comments should be accompanied by cost estimates. Commenters should identify the regulatory docket or notice number and submit comments in duplicate to the Docket address specified above. All comments received, as well as a report summarizing each substantive public contact with FAA personnel concerning this rulemaking, will be filed in the docket. All comments received on or before the closing date will be considered by the Administrator before taking action on this proposed rulemaking. Late filed comments will be considered to the extent practicable. The proposals contained in this notice may be changed in light of the comments received. The Docket is available for public inspection before and after the comment closing date. Commenters wishing the FAA to acknowledge receipt of their comments submitted in response to this notice must include with those comments a pre-addressed, stamped postcard on which the following statement is made: "Comments to Docket No. FAA- 1999-6111." The postcard will be date stamped and mailed to the commenter.

Availability of the NPRM

An electronic copy of this document may be downloaded using a modem and suitable communications software from the FAA regulations section of the Fedworld electronic bulletin board service (telephone: 703-321-3339), the Government Printing Office's electronic bulletin board service (telephone: 202-5 12-1661), or the FAA's Aviation Rulemaking Advisory Committee Bulletin Board service (telephone: (800) 322-2722 or (202) 267-5948).

Internet users may reach the FAA's web page at http://www.faa.gov/avr/arm/nprm/nprm.htm or the Government Printing Office's webpage at http://www.access.gpo.gov/nara for access to recently published rulemaking documents.

Any person may obtain a copy of this NPRM by submitting a request to the Federal Aviation Administration, Office of Rulemaking, ARM-l, 800 Independence Avenue, SW., Washington, DC 20591, or by calling (202) 267-9680. Communications must identify the notice number or docket number of this NPRM.

Persons interested in being placed on the mailing list for future NPRM's should request from the above office a copy of Advisory Circular No. 1 1-2A, Notice of Proposed Rulemaking Distribution System, that describes the application procedure.

Background

On July 17, 1996, a 25-year old Boeing 747-l 00 series airplane was involved in an inflight breakup after takeoff from Kennedy International Airport in New York, resulting in 230 fatalities. The accident investigation conducted by the National Transportation Safety Board (NTSB) indicated that the center wing fuel tank exploded due to an unknown ignition source. The NTSB has issued recommendations intended to reduce heating of the fuel in the center wing fuel tanks on the existing fleet of transport airplanes, reduce or eliminate operation with flammable vapors in the fuel tanks of new type certificated airplanes, and also to reevaluate the fuel system design and maintenance practices on the fleet of transport airplanes. The accident investigation has now focused on mechanical failure as providing the energy source that ignited the fuel vapors inside the tank. This accident has prompted the FAA to examine the underlying safety issues surrounding fuel tank explosions, the adequacy of the existing regulations, the service history of airplanes certificated to these regulations, and existing fuel tank system maintenance practices.

Flammability Characteristics

The flammability characteristics of the various fuels approved for use in transport airplanes results in the presence of flammable vapors in the vapor space of fuel tanks at various times during the operation of the airplane. Vapors from Jet A fuel (the typical commercial turbojet engine fuel) at temperatures below approximately 100°F are too lean to be flammable at sea level; at higher altitudes the fuel vapors become flammable at temperatures above approximately 45°F (at 40,000 feet altitude). However, the regulatory authorities and aviation industry have always presumed that a flammable fuel air mixture exists in the fuel tanks at all times and have adopted the philosophy that the best way to ensure airplane fuel tank safety is to preclude ignition sources within fuel tanks. This philosophy has been based on the application of fail-safe design requirements to the airplane fuel tank system to preclude ignition sources from being present in fuel tanks when component failures, malfunctions, or lightning encounters occur. Possible ignition sources that have been considered include electrical arcs, friction sparks, and autoignition. (The autoignition temperature is the temperature at which the fuel/air mixture will spontaneously ignite due to heat in the absence of an ignition source.) Some events that could produce sufficient electrical energy to create an arc include lightning, electrostatic charging, electromagnetic interference (EMI), or failures in airplane systems or wiring that introduce high-power electrical energy into the fuel tank system. Friction sparks may be caused by mechanical contact between certain rotating components in the fuel tank, such as a steel fuel pump impeller rubbing on the pump inlet check valve. Autoignition of fuel vapors may be caused by failure of components within the fuel tank, or external components or systems that cause components or tank surfaces to reach a high enough temperature to ignite the fuel vapors in the fuel tank.

Existing Regulations/Certification Methods

The current 14 CFR part 25 regulations that are intended to require designs that preclude the presence of ignition sources within the airplane fuel tanks are as follows:

Section 25.901 is a general requirement that applies to all portions of the propulsion installation, which includes the airplane fuel tank system. It requires, in part, that the propulsion and fuel tank systems be designed to ensure fail-safe operation between normal maintenance and inspection intervals, and that the major components be electrically bonded to the other parts of the airplane.

Airplane system fail-safe requirements are provided in §§ 25.901 (c) and 25.1309. Section 25.901(c) requires that "no single failure or malfunction or probable combination of failures will jeopardize the safe operation of the airplane." In general, the FAA's policy has been to require applicants to assume the presence of foreseeable latent (undetected) failure conditions when demonstrating that subsequent single failures will not jeopardize the safe operation of the airplane. Certain subsystem designs must also comply with § 25.1309, which requires airplane systems and associated systems to be "designed so that the occurrence of any failure condition which would prevent the continued safe flight and landing of the airplane is extremely improbable, and the occurrence of any other failure conditions which would reduce the capability of the airplane or the ability of the crew to cope with adverse operating conditions is improbable." Compliance with § 25.1309 requires an analysis, and testing where appropriate, considering possible modes of failure, including malfunctions and damage from external sources, the probability of multiple failures and undetected failures, the resulting effects on the airplane and occupants, considering the stage of flight and operating conditions, and the crew warning cues, corrective action required, and the capability of detecting faults.

This provision has the effect of mandating the use of "fail-safe" design methods which require that the effect of failures and combinations of failures be considered in defining a safe design. Detailed methods of compliance with §§ 25.1309(b), (c), and (d) are described in Advisory Circular (AC) 25.1309-1A, "System Design

Analysis," and are intended as a means to evaluate the overall risk, on average, of an event occurring within a fleet of aircraft. The following guidance involving failures is offered in that AC:

1. In any system or subsystem, a single failure of any element or connection during any one flight must be assumed without consideration as to its probability of failing. This single failure must not prevent the continued safe flight and landing of the airplane.

2. Additional failures during any one flight following the first single failure must also be considered when the probability of occurrence is not shown to be extremely improbable. The probability of these combined failures includes the probability of occurrence of the first failure.

As described in the AC, the FAA fail-safe design concept consists of the following design principles or techniques intended to ensure a safe design. The use of only one of these principles is seldom adequate. A combination of two or more design principles is usually needed to provide a fail-safe design (i.e., to ensure that catastrophic failure conditions are not expected to occur during the life of the fleet of a particular airplane model).

- Design integrity and quality, including life limits, to ensure intended function and prevent failures.
- Redundancy or backup systems that provide system function after the first failure (e.g., two or more engines, two or more hydraulic systems, dual flight controls, etc.)
- Isolation of systems and components so that failure of one element will not cause failure of the other (sometimes referred to as system independence).
- Detection of failures or failure indication.
- Functional verification (the capability for testing or checking the component's condition).
- Proven reliability and integrity to ensure that multiple component or system failures will not occur in the same flight.
- Damage tolerance that limits the safety impact or effect of the failure.
- Designed failure path that controls and directs the failure, by design, to limit the safety impact.
- Flightcrew procedures following the failure designed to assure continued safe flight by specific crew actions.
- Error tolerant design that considers probable human error in the operation, maintenance, and fabrication of the airplane.
- Margins of safety that allow for undefined and unforeseeable adverse flight conditions.

These regulations, when applied to typical airplane fuel tank systems, lead to a requirement for prevention of ignition sources inside fuel tanks. The approval of the installation of mechanical and electrical components inside the fuel tanks was typically based on a qualitative system safety analysis and component testing which showed: (1) that mechanical components would not create sparks or high temperature surfaces in the event of any failure, and (2) that electrical devices would not create arcs of sufficient energy to ignite a fuel-air mixture in the event of a single failure or probable combination of failures.

Section 25.901(b)(2) requires that the components of the propulsion system be "constructed, arranged, and installed so as to ensure their continued safe operation between normal inspection or overhauls." Compliance with this regulation is typically demonstrated by substantiating that the propulsion installation, which includes the fuel tank system, will safely perform its intended function between inspections and overhauls defined in the maintenance instructions.

Section 25.901(b)(4) requires electrically bonding the major components of the propulsion system to the other parts of the airplane. The affected major components of the propulsion system include the fuel tank system. Compliance with this requirement for fuel tank systems has been demonstrated by showing that all major components in the fuel tank are electrically bonded to the airplane structure. This precludes accumulation of electrical charge on the components and the possible arcing in the fuel tank that could otherwise occur. In most cases, electrical bonding is accomplished by installing jumper wires from each major fuel tank system component to airplane structure. Advisory Circular 25-8, "Auxiliary Fuel Tank Installations," also provides guidance for bonding of fuel tank system components and means of precluding ignition sources within transport airplane fuel tanks,

Section 25.954 requires that the fuel tank system be designed and arranged to prevent the ignition of fuel vapor within the system due to the effects of lightning strikes. Compliance with this regulation is typically shown by incorporation of design features such as minimum fuel tank skin thickness, location of vent outlets out of likely lightning strike areas, and bonding of fuel tank system structure and components. Guidance for demonstrating compliance with this regulation is provided in AC 20-53A, "Protection of Aircraft Fuel Systems Against Fuel Vapor Ignition Due to Lightning."

Section 25.981 requires that the applicant determine the highest temperature allowable in fuel tanks that provides a safe margin below the lowest expected autoignition temperature of the fuel that is approved for use in the fuel tanks. No temperature at any place inside any fuel tank where fuel ignition is possible may then exceed that maximum allowable temperature. This must be shown under all probable operating, failure, and malfunction conditions of any component whose operation, failure, or malfunction could increase the temperature inside the tank. Guidance for demonstrating compliance with this regulation has been provided in AC 25.981-1A, "Guidelines For Substantiating Compliance With the Fuel Tank Temperature Requirements." The AC provides a listing of failure modes of fuel tank system components that should be considered when showing that component failures will not create a hot surface that exceeds the maximum allowable fuel tank component or tank surface temperature for the fuel type for which approval is being requested. Manufacturers have demonstrated compliance with this regulation by testing and analysis of components to show that design features, such as thermal fuses in fuel pump motors, preclude an ignition source in the fuel tank when failures such as a seized fuel pump rotor occur.

Airplane Maintenance Manuals and Instructions for Continued Airworthiness

Historically, manufacturers have been required to provide maintenance related information for fuel tank systems in the same manner as for other systems. Prior to 1970, most manufacturers provided manuals containing maintenance information for large transport category airplanes, but there were no standards prescribing minimum content, distribution, and a timeframe in which the information must be made available to the operator. Section 25.1529, as amended by Amendment 25-21 in 1970, required the applicant for a type certificate (TC) to provide airplane maintenance manuals (AMM) to owners of the airplanes. This regulation was amended in 1980 to require that the applicant for type certification provide Instructions for Continued Airworthiness (ICA) prepared in accordance with Appendix H to part 25. In developing the ICA, the applicant is required to include certain information such as a description of the airplane and its systems, servicing information, and maintenance instructions, including the frequency and extent of inspections necessary to provide for the continuing airworthiness of the airplane (including the fuel tank system). As required by Appendix H to part 25, the ICA must also include an FAA-approved Airworthiness Limitations section enumerating those mandatory inspections, inspection intervals, replacement times, and related procedures approved under § 25.571, relating to structural damage tolerance. Currently the Airworthiness Limitations section of the ICA applies only to airplane structure and not to the fuel tank system.

One method of establishing initial scheduled maintenance and inspection tasks is the Maintenance Steering Group (MSG) process, which develops a Maintenance Review Board (MRB) document for a particular airplane model. Operators may incorporate those provisions, along with other maintenance information contained in the TCA, into their maintenance or inspection program.

Section 21.50 requires the holder of a design approval, including the TC or supplemental type certificate (STC) for an airplane, aircraft engine, or propeller for which application was made after January 28, 1981, to furnish at least one set of the complete TCA to the owner of the product for which the application was made. The ICA for original type certificated products must include instructions for the fuel tank system. A design approval holder who has modified the fuel tank system must furnish a complete set of the ICA for the modification to the owner of the product.

Type Certificate Amendments Based on Major Change in Type Design

Over the years, many design changes have been introduced into fuel tank systems that may affect their safety. There are three ways in which major design changes can be approved: (1) the TC holder can apply for an amendment to the type design; (2) any person, including the TC holder, wanting to alter a product by introducing a major change in the type design not great enough to require a new application for a TC, may apply for an STC; and (3) in some instances a person may also make a major alteration to the type design through a field approval. The field approval process is a streamlined method for obtaining approval of relatively simple modifications to airplanes. An FAA Flight Standards Inspector can approve the alteration using Form FAA-337.

Maintenance and Inspection Program Requirements

Airplane operators are required to have extensive maintenance or inspection programs that include provisions relating to fuel tank systems.

Section 9 1.409(e), which generally applies to other than commercial operations, requires an operator of a large turbojet multiengine airplane or a turbopropeller-powered multiengined airplane to select one of the following four inspection programs:

1. A continuous airworthiness inspection program that is part of a continuous airworthiness maintenance program currently in use by a person holding an air carrier operating certificate, or an operating certificate issued under part 119 for operations under parts 12 1 or 135, and operating that make and model of airplane under those parts;

2. An approved airplane inspection program approved under § 135.419 and currently in use by a person holding an operating certificate and operations specifications issued under part 119 for part 135 operations;

3. A current inspection program recommended by the manufacturer; or

4. Any other inspection program established by the registered owner or operator of that airplane and approved by the Administrator.

Section 121.367, which is applicable to those air carrier and commercial operations covered by part 121, requires operators to have an inspection program, as well as a program covering other maintenance, preventative maintenance, and alterations.

Section 125.247, which is generally applicable to operation of large airplanes, other than air carrier operations conducted under part 12 1, requires operators to inspect their airplanes in accordance with an inspection program approved by the Administrator.

Section 129.14 requires a foreign air carrier and each foreign operator of a U.S. registered airplane in common carriage, within or outside the U.S., to maintain the airplane in accordance with an FAA-approved program.

In general, the operators rely on the TC data sheet, MRB reports, ICA's, the Airworthiness Limitations section of the TCA, other manufacturers' recommendations, and their own operating experience to develop the overall maintenance or inspection program for their airplanes.

The intent of the rules governing the inspection and/or maintenance program is to ensure that the inherent level of safety that was originally designed into the system is maintained and that the airplane is in an airworthy condition.

Historically, for fuel tank systems these required programs include operational checks (e.g., preflight and enroute), functional checks following maintenance actions (e.g., component replacement), overhaul of certain components to prevent dispatch delays, and general zonal visual inspections conducted concurrently with other maintenance actions, such as structural inspections. However, specific maintenance instructions to detect and correct conditions that degrade fail-safe capabilities have not been deemed necessary because it has been assumed that the original fail-safe capabilities would not be degraded in service.

Design and Service History Review

The FAA has examined the service history of transport airplanes and performed an analysis of the history of fuel tank explosions on these airplanes. While there were a significant number of fuel tank fires and explosions that occurred during the 1960's and 1970's on several airplane types, in most cases the fire or explosion was found to be related to design practices, maintenance actions, or improper modification of fuel pumps. Some of the events were apparently caused by lightning strikes. In most cases, an extensive design review was conducted to identify possible ignition sources and actions were taken that were intended to prevent similar occurrences. However, recent fuel tank system related accidents have occurred in spite of these efforts.

On May 11, 1990, the center wing fuel tank of a Boeing 737-300 exploded while the airplane was on the ground at Nimoy Aquino International Airport, Manila, Philippines. The airplane was less than one year old. In the accident, the fuel-air vapors in the center wing tank exploded as the airplane was being pushed back from a terminal gate prior to flight. The accident resulted in 8 fatalities and injuries to an additional 30 people. Accident investigators considered a plausible scenario in which damaged wiring located outside the fuel tank may have created a short between 115 volt airplane system wires and 28 volt wires to a fuel tank level switch. This, in combination with a possibly defective fuel level float switch, was investigated as a possible source of ignition. However, a definitive ignition source was never confirmed during the accident investigation. This unexplained accident occurred on a newer airplane, in contrast to the July 17, 1996, accident which occurred on an older Boeing 747 airplane that was approaching the end of its initial design life. These two accidents indicate that the development of an ignition source inside the fuel tank may be related to both the design and maintenance of the fuel tank systems.

National Transportation Safety Board (NTSB) Recommendations

Since the July 17, 1996, accident, the FAA, NTSB, and aviation industry have been reviewing the design features and service history of the Boeing 747 and certain other transport airplane models. Based upon its review, the NTSB has issued the following recommendations to the FAA intended to reduce the exposure to operation with flammable vapors in fuel tanks and address possible degradation of the original type certificated fuel tank system designs on transport airplanes.

Reduced Flammability Exposure

A-96-l 74: Require the development of and implementation of design or operational changes that will preclude the operation of transport-category airplanes with explosive fuel-air mixtures in the fuel tanks.

LONG TERM DESIGN MODIFICATIONS:

(a) Significant consideration should be given to the development of airplane design modification, such as nitrogen-inetting systems and the addition of insulation between heat-generating equipment and fuel tanks.

Appropriate modifications should apply to newly certificated airplanes and, where feasible, to existing airplanes.

A-96-175: Require the development of and implementation of design or operational changes that will preclude the operation of transport-category airplanes with explosive fuel-air mixtures in the fuel tanks:

NEAR TERM OPERATIONAL

(b) Pending implementation of design modifications, require modifications in operational procedures to reduce the potential for explosive fuel-air mixtures in the fuel tanks of transport-category aircraft. In the B-747, consideration should be given to refueling the center wing fuel tank (CWT) before flight whenever possible from cooler ground fuel tanks, proper monitoring and management of the CWT fuel temperature, and maintaining an appropriate minimum fuel quantity in the CWT.

A-96-176: Require that the B-747 Flight Handbooks of TWA and other operators of B-747s and other aircraft in which fuel tank temperature cannot be determined by flightcrews be immediately revised to reflect the increases in CWT fuel temperatures found by flight tests, including operational procedures to reduce the potential for exceeding CWT temperature limitations.

A-96-177: Require modification of the CWT of B-747 airplanes and the fuel tanks of other airplanes that are located near heat sources to incorporate temperature probes and cockpit fuel tank temperature displays to permit determination of the fuel tank temperatures.

Ignition Source Reduction

A-98-36: Conduct a survey of fuel quantity indication system probes and wires in Boeing 747's equipped with systems other than Honeywell Series l-3 probes and compensators and in other model airplanes that are used in Title 14 Code of Federal Regulations Part 121 service to determine whether potential fuel tank ignition sources exist that are similar to those found in the Boeing 747. The survey should include removing wires from fuel probes and examining the wires for damage. Repair or replacement procedures for any damaged wires that are found should be developed.

A-98-38: Require in Boeing 747 airplanes, and in other airplanes with fuel quantity indication system (FQIS) wire installations that are co-routed with wires that may be powered, the physical separation and electrical shielding of FQIS wires to the maximum extent possible.

A-98-39: Require, in all applicable transport airplane fuel tanks, surge protection systems to prevent electrical power surges from entering fuel tanks through fuel quantity indication system wires.

Service History

The FAA has also reviewed service difficulty reports for the transport airplane fleet and evaluated the certification and design practices utilized on these previously certificated airplanes. In addition, an inspection of fuel tanks on Boeing 747 airplanes was initiated. Representatives from the Air Transport Association (ATA), Association of European Airlines (AEA), the Association of Asia Pacific Airlines (AAPA), the Aerospace Industries Association of America, and the Association Europeenne de Constructeurs de Materiel Aerospatial (AECMA) initiated a joint effort to inspect and evaluate the condition of the fuel tank system installations on a representative sample of airplanes within the transport fleet. Data from initial inspections conducted as part of this effort and shared with the FAA have assisted in establishing a basis for developing corrective action for airplanes within the transport fleet. In addition to the results from these inspections, the FAA has received reports of anomalies on in-service airplanes that have necessitated actions to preclude development of ignition sources in or adjacent to airplane fuel tanks. The following provides a summary of findings from design evaluations, service difficulty reports, and a review of current airplane maintenance practices.

Aging Airplane Related Phenomena

Fuel tank inspections initiated as part of the Boeing 747 accident investigation identified aging of fuel tank system components, contamination, corrosion of components and copper-sulfur deposits on components as possible conditions that could contribute to development of ignition sources within the fuel tanks. Results of detailed inspection of the fuel pump wiring on several Boeing 747 airplanes showed debris within the fuel tanks consisting of lockwire, rivets, and metal shavings. Debris was also found inside scavenge pumps. Corrosion and damage to insulation on FQIS probe wiring was found on wiring of 6 out of 8 probes removed from in-service airplanes. In addition, inspection of airplane fuel tank system components from out-of-service (retired) airplanes, initiated following the accident, revealed damaged wiring and corrosion buildup of conductive copper-sulfur deposits on the

FQIS wiring on some Boeing 747 airplanes. The conductive deposits or damaged wiring may result in a location where arcing could occur if high power electrical energy was transmitted to the FQIS wiring from another airplane source. While the effects of corrosion on fuel tank system safety have not been fully evaluated, the FAA is developing a research program to obtain a better understanding of the effects of copper-sulfur deposits and corrosion on airplane fuel tank system safety.

Wear or chafing of electrical power wires routed in conduits that are located inside fuel tanks can result in arcing through the conduits. On December 9, 1997, the FAA issued Airworthiness Directive (AD) 96-26-06, applicable to certain Boeing 747 airplanes, which required inspection of electrical wiring routed within conduits to fuel pumps located in the wing fuel tanks and replacement of any damaged wiring. Inspection reports indicated that many instances of wear had occurred on Teflon sleeves installed over the wiring to protect it from damage and possible arcing to the conduit.

Inspections of wiring to fuel pumps on Boeing 737 airplanes with over 35,000 flight hours have shown significant wear to the insulation of wires inside conduits that are located in fuel tanks. In nine reported cases, wear resulted in arcing to the fuel pump wire conduit on airplanes with greater than 50,000 flight hours. In one case, wear resulted in burnthrough of the conduit into the interior of the 737 main tank fuel cell. On May 14, 1998, the FAA issued a telegraphic AD, T98-11-52, which required inspection of wiring to Boeing 737 airplane fuel pumps routed within electrical conduits and replacement of any damaged wiring. Results of these inspections showed that wear of the wiring occurred in many instances, particularly on those airplanes with high numbers of flight cycles and operating hours.

The FAA has also received reports of corrosion on bonding jumper wires within the fuel tanks on one in-service Airbus A300 airplane. The manufacturer investigating this event did not have sufficient evidence to determine conclusively the level of damage and corrosion found on the jumper wires. Although the airplane was in long-term storage, it does not explain why a high number of damaged/corroded jumper wires were found concentrated in a specific area of the wing tanks. Further inspections of a limited number of other Airbus models did not reveal similar extensive corrosion or damage to bonding jumper wires. However, they did reveal evidence of the accumulation of copper-sulfur deposits around the outer braid of some jumper wires. Tests by the manufacturer have shown that these deposits did not affect the bonding function of the leads. Airbus has developed a one-time-inspection service bulletin for all its airplanes to ascertain the extent of the copper-sulfur deposits and to ensure that the level of jumper wire damage found on the one A300 airplane is not widespread.

On March 30, 1998, the FAA received reports of three recent instances of electrical arcing within fuel pumps installed in fuel tanks on Lockheed L-1011 airplanes. In one case, the electrical arc had penetrated the pump and housing and entered the fuel tank. Preliminary investigation indicates that features incorporated into the fuel pump design that were intended to preclude overheating and arc-through into the fuel tank may not have functioned as intended due to discrepancies introduced during overhaul of the pumps. Emergency AD 98-08-09 was issued

April 3, 1998, to specify a minimum quantity of fuel to be carried in the fuel tanks for the purpose of covering the pumps with liquid fuel and thereby precluding ignition of vapors within the fuel tank until such time as terminating corrective action could be developed.

Unforeseen Fuel Tank System Failures

After an extensive review of the Boeing 747 design following the July 17, 1996, accident, the FAA determined that during original certification of the fuel tank system, the degree of tank contamination and the significance of certain failure modes of fuel tank system components had not been considered to the degree that more recent service experience indicates is needed. For example, in the absence of contamination, the FQIS had been shown to preclude creating an arc if FQIS wiring were to come in contact with the highest level of electrical voltage on the airplane. This was shown by demonstrating that the voltage needed to cause an arc in the fuel probes due to an electrical short condition was well above any voltage level available in the airplane systems. However, recent testing has shown that if contamination, such as conductive debris (lock wire, nuts, bolts, steel wool, corrosion, copper-sulfur deposits, metal filings, etc.) is placed within gaps in the fuel probe, the voltage needed to cause an arc is within values that may occur due to a subsequent electrical short or induced current on the FQIS probe wiring from electromagnetic interference caused by adjacent wiring. These anomalies, by themselves, could not lead to an electrical arc within the fuel tanks without the presence of an additional failure. If any of these anomalies were combined with a subsequent failure within the electrical system that creates an electrical short, or if high-intensity radiated fields (HIRF) or electrical current flow in adjacent wiring induces EMI voltage in the FQIS wiring, sufficient energy could enter the fuel tank and cause an ignition source within the tank.

On November 26, 1997, in Docket No. 97-NM-272-AD, the FAA proposed a requirement for operators of Boeing 747-100, -200, and -300 series airplanes to install components for the suppression of electrical transients and/or the installation of shielding and separation of fuel quantity indicating system wiring from other airplane system wiring. After reviewing the comments received on the proposed requirements, the FAA issued AD 98-20-40 on September 23, 1998 that requires the installation of shielding and separation of the electrical wiring of the fuel quantity indication system. On April 14, 1998, the FAA proposed a similar requirement for Boeing 737-100, -200, -300, -400, and -500 series airplanes in Docket No. 98-NM-50-AD, which led to the FAA issuing AD 99-03-04 on January 26, 1999. The FAA action required in those two airworthiness directives is intended to preclude high levels of electrical energy from entering the airplane fuel tank wiring due to electromagnetic interference or electrical shorts. All later model Boeing 747 and 737 FQIS's have wire separation and fault isolation features that may meet the intent of these AD actions. This proposed rulemaking will require evaluation of these later designs.

Other examples of unanticipated failure conditions include incidents of parts from fuel pump assemblies impacting or contacting the rotating fuel pump impeller. The first design anomaly was identified when two incidents of damage to fuel pumps were reported on Boeing 767 airplanes. In both cases objects from a fuel pump inlet diffuser assembly were ingested into the fuel pump, causing damage to the pump impeller and pump housing.

The damage could have caused sparks or hot debris from the pump to enter the fuel tank. To address this unsafe condition, the FAA issued AD 97- 19- 15. This AD requires revision of the airplane flight manual to include procedures to switch off the fuel pumps when the center tank approaches empty. The intent of this interim action is to maintain liquid fuel over the pump inlet so that any debris generated by a failed fuel pump will not come in contact with fuel vapors and cause a fuel tank explosion.

The second design anomaly was reported on Boeing 747-400 series airplanes. The reports indicated that inlet adapters of the override/jettison pumps of the center wing fuel tank were found to be worn. Two of the inlet adapters had worn down enough to cause damage to the rotating blades of the inducer. The inlet check valves also had significant damage. Another operator reported damage to the inlet adapter that was so severe that contact had occurred between the steel disk of the inlet check valve and the steel screw that holds the inducer in place. Wear to the inlet adapters has been attributed to contact between the inlet check valve and the adapter. Such excessive wear of the inlet adapter can lead to contact between the inlet check valve and inducer, which could result in pieces of the check valve being ingested into the inducer and damaging the inducer and impellers. Contact between the steel disk of the inlet check valve and the steel rotating inducer screw can cause sparks. To address this unsafe condition, the FAA issued an immediately adopted rule, AD 98-16-19, on July 30, 1998.

Another design anomaly was reported in 1989 when a fuel tank ignition event occurred in an auxiliary fuel tank during refueling of a Beech 400 airplane. The auxiliary fuel tank had been installed under an STC. Polyurethane foam had been installed in portions of the tank to minimize the potential of a fuel tank explosion if uncontained engine debris penetrated those portions of the tank. The accident investigation indicated that electrostatic charging of the foam during refueling resulted in ignition of fuel-air vapors in portions of the adjacent fuel tank system that did not contain the foam. The fuel vapor explosion caused distortion of the tank and fuel leakage from a failed fuel line. Modifications to the design, including use of more conductive polyurethane foam and installation of a standpipe in the refueling system, were incorporated to prevent reoccurrence of electrostatic charging and resulting fuel tank ignition source.

Review of Fuel Tank System Maintenance Practices

In addition to the review of the design features and service history of the Boeing 747 and other airplane models in the transport airplane fleet, the FAA has also reviewed the current fuel tank system maintenance practices for these airplanes.

Typical transport category airplane fuel tank systems are designed with redundancy and fault indication features such that single component failures do not result in any significant reduction in safety. Therefore, fuel tank systems historically have not had any life-limited components or specific detailed inspection requirements, unless mandated by airworthiness directives. Most of the components are “on condition,” meaning that some test, check, or other inspection is performed to determine continued serviceability, and maintenance is performed only if the inspection identifies a condition requiring correction. Visual inspection of fuel tank system components is by far the predominant method of inspection for components such as boost pumps, fuel lines, couplings, wiring, etc. Typically these inspections are conducted concurrently with zonal inspections or internal or external fuel tank structural inspections. These inspections normally do not provide information regarding the continued serviceability of components within the fuel tank system, unless the visual inspection indicates a potential problem area. For example, it would be difficult, if not impossible, to detect certain degraded fuel tank system conditions, such as worn wiring routed through conduit to fuel pumps, debris inside fuel pumps, corrosion to bonding wire interfaces, etc., without dedicated intrusive inspections that are much more extensive than those normally conducted.

Listing of Deficiencies

The list provided below summarizes fuel tank system design features, malfunctions, failures, and maintenance related actions that have been identified through service experience to result in a degradation of the safety features of airplane fuel tank systems. This list was developed from service difficulty reports and incident and accident reports. These anomalies occurred on in-service transport category airplanes contrary to the intent of regulations and policies intended to preclude the development of ignition sources within airplane fuel tank systems.

1. Pumps:

- Ingestion of the pump inducer into the pump impeller and generation of debris into the fuel tank.
- Pump inlet case degradation, allowing the pump inlet check valve to contact the impeller.
- Stator winding failures during operation of the fuel pump. Subsequent failure of a second phase of the pump resulting in arcing through the fuel pump housing.
- Deactivation of thermal protective features incorporated into the windings of pumps due to inappropriate wrapping of the windings.
- Omission of cooling port tubes between the pump assembly and the pump motor assembly during fuel pump overhaul.
- Extended dry running of fuel pumps in empty fuel tanks, which was contrary to the manufacturer's recommended procedures.
- Use of steel impellers that may produce sparks if debris enters the pump.
- Debris lodged inside pumps.
- Arcing due to the exposure of electrical connections within the pump housing that have been designed with inadequate clearance to the pump cover.
- Thermal switches resetting over time to a higher trip temperature.
- Flame arrestors falling out of their respective mounting.
- Internal wires coming in contact with the pump rotating group, energizing the rotor and arcing at the impeller/adapter interface.
- Poor bonding across component interfaces.

- Insufficient ground fault current protection capability.
- Poor bonding of components to structure.

2. Wiring to pumps in conduits located inside fuel tanks:

- Wear of Teflon sleeving and wiring insulation allowing arcing from wire through metallic conduits into fuel tanks.

3. Fuel pump connectors:

- Electrical arcing at connections within electrical connectors due to bent pins or corrosion.
- Fuel leakage and subsequent fuel fire outside of the fuel tank caused by corrosion of electrical connectors inside the pump motor which lead to electrical arcing through the connector housing (connector was located outside the fuel tank).
- Selection of improper materials in connector design.

4. FQIS wiring:

- Degradation of wire insulation (cracking), corrosion and copper-sulfur deposits at electrical connectors
- Unshielded FQIS wires routed in wire bundles with high voltage wires.

5. FQIS probes:

- Corrosion and copper-sulfur deposits causing reduced breakdown voltage in FQIS wiring.
- Terminal block wiring clamp (strain relief) features at electrical connections on fuel probes causing damage to wiring insulation.
- Contamination in the fuel tanks causing reduced arc path between FQIS probe walls (steel wool, lock wire, nuts, rivets, bolts; mechanical impact damage to probes).

6. Bonding straps:

- Corrosion to bonding straps.
- Loose or improperly grounded attachment points.
- Static bonds on fuel tank system plumbing connections inside the fuel tank worn due to mechanical wear of the plumbing from wing movement and corrosion.

7. Electrostatic charge:

- Use of non-conductive reticulated polyurethane foam that holds electrostatic charge buildup.

- Spraying of fuel into fuel tanks through inappropriately designed refueling nozzles or pump cooling flow return methods.

Fuel Tank Flammability

In addition to the review of potential fuel tank ignition, the FAA has undertaken a parallel effort to address the threat of fuel tank explosions by eliminating or significantly reducing the presence of explosive fuel air mixtures within the fuel tanks of new type designs, in-production, and the existing fleet of transport airplanes. On April 3, 1997, the FAA published a notice in the Federal Register (62 FR 160 14) that requested comments concerning the 1997 NTSB recommendations regarding reduced flammability listed earlier in this notice. That notice provided significant discussion of service history, background, and issues relating to reducing flammability in transport airplane fuel tanks. Comments received from that notice indicated that additional information was needed before the FAA could initiate rulemaking action to address the recommendations.

On January 23, 1998, the FAA published a notice in the Federal Register that established an Aviation Rulemaking Advisory Committee (ARAC) working group, the Fuel Tank Harmonization Working Group (FTHWG), tasked to achieve this goal. The ARAC consists of interested parties, including the public, and provides a public process for advice to be given to the FAA concerning development of new regulations. The FTHWG evaluated numerous possible means of reducing or eliminating hazards associated with explosive vapors in fuel tanks. On July 23, 1998, the ARAC submitted its report to the FAA. The full report has been placed in a docket that was created for this ARAC working group (Docket No. FAA- 1998-4 183). That docket can be reviewed on the U.S. Department of Transportation electronic Document Management System on the Internet at http://dms.dot.gov. The full report has also been placed in the docket for this rulemaking.

The report provided a recommendation for the FAA to initiate rulemaking action to amend § 25.981, applicable to new type design airplanes, to include a requirement to limit the time transport airplane fuel tanks could operate with flammable vapors in the vapor space of the tank. The recommended regulatory text proposed, "Limiting the development of flammable conditions in the fuel tanks, based on the intended fuel types, to less than 7 percent of the expected fleet operational time, or providing means to mitigate the effects of an ignition of fuel vapors within the fuel tanks such that any damage caused by an ignition will not prevent continued safe flight and landing." The report discussed various options of showing compliance with this proposal, including managing heat input to the fuel tanks, installation of inerting systems or polyurethane fire suppressing foam, and suppressing an explosion if one occurred, etc.

The level of flammability defined in the proposal was established based upon comparison of the safety record of center wing fuel tanks that, in certain airplanes, are heated by equipment located under the tank, and unheated fuel tanks located in the wing. The FTHWG concluded that the safety record of fuel tanks located in the wings was adequate and that if the same level could be achieved in center wing fuel tanks, the overall safety objective would be achieved. Results from thermal analyses documented in the report indicate that center wing fuel tanks that are heated by air conditioning equipment located beneath them are flammable, on a fleet average basis, for up to 30 percent of the fleet operating time.

During the ARAC process it was also determined that certain airplane types do not locate heat sources adjacent to the fuel tanks. These airplanes provide significantly reduced flammability exposure, near the 5 percent value of the wing tanks. The group therefore determined that it would be feasible to design new airplanes such that fuel tank operation in the flammable range would be limited to near that of the wing fuel tanks. The primary method of compliance with the requirement proposed by the ARAC would likely be to control heat transfer into and out of fuel tanks such that heating of the fuel would not occur. Design features such as locating the air conditioning equipment away from the fuel tanks, providing ventilation of the air conditioning bay to limit heating and cool fuel tanks, and/or insulating the tanks from heat sources, would be practical means of complying with the regulation proposed by the ARAC.

In addition to its recommendation to revise § 25.98 1, the ARAC also recommended that the FAA continue to evaluate means for minimizing the development of flammable vapors within the fuel tanks to determine whether other alternatives, such as ground based inerting of fuel tanks, could be shown to be cost effective.

Discussion of the Proposal

The FAA review of the service history, design features, and maintenance instructions of the transport airplane fleet indicates that aging of fuel tank system components and unforeseen fuel tank system failures and malfunctions have become a safety issue for the fleet of turbine-powered transport category airplanes. The FAA proposes to amend the current regulations in four areas.

The first area of concern encompasses the possibility of the development of ignition sources within the existing transport airplane fleet. Many of the design practices used on airplanes in the existing fleet are similar. Therefore anomalies that have developed on specific airplane models within the fleet could develop on other airplane models. As a result, the FAA considers that a one-time design review of the fuel tank system for transport airplane models in the current fleet is needed.

The second area of concern encompasses the need to require the design of future transport category airplanes to more completely address potential failures in the fuel tank system that could result in an ignition source in the fuel tank system.

Third, certain airplane types are designed with heat sources adjacent to the fuel tank, which results in heating of the fuel and a significant increase in the formation of flammable vapors in the tank. The FAA considers that fuel tank safety can be enhanced by reducing the time fuel tanks operate with flammable vapors in the tank and is therefore proposing a requirement to provide means to minimize the development of flammable vapors in fuel tanks or provide means to prevent catastrophic damage if ignition does occur.

Fourth, the FAA considers that it is necessary to impose operational requirements so that any required maintenance or inspection actions will be included in each operator's FAA-approved program.

Proposed SFAR

Historically, the FAA has worked together with the TC holders when safety issues arise to identify solutions and actions that need to be taken. Some of the safety issues that have been addressed by this voluntary cooperative process include those involving aging aircraft structure, thrust reversers, cargo doors, and wing icing protection. While some manufacturers have aggressively completed these safety reviews, others have not applied the resources necessary to complete these reviews in a timely manner, which delayed the adoption of corrective action. Although these efforts have frequently been successful in achieving the desired safety objectives, a more uniform and expeditious response is considered necessary to address fuel tank safety issues.

While maintaining the benefits of FAA-TC holder cooperation, the FAA considers that a Special Federal Aviation Regulation (SFAR) provides a means for the FAA to establish clear expectations and standards, as well as a timeframe within which the design approval holders and the public can be confident that fuel tank safety issues on the affected airplanes will be uniformly examined.

This proposed rulemaking is intended to ensure that the design approval holder completes a comprehensive assessment of the fuel tank system and develops any required inspections, maintenance instructions, or modifications.

Safety Review

The proposed SFAR would require the design approval holder to perform a safety review of the fuel tank system to show that fuel tank fires or explosions will not occur on airplanes of the approved design. In conducting the review, the design approval holder would be required to demonstrate compliance with the standards proposed in this notice for § 25.981(a) and (b) (discussed below) and the existing standards of § 25.90 1. As part of this review, the design approval holder would be required to submit a report to the cognizant FAA Aircraft Certification Office (ACO) that substantiates that the fuel tank system is fail-safe.

The FAA intends that those failure conditions listed previously in this notice, and any other foreseeable failures, should be assumed when performing the system safety analysis needed to substantiate that the fuel tank system design is fail-safe. The system safety analysis should be prepared considering all airplane inflight, ground, service, and maintenance conditions, assuming that an explosive fuel air mixture is present in the fuel tanks at all times, unless the fuel tank has been purged of fuel vapor for maintenance. The design approval holder would be expected to develop a failure modes and effects analysis (FMEA) for all components in the fuel tank system. Analysis of the FMEA would then be used to determine whether single failures, alone or in combination with foreseeable latent failures, could cause an ignition source to exist in a fuel tank. A subsequent quantitative fault tree analysis should then be developed to determine whether combinations of failures expected to occur in the life of the affected fleet could cause an ignition source to exist in a fuel tank system.

Because fuel tank systems typically have few components within the fuel tank, the number of possible sources of ignition is limited. The system safety analysis required by this proposed rule would include all components or systems that could introduce a source of fuel tank ignition. This may require analysis of not only the fuel tank system components, (e.g., pumps, fuel pump power supplies, fuel valves, fuel quantity indication system probes, wiring, compensators, densitometers, fuel level sensors, etc.), but also other airplane systems that may affect the fuel tank system. For example, failures in airplane wiring or electromagnetic interference from other airplane systems could cause an ignition source in the airplane fuel tank system under certain conditions and therefore would have to be included in the system safety analysis. A proposed revision to AC 25.981-1A, discussed later in this document, is being developed to provide guidance on performing the safety review.

The intent of the design review proposed in this notice is to assure that each fuel tank system design that is affected by this action will be fully assessed and that the design approval holder identifies any required modifications, added flight deck or maintenance indications, and/or maintenance actions necessary to meet the fail-safe criteria.

Maintenance Instructions

The FAA anticipates that the safety review would identify critical areas of the fuel tank and other related systems that would require maintenance actions to account for the affects of aging, wear, corrosion, and possible contamination on the fuel tank system. For example, service history indicates that copper-sulfur deposits may form on fuel tank components, including bonding straps and FQIS components, which could degrade the intended design capabilities by providing a mechanism by which arcing could occur. Therefore, it might be necessary to provide maintenance instructions to identify and eliminate such deposits.

The proposed SFAR would require that the design approval holder develop any specific maintenance and inspection instructions necessary to maintain the design features required to preclude the existence or development of an ignition source within the fuel tank system. These instructions would have to be established to ensure that an ignition source will not develop throughout the remaining operational life of the airplane.

Possible Airworthiness Directives

The design review may also result in identification of unsafe conditions on certain airplane models that would require issuance of airworthiness directives. For example, as discussed previously in this notice, the FAA has required or proposed requirements for design changes to the Boeing 737, 747, and 767; Boeing Douglas Products Division DC-10 and Lockheed L-101 1 airplanes. Design practices utilized on these models may be similar to those of other airplane types; therefore, the FAA expects that modifications to airplanes with similar design features may also be required.

The number and scope of any possible AD's may vary by airplane type design. For example, wiring separation and shielding of FQIS wires on newer technology airplanes significantly reduces the likelihood of an electrical short causing an electrical arc in the fuel tank; many newer transport airplanes do not route electrical power wiring to fuel pumps inside the airplane fuel tanks. Therefore, some airplane models may not require significant modifications or additional dedicated maintenance procedures. Other models may require significant modifications or more maintenance. For example, the FQIS wiring on some older technology airplanes is routed in wire bundles with high voltage power supply wires. The original failure analyses conducted on these airplane types did not consider the possibility that the fuel quantity indication system may become degraded allowing a significantly lower voltage level to produce a spark inside the fuel tank. Causes of degradation observed in service include aging, corrosion, or undetected contamination of the system. As previously discussed, the FAA has issued AD actions for certain Boeing 737 and 747 airplanes to address this condition. -Modification of similar types of installations on other airplane models may be required to address this unsafe condition and to achieve a fail-safe design,

It should be noted that any design changes may, in themselves, require maintenance actions. For example, transient protection devices typically require scheduled maintenance in order to detect latent failure of the suppression feature. As a part of the required design review, the manufacturer would define the necessary maintenance procedures and intervals for any required maintenance actions.

Applicability of the proposed SFAR

As proposed, the SFAR would apply to holders of TCs, and STCs for modifications that affect the fuel tank systems of turbine-powered transport category airplanes, for which the TC was issued after January 1, 1958, and the airplane has a maximum type certificated passenger capacity of 30 or more, or a maximum type certificated payload capacity of 7500 pounds or more. The SFAR would also apply to applicants for type certificates, amendments to a type certificate, and supplemental type certificates affecting the fuel tank systems for those airplanes identified above if the application was filed before the effective date of the proposed SFAR and the certificate was not issued before the effective date of the SFAR. The FAA has determined that turbine-powered airplanes, regardless of whether they are turboprops or turbojets, should be subject to the rule, because the potential for ignition sources in fuel tank systems is unrelated to the engine design. This would result in the coverage of the large transport category airplanes where the safety benefits and public interest are greatest. This action would affect approximately 6,000 U.S. registered airplanes in part 91, 121, 125, and 129 operations.

The date January 1, 1958, was chosen so that only turbine-powered airplanes, except for a few 1953-1958 vintage Convair 340s and 440s converted from reciprocating power, would be included. No reciprocating-powered transport category airplanes are known to be used currently in passenger service, and the few remaining in cargo service would be excluded. Compliance is not proposed for those older airplanes because their advanced age and small numbers would likely make compliance impractical from an economic standpoint. This is consistent with similar exclusions made for those airplanes from other requirements applicable to existing airplanes, such as the regulations adopted for flammability of seat cushions (49 FR 43 188, October 24, 1984); flammability of cabin interior components (5 1 FR 26206, July 2 1, 1986); cargo compartment liners (54 FR 7384, February 17, 1989);

access to passenger emergency exits (57 FR 19244, May 4, 1992); and Class D cargo or baggage compartments (63 FR 8032, February 17, 1998).

In order to achieve the benefits of this rulemaking for large transport airplanes as quickly as possible, the FAA has decided to proceed with this rulemaking with the applicability of the SFAR limited to airplanes with a maximum certificated passenger capacity of at least 30 or at least 7,500 pounds payload. Compliance is not proposed for smaller airplanes because it is not clear at this time that the possible benefits for those airplanes would be commensurate with the costs involved. However, the FAA intends to undertake a full regulatory evaluation of applying these requirements to small transport category and commuter category airplanes to determine the merits of subsequently extending the rule to airplanes with a passenger capacity of fewer than 30 and less than 7,500 pounds payload. Therefore, the FAA specifically requests comments as to the feasibility of requiring holders of type certificates issued prior to January 1, 1958, or for airplanes having a passenger capacity of fewer than 30 and less than 7,500 pounds payload, to comply and the safety benefits likely to be realized.

Supplemental Type Certificates (STC)

The FAA considers that this rule should apply to STC holders as well, because a significant number of STCs effect changes to fuel tank systems, and the objectives of this proposed rule would not be achieved unless these systems are also reviewed and their safety ensured. The service experience noted in the background of this proposed rule indicates modifications to airplane fuel tank systems incorporated by STCs may affect the safety of the fuel tank system.

Modifications that could affect the fuel tank system include those that could result in an ignition source in the fuel tank. Examples include installation of auxiliary fuel tanks and installation of, or modification to, other systems such as the fuel quantity indication system, the fuel pump system (including electrical power supply), airplane refueling system, any electrical wiring routed within or adjacent to the fuel tank, and fuel level sensors or float switches. Modifications to systems or components located outside the fuel tank system may also affect fuel tank safety. For example, installation of electrical wiring for other systems that was inappropriately routed with FQIS wiring could violate the wiring separation requirements of the type design. Therefore, the FAA intends that a fuel tank system safety review be conducted for any modification to the airplane that may affect the safety of the fuel tank system. The level of evaluation that is intended would be dependent upon the type of modification. In most cases a simple qualitative evaluation of the modification in relation to the fuel tank system, and a statement that the change has no effect on the fuel tank system, would be all that is necessary. In other cases where the initial qualitative assessment shows that the modification may affect the fuel tank system, a more detailed safety review would be required.

Design approvals for modification to airplane fuel tank systems approved by STCs require the applicant to have knowledge of the airplane fuel tank system in which the modification is installed. The majority of these approvals are held by the original airframe manufacturers or airplane modifiers that specialize in fuel tank system modifications, such as installation of auxiliary fuel tanks. Therefore, the FAA expects that the data needed to complete the safety review proposed in this notice would be available to the STC holder.

Compliance

This notice proposes a 12-month compliance time from the effective date of the final rule, or within 12 months after the issuance of a certificate for which application was filed before the effective date of this SFAR, whichever is later, for design approval holders to conduct the safety review and develop the compliance documentation and any required maintenance and inspection instructions. The FAA would expect each design approval holder to work with the cognizant FAA Aircraft Certification Office (ACO) and Aircraft Evaluation Group (AEG) to develop a plan to complete the safety review and develop the required maintenance and inspection instructions within the 12 month period. The plan should include periodic reviews with the ACO and AEG of the ongoing safety review and the associated maintenance and inspection instructions.

During the proposed 12-month compliance period, the FAA is committed to working with the affected design approval holders to assist them in complying with the requirements of this proposed SFAR. However, failure to comply within the specified time would constitute a violation of the proposed requirements and may subject the violator to certificate action to amend, suspend, or revoke the affected certificate in accordance with 49 U.S.C. § 44709. It may also subject the violator to a civil penalty of not more than $1,100 per day until the SFAR is complied with, in accordance with 49 U.S.C. § 46301.

Proposed Operating Requirements

This proposed rule would require that affected operators incorporate FAA-approved fuel tank system maintenance and inspection instructions in their maintenance or inspection program within 18 months of the effective date of the proposed rule. If the design approval holder has complied with the SFAR and developed an FAA-approved program, the operator could incorporate that program to meet the proposed requirement. The operator would also have the option of developing its own program independently, and would be ultimately responsible for having an FAA-approved program, regardless of the action taken by the design approval holder.

The proposed rule would prohibit the operation of certain transport category airplanes operated under parts 9 1, 12 1, 125, and 129 beyond a specified compliance time, unless the operator of those airplanes has incorporated FAA-approved fuel tank maintenance and inspection instructions in its maintenance or inspection program, as applicable. The proposed regulation would require that the maintenance and inspection instructions be approved by the Administrator; for the purposes of this rule, the Administrator is considered to be the manager of the cognizant FAA ACO.

The operator would need to consider the following:

1. The fuel tank system maintenance and inspection instructions that would be incorporated into the operator's existing maintenance or inspection program would need to be approved by the FAA ACO having cognizance over the TC of the airplane. If the operator can establish that the existing maintenance and inspection

instructions fulfill the requirements of this proposed rule, then the ACO may approve the operator's existing maintenance and inspection instructions without change.

2. The means by which the FAA-approved fuel tank system maintenance and inspection instructions would be incorporated into a certificate holder's FAA-approved maintenance or inspection program would be subject to approval by the certificate holder's principal maintenance inspector (PMI) or other cognizant airworthiness inspector. The FAA intends that any escalation to the FAA-approved inspection intervals would require the operator to receive FAA approval of the amended program. Any request for escalation to the FAA approved inspection intervals would need to include data to substantiate that the proposed interval will provide the level of safety intended by the original approval. If inspection results and service experience indicate that additional or more frequent inspections are necessary, the FAA may issue AD's to mandate such changes to the inspection program.

3. This rule would not impose any new reporting requirements; however, normal reporting required under 14 CFR §§ 121.703 and 125.409 would still apply.

4. This rule would not impose any new FAA recordkeeping requirements. However, as with all maintenance, the current operating regulations (e.g., 14 CFR §§ 12 1.380 and 9 1.4 17) already impose recordkeeping requirements that would apply to the actions required by this proposed rule. When incorporating the fuel tank system maintenance and inspection instructions into its approved maintenance or inspection program, each operator should address the means by which it will comply with these recordkeeping requirements. That means of compliance, along with the remainder of the program, would be subject to approval by the cognizant PMI or other cognizant airworthiness inspector.

5. The maintenance and inspection instructions developed by the TC holder under the proposed rule generally would not apply to fuel tank systems modified by an STC, including any auxiliary fuel tank installations or other modifications. The operator, however, would still be responsible to incorporate specific maintenance and inspection instructions applicable to the entire fuel tank system that meet the requirements of this proposed rulemaking. This means that the operator should evaluate the fuel tank systems and any alterations to the fuel tank system and then develop, submit, and gain FAA approval of the maintenance and inspection instructions to evaluate repairs to such fuel tank systems.

The FAA recognizes that operators may not have the resources to develop maintenance or inspection instructions for the airplane fuel tank system. The proposed rule would therefore require the TC and STC holders to develop fuel tank system maintenance and inspection instructions that may be used by operators. If however, the STC holder is out of business or otherwise unavailable, the operator would independently have to acquire the FAA-approved inspection instructions. To keep the airplanes in service, operators, either individually or as a group, could hire the necessary expertise to develop and gain approval of maintenance and inspection instructions.

Guidance on how to comply with this aspect of the proposed rule would be provided in the planned revision to AC 25.981-1A.

After the PMI having oversight responsibilities is satisfied that the operator's continued airworthiness maintenance or inspection program contains all of the elements of the FAA-approved fuel tank system maintenance and inspection instructions, the airworthiness inspector would approve the maintenance or inspection program revision. This approval would have the effect of requiring compliance with the maintenance and inspection instructions.

Applicability of the proposed operating requirements

This proposed rule would prohibit the operation of certain transport category airplanes operated under 14 CFR parts 9 1, 12 1, 125, and 129 beyond a specified compliance time, unless the operator of those airplanes has incorporated FAA-approved specific maintenance and inspection instructions applicable to the fuel tank system in its approved maintenance or inspection program, as applicable. The operational applicability was established so that all airplane types affected by the SFAR, regardless of type of operation, would be subject to FAA approved fuel tank system maintenance and inspection procedures. As discussed earlier, this proposed rulemaking would include each turbine-powered transport category airplane model, provided its TC was issued after January 1, 1958, and it has a maximum type certificated passenger capacity of 30 or more, or a maximum type certificated payload capacity of 7,500 pounds or more.

Field approvals

A significant number of changes to other transport category airplane fuel tank systems have been incorporated through field approvals issued to the operators of those airplanes. These changes may also significantly affect the safety of the fuel tank system. The operator of any airplane with such changes would be required to develop the fuel tank system maintenance and inspection program instructions and submit it to the FAA for approval, together with the necessary substantiation of compliance with the design review requirements of the SFAR.

Compliance

This notice proposes an 18 month compliance time from the effective date of the final rule for operators to incorporate FAA-approved long term fuel tank system maintenance and inspection instructions into their approved program. The FAA would expect each operator to work with the airplane TC holder or STC holder to develop a plan to implement the required maintenance and inspection instructions within the 18 month period. The plan should include periodic reviews with the cognizant ACO and AEG that would approve the associated maintenance and inspection instructions.

Proposed Changes to Part 25

Currently, § 25.981 defines limits on surface temperatures within transport airplane fuel tank systems. In order to address future airplane designs, the FAA proposes to revise § 25.981 to address both prevention of ignition sources in fuel tanks and reduction in the time fuel tanks contain flammable vapors. The first proposal would explicitly include a requirement for effectively precluding ignition sources within the fuel tank systems of transport category airplanes. The second proposal would require minimizing the formation of flammable vapors in the fuel tanks.

Fuel Tank Ignition Source Proposal

The title of § 25.981 would be changed from "Fuel tank temperature" to "Fuel tank ignition prevention." The FAA proposes to retain the substance of existing paragraph (a), which requires the applicant to determine the highest temperature that allows a safe margin below the lowest expected auto ignition temperature of the fuel; and the existing paragraph (b), which requires precluding the temperature in the fuel tank from exceeding the temperature determined under paragraph (a). These requirements are redesignated as (a)(1) and (2) respectively.

Compliance with these paragraphs requires the determination of the fuel flammability characteristics of the fuels approved for use. Fuels approved for use on transport category airplanes have differing flammability characteristics. The fuel with the lowest autoignition temperature is JET A (kerosene), which has an autoignition temperature of approximately 450°F at sea level. The autoignition temperature of JP-4 is approximately 470°F at sea level. Under the same atmospheric conditions the autoignition temperature of gasoline is approximately 800°F. The autoignition temperature of these fuels increases at increasing altitudes (lower pressures). For the purposes of this rule the lowest temperature at which autoignition can occur for the most critical fuel approved for use should be determined. The FAA intends that a temperature providing a safe margin is at least 50°F below the lowest expected autoignition temperature of the fuel throughout the altitude and temperature envelopes approved for the airplane type for which approval is requested.

This proposal would also add a new paragraph (a)(3) to require that a safety analysis be performed to demonstrate that the presence of an ignition source in the fuel tank system could not result from any single failure, from any single failure in combination with any latent failure condition not shown to be extremely remote, or from any combination of failures not shown to be extremely improbable.

These new requirements define three scenarios that must be addressed in order to show compliance with the proposed paragraph (a)(3). The first scenario is that any single failure, regardless of the probability of occurrence of the failure, must not cause an ignition source. The second scenario is that any single failure, regardless of the probability occurrence, in combination with any latent failure condition not shown to be at least extremely remote (i.e., not shown to be extremely remote or extremely improbable), must not cause an ignition source. The third scenario is that any combination of failures not shown to be extremely improbable must not cause an ignition source.

For the purpose of this proposed rule, "extremely remote" failure conditions are those not anticipated to occur to each airplane during its total life, but which may occur a few times when considering the total operational life of all airplanes of the type. This definition is consistent with that proposed by the Aviation Rulemaking

Advisory Committee (ARAC) for a revision to FAA AC 25.1309-1A and that currently used by the Joint Aviation Authorities (JAA) in AMJ 25.1309. "Extremely improbable" failure conditions are those so unlikely that they are not anticipated to occur during the entire operational life of all airplanes of one type. This definition is consistent with the definition provided in FAA AC 25.1309-1A and retained in the draft revision to AC 25.1309-1A proposed by the ARAC.

The severity of the external environmental conditions that should be considered when demonstrating compliance with this proposed rule are those established by certification regulations and special conditions (e.g., HTRF), regardless of the associated probability. The proposed regulation would also require that the effects of manufacturing variability, aging, wear, and likely damage be taken into account when demonstrating compliance.

The proposed requirements are consistent with the general powerplant installation failure analysis requirements of § 25.901(c) and the systems failure analysis requirements of § 25.1309 as they have been applied to powerplant installations. This proposal is needed because the general requirements of §§ 25.901 and 25.1309 have not been consistently applied and documented when showing that ignition sources are precluded from transport category airplane fuel tanks. Compliance with the proposed revision to § 25.981 would require analysis of the airplane fuel tank system using analytical methods and documentation currently used by the aviation industry in demonstrating compliance with §§ 25.901 and 25.1309. In order to eliminate any ambiguity as to the necessary methods of compliance, the proposed rule explicitly requires that the existence of latent failures be assumed unless they are extremely remote, which is currently required under § 25.901, but not under § 25.1309. The analysis should be conducted assuming design deficiencies listed in the background section of this notice, and any other failure modes identified within the fuel tank system functional hazard assessment.

Based upon the evaluations required by paragraph (a), a new requirement would be added to paragraph (b) to require that critical design configuration control limitations, inspections, or other procedures be established as necessary to prevent development of ignition sources within the fuel tank system, and that they be included in the Airworthiness Limitations section of the ICA required by § 25.1529. This requirement would be similar to that contained in § 25.571 for airplane structure. Appendix H to part 25 would also be revised to add a requirement to provide any mandatory fuel tank system inspections or maintenance actions in the limitations section of the ICA.

Critical design configuration control limitations include any information necessary to maintain those design features that have been defined in the original type design as needed to preclude development of ignition sources. This information is essential to ensure that maintenance, repairs or alterations do not unintentionally violate the integrity of the original fuel tank system type design. An example of a critical design configuration control limitation for current designs discussed previously would be maintaining wire separation between FQIS wiring and other high power electrical circuits. The original design approval holder must define a method of ensuring that this essential information will be evident to those that may perform and approve such repairs and alterations. Placards, decals or other visible means must be placed in areas of the airplane where these actions may degrade the integrity of the design configuration. In addition, this information should be communicated by statements in appropriate manuals, such as Wiring Diagram Manuals.

Flammability Proposal

The FAA agrees with the intent of the recommended regulatory text recommended by the ARAC. However, due to the short timeframe that the ARAC was provided to complete the tasking, sufficient detailed economic evaluation was not completed to determine if practical means, such as ground based inerting, were available to reduce the exposure below the specific value of 7 percent of the operational time included in the ARAC proposal. In addition the 7 percent level of flammability proposed by the FTHWG does not minimize flammability on certain applications, while in other applications, such as very short haul operations, it may not be practical to achieve. Therefore, the FAA is proposing a more objective regulation that is intended to minimize exposure to operation with flammable conditions in the fuel tanks.

As discussed previously, the ARAC has submitted a recommendation to the FAA that the FAA continue to evaluate means for minimizing the development of flammable vapors within the fuel tanks. Development of a definitive standard to address this recommendation will require a significant research effort that will likely take some time to complete. In the meantime, however, the FAA is aware that historically certain design methods have been found acceptable that, when compared to readily available alternative methods, increase the likelihood that flammable vapors will develop in the fuel tanks. For example, in some designs, including the Boeing 747, air conditioning packs have been located immediately below a fuel tank without provisions to reduce transfer of heat from the packs to the tank.

Therefore, in order to preclude the future use of such design practices, this proposal would revise § 25.981 to add a requirement that fuel tank installations be designed to minimize the development of flammable vapors in the fuel tanks. Alternatively, if an applicant concludes that such minimization is not advantageous, it may propose means to mitigate the effects of an ignition of fuel vapors in the fuel tanks. For example, such means might include installation of fire suppressing polyurethane foam or installation of an explosion suppression system.

This proposal is not intended to prevent the development of flammable vapors in fuel tanks because total prevention has currently not been found to be feasible. Rather, it is intended as an interim measure to preclude, in new designs, the use of design methods that result in a relatively high likelihood that flammable vapors will develop in fuel tanks when other practicable design methods are available that can reduce the likelihood of such development. For example, the proposal would not prohibit installation of fuel tanks in the cargo compartment, placing heat exchangers in fuel tanks, or locating a fuel tank in the center wing. The proposal would, however, require that practical means, such as transferring heat from the fuel tank (e.g., use of ventilation or cooling air), be incorporated into the airplane design if heat sources were placed in or near the fuel tanks that significantly increased the formation of flammable fuel vapors in the tank, or if the tank is located in an area of the airplane where little or no cooling occurs. The intent of the proposal is to require that fuel tanks are not heated, and cool at a rate equivalent to that of a wing tank in the transport airplane being evaluated. This may require incorporating design features to increase or provide ventilation means for fuel tanks located in the center wing box, horizontal stabilizer, or auxiliary fuel tanks located in the cargo compartment. At such time as the FAA has completed the necessary research and identified an appropriate definitive standard to address this issue, new rulemaking would be considered to revise the standard proposed in this rulemaking.

Applicability of Proposed Part 25 Change

The proposed amendments to part 25 would apply to all transport category airplane models for which an application for type certification is made after the effective date of the rule, regardless of passenger capacity or size. In addition, as currently required by the provisions of § 2 1 SO, applicants for any future changes to existing part 25 type certificated airplanes, including STCs, that could introduce an ignition source in the fuel tank system would be required to provide any necessary Instructions for Continued Airworthiness, as required by § 25.1529 and the proposed change to the Airworthiness Limitations section, paragraph H25.4 of Appendix H. In cases where it is determined that the existing ICA are adequate for the continued airworthiness of the altered product, then it should be noted on the STC, PMA supplement, or major alteration approval.

FAA Advisory Material

In addition to the amendments proposed in this notice, the FAA is developing a proposed revision to AC 25.98 1- 1 A, "Guidelines for Substantiating Compliance With the Fuel Tank Temperature Requirements." The proposed revision will include consideration of failure conditions that could result in sources of ignition of vapors within fuel tanks. The revised AC will provide guidance on how to substantiate that ignition sources will not be present in airplane fuel tank systems following failures or malfunctions of airplane components or systems. This AC will also include guidance for developing any limitations for the ICA that may be generated by the fuel tank system safety assessment. Public comments concerning the proposed AC will be requested by separate notice published in the Federal Register.

Future Regulatory Actions

The ARAC report discussed earlier does not recommend specific actions to eliminate or significantly reduce the flammability of fuel tanks in current production and the existing fleet of transport airplanes. The report, however, recommends that the FAA continue to investigate means to achieve a cost-effective reduction in flammability exposure for these airplanes. The FAA has reviewed the report and established research programs to support the further evaluation needed to establish the practicality of methods for achieving reduced flammability exposure for newly manufactured and the existing fleet of transport airplanes. The FAA intends to initiate rulemaking to address these airplanes if practical means are established.

Economic Evaluation, Regulatory Flexibility Determination, International Trade Impact Assessment, and Unfunded Mandates Assessment

Proposed changes to Federal regulations must undergo several economic analyses. First, Executive Order 12866 directs that each Federal agency shall propose or adopt a regulation only upon a reasoned determination that the benefits of the intended regulation justify its costs. Second, the Regulatory Flexibility Act of 1980 requires agencies to analyze the economic impact of regulatory changes on small entities, Third, the Office of Management and Budget directs agencies to assess the effects of regulatory changes on international trade. And fourth, the Unfunded Mandates Reform Act of 1995 (Pub. L. 104-4) requires agencies to prepare a written assessment of the costs, benefits, and other effects of proposed or final rules that include a Federal mandate likely to result in the expenditure by State, local, or tribal governments, in the aggregate, or by the private sector, of $100 million or more annually (adjusted for inflation). In conducting these analyses, the FAA has determined that this proposed rulemaking: (1) would generate benefits that justify its costs as required by Executive Order 12866 and would be a "significant regulatory action" as defined in DOT's Regulatory Policies and Procedures; (2) would have a significant economic impact on a substantial number of small entities; (3) would have minimal effects on international trade; and (4) would not contain a significant intergovernmental or private sector mandate. These analyses, available in the docket, are summarized as follows.

<u>Affected Industries</u>

Based on 1996 data, the proposal would affect 6,006 airplanes, of which 5,700 airplanes are operated by 114 air carriers under part 12 1 service, 193 airplanes are operated by 7 carriers that operate under both part 12 l and part 135, 22 airplanes are operated by 10 carriers under part 125 service, and 91 airplanes are operated by 23 carriers operating U.S.-registered airplanes under part 129. At this time, the FAA does not have information on airplanes operating under part 91 that would be affected by the proposed rulemaking; however, the FAA believes that very few airplanes operating under part 91 would be affected by the proposal.

The proposed rule would also affect 12 manufacturers holding 35 type certificates (TCs) and 26 manufacturers and airlines holding 168 supplemental type certificates (STCs). The proposed rule would also affect manufacturers of future, new part 25 type certificated airplane models and holders of future, new part 25 supplemental type certificates for new fuel tank systems. At this time, the FAA cannot predict the number of new airplane models. Based on the past 10 years average, the FAA anticipates that about 17 new fuel tank system STCs would be granted annually. The FAA requests comments on these estimates and requests that commenters provide clear supporting additional information,

<u>Benefits</u>

In order to quantify the benefits from preventing future fuel tank explosions, the FAA assumes that the potential U.S. fuel tank explosion rate due to an unknown internal fuel tank ignition source is similar to the worldwide fleet explosion rate over the past 10 years. On that basis, the FAA estimates that if no preventative actions were to be taken, between one and two (the expected value would be 1.25) fuel tank explosions would be expected to occur during the next 10 years in U.S. operations.

By way of illustrating the potential effectiveness of an enhanced fuel tank system inspection program, on May 14, 1998, the FAA issued AD T98-1 l-52 requiring the inspection of fuel boost pump wires in the center wing tank of all Boeing 737's with more than 30,000 hours. Of the 599 airplanes inspected as of June 30, 1998, 273 wire bundles had noticeable chafing to wire insulation, 33 had significant (greater than 50 percent) insulation chafing, 8 had arcing on the cable but not through the conduit, while 2 had arcing through the conduit into the fuel tank.

In light of the findings from these inspections, the FAA believes that better fuel tank system inspections would be a significant factor in discovering potential fuel tank ignition sources. The FAA anticipates that compliance with the proposal would prevent between 75 percent and 90 percent of the potential future fuel tank explosions from unknown ignition sources.

Using a value of $2.7 million to prevent a fatality, a value of the destroyed airplane of $20 million, an average of $30 million for an FAA investigation of an explosion, and assuming the proposal would prevent between 75 percent and 90 percent of these potential fuel tank explosions from an unknown ignition source, the potential present value of the expected benefits discounted over 10 years at 7 percent would be between $260 million and $520 million.

In addition, the proposed part 25 change would reduce the length of time that an explosive atmosphere would exist in the fuel tank during certain operations for new part 25 type certificated airplanes and for new fuel tank system STCs. At this time, the FAA cannot quantify these potential benefits, but they are not expected to be considerable in the immediate future. The FAA expects that these benefits would increase over time as new part 25 type certificated airplanes replace the older part 25 type certificated airplanes in the fleet.

Compliance Costs

The proposal consists of three parts. The first two are separate but interrelated parts, each of which would impose costs on the industry. The first is the proposed SFAR. The second is the proposed operational rules changes from the recommendations following the SFAR. The third part is the proposed part 25 change.

The compliance costs for the proposed SFAR would be due to the requirement for the design approval holder to complete a comprehensive fuel tank system design assessment and to provide recommendations for the inspections and model-specific service instructions within one year from the SFAR's effective date. The assessment may identify conditions that would be addressed by specific service bulletins or unsafe conditions that would result in FAA issuance of an airworthiness directive (AD). However, those future costs would be the result of compliance with the service bulletin or the AD and are not costs of compliance with the proposed rulemaking. Those costs would be estimated for each individual AD, when proposed. In addition, the compliance costs do not include the compliance costs from an existing fuel tank AD.

The compliance costs for the proposed operational rule changes would be due to the requirement for the air carrier to incorporate these recommendations into its fuel tank system inspection and maintenance program within 18 months from the proposal's effective date. These compliance costs do not include the costs to repair and replace equipment and wiring that is found to need repair or replacement during the inspection. Although these costs are likely to be substantial, they are attributable to existing FAA regulations that require such repairs and replacements be made to assure the airplane's continued airworthiness.

The FAA anticipates that the proposed part 25 change would have a minimal effect on the cost of future type certificated airplanes because compliance with the proposed change would be done during the design phase of the airplane model before any new airplanes would be manufactured.

In addition, the FAA determines, after discussion with industry representatives, that the proposed part 25 changes would have a minimal impact on future fuel tank system STCs because current industry design practices could be adapted to allow compliance with the proposed requirement.

Costs of Fuel Tank System Design Assessments - New SFAR

The FAA has determined that 35 TCs and 68 fuel tank system STCs (many of the 168 STCs duplicate other STCs) would need a fuel tank system design assessment. Depending upon the complexity of the fuel tank system and the number of tanks, the FAA has estimated that a fuel tank system design assessment would take between 0.5 to 2 engineer years for a TC holder and an average of 0.25 engineer years for an STC holder. The FAA estimates that developing manual revisions and service bulletins would take between 0.25 to 1 engineer years for a TC holder and an average of 0.1 engineer years for an STC holder. In addition, the FAA and the TC or STC holder would each spend between 1 day and 5 days to review, revise, and approve the assessment and the changes to the manual.

Using a total engineer compensation rate (salary and fringe benefits plus a mark-up for hours spent by management, legal, etc. on the assessment) of $100 an hour, the FAA estimates that the one-time fuel tank system design assessment would cost TC holders a total of $9.5 million, it would cost STC holders a total of $4.9 million, and it would cost the FAA about $220,000.

The FAA requests comments on the assumptions and the methodology and also requests that commenters provide additional data.

Costs of Fuel Tank System Inspections - Operational Rule Changes

Methodology: The costs to air carriers of complying with the operational requirements proposed for Parts 9 1, 12 1, 125, and 129 would be the additional (incremental) labor hours and additional airplane out-of-service time to perform the enhanced fuel tank system maintenance and inspections. However, the costs of the fuel tank system inspections that have been required by recent ADs are not included as a cost of complying with the proposed operational amendments.

The FAA intends that any additional fuel tank system inspection and maintenance actions resulting from the SFAR review would occur during an airplane's regularly scheduled major maintenance checks. From a safety standpoint, repeated entry increases the risk of damage to the airplane. Thus, the proposal would not require air carriers to alter their maintenance schedules, and the FAA anticipates that few or no airplanes would be taken out of service solely to comply with the proposal unless an immediate safety concern is identified. In that case, corrective action would be mandated by an AD.

The FAA anticipates that the proposal would require additional time out of service and man-hours to complete a fuel tank system inspection and equipment and wiring testing.

The FAA-estimated number of additional hours (for both man-hours and time out of service) to perform each of the various inspections is derived primarily from the available service bulletins and from discussions with airline maintenance engineers. For those turbojet models that have not been the subject of a fuel tank system inspection service bulletin, the FAA adopted the estimated hours from existing service bulletins of similar types of turbojet models. Although there have been no fuel tank system inspection service bulletins for turboprops, the FAA received information concerning the estimated fuel tank system inspection time for a turboprop from commuter airline maintenance personnel. Based on this information and an FAA analysis that turboprop fuel tanks are smaller and have less equipment than turbojet fuel tanks, the FAA estimates that a turboprop fuel tank system inspection would take between one-third to one-half of the time it would take for the turbojet fuel tank system inspections defined in available bulletins.

The FAA requests comments on these estimates and that commenters provide supporting data.

Estimated Compliance Costs: The following cost and hour estimates are summaries of the Regulatory Evaluation of the proposal. The detailed estimated compliance costs, including all assumptions and the spreadsheet used for the calculations, are in that document, which is available in the docket.

The incremental cost of complying with the operational proposals would consist of the following four components: (1) the labor hours to incorporate the recommendations into the inspections manual; (2) the labor hours needed to perform the fuel tank system inspection; (3) the cost of the additional downtime required to complete the inspection; and (4) the increased documentation and reporting of the inspection and subsequent findings.

The FAA estimates that it would take an average of 5 engineer days to incorporate the recommendations into the inspections manual, for a cost of about $4,000 per airplane model per operator, with a total cost of about $1.16 million.

The FAA estimates that the increased number of labor hours per airplane resulting from the enhanced fuel tank system inspection and maintenance would range from 19 hours to 110 hours in the first three years, and would decline to 9 hours to 60 hours beginning in the fourth year. Using a total compensation rate (wages plus fringe benefits) of $70 an hour for maintenance personnel, the FAA estimates that the annual per airplane costs of compliance would range from $1,330 to $7,700 in each of the first 3 years and from $630 to $4,200 in each year thereafter.

The FAA estimates that the total annual inspection costs would be about $2 1.1 million during the first year, increasing by 4.3 percent per year from the projected increase in airline operations until the fourth year, when it would decline to about $10.1 million increasing by 4.3 percent each year thereafter. The present value of the total operational cost, discounted at 7 percent over 10 years, would be about $100 million.

As noted earlier, equipment costs would not be attributed to the proposal but rather to the existing FAA airworthiness requirements. For example, inspecting fuel boost pump wiring may involve its disassembly and then reinstallation. Regardless of the wiring's condition, the cost of complying with the proposal would include reinstallation time. However, if the inspection or testing revealed the need for new wiring, the new wiring cost is not attributed to the proposal.

The proposal would increase out-of-service time because only a limited number of maintenance employees can work inside of a fuel tank at any point in time, and thereby would not allow air carriers the flexibility to perform the fuel tank system inspections during regularly scheduled major maintenance checks. Thus, the time to open the tank, drain the fuel, vent the tank, and close the tank are not costs attributed to the proposal because those activities are necessary to complete a scheduled maintenance check. On that basis, the FAA estimates that this annual increase in out-of-service time would be between 11.5 hours and 32 hours per airplane for each of the first 3 years and then decline to 10 to 25 hours per airplane in each year thereafter.

The economic cost of out-of-service time is lost net revenue, which is computed using the Office of Management and Budget (OMB) determination that the average annual risk-free productive rate of return on capital is 7 percent of the average value of that airplane model. Thus, out-of-service lost net revenue per fuel tank system inspection ranges from $50 to $9,750 per airplane, depending upon the airplane model. Assuming one major inspection per year, the total annual out-of-service lost net revenue would be about $6.4 million during the first year, increasing by 4.3 percent per year until the fourth year when it would decline to about $2.95 million but increase by 4.3 percent each year thereafter. The present value of this total lost net revenue, discounted at 7 percent over 10 years, would be about $35.6 million.

The FAA estimates that the increased annual documentation and reporting time would be one hour of recordkeeping for every 8 hours of labor time in the first three years, and one hour of recordkeeping for every 10 hours of labor time in every year thereafter. Thus, the per airplane annual documentation cost would be between $150 and $850 in the first three years becoming $100 to $540 each year thereafter.

To estimate the total documentation cost, it is noted that there is a voluntary industry program to inspect certain airplane model fuel tanks and report the findings and corrective actions taken to the manufacturer. The reporting costs of compliance associated with the proposal would not include these airplanes. On that basis, the FAA estimates that the present value of the total recordkeeping cost discounted at 7 percent for 10 years would be about $17.4 million.

<u>Costs of Future Fuel Tank System Design Changes • Revised Part 25</u>

The FAA anticipates that these discounted costs would be minimal for new type certificated airplanes because these design costs would be incurred in the future by airplane models yet to be designed. After consultation with industry, the FAA also anticipates that these discounted costs would be minimal for future fuel tank system design supplemental type certificates because the existing systems would largely be in compliance. The FAA requests comments and supporting data on these determinations.

<u>Total Costs of Proposed SFAR and Proposed Operational Rules Changes</u>

Thus, the FAA estimates that the present value of the total cost of complying with the proposed SFAR and the proposed operational rules changes discounted over 10 years at 7 percent would be about $170 million.

Benefit-Cost Comparison of the Proposed Part 25 Change

Although the FAA does not have quantified costs and benefits from the proposed part 25 changes at this time, the FAA believes that the future benefits would likely be greater than the future costs. The FAA requests comments and additional data on this determination.

Benefit-Cost Comparison of the Proposed SFAR and the Proposed Operational Rules Changes

In comparing the estimated benefits and costs, the FAA determines that using the lowest expected benefit estimate, the expected present value of the benefits ($260 million) would be about 50 percent greater than the present value of the total compliance costs ($170 million). Thus, the FAA concludes that the proposed SFAR and the proposed operational rules changes would be cost-beneficial.

Regulatory Flexibility Determination

The Regulatory Flexibility Act of 1980 establishes "as a principle of regulatory issuance that agencies shall endeavor, consistent with the objective of the rule and of applicable statutes, to fit regulatory and informational requirements to the scale of the business, organizations, and governmental jurisdictions subject to regulation." To achieve that principle, the Act requires agencies to solicit and consider flexible regulatory proposals and to explain the rationale for their actions. The Act covers a wide range of small entities, including small businesses, not-for-profit organizations, and small governmental jurisdictions.

Agencies must perform a review to determine whether a proposed or final rule will have a significant economic impact on a substantial number of small entities. If the determination finds that it will, the agency must prepare a Regulatory Flexibility Analysis (RFA) as described in the Act.

However, if an agency determines that a proposed or final rule is not expected to have a significant economic impact on a substantial number of small entities, section 605(b) of the 1980 Act provides that the head of the agency may so certify, and an RFA is not required. The certification must include a statement providing the factual basis for this determination, and the reasoning should be clear. Recently, the Office of Advocacy of the Small Business Administration (SBA) published new guidance for Federal agencies in responding to the requirements of the Regulatory Flexibility Act, as amended.

Application of that guidance to the proposed part 25 change would only affect future airplane manufacturers; and currently all manufacturers of part 25 type certificated airplanes are considered to be large manufacturers. Although the proposed changes to part 25 would also affect future fuel tank system STCs, industry sources indicate that current industry designs would meet the proposed requirement. Thus, the FAA certifies that the proposed part 25 change would not have a significant economic impact on a substantial number of small airplane manufacturing entities.

However, application of that guidance to the proposed SFAR and to the proposed operational rule changes indicates that it would have a significant economic impact on a substantial number of small air carrier entities that have one to nineteen airplanes. Accordingly, a complete preliminary regulatory flexibility analysis was conducted for those two elements of the proposal and is summarized as follows.

1. Reasons why the FAA is considering the proposed rule. This proposed action is being considered in order to prevent airplane explosions and the resultant loss of life (as evidenced by TWA Flight 800). Existing fuel tank system inspection programs may not provide comprehensive, systematic prevention and control of ignition sources in airplane fuel tanks.

2. The objectives and legal basis for the proposal. The objective of the proposal is to ensure the continuing airworthiness of airplanes certificated with 30 or more passengers or with a payload of 7,500 pounds or more. The design approval holder [including type certificates (TC) and supplemental type certificates (STC)] would be required to perform a design fuel tank system assessment and provide recommendations and instructions concerning fuel tank system inspections and equipment and wiring testing to the operators of those airplanes, as well as to create service bulletins and provide data to the FAA to support any needed ADs. An operator working under part 9 1, under part 12 1, under part 125, and all U.S.-registered airplanes used in scheduled passenger carrying operations under part 129, would be required to incorporate these recommendations or other approved instructions into the inspection manual and to perform these inspections and tests. The legal basis for the proposal is found in 49 U.S.C. 44901 et seq. As a matter of policy, the FAA must, as its highest priority (49 U.S.C. 40101 (d)), maintain and enhance safety and security in air commerce.

3. All relevant federal rules that may duplicate, overlap, or conflict with the proposal. The FAA is unaware of any federal rules that would duplicate, overlap, or conflict with the proposal.

4. A description and an estimate of the number of small entities to which the proposal would apply. The proposal would apply to the operators of all airplanes certificated with 30 or more passengers or a 7,500 pound or more payload operated under part 91, part 12 1, part 125, and all U.S.-registered airplanes operated under part 129. Standard industrial classification (SIC) coding does not exactly coincide with the subsets of operators who could be affected by the proposal. Nevertheless, using data from the SBA, the distributions of employment size and estimated receipts for all scheduled air transportation firms (SIC Code 45 12), given in Table 1 below, are representative of the operators who would be affected by the proposal.

5. The projected reporting, recordkeeping, and other compliance requirements of the proposal. The proposal would not impose any incremental recordkeeping authority. Existing 14 CFR part 43, in part, already prescribes the content, form, and disposition of maintenance, preventive maintenance, rebuilding, and alteration records for any aircraft having a U.S. airworthiness certificate or any foreign registered aircraft used in common carriage under part 12 1. The FAA recognizes, however, that the proposal would necessitate additional inspection and testing work, and consequently would also require the completion of the additional recordkeeping associated

with that additional work.

The FAA estimates that each 8 additional hours of actual inspection and testing required under the proposal would require one additional hour for reporting and recordkeeping (7.5 recordkeeping minutes per inspection hour). This recordkeeping would be performed by the holder of an FAA-approved repairman or maintenance certificate. The projected recordkeeping and reporting costs of the proposal are included as part of the overall costs computed in the evaluation and included below in the Regulatory Flexibility Cost Analysis.

TABLE 1

OPERATOR CATEGORY (No. of Employees)	NUMBER OF FIRMS	ESTIMATED RECEIPTS (in $1,000)
0 - 4	153	193,166
5 - 9	57	145,131
10 - 19	56	198,105
20 - 99	107	1,347,711
101 - 499	74	3,137,624
500+	73	112,163,942
TOTAL	520	117,185,679

Table 2 categorizes the estimated number of operators by number of airplanes that would be affected by the proposal and provides an estimate of the total number of affected airplanes in that operator category. Based on existing operator/airplane distributions, the FAA estimates that 13 1 U.S. operators would be subject to the proposal. (Note that this excludes the 19 non-U.S. owners of U.S.-registered airplanes that would be affected by the proposal. It should also be noted that Table 2 excludes Boeing 747 models, and, therefore, operators who exclusively fly Boeing 747s.)

TABLE 2

OPERATOR CATEGORY (No. of Airplanes)	NO. OF OPERATORS	TOTAL NO. OF AIRPLANES
0 - 4	48	93
5 - 9	17	108
10 - 19	22	271
20 - 29	13	277
30 - 39	4	145
40 - 49	5	220
TOTAL 0 - 50	109	1,114
50+	22	4,594
U.S. TOTAL	131	5,708
Non-U.S.	23	62
TOTAL	154	5,770

6. Regulatory Flexibility Cost Analysis. The proposal would consist of two actions affecting small business expenses. The first action, the proposed SFAR, would require all design approval TC holders and fuel tank system STC holders: (1) to complete a fuel tank system design assessment and to generate future service bulletins and provide data to the FAA; and (2) to provide operators with recommendations for fuel tank system inspections, testing, and maintenance. The second action, the proposed operational rules changes, would require that operators incorporate these recommendations for an enhanced fuel tank system inspection and equipment and wiring testing into the inspection and maintenance manuals. This proposal would apply to both existing and future production airplanes and to future TCs and STCs. This Regulatory Flexibility Cost Analysis focuses on the costs to operators of existing and future production airplanes, because almost 99 percent of the estimated costs of the proposal would be incurred by operators of those airplanes.

Table 3 summarizes the results for the total annualized compliance costs for U.S. operators only and also provides the estimated cost per operator and per airplane by each operator size category.

TABLE 3

OPERATOR CATEGORY (No. of Airplanes)	TOTAL COSTS	PER OPERATOR COST	PER AIRPLANE COST
o - 4	$293,000	$6,100	$3,150
5 - 9	$275,000	$16,175	$2,550
10 - 19	$1,123,000	$51,050	$4,150
20 - 29	$784,000	$60,300	$2,825
30 - 39	$234,000	$58,500	$1,600
40 - 49	$262,000	$52,400	$1,200
TOTAL 0 - 4	$2,971,000	$27,250	$2,675
50+	$17,820,000	$810,000	$3,775
TOTAL	$20,791,000	$158,700	$3,650

7. Affordability Analysis. Although the FAA lacks financial data for most of the smallest operators, if the average operating revenues, calculated to be about $1.25 million for the category of 0 to 4 employees from Table 1, are compared to the average annualized compliance costs from Table 3 (an admittedly crude method), it appears that the average operator would pay no more than 0.5 percent of operating revenues, based on an average annual risk-free return of 7 percent of the value of the airplane, to comply with the proposal. On that basis, most small entities would be able to offset the incremental compliance costs. Nevertheless, it is likely that there would be some of the very small operators (those with 1 to 9 affected airplanes) that may have difficulties in offsetting these incremental costs. However, due to the unavailability of current financial data from the Department of Transportation on these smallest operators, the FAA cannot more definitively determine the potential impact on these smallest affected operators. The FAA solicits comments on these costs and requests that all comments be accompanied with clear supporting data.

8. Disproportionality analysis. The principle factors determining the compliance cost for an operator would be the type of airplane model in the operator's fleet and the number of airplanes that would be affected by the proposal. As noted in the compliance cost section, the cost to inspect the fuel tank system of larger transport category airplane models would be 3 to 4 times more than the cost for a small transport category turboprop. Consequently, as seen in Table 3, the average per airplane compliance cost for operators with more than 50

airplanes is generally higher than the average cost per airplane for operators with fewer than 50 airplanes. This is due to the predominance of turboprops in the 30-50 airplane fleets, which would have the lowest compliance costs. However the per airplane cost for operators with 1 to 29 airplanes is higher than for the 30 to 50 airplane operators. Many of the smallest operators with fewer airplanes are cargo operators utilizing larger and older turbojets, and they have fewer airplanes available to average the fixed costs associated with compliance with the proposal. Nevertheless, in general, the average compliance cost per airplane is relatively consistent for operators with fewer than 50 affected airplanes. Further, the compliance cost relative to these airplanes operating revenues would be relatively small. As a result, the FAA does not believe that small entities, as a group, would be disadvantaged relative to large air carriers due solely to the slight disproportionate cost effects from compliance with the proposal.

9. Competitiveness Analysis.

The proposal would likely impose significant costs on some of the smallest air carriers (those with 1 to 19 airplanes) and, as a consequence, may affect the relative position of these carriers in their markets. However, most of these smallest air carriers operate in “niche” markets in which the competition that occurs arises from other small operators using largely similar equipment and often competing on the basis of service rather than on the basis of price. In such markets, the number of competitors is very limited. For example, Atlas Air specializes in supplying international air cargo by using large all-cargo airplanes to carry bulky cargo, like oil rig equipment. Similarly, Northern Air Cargo specializes in mail and air cargo to rural Alaska.

The FAA believes that most of the markets served by these smallest air carriers are low-volume niche markets that larger air carriers have in many cases abandoned, because the larger air carriers’ fleets have been designed for high-volume markets. Further, larger air carriers would not be interested in servicing most of these markets because they cannot compete on a cost basis. Thus, these smallest operators would be able to avoid direct competition with larger air carriers. As a result, to the extent that there would be adverse competitiveness effects, they would likely be minimal and they would occur with other similar-sized (1 to 19) air carriers. On that basis, the FAA concludes that small air carriers would not lose market share to larger air carriers.

The proposal would not impose significant compliance costs on a substantial number of small operators that have 20 or more airplanes that would be affected by the proposal. These operators include large regionals, medium regionals, commuter airlines, and air cargo carriers. To some extent, these operators avoid direct competition with major carriers. However, in those markets where there is competition between the small entities and the larger air carriers, the proposal would have minimal competitive impact, because the per airplane compliance cost for a given airplane model would be roughly the same for a large and a small operator.

10. Business Closure Analysis. The FAA is unable to determine with certainty the extent to which small entities that would be significantly affected by the proposal would have to close their operations. Many of the very small operations (1 to 4 airplanes) operate very close to the margin, as evidenced by the constant exit from and entry into air carrier service of these types of air carriers. Consequently, in the absence of financial data, it is difficult to

determine the extent to which the proposal would make the difference in an entity's remaining in business.

11. Description of Alternatives. In the general course of promulgating the proposed rule, the FAA has considered four approaches. The three alternatives to the proposed rule are described below. In formulating the alternatives, the FAA focused on its responsibility for aviation safety and its particular obligation under 49 U.S.C. 44717 to ensure the continuing airworthiness of airplanes. The three primary alternatives to the proposal considered by the FAA varied with respect to the number of airplanes to be included in the proposal. The proposed rule would limit the potential impact on airplanes most likely to be used by small entities, while meeting the Agency's safety responsibility.

Alternative 1: Require all airplanes in commercial service with more than 10 seats to be covered by the proposal.

Alternative 1 would require all airplanes operating under part 91, 12 1, 125, and 129 to comply with the proposal. This would also include operators supplying on-demand service under part 135. The FAA estimates that about 45 additional airplane models, about 2,360 additional airplanes, and about 550 additional operators would be covered by this proposed alternative. The airplane operation is not the principle business for many of these additional operators. In estimating these potential compliance costs, the FAA assumes that, due to the their small fuel tanks and relative straightforward fuel systems, these airplanes would need one-half of the time reported for the smallest part 25 turboprop to complete the fuel tank system design assessment. In addition, the FAA assumes that it would also take one-quarter of the time reported for the smallest part 25 turboprop to complete the enhanced fuel tank system inspection and maintenance and wiring testing. Further, the FAA assumes that the out-of-service time would be one-half of the labor time to complete the inspection and testing. However, there would be no out-of-service time for part 135 on-demand airplanes because those operators would normally schedule maintenance when there was no activity. For the other operators, the FAA estimates the value of the average airplane would be about $750,000.

The FAA estimates that the total additional compliance costs of including these operators (including the fuel tank system design assessment cost) would be about $7.4 million in the first-year, becoming about $1.1 million in the fourth year. The total compliance cost, discounted over 10 years at 7 percent, would be about $17.1 million. The annualized cost, discounted over 10 years at 7 percent, would be about $2.4 million.

This proposed alternative would not significantly increase the expected quantitative benefits because there have been no in-flight fuel tank explosions of these airplanes. In light of the absence of a fuel tank explosion accident history, the FAA does not believe at this time that the increased cost from including these smaller airplanes would be met with a commensurate level of benefits.

The FAA requests comments on these estimates and requests commenters to provide supporting data for the comments.

Alternative 2: Require all airplanes in commercial service with 30 or more seats (the proposed rule), plus all airplanes with 10 or more seats in scheduled commercial service, to be covered by the proposal.

Alternative 2 would add the requirement for all airplanes with 10 or more seats in scheduled commercial service operating under part 9 1, part 12 1, part 125, and part 129 to comply with the proposal. The FAA estimates that 30 additional airplane models, 724 additional airplanes, and about 84 additional operators would be covered by this proposed alternative. However, 35 of the 84 additional operators would already have airplanes that would be covered by the proposal. In estimating these potential compliance costs, the FAA makes the same assumptions that were described under Alternative 1.

On that basis, the FAA estimates that the additional compliance costs of including these operators (including the fuel tank system design assessment cost) would be about $2.7 million in the first-year and about $340,000 in the fourth year. The total compliance cost, discounted over 10 years at 7 percent, would be about $5.7 million. The annualized cost, discounted over 10 years at 7 percent, would be about $806,000. However, as also described under Alternative 1, this proposed alternative would not significantly increase the expected quantitative benefits because there have been no in-flight fuel tank explosions of these airplanes.

The FAA requests comments on these estimates and requests commenters to provide supporting data for the comments.

Alternative 3: Require that only turbojet airplanes in commercial service be covered by the proposal.

This alternative would allow 1,034 turboprop airplanes certificated under part 25 to be exempt from the proposal's requirements. By doing so, it would reduce the first year cost of compliance to all of these exempted airplanes by about $1.8 million, becoming about $545,000 in the fourth year. The total compliance cost savings, discounted over 10 years at 7 percent, would be about $8.3 million. The total annualized cost savings, discounted over 10 years at 7 percent, would be about $1.2 million.

Although there have been no in-flight fuel tank explosions associated with these part 25 turboprop airplane models, the FAA believes that the underlying fuel tank system risk is similar to those of the larger turbojets. On that basis, as the FAA's estimated overall benefits are larger than its estimated overall costs, by extrapolation, removing 20 percent of the population at risk from the proposed rule would remove 20 percent of both the benefits and costs. As the benefits are estimated to be greater than the costs, the result would be a reduction in the net dollar benefits and higher safety risk. Finally, these airplanes are part 25 certificated and the FAA considers that the same level of safety should be applied to all part 25 certificated airplanes. Thus, as a result of performing the regulatory flexibility analysis and addressing the concerns of the SBA, the FAA believes that, in comparison to the two higher cost alternatives and the one lower cost alternative evaluated by the FAA, the proposal would provide the necessary level of safety in the most cost-effective manner.

12. Special Considerations. As seen in Table 3, on a proportional basis the proposal would have a slightly greater impact on larger air carriers. The per airplane annualized cost for a large operator with 50 or more airplanes would be $3,775, where it would be about $2,675 for a smaller operator. However, this difference is relatively

small, and the FAA concludes that the proposal would not alter the competitiveness of small air carriers relative to larger air carriers.

13. Conclusion. For a small operator with an airplane worth $5 million, an annualized cost of $2,675 would be equal to about three days of lost net revenue, based on an average annual risk-free productive rate of return on capital of 7 percent. However, the FAA also considers that even for small operators of these affected airplanes, the safety benefits would be greater than the compliance costs. The FAA requests comments on this analysis and requests commenters to supply supporting data for the comments.

International Trade Impact Assessment

Consistent with the Administration's belief in the general superiority, desirability, and efficacy of free trade, it is the policy of the Administrator to remove or diminish, to the extent feasible, barriers to international trade, including both barriers affecting the export of American goods and services to foreign countries and those affecting the import of foreign goods and services into the United States.

In accordance with that policy, the FAA is committed to develop as much as possible its aviation standards and practices in harmony with its trading partners. Significant cost savings can result from this, both to American companies doing business in foreign markets, and foreign companies doing business in the United States.

This proposed rule would have little or no impact on international trade. The proposed part 25 change would equally affect all future part 25 airplanes, wherever manufactured, that would be registered in the United States. Although the proposed operational rules changes would affect only U.S. registered airplanes, the net effect is expected to be small and the European Joint Aviation Authorities may consider similar regulations.

Unfunded Mandates Assessment

Title II of the Unfunded Mandates Reform Act of 1995 (the Act), enacted as Pub. L. 104-4 on March 22, 1995, requires each Federal agency, to the extent permitted by law, to prepare a written assessment of the effects of any Federal mandate in a proposed or final agency rule that may result in the expenditure by State, local, and tribal governments, in the aggregate, or by the private sector, of $100 million or more (adjusted annually for inflation) in any one year. Section 204(a) of the Act, 2 U.S.C. 1534(a), requires the Federal agency to develop an effective process to permit timely input by elected officers (or their designees) of State, local, and tribal governments on a proposed "significant intergovernmental mandate." A "significant intergovernmental mandate" under the Act is any provision in a Federal agency regulation that will impose an enforceable duty upon State, local, and tribal governments, in the aggregate, of $100 million (adjusted annually for inflation) in any one year. Section 203 of the Act, 2 U.S.C. 1533, which supplements section 204(a), provides that before establishing any regulatory requirements that might significantly or uniquely affect small governments, the agency shall have developed a plan that, among other things, provides for notice to potentially affected small governments, if any, and for a meaningful and timely opportunity to provide input in the development of regulatory proposals.

The FAA determines that this proposed rule would not contain a significant intergovernmental or private sector mandate as defined by the Act.

Federalism Implications

The regulations proposed herein will not have substantial direct effects on the States, or on the relationship between the national government and the States, or on the distribution of power and responsibility among the various levels of the government. Therefore, in accordance with Executive Order 12612, it is determined that this proposed rule would not have significant federalism implications to warrant the preparation of a Federalism Assessment.

International Civil Aviation Organization (ICAO) and Joint Aviation Regulations

In keeping with U.S. obligations under the Convention on International Civil Aviation, it is FAA policy to comply with ICAO Standards and Recommended Practices to the maximum extent practicable. The FAA has determined that this proposed rule would not conflict with any international agreement of the United States,

Paperwork Reduction Act

There are no new requirements for information collection associated with this proposed rule that would require approval from the Office of Management and Budget pursuant to the Paperwork Reduction Act of 1995 (44 U.S.C. 3507(d)).

Regulations Affecting Intrastate Aviation in Alaska

Section 1205 of the FAA Reauthorization Act of 1996 (110 Stat. 3213) requires the Administrator, when modifying regulations in Title 14 of the CFR in a manner affecting intrastate aviation in Alaska, to consider the extent to which Alaska is not served by transportation modes other than aviation, and to establish such regulatory distinctions as he or she considers appropriate. Because this proposed rule would apply to the operation of certain transport category airplanes under parts 9 1, 12 1, 125, and 129 of Title 14, it could, if adopted, affect intrastate aviation in Alaska. The FAA therefore specifically requests comments on whether there is justification for applying the proposed rule differently to intrastate operations in Alaska.

List of Subjects

I4 CFR Part 21, 25, 91, 125, and 129

Aircraft, Aviation safety, Reporting and recordkeeping requirements

~~*14 CFR Part 25*~~

~~Aircraft, Aviation safety, Reporting and recordkeeping requirements~~

~~*14 CFR Part 91*~~

~~Aircraft, Aviation safety, Reporting and recordkeeping requirements~~

14 CFR Part 121

~~Aircraft, Aviation safety, Reporting and recordkeeping requirements,~~ Safety, Transportation

~~*14 CFR Part 125*~~

~~Aircraft, Aviation safety, Reporting and recordkeeping requirements~~

~~*14 CFR Part 129*~~

~~Aircraft, Aviation safety, Reporting and recordkeeping requirements~~

The Proposed Amendment

In consideration of the foregoing, the Federal Aviation Administration proposes to amend parts 21, 25, 91, 12 1, 125, and 129 of Title 14, Code of Federal Regulations, as follows:

PART 21 - CERTIFICATION PROCEDURES FOR PRODUCTS AND PARTS

1. The authority citation for Part 2 1 continues to read as fol lows:

Authority: 42 U.S.C. 7572; 40105; 40113; 44701-44702, 44707. 44709, 44711, 44713, 44715, 45303

2. In part 21~~, the table of contents of Special Federal Aviation Regulations is amended by adding a reference to SFAR No. XX to read as follows~~add SFAR No. XX to rend as follows:

SPECIAL FEDERAL AVIATION REGULATIONS

* * * * *

SFAR No. XX - FUEL TANK SYSTEM FAULT TOLERANCE EVALUATION REQUIREMENTS

1. Applicability. This SFAR applies to the holders of type certificates, and supplemental type certificates affecting the airplane fuel tank system, for turbine-powered transport category airplanes, provided the type certificate was issued after January 1, 1958, and the airplane has a maximum type certificated passenger capacity of 30 or more, or a maximum type certificated payload capacity of 7500 pounds or more. This SFAR also applies to applicants for type certificates, amendments to a type certificate, and supplemental type certificates affecting the fuel tank systems for those airplanes identified above, if the application was filed before the effective date of this SFAR and the certificate was not issued before the effective date of this SFAR.

2. Compliance: No later than [12 months after the effective date of the final rule], or within 12 months after the issuance of a certificate for which application was filed before [effective date of the final rule], whichever is later, each type certificate holder, or supplemental type certificate holder of a modification affecting the airplane fuel tank system, must accomplish the following:

(a) Conduct a safety review of the airplane fuel tank system to determine that the design meets the requirements of §§ 25.901 and 25.981(a) and (b) of this Chapter. If the current design does not meet these requirements, develop all design changes necessary to the fuel tank system to meet these requirements.

(b) Develop all maintenance and inspection instructions necessary to maintain the design features required to preclude the existence or development of an ignition source within the fuel tank system of the airplane.

(c) Submit a report for approval of the Administrator that:

(1) Provides substantiation that the airplane fuel tank system design, including all necessary design changes, meets the requirements of §§ 25.901 and 25.981(a) and (b) of this Chapter; and

(2) Contains all maintenance and inspection instructions necessary to maintain the design features required to preclude the existence or development of an ignition source within the fuel tank system throughout the full operational life of the airplane.

PART 25 - AIRWORTHINESS STANDARDS: TRANSPORT CATEGORY ATRPLANES.

3. The authority citation for part 25 continues to read:

Authority: 49 U.S.C. 106(g), 40 113, 44701-44702, and 44704.

4. Section 25.981 is revised to read as follows:

§ 25.981 Fuel tank ignition prevention.

(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:

(1) Determining the highest temperature allowing a safe margin below the lowest expected autoignition temperature of the fuel in the fuel tanks.

(2) Demonstrating that no temperature at each place inside each fuel tank where fuel ignition is possible will exceed the temperature determined under paragraph (a)(l) of this section. This must be verified under all probable operating, failure and malfunction conditions of each component whose operation, failure or malfunction could increase the temperature inside the tank.

(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.

(b) Based on the evaluations required by this section, critical design configuration control limitations, inspections or other procedures must be established as necessary to prevent development of ignition sources within the fuel tank system and must be included in the Airworthiness Limitations section of the ICA required by § 25.1529. Placards, decals or other visible means must be placed in areas of the airplane where maintenance, repairs or alterations may violate the critical design configuration limitations.

(c) The fuel tank installation must include--

(1) Means to minimize the development of flammable vapors in the fuel tanks; or

(2) Means to mitigate the effects of an ignition of fuel vapors within fuel tanks such that no damage caused by an ignition will prevent continued safe flight and landing.

5. Paragraph H25.4 of Appendix H is revised to read as follows:

APPENDIX H TO PART 25 - INSTRUCTIONS FOR CONTINUED AIRWORTHINESS

H25.4 <u>Airworthiness Limitations section.</u>

(a) The Instructions for Continued Airworthiness must contain a section titled Airworthiness Limitations that is segregated and clearly distinguishable from the rest of the document. This section must set forth--

(1) Each mandatory replacement time, structural inspection interval, and related structural inspection procedures approved under § 25.571; and

(2) Each mandatory replacement time, inspection interval, related inspection procedure, and all critical design configuration control limitations approved under $25.981 for the fuel tank system.

(b) If the Instructions for Continued Airworthiness consist of multiple documents, the section required by this paragraph must be included in the principle manual. This section must contain a legible statement in a prominent location that reads: "The Airworthiness Limitations section is FAA-approved and specifies maintenance required under §§ 43.16 and 91.403 of the Federal Aviation Regulations, unless an alternative program has been FAA approved."

PART 91 - GENERAL OPERATING AND FLIGHT RULES

6. The authority citation for Part 91 continues to read:

Authority: 49 U.S.C. 1301(7), 1303, 1344, 1348, 1352 through 1355, 1401, 1421 through 1431, 1471, 1472, 1502, 15 10, 1522, and 2 12 1 through 2 125; Articles 12, 29, 3 1, and 32(a) of the Convention on International Civil Aviation (61 Stat 1180); 42 U.S.C. 4321 et. seq.; E.O. 115 14; 49 U.S.C. 106(g) (Revised Pub. L. 97-449, January 2 1, 1983).

7. By adding a new § 9 1.4 10 to read as follows:

§ 91.410 Fuel tank system maintenance and inspection instructions.

After [18 months after the effective date of the final rule], no person may operate a turbine-powered transport category airplane with a type certificate issued after January 1, 1958, and a maximum type certificated passenger capacity of 30 or more, or a maximum type certificated payload capacity of 7500 pounds or more, unless instructions for maintenance and inspection of the fuel tank system are incorporated into its inspection program. Those instructions must be approved by the Administrator. Thereafter, the approved instructions can be revised only with the approval of the Administrator.

PART 121 - OPERATING REQUIREMENTS: DOMESTIC, FLAG, AND SUPPLEMENTAL OPERATIONS

8. The authority citation for part 12 1 continues to read:

Authority: 49 U.S.C. 106(g), 40113, 40119, 44101, 44701-44702, 44705, 44709-44711, 44713, 44716-44717, 44722, 44901, 44903-44904, 44912, 46105.

9. By adding a new § 121.370 to read as follows:

§ 121.370 Fuel tank system maintenance and inspection instructions.

After [18 months after the effective date of the final rule], no certificate holder may operate a turbine-powered transport category airplane with a type certificate issued after January 1, 1958, and a maximum type certificated passenger capacity of 30 or more, or a maximum type certificated payload capacity of 7500 pounds or more, unless instructions for maintenance and inspection of the fuel tank system are incorporated in its maintenance program. Those instructions must be approved by the Administrator. Thereafter, the approved instructions can be revised only with the approval of the Administrator.

PART 125 - CERTIFICATION AND OPERATIONS: AIRPLANES HAVING A SEATING CAPACITY OF 20 OR MORE PASSENGERS OR A MAXIMUM PAYLOAD CAPACITY OF 6,000 POUNDS OR MORE

10. The authority citation for part 125 continues to read:

Authority: 49 U.S.C. 106(g), 40 113, 44701-44702, 44705, 447 1 O-447 11,447 13,447 16-447 17, 44722.

11. By adding a new § 125.248 to read as follows:

§ 125.248 Fuel tank system maintenance and inspection instructions.

After [18 months after the effective date of the final rule], no certificate holder may operate a turbine-powered transport category airplane with a type certificate issued after January 1, 1958, and a maximum type certificated passenger capacity of 30 or more, or a maximum type certificated payload capacity of **7500** pounds or more unless instructions for maintenance and inspection of the fuel tank system are incorporated in its inspection program. Those instructions must be approved by the Administrator. Thereafter, the approved instructions can be revised only with the approval of the Administrator.

PART 129 - OPERATIONS: FOREIGN AIR CARRIERS AND FOREIGN OPERATORS OF U.S.-REGISTERED AIRPLANE ENGAGED IN COMMON CARRIAGE

12. The authority citation for part 129 continues to read:

Authority: 49 U.S.C. 106(g), 40104-40105, 40113, 40119, 44701-44702, 44712, 44716-44717, 44722, 44901-44904,44906.

13. By ~~revising~~ amending § 129.14 by adding a new paragraph (c) to read as follows:

§ 129.14 Maintenance program and minimum equipment list requirements for U.S.-registered airplanes.

* * * * *

(c) For turbine-powered transport category airplanes with a type certificate issued after January 1, 1958, and a maximum type certificated passenger capacity of 30 or more, or a maximum type certificated payload capacity of 7500 pounds or more, no later than [18 months after the effective date of the final rule], the program required by paragraph (a) of this section must include instructions for maintenance and inspection of the fuel tank systems. Those instructions must be approved by the Administrator. Thereafter the approved instructions can be revised only with the approval of the Administrator.

Issued in Washington, D.C., on 26 October- 1999

/S/

Elizabeth Erickson

Director, Aircraft Certification Service

~~revised 8-20-98: incorporate reg eval summary~~

~~revised 8-28-98: include part 25 fuel tank flammability requirement.~~

~~revised 9-4-98: incorporates ANM-7 comments (on 8-20 version)~~

~~revised 9-11-98:ps:per Joe Conte's cmnts of 9/8/98 and add'l. editorial chgs.~~

~~revised 9-21-98 to add revised reg. eval.~~

~~revised 9-25-98 to add latest reg. eval. from APO.~~

~~revised 9-30-98 to add add'l. clarifying chgs. and to prepare document for return to Hdq.~~

~~revised 10-15-98 to add additional clarifying language to the SFAR compliance/applicability paragraphs, as well as a corresponding change to the preamble.~~

~~revised 11-20-98:ps:to revise reg. eval. summary per APO (John Rodgers) direction; also added RIN number.~~

~~revised 1-12-98:ps:to add chgs from AGC (CWT/Nancy), including adding section nos.~~

~~revised 6-16-99:mc/ps:revised to address OST (Bklothe) cmnts this date.~~

~~Revised 10-25-99:mc/ps:updated info relative to AD's and ARAC report~~