Federal Register

**Monday,**
**July 21, 2008**

## Part III

# Department of Transportation

**Federal Aviation Administration**
**14 CFR Parts 25, 26, 121 et al.**
**Reduction of Fuel Tank Flammability in Transport Category Airplanes; Final Rule**

**DEPARTMENT OF TRANSPORTATION**

**Federal Aviation Administration**

**14 CFR Parts 25, 26, 121, 125, and 129**

**[Docket No. FAA–2005–22997; Amendment Nos. 25–125, 26–2, 121–340, 125–55, and 129–46]**

**RIN 2120–AI23**

# Reduction of Fuel Tank Flammability in Transport Category Airplanes

**AGENCY:** Federal Aviation Administration (FAA), DOT.

**ACTION:** Final rule, request for comments.

**SUMMARY:** This final rule amends FAA regulations that require operators and manufacturers of transport category airplanes to take steps that, in combination with other required actions, should greatly reduce the chances of a catastrophic fuel tank explosion. The final rule does not direct the adoption of specific inerting technology either by manufacturers or operators, but establishes a performance-based set of requirements that set acceptable flammability exposure values in tanks most prone to explosion or require the installation of an ignition mitigation means in an affected fuel tank. Technology now provides a variety of commercially feasible methods to accomplish these vital safety objectives.

**DATES:** These amendments become September 19, 2008. Send your comments by January 20, 2009. The incorporation by reference of the document listed in the rule is approved by the Director of the Federal Register as of September 19, 2008.

**FOR FURTHER INFORMATION CONTACT:** If you have technical questions about this action, contact Michael E. Dostert, FAA, Propulsion/Mechanical Systems Branch, ANM–112, Transport Airplane Directorate, Aircraft Certification Service, 1601 Lind Avenue, SW., Renton, Washington 98057–3356; telephone (425) 227–2132, facsimile (425) 227–1320; e-mail: *mike.dostert@faa.gov*. Direct any legal questions to Doug Anderson, ANM–7, FAA, Office of Regional Counsel, 1601 Lind Avenue, SW, Renton, WA 98057–3356; telephone (425) 227–2166; facsimile (425) 227–1007, e-mail *Douglas.Anderson@faa.gov*.

**SUPPLEMENTARY INFORMATION:** Later in this preamble under the ADDITIONAL INFORMATION section, we discuss how you can comment on a certain portion of this final rule and how we will handle your comments. Included in this discussion is related information about the docket, privacy, and the handling of proprietary or confidential business information. We also discuss how you can get a copy of this final rule and related rulemaking documents.

## Authority for Rulemaking

The FAA's authority to issue rules regarding aviation safety is found in Title 49 of the United States Code. Subtitle I, Section 106 describes the authority of the FAA Administrator. Subtitle VII, Aviation Programs, describes in more detail the scope of the agency's authority.

This rulemaking is promulgated under the authority described in Subtitle VII, Part A, Subpart III, Section 44701, ''General requirements.'' Under that section, the FAA is charged with promoting safe flight of civil aircraft in air commerce by prescribing minimum standards required in the interest of safety for the design and performance of aircraft; regulations and minimum standards in the interest of aviation safety for inspecting, servicing, and overhauling aircraft; and regulations for other practices, methods, and procedures the Administrator finds necessary for safety in air commerce. This regulation is within the scope of that authority because it prescribes

- New safety standards for the design of transport category airplanes, and
- New requirements necessary for safety for the design, production, operation and maintenance of those airplanes, and for other practices, methods, and procedures related to those airplanes.

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## I. Executive Summary

*A. Statement of the Problem*

Fuel tank explosions have been a constant threat with serious aviation safety implications for many years. Since 1960, 18 airplanes have been damaged or destroyed as the result of a fuel tank explosion. Two of the more recent explosions—one involving a Boeing 747 (Trans World Airways (TWA) Flight 800) off Long Island, New York in 1996 and the other, a Boeing 727 terrorist-initiated explosion (Avianca Flight 203) in Bogotá, Columbia in 1989 [1]—occurred during flight and led to catastrophic losses (including the deaths of 337 individuals). Two other recent explosions on airplanes operated by Philippine Airlines and Thai Airlines occurred on the ground (resulting in nine fatalities).[2] While the accident investigations of the TWA, Philippine Airlines and Thai Airlines accidents failed to identify the ignition source that caused the explosion, the investigations found several similarities. In each instance:

1. The weather was warm, with an outside air temperature over 80 °F;
2. The explosion occurred on the ground or soon after takeoff; and
3. The explosion involved empty or nearly empty tanks that contained residual fuel from the previous fueling.

Additionally, investigators were able to conclude that the center wing fuel tank in all three airplanes contained flammable vapors in the ullage (that portion of the fuel tank not occupied by liquid fuel) when the fuel tanks exploded. This was also the case with the Avianca airplane.

A system designed to reduce the likelihood of a fuel tank fire, or mitigate the effects of a fire should one occur, would have prevented these four fuel tank explosions.

A statistical evaluation of these accidents has led the FAA to project that, unless remedial measures are taken, four more United States (U.S.) registered transport category airplanes will likely be destroyed by a fuel tank explosion in the next 35 years. Although we cannot forecast precisely when these accidents will occur, computer modeling that has been an accurate predictor in the past indicates these events are virtually certain to occur. We believe at least three of these explosions are preventable by the adoption of a comprehensive safety regime to reduce both the incidence of ignition sources developing and the likelihood of the fuel tank containing flammable fuel vapors.

*B. Reducing the Chance of Ignition*

To address the first part of this comprehensive safety regime, we have taken several steps to reduce the chances of ignition. Since 1996, we have imposed numerous airworthiness requirements (including airworthiness directives or ''ADs'') directed at the elimination of fuel tank ignition sources. Special Federal Aviation Regulation No. 88 of 14 Code of Federal Regulations (CFR) part 21 (SFAR 88; 66 FR 23086, May 7, 2001) requires the detection and correction of potential system failures that can cause ignition. Although these measures should prevent some of the four forecast explosions, our review of the current transport category airplane designs of all major manufacturers has shown that unanticipated failures and maintenance errors will continue to generate unexpected ignition sources. Since manufacturers completed their SFAR 88 ignition prevention reviews, we have had reports of potential ignition sources (including unsafe conditions) that were not identified in the SFAR 88 reviews. For example:

- We issued AD 2006–06–14 to require the inspection of fuel quantity indicating probes within the fuel tanks of Airbus A320 airplanes to prevent an ignition source due to sparks that could be created following a lightning strike. This failure mode was not identified as a possible ignition source in the SFAR 88 analysis presented to the FAA.
- We issued AD 2006–12–02 following a report of an improperly installed screw inside the fuel pump housings of A320 airplanes that could loosen and fall into the pump's electrical windings. This could create a spark and ignite fuel vapors in the pump. The ignited vapors could then exit the fuel pump housing, enter the fuel tank through the hole created when the screw fell out of the housing, and cause a fuel tank explosion. This failure mode was not identified as a possible ignition source in the SFAR 88 analysis presented to the FAA.
- We received an in-service report on a Boeing 777 that was operated for over 30 days with an open vent hole between the center wing fuel tank and the wheel well of the airplane. During maintenance, a vent hole cover used to facilitate venting of the tank was inadvertently left off. This was not discovered until a flight occurred where the tank was fueled to a level where the fuel spilled from the tank into the wheel well during pitching up of the airplane for takeoff. Since the airplane brakes routinely exceed temperatures that could ignite fuel vapors and the wheels are retracted into the wheel well, the open vent port could have allowed ignition of fuel vapors in the center tank and a fuel tank explosion. This type of maintenance error was also not identified as providing a possible ignition source during the SFAR 88 safety reviews.
- On May 5, 2006, an explosion occurred in the wing fuel tank of a Boeing 727 in Bangalore, India, while the airplane was on the ground. This event occurred after a modification to include special Teflon sleeving and recurring inspections had been implemented to prevent possible arcing of the fuel pump wires to metallic conduits located in the fuel tank. Initial information indicates that the identified

[1] Although it was determined that a terrorist's bomb had caused the explosion of the center tank in the Bogotá accident, the NTSB determined the ''bomb explosion did not compromise the structural integrity of the airplane; however, the explosion punctured the [center wing tank] and ignited the fuel-air vapors in the ullage, resulting in destruction of the airplane.''

[2] Philippine Airlines Boeing 737 accidnet in Manila in 1990, and a Thai Airlines Boeing 737 accident in Bangkok in 2001.

AD action was inadequate to prevent the formation of an ignition source in the fuel tank and that the change intended to improve safety caused premature wear of the sleeving and an unsafe condition. Premature wear of Teflon sleeving on the Boeing 737 has also been reported, resulting in AD action to modify the design and replace the existing sleeving. This failure mode was not identified as a possible ignition source in the SFAR 88 analysis presented to the FAA.

- We also received a report that during a recent certification program test, an ignition source developed in the fuel pumps causing pump failure. These pumps had been designed to meet the most stringent requirements of SFAR 88 and Amendment 25–102 to 14 CFR 25.981 (issued concurrently with SFAR 88), yet the pump failed in a manner that allowed a capacitor to arc to the pump enclosure and create an ignition source. The applicant has since conducted a design review that has resulted in numerous modifications to the pump's design.
- Following the TWA 800 accident, the risk of uncontrolled fire adjacent to the fuel tanks causing a fuel tank explosion was identified as an unsafe condition. In 2006, we issued a MD–80 AD (AD 2006–15–15) to prevent worn insulation on wires from arcing at the auxiliary hydraulic pump, which could result in a fire in the wheel well of the airplane. The AD required inspections to validate the pump wire integrity as well as incorporating sleeving on portions of the wires. In April 2008, we received reports of improper means of compliance being used regarding the requirements of AD 2006–15–15. Human error in completing the procedures required by the AD resulted in airplanes being operated without the needed safety improvements.

Based on the above examples, we have concluded that we are unlikely to identify and eradicate all possible sources of ignition.

### *C. Reducing the Likelihood of an Explosion After Ignition*

To ensure safety, therefore, we must also focus on the environment that permits combustion to occur in the first place. Many transport category airplanes are designed with heated center wing tanks in which the fuel vapors are flammable for significant portions of their operating time. This final rule addresses the risk of a fuel tank explosion by reducing the likelihood that fuel tank vapors will explode when an ignition source is introduced into the tank.

Technology now exists that can prevent ignition of flammable fuel vapors by reducing their oxygen concentration below the level that will support combustion. By making the vapors ''inert,'' we can significantly reduce the likelihood of an explosion when a fire source is introduced to the fuel tank. FAA-developed prototype onboard fuel tank inerting systems have been successfully flight tested on Airbus A320 and Boeing 747 and 737 airplanes. We have also approved inerting systems for the Boeing 747 and 737 airplanes, and two airplanes of each model type have performed as expected during airline in-service evaluations. Boeing plans to install these systems on all new production airplanes.

Given that ignition sources will develop, the chances of a fuel tank explosion naturally correlate with the exposure of the tank to flammable vapors. The requirements in this final rule mitigate the effects of such flammability exposure and limit it to acceptable levels by mandating the installation of either a Flammability Reduction Means (FRM) or an Ignition Mitigation Means (IMM).[3] In either case, the technology has to adhere to performance and reliability standards that are set by us and contained in Appendices M and N to Title 14 Code of Federal Regulations (CFR) part 25.

This final rule amends the existing airworthiness standards contained in 14 CFR 25.981 to require all future type certificate (TC) applicants for transport category airplanes to reduce fuel tank flammability exposure to acceptable levels. It also amends 14 CFR part 26 ''Continued Airworthiness and Safety Improvements'' [4] to require TC holders to develop FRM or IMM for many large turbine-powered transport category airplanes with high-risk fuel tanks. Finally, it amends 14 CFR parts 121, 125 and 129 to require operators of these airplanes to incorporate the approved FRM or IMM into the fleet and to keep them operational. We estimate that approximately 2,700 existing Airbus and Boeing airplanes operating in the United States as well as about 2,300 newly manufactured airplanes that enter U.S. airline passenger service will be affected. Fuel tank system designs in several pending type-certification applications, including the Boeing 787 [5] and Airbus A350, also have to meet these requirements.

We acknowledge that these requirements are costly and have adopted these steps only after spending several years researching the most cost-effective ways to prevent fuel tank explosions in cooperation with engineers and other experts from the affected industry. Those efforts have resulted in the development of fuel-inerting technology that is vastly cheaper than originally thought.

In contrast, the loss of a single, fully loaded large passenger airplane in flight, such as a Boeing 747 or Airbus A380, would result in death and destruction causing societal loss of at least $1.2 billion (based on costs of prior calamities). We estimate that compliance with this new rule will prevent between one and two accidents of some type (for analytical purposes we assume the accidents would involve ''average'' airplanes with ''average'' passenger loads) over 35 years.[6] In addition to the direct costs of such an accident, we now recognize that, in the post-9/11 aviation environment, the public could initially assume that an in-flight fuel tank explosion is the result of terrorist actions. This could cause a substantial immediate disruption of flights, similar to what occurred in Britain on August 10, 2006, due to the discovery of a terrorist plot.[7] This could have an immediate and substantial adverse economic effect on the aviation industry as a whole.

The FAA's safety philosophy is to address aviation safety threats whenever practicable solutions are found, especially when dealing with intractable and catastrophic risks like fuel tank explosions that are virtually certain to

[3] FRM consist of systems or features installed to reduce or control fuel tank flammability to acceptable levels. IMM is based upon mitigating the effects of a fuel vapor ignition in a fuel tank so that an explosion does not occur. Polyurethane foam installed in a fuel tank is one form of an IMM. See AC 25.981–2 for additional information.

[4] Part 26 was added to the Code of Federal Regulations to include all requirements for Continued Operational Safety. See Docket number FAA–2004–18379 for more information on this subject.

[5] This airplane model already includes a FRM in its design that the applicant intends to show will meet today's final rule, so no additional modifications will be required.

[6] Although Boeing has committed to installing compliant FRM in all future production airplanes, regardless of this rule, operators could deactivate the systems unless this rulemaking is adopted. The final regulatory evaluation includes the costs and benefits of these actions for newly produced Boeing and Airbus airplanes.

[7] Flight schedules in Britain were significantly disrupted due to flight cancellation of all flights into Heathrow Airport and 30 percent of all short-haul flights out of Heathrow Airport for one day (according to Secretary of State for Transport Douglas Alexander). The day after the event, the crowds and lines that log-jammed British airports the day before were largely gone, he said. British Airways stated that it cancelled 1,280 flights between August 10–17 due to the discovery of the terror plot and subsequent security measures. EasyJet said it was forced to cancel 469 flights because of the disruption caused by the terror alert. Ryanair said it cancelled a total of 265 flights.

occur. Thus, now that solutions are reasonably cost effective, we have determined that it is necessary for safety and in the public's best interest to adopt these requirements.

**II. Background**

*A. Summary of the NPRM*

On November 23, 2005, the FAA published in the **Federal Register** the Notice of Proposed Rulemaking (NPRM) entitled ''Reduction of Fuel Tank Flammability in Transport Category Airplanes'' (70 FR 70922). This NPRM is the basis for this final rule.

In the NPRM, we proposed steps to be taken by manufacturers and operators of transport category airplanes to significantly reduce the chances of a catastrophic fuel tank explosion. The proposal followed seven years of intensive research by the FAA and industry into technologies designed to make fuel tanks effectively inert. Inerting reduces the amount of oxygen in the fuel tank vapor space so that combustion cannot take place if there is an ignition source. Although the NPRM did not specifically direct the adoption of inerting technology, it did propose a performance-based set of requirements for reducing fuel tank flammability to an acceptably safe level.

We proposed regulatory changes to require manufacturers and operators to reduce the average fuel tank flammability exposure in affected fleets. The main premise of the proposal was that a balanced approach to fuel tank safety was needed that provides both prevention of ignition sources and reduction of flammability of the fuel tanks. While the focus of the NPRM was on airplanes used in passenger operations, we requested comments on whether the new requirements should also be applied to all-cargo airplanes.

We also proposed changes to expand the coverage of part 25 by making manufacturers generally responsible for the development of service information and safety improvements (including design changes) where needed to ensure the continued airworthiness of previously certificated airplanes. This change was proposed to ensure that operators would be able to obtain service instructions for making necessary safety improvements in a timely manner.

As to fuel tank flammability specifically, we proposed to require manufacturers, including holders of certain airplane TCs and of auxiliary fuel tank supplemental type certificates (STCs), to conduct a flammability exposure analysis of their fuel tanks. We proposed a new Appendix L (now Appendix N) to part 25 that provides a method for calculating overall and warm day fuel tank flammability exposure. Where the required analyses indicated that the fuel tank has an average flammability exposure below 7 percent, we anticipate no changes would be required. However, for the other fuel tanks, manufacturers would be required to develop design modifications to support a retrofit of the airplane fuel tanks. Under the NPRM, the average flammability exposure of any affected wing tank would have to be reduced to no more than 7 percent. In addition, for any normally emptied fuel tank (including auxiliary fuel tanks) located in whole or in part in the fuselage, flammability exposure was to be reduced to 3 percent, both for the overall fleet average and for operations on warm days.

We also proposed to set more stringent safety levels for certain critically located fuel tanks in most new type designs, while maintaining the current, general standard under § 25.981 for all other fuel tanks. The expectation was that the design of most normally emptied and auxiliary tanks located in whole or in part in the fuselage of transport category airplanes would need to incorporate some form of FRM or IMM.

In Appendix M to part 25, we proposed to adopt detailed specifications for all FRM, if they were used to meet the flammability exposure limitations. These additional requirements were designed to ensure the effectiveness and reliability of FRM, mandate reporting of performance metrics, and provide warnings of possible hazards in and around fuel tanks.

We also proposed that TC holders for specific airplane models with high flammability exposure fuel tanks be required to develop design changes and service instructions to facilitate operators' installation of IMM or FRM. Manufacturers of these airplanes would also have to incorporate these design changes in airplanes produced in the future. In addition, design approval holders (TC and STC holders) and applicants would have to develop airworthiness limitations to ensure that maintenance actions and future modifications do not increase flammability exposure above the limits specified in the proposal. These design approval holders would have to submit binding compliance plans by a specified date, and these plans would be closely monitored by the design approval holders' FAA Oversight Offices to ensure timely compliance.

Lastly, the proposal would require affected operators to incorporate FRM or IMM for high-risk fuel tanks in their existing fleet of affected airplane models. The proposal would have applied to operators of airplanes under parts 91, 125, 121, and 129. Operators would also have to revise their maintenance and inspection programs to incorporate the airworthiness limitations developed under the NPRM. We also proposed strict retrofit deadlines, which were premised on prompt compliance by manufacturers with their compliance plans.

The NPRM contains the background and rationale for this rulemaking and, except where we have made revisions in this final rule, should be referred to for that information.

*B. Related Activities*

On November 28, 2005, the FAA published a Notice of Availability of Proposed Advisory Circular (AC) 25.981–2A, Fuel Tank Flammability, and request for comments in the **Federal Register** (70 FR 71365). The notice announced the availability of a proposed AC that would set forth an acceptable means, but not the only means, of demonstrating compliance with the provisions of the airworthiness standards set forth in the NPRM. On March 21, 2006, the FAA published a notice that extended the comment period as a result of an extension of the NPRM's comment period to May 8, 2006 (71 FR 14281).

*C. Differences Between the NPRM and the Final Rule*

As a result of the comments received and our own continued review of the proposals in the NPRM, we have made several changes to the proposed regulatory text. The majority of these changes will be discussed in the ''Discussion of the Final Rule'' section below. The following is a summary of the main differences between the NPRM and this final rule.

1. *Design Approval Holders.* The design approval holder (DAH) requirements proposed in the NPRM as subpart I of part 25 are now contained in new part 26. This was done to harmonize with the regulatory structure of other international airworthiness authorities. We also revised the applicability for the retrofit requirement so the DAH requirements do not apply to airplanes manufactured before 1992. The effect of this change is that DAHs will not have to develop FRM or IMM for many older airplane models that do not have significant remaining useful life in passenger operations. We revised the compliance times for DAHs to

develop and make available service instructions for FRM or IMM by replacing specific compliance dates with a compliance time of 24 months after the effective date of this rule for all affected airplane models. We have also made some changes, discussed later, to the compliance planning sections of the DAH requirements.

2. *Auxiliary Fuel Tanks*. We have learned that few auxiliary fuel tanks installed under STCs and field approvals remain in service, and we need to obtain additional information to decide whether the risks from these tanks justify retrofit requirements. Therefore, we have removed the requirements for an FRM or IMM retrofit for these tanks.

3. *Impact Assessments*. We limited the requirement for impact assessments for auxiliary fuel tanks to airplanes with high flammability tanks for which an FRM is required (i.e., Heated Center Wing Tank airplanes).

4. *All-Cargo Airplanes*. We retained the proposal to exclude all-cargo airplanes from the requirement to retrofit high flammability tanks with FRM or IMM. However, we added a requirement that when any airplane that has an FRM or IMM is converted from passenger use to all-cargo use, these safety features must remain operational. We also added a requirement that newly manufactured all-cargo airplanes must meet the same requirements as newly manufactured passenger airplanes. We revised § 25.981 to remove the exclusion of all-cargo airplanes so that any newly certificated transport category airplane, regardless of the type of operation, must meet the same safety standards.

5. *Part 91 Operators*. The proposed rule would have applied to operators under part 91, which is limited to private use operations. However, the final rule does not include part 91 requirements.

6. *Retrofit Requirements for Operators*. We have added a provision for air carrier operators that allows a one year extension in the compliance time to retrofit of their affected fleets if they revise their operations specifications and manuals to use ground conditioned air [8] when it is available. Instead of requiring retrofit for all airplanes with high flammability fuel tanks, we revised the operating rules to prohibit operation of these airplanes in passenger service after 2016 unless an FRM or IMM is installed. This approach gives operators the option of converting these airplanes to all-cargo service. We also prohibit the operation of airplanes with high flammability fuel tanks produced after 2009 unless they are equipped with FRM or IMM. This requirement parallels the proposed production cut-in requirement, but also applies to foreign manufactured airplanes. Finally, instead of requiring retrofit of high flammability auxiliary fuel tanks, we prohibit installation of auxiliary fuel tanks after 2016 unless they comply with the new requirements of § 25.981.

## III. Discussion of the Final Rule

### *A. Summary of Comments*

The FAA received over 100 comment letters to the proposed rule and guidance material. These letters covered a wide spectrum of topics and range of responses to the rulemaking package, which will be discussed more fully below. While there was much support for the general intent of the rule changes and the guidance material, there were several requests for changes and for clarification.

### *B. Necessity of Rule*

#### 1. Estimates/Conclusions Supporting Need for Rule

In the NPRM and its supporting documents, we noted several estimates and conclusions that we used to determine the necessity and content of this rule. We received comments on the following assumptions:

- The historical accident rate for heated center wing tank (HCWT) airplanes is 1 accident per 60 million hours of flight (before implementing corrective actions following TWA 800).
- That SFAR 88 and other corrective actions would prevent 50 percent of future fuel tank explosions.
- That Boeing and Airbus airplanes have an equal risk of an explosion.
- That a HCWT, depending upon the airplane model and its mode of operation, is explosive 12 to 24 percent of the time.
- That the rate of accidents directly correlates to flammability exposure.

Based on the comments received, we have changed the historical accident rate estimate to 1 accident per 100 million hours. This change does not affect our conclusion that the historical accident rate for HCWT airplanes supports the need for this rule. As for the other estimates and conclusions, we have not changed these in the final rule.

#### a. Historical (pre-TWA 800) Accident Rate

Airbus, the Air Transport Association (ATA), Alaska Airlines (Alaska), the Association of Asia Pacific Airlines (AAPA), the Association of European Airlines (AEA), Boeing, Cathay Pacific Airways (Cathay), Delta Air Lines (Delta) and FedEx stated that the historical accident rate of 1 accident every 60 million fleet operating hours was too high. Most of these commenters recommended a rate of 1 accident per 140 million hours. Their proposed rate is based on the number of accidents and the total fleet hours for heated center wing tank (HCWT) airplanes through 2005 (3 accidents over 430 million hours). Several of these commenters also noted that this rate is closer to the conservative estimate in the MITRE Corporation's assessment of the FAA's accident prediction/avoidance model (1 accident every 160 million hours).[9]

Boeing proposed a rate of 1 accident every 100 million hours. Boeing's analysis also started with the number of accidents and the total fleet hours for HCWT airplanes through 2005. However, Boeing recognized that some of the improvement since 2001 may be attributable to the FAA/industry focus on ignition prevention and concluded that the rate of 1 accident every 100 million hours more accurately represents the pre-TWA 800 rate.

FedEx stated that, from a historical basis, 140 million hours would be a correct mean time between accidents. However, FedEx noted that a more conservative estimate closer to 100 million hours would still be acceptable.

In a related comment, ATA questioned our use of flight hours as the measure of exposure to risk. ATA noted that two of the historical accidents did not occur in flight. Therefore, flight hours may understate exposure and overstate risk. ATA concluded that these accidents support the use of block hours or some other measure that accounts for time on the ground (and would lower the accident rate by about 16 percent).

We agree that the accident rate used in the NPRM was too high and needs adjustment. While the rate of 1 accident every 140 million hours is correct if you only use the total fleet hours for HCWT airplanes through 2005, it fails to consider the beneficial effects of FAA/industry action following the TWA 800 accident. Since that accident, we have issued many ADs to address specific findings of unsafe conditions that could produce fuel tank ignition sources. In addition, the Fuel Tank Safety Rule, of which SFAR 88 was a part, was issued in 2001 to establish a systematic process for identifying and eliminating ignition

[8] ''Ground conditioned air'' is temperature controlled air used to ventilate the airplane cabin while the airplane is parked between flights.

[9] The Mitre assessment of the FAA accident prediction methodology is included as Appendix H of the Initial Regulatory Evaluation and is available in the docket for this rulemaking (Document Number FAA–2005–22997–3).

sources. Many of the improvements resulting from these actions have been implemented in the transport airplane fleet, and the improved safety record since TWA 800 is largely attributable to them. While the commenters acknowledge that these actions have been effective at preventing future accidents, most of them failed to reduce their proposed historical rate accordingly to address these benefits. In contrast, Boeing's recommended rate considers the benefits of these actions (which we calculate covers about 170 million hours).

We believe that an accident rate of 1 per 100 million hours is an accurate calculation of the historical accident rate before implementation of post-TWA 800 ignition prevention actions. Therefore, we used this rate in developing this final rule and its supporting documents. However, this change does not affect our conclusion that the historical accident rate for HCWT airplanes supports the need for this rule. We continue to believe that the risk of an accident is too high.

Several commenters referred to the rate in the MITRE Corporation's report (1 accident every 160 million hours). This rate includes operations of airplanes without HCWT. Recommendations resulting from MITRE's review included a suggestion that only fleet hours from airplanes with HCWT be used in the accident prediction model. We agreed with this recommendation and have adjusted the accident rate accordingly.

Finally, we do not agree with ATA's conclusion that the use of flight hours to predict future accidents results in an overstated risk. Both the past accident rate and the future predicted number of accidents were based upon the number of flight hours of airplanes with high flammability fuel tanks, and in both cases the number of flight hours does not include ground time. The ratio of flight time to ground time is unlikely to change significantly in the future because the average flight length and the amount of time spent on the ground before and after each flight are unlikely to change significantly. Therefore, whether past and future accident rates are stated in terms of flight time only or flight time plus ground time, the projected future accident rates would predict the same number of accidents over any given time period.

b. SFAR 88 Effectiveness Rate

In the NPRM and its supporting documents, we estimated that SFAR 88 would prevent 50 percent of future fuel tank explosions (although we also conducted a sensitivity analysis using effectiveness rates of 25 and 75 percent). ATA stated that the 50 percent effectiveness rate was without basis or explanation and recommended a rate of 90 percent. Airbus recommended an effectiveness rate in the range of 75 to 90 percent. If these higher rates are used, ATA and Airbus noted the safety benefits of the proposed rule are insufficient to justify the costs, and they requested that we withdraw the NPRM.

Predicting the effectiveness of ignition prevention actions is challenging, since many ignition sources are the result of human error, which cannot be precisely predicted or quantitatively evaluated. Despite extensive efforts by the FAA and industry to prevent ignition sources, we continue to learn of new ignition sources. Some of these ignition sources are attributable to failures on the part of engineering organizations to identify potential ignition sources and provide design changes to prevent them. Others are attributable to actions by production, maintenance, and other operational personnel, who inadvertently compromise wiring and equipment producing ignition sources. Regardless of the causes, we believe that ignition prevention actions, while necessary, are insufficient to eliminate ignition sources.

Based on the recently discovered ignition sources discussed earlier, we continue to believe that an assumed effectiveness rate of 50 percent is reasonable and appropriate. In its study on SFAR 88 effectiveness, Sandia National Laboratories concluded that our estimate of 50 percent was reasonable, and the value of 75 percent effectiveness assumed in the initial Aviation Rulemaking Advisory Committee (ARAC) report was overly optimistic. While the report of the ARAC Fuel Tank Inerting Harmonization Working Group [10] initially assumed an effectiveness of 75 percent, the report was later amended to use a range of effectiveness between 25 to 75 percent because of the uncertainty in predicting the effectiveness.

Finally, since ATA did not submit any data to substantiate that a higher effectiveness rate is more reasonable, we believe the post-SFAR 88 service experience supports the use of a range of effectiveness between 25 to 75 percent and a median value of 50 percent.

c. Boeing and Airbus Airplanes Have an Equal Risk of an Explosion

We concluded that all airplanes with HCWT had similar levels of fuel tank flammability and the associated increase in the likelihood of a fuel tank explosion. We based the SFAR 88 effectiveness estimates on the HCWT fleet as a whole. We did not differentiate among airplane models based upon design differences that could affect the likelihood of an ignition source forming.

AEA, Airbus, Frontier Airlines (Frontier), the Air Safety Group UK, Singapore Airlines (Singapore), BAE Systems (BAE), TDG Aerospace (TDG) disagreed with this proposal and argued that the risk of an explosion is lower for Airbus airplanes. These commenters noted that fuel tank designs for those airplanes that experienced a fuel tank explosion are at least a decade older than Airbus' designs. Airbus argued that its airplanes use newer technology and design philosophies that have incorporated the lessons learned from prior designs. BAE and two individuals suggested that we address fuel tank flammability by issuing ADs to address specific design shortfalls in the two airplane types that have experienced fuel tank explosions (i.e., the Boeing 737 and 747 series airplanes).

While we did note differences between the designs and technologies used by Boeing and Airbus, we concluded that the risk of an explosion was equal for Boeing and Airbus airplanes based on similarities in their fuel tank designs and service history. We found that both manufacturers have similar problematic fuel tank design features. For example, air conditioning equipment is located below the center wing tank in both manufacturers' designs (and HCWT have flammability exposure well above that of a conventional unheated aluminum wing tank). Likewise both manufacturers locate fuel gauging systems with capacitance measuring probes inside the fuel tank, and associated wiring to the probes enters the fuel tank from outside. These wires are co-routed with high-energy wiring to other airplane systems that have sufficient energy to cause an ignition source inside the fuel tanks. Finally, high-energy electrical fuel pumps are located within the fuel tanks and are fuel-cooled and manufactured by the same component suppliers. Arcing of the pump could cause a spark inside the fuel tank or could create a hole at the pump connector, causing a fuel leak and an uncontrolled fire outside of the tank.

As for the service history and design reviews of Airbus airplanes, we found numerous situations that indicate a risk of an explosion similar to those aboard Boeing airplanes, including:

- The electrical bonding straps used on Airbus airplanes have been reported

[10] Document Number FAA–22997–6 in the docket for this rulemaking.

to degrade due to corrosion; the bonding jumpers used by Boeing are made of a different material that does not corrode.

- All fuel pumps on Boeing airplanes are being modified to incorporate ground fault power interrupters, whereas only pumps that can arc directly into the fuel tank ullage are being modified to incorporate ground fault power interrupters on Airbus airplanes.
- The safety assessments conducted by both manufacturers resulted in very similar numbers of ignition sources that required modifications to their airplanes.
- After the SFAR 88 assessments were completed, we learned that fuel quantity indicating probes within the fuel tanks of Airbus A320 airplanes could be an ignition source due to sparks that could be created following a lightning strike. This resulted in the issuance of AD 2006–06–14.
- After the SFAR 88 assessments were completed, we learned that the improper installation of a screw inside the fuel pumps of Airbus A320 airplanes could result in the screw loosening and falling into the pump electrical windings. This could create a spark and ignite vapors in the pump that could exit the fuel pump housing into the fuel tank through the hole created when the screw fell out of the housing. This resulted in the issuance of AD 2006–12–02.

The recent discovery of the ignition sources in Airbus A320 airplanes is evidence that unforeseen failures will occur in the future that can result in ignition sources on Airbus airplanes. The Airbus fleet has significantly fewer flight hours than Boeing airplanes and, as the Airbus airplanes age, we expect to see more unforeseen failures. Therefore, based on design similarities and service history, we see no reason to differentiate between Airbus and Boeing airplanes. This rule requires all affected manufacturers to determine the fuel tank flammability exposure of their airplanes by assessing them against performance-based requirements that specify a flammability exposure that we have determined provides an acceptable level of safety. Additional action is only required for those airplanes that do not meet the required level of fuel tank flammability safety.

d. ARAC Flammability Exposure Data

Airbus and AEA both commented that the ARAC flammability exposure data cited in the NPRM are incorrect and need to be reduced based on updated data developed by both Boeing and Airbus. They said this reduction is important since the lower data reduce the level of safety improvement that can be achieved by this rule from the FAA's intended ''order of magnitude'' (factor of 10) to a safety improvement in the range of only a factor of 7.7 to 2.7, depending on the model used. Airbus also objected to our conclusion that a HCWT, depending upon the airplane model and its mode of operation, is explosive 12 to 24 percent of the time. Airbus requested that this be corrected to reflect the latest industry estimates for Airbus products (i.e., 8 to 12 percent) and 16 to 18 percent for other manufacturers.

We acknowledge that the flammability exposure data cited in the NPRM may not reflect current values. However, Boeing and Airbus submitted those data to us as part of the SFAR 88 reviews. While we agree with Airbus that more recent information has indicated lower flammability for HCWTs, we do not agree that the more recent values should be used since the manufacturers have not submitted a validated analysis using the revised flammability assessment techniques (as defined in § 25.981) to support its figures. Changes to the method for calculating fuel tank flammability, such as airplane ground times used in the Monte Carlo analysis required by Appendix N may result in additional variations in flammability calculations. Since flammability reduction was first considered by the aviation industry, the flammability values quoted by airplane manufacturers have varied considerably. These variations were the result of the method used to calculate the flammability of the fuel tanks and more accurate fuel tank temperature data based upon flight tests. For example, the first ARAC determined values ranged from 10 to 50 percent for generic airplanes equipped with HCWT. After the conclusion of this activity, Airbus was quoted in *Air Safety Week* as stating the A310 HCWT having a flammability exposure of 4 percent. In 2001, as part of the SFAR 88 compliance, Airbus submitted flammability values to the European Aviation Safety Agency (EASA) and to us that ranged between 12 and 23 percent.

We recognize that as methods for measuring fuel tank flammability are refined, it is likely that calculated flammability exposure will also change. These refinements also apply to the conventional unheated aluminum wing tanks that ARAC used as the baseline for determining an acceptable exposure. We now know that the exposure of these tanks is considerably lower than originally estimated by ARAC. However, none of this new information changes the findings of ARAC that HCWTs have significantly higher risk of fuel tank explosions, or that the reduction in flammability exposure would be on the order of a factor of 10. Therefore, we do not believe that these refinements change the overall conclusion that certain fuel tanks that are affected by this rule have significantly higher flammability exposure than conventional unheated aluminum wing tanks. No change has been made to the final rule as a result of these comments.

e. Accidents Directly Correlate to Flammability Exposure

Airbus did not agree with the assumption that the rate of accidents directly correlates to flammability exposure. Airbus contended that the risk of ignition source development must also be considered when evaluating the benefits of flammability reduction.

We agree with Airbus that the overall risk of a fuel tank explosion includes both the potential for an ignition source and the likelihood that the fuel tank will be flammable when an ignition source occurs. There may be differences in the likelihood of an ignition source occurring between different airplane types, but these differences would be very difficult to quantify. We have no statistically significant, validated data that could be used to establish rates of development of ignition sources for different airplane types. As discussed in the Sandia report, there is a wide variation in the predicted rate of ignition sources developing in fuel tanks and there is no industry agreement on the rate that should be used for individual airplane designs. In addition, recent service history shows there have been a number of ignition sources that have developed following the TWA 800 accident in both Airbus and Boeing airplane models.

Given this lack of data and consensus on ignition source risks, we continue to believe that correlating accident rates with flammability exposure is the most appropriate analytical approach.

2. Additional Research Needed

Airbus, AAPA, AEA, EASA, Iberia Maintenance and Engineering (Iberia), Singapore and Virgin Atlantic Airways (Virgin) stated that this rulemaking is premature because the risks of additional fuel tank explosions are not adequately defined. These commenters argued that additional research is necessary to better understand flammability, SFAR 88 effectiveness and the risks of additional explosions. In a related comment, the International Federation Victims of Aviation Accident (IFVAA) stated that additional research should be performed to identify technology that would completely eliminate, not just reduce, fuel tank flammability.

We think it would be a mistake to delay this rule to conduct additional research. Service history and the recent occurrences of ignition sources described earlier demonstrate that the risk of future explosions remains significant. In addition, we believe that additional research would not provide any useful information that would change our finding that flammability reduction, in combination with the SFAR 88 measures, is needed to prevent such explosions. As for IFVAA's comment, we consider existing flammability reduction means highly effective and sufficient to reduce the risk of fuel tank explosions to an acceptable level. While further research might identify even better solutions, the resulting delay would deprive the public of the benefits of these currently available safety improvements.

3. Consistent Safety Level With Other Systems

Airbus commented that SFAR 88 improvements, together with the current rate of occurrence, put fuel tank safety on the order of one accident for every billion flight hours (i.e. $10^{-9}$ accidents per flight hour) which is consistent with safety objectives of other critical airplane systems.[11] Airbus argued that this rule requires fuel tanks to go to a higher level of safety than other critical systems and that this is inconsistent with the overall risk.

Application of existing safety standards to prevent ignition sources that are similar to those applied to other systems has not resulted in an acceptable level of safety, and we have determined that limiting fuel tank flammability is also needed. Fuel tank explosions are unacceptably occurring at a rate greater than $10^{-9}$ per flight hour and the recent events described above show that unanticipated failures continue to result in ignition sources within airplane fuel tanks. To protect the flying public, we have developed a ''fail safe'' policy for fuel tank safety that includes both ignition prevention and flammability reduction to reduce fuel tank explosion risk to an acceptable level.

4. Human Errors

AEA stated that human errors are not new and should not be used to justify this rule. AEA pointed out that TC holders are obliged to consider human error during airplane design to mitigate errors. In addition, continuing airworthiness instructions (e.g., maintenance manuals) highlight safety considerations where necessary. AEA also contended that, in the 17 accidents cited by the FAA in the NPRM, there is no evidence that any were caused by the introduction of an ignition source through human error. Finally, AEA noted that human errors will always be a factor in aviation safety, particularly when introducing added complexity such as an inerting system.

We agree with AEA that human errors are not a new phenomenon and that the introduction of new systems on airplanes can have unintended consequences resulting from human error. We also believe the safety benefits of FRM or IMM is warranted. Service history shows the current regulations do not provide an adequate mitigation of human errors for fuel tank systems. Ignition sources continue to occur even though designers have conducted analyses that concluded ignition sources would not occur. Earlier in this document, we discussed numerous ignition sources that have recently developed in airplanes that had previously been shown by safety assessments to have features that would prevent ignition sources from developing. These ignition sources were caused by errors in defining assumptions in safety assessments, as well as in the design, manufacture and maintenance of these airplanes. These events show that an additional layer of protection (in the form of FRM or IMM) is needed to prevent future fuel tank explosions.

5. Explosion Risk Analysis

American Trans Air commented that the assumptions made in the explosion risk analysis were erroneous and not within the range of reasonable values. American Trans Air recommended that a completely new analysis of the fuel tank explosion risk be undertaken. This new analysis should utilize widely accepted assumptions, including taking into account:

- The history of particular type designs.
- The actual ignition risk potential (i.e., potential ignition sources not in the ullage are either exempted, or substantially discounted in the analysis).
- Actual ignition energies, applying these energies to the potential ignition sources.
- The definitions and assumptions of fuel-air vapor mixtures that have been further derived and applied on an individual type design basis.

We agree with the commenter that the assumed fuel air vapor mixture should be based upon the individual fuel tank design, and we included variations in the pressure and temperature of the fuel when developing the fuel tank flammability model. This factor is already accounted for in the Monte Carlo method defined in Appendix N. As for the other assumptions offered by American Trans Air, they cannot be used in an analysis, because there is a wide variation in the possible values.

6. Special Certification Review Process vs. Rulemaking

American Trans Air commented that if an analysis identifies type designs still found to have unacceptable risk after all SFAR 88 alterations have been executed, an appropriate response to address the remaining at-risk type designs may be the use of the special certification review process. American Trans Air noted that there appears to be wide variability in the risk between type designs, and concluded that generalized rulemaking is inappropriate at this time.

We do not agree that we should address each type design with unacceptable flammability risk by special certification review and then by an appropriate AD. Through careful study, we have determined that the flammability risk on many airplanes is too high. To address this risk, we have created an objective design standard by which all airplanes can be measured. If airplanes currently meet this design standard, no action will be required. The TC holder for those airplanes that do not meet it will have to make only those changes that bring that airplane model into compliance. We have determined that the uncertainty involved in the elimination of ignition sources requires reduced flammability to acceptably reduced tank explosion risk, and the most effective and efficient way to address this issue is through the rulemaking process.

7. Flammability Reduction Means (FRM) Effectiveness

In the NPRM, we said lowering the flammability exposure of the affected fuel tanks in the existing fleet and limiting the permissible level of flammability on new production airplanes would result in an overall reduction in the flammability potential of these airplanes of approximately 95 percent. Airbus and AEA commented that we overstated the potential benefits of flammability reduction measures by a factor between 4 and 7. They said we used a factor of 20 (95 percent) for the

[11] This is the quantitative probability measure (one in one billion) of an event that is ''extremely improbable'' as that term is used in § 25.1309 and other part 25 airworthiness standards. See AC 25.1309.

reduction in flammability exposure achieved by reducing the flammability of HCWT to 3 percent or less. They said the subsequent reduction in flammability will be in the order of a factor of three to five and not a factor of 20. Therefore, the number of accidents prevented would consequentially be less than projected by the FAA. Airbus also said the FAA appears not to have considered the effectiveness of the FRM itself, which it said is in the order of 67 to 87 percent by latest industry estimates. Therefore, Airbus suggests that the Initial Regulatory Evaluation (IRE) is incomplete and should be revised to include this key parameter.

The 95 percent value used in the NPRM was not based on the ratio of fuel tank fleet average flammability exposure before and after implementing the requirements of this rule. It was derived by qualitatively evaluating the effectiveness of an FRM in preventing fuel tank explosions that would not be prevented by ignition prevention measures.

When an FRM is installed on a fuel tank, it must meet both the 3 percent fleet average flammability exposure and also the 3 percent warm day (specific risk) flammability exposure requirements.[12] For the warm day requirement, the flammability exposure must be below 3 percent during ground and takeoff/climb conditions for those days above 80 degrees F when the FRM is operational. These are the conditions when fuel tanks tend to have the highest flammability exposure and when the accidents discussed earlier occurred.

The combination of the warm day requirement and the fleet average flammability requirement results in an FRM with overall flammability reduction benefits that are significantly higher than those estimated by the commenters. Since the NPRM was issued, we have reviewed and approved FRM designs and have found the performance exceeds the certification limits. When the FRM is operating, the fuel tanks are rarely flammable. So, the major risk of fuel tank flammability occurs when the system is inoperative and this time is limited to a maximum of 1.8 percent of the Flammability Exposure Evaluation Time (FEET). Historically, designers provide a safety margin in the design so that the design limits are never exceeded, so we would expect the flammability to be below this level.

Another consideration in using a 95 percent effectiveness measure is the safety improvement noted during warm days. Without any FRM, a HCWT is flammable about 50 percent of the time during climb. Meeting both the 3 percent warm day requirement and the 3 percent reliability requirement results in a flammability exposure of the tank of less than half of one percent during climb. For an airplane with an initial warm day flammability of 50 percent, this is a 99 percent reduction in the flammability during climb. We, therefore, used the 95 percent effectiveness for flammability reduction in the risk model for the final regulatory evaluation.

### *C. Applicability*

#### 1. Airplanes With Fewer Than 30 Seats

The proposed DAH requirements would apply (with some exclusions) to transport category turbine-powered airplanes approved for a passenger capacity of 30 or more persons or a maximum payload capacity of 7,500 pounds or more. The UK Air Safety Group disagreed with the proposed rule's limited applicability because the design of fuel tank systems is similar for both large and small airplanes. Therefore, it argued that the potential explosion hazard is equal. The commenter also noted that EASA's CS–25 regulation for Fuel Tank Ignition Prevention does not make any distinction based on the number of passenger seats.

We did not include smaller part 25 airplanes in the DAH requirements of this final rule because those airplanes generally do not have high flammability tanks. While some parts of their fuel tank system designs are similar to those of larger airplanes, we do not agree that the overall architecture and the risk of a fuel tank explosion are equal. Data submitted by manufacturers of smaller part 25 airplanes as part of the SFAR 88 analysis show that their airplanes typically do not have fuel tanks located within the fuselage contour, and would not be considered high flammability fuel tanks. In most cases, cool fuel from the wing tanks is drawn into the center wing box, so the overall flammability is low. In addition, these tanks are not normally emptied, reducing the amount of ullage.

Based on these facts, the benefits of including these smaller airplanes in all of the requirements of this rule are minimal and do not warrant the cost. However, we do agree that the part 25 requirements applicable to new type designs should be the same for all transport category airplanes, regardless of size. The cost to design and produce a new airplane to meet the flammability requirements is significantly less than that for existing airplanes since the designers can optimize the performance of the FRM or IMM and integrate it into the airplane design to minimize costs. Therefore, § 25.981 of this rule applies to all transport category airplanes regardless of size.

#### 2. Part 91 and 125 Operators

The NPRM proposed that operators under parts 91, 121, 125, and 129 incorporate FRM or IMM and keep it operational on their affected airplanes. The AEA and Airbus asked that parts 91 and 125 operations be excluded and cited corporate use airplanes as an example of operations where the cost would far exceed the benefit. According to AEA and Airbus, the cost/benefit analysis for these airplanes, when operated under part 91 or part 125, would produce results similar to those for all-cargo airplanes (which are excluded from the retrofit requirements of this rule).

We recognize a distinction between part 91 and part 125 operations, in that part 91 does not allow commercial operations for compensation or hire, while part 125 does allow such operations, as long as the operator does not ''hold out'' to the public that they are available for such operations (in which case they would be required to operate as an air carrier). For example, many business jets are operated under part 91 if the operator does not receive compensation for transporting passengers (e.g., a corporate jet transporting the corporation's employees). On the other hand, charter companies frequently operate under part 125 to transport sports teams and other groups for compensation.

While we recognize that private owners and operators may choose to assume the risk of possible fuel tank explosions, we see no reason why persons flying on commercial charter flights should be exposed to a greater risk of a fuel tank explosion than passengers flying on airplanes operated under parts 121 and 129. Commercial charter passengers are in no better position to recognize and accept the risk of a fuel tank explosion than are air carrier passengers. Additionally, the risk and likelihood of a fuel tank explosion are potentially commensurate with that of the same airplane model operated

[12] The overall time the fuel tank is flammable cannot exceed 3 percent of the Flammability Exposure Evaluation Time (FEET), which is the total time, including both ground and flight time, considered in the flammability assessment defined in proposed Appendix N. As a portion of this 3 percent, if flammability reduction means (FRM) are used, each of the following time periods cannot exceed 1.8 percent of the FEET: (1) When any FRM is operational but the fuel tank is not inert and the tank is flammable; and (2) when any FRM is inoperative and the tank is flammable.

under parts 121 and 129. Therefore, the final rule has been revised to exclude part 91 operations, but does not exclude part 125 operations. However, because of the significant safety benefits of this rule, we encourage part 91 operators to install FRM on their airplanes, and not to remove it if it is already installed.

3. All-Cargo Airplanes

In response to our request for comments on the proposed exclusion of all-cargo airplanes from this rulemaking, we received numerous comments both supporting and opposing the exclusion. Airbus, the Cargo Airline Association (CAA), FedEx, ATA, ABX Air (ABX), United Parcel Service (UPS), and National Air Carrier Association (NACA) agreed that all-cargo airplanes should be excluded from this rulemaking. The CAA argued that the risks are lower for cargo carriers due to several factors:

a. Cargo operations are predominately night operations with lower outside ambient temperatures (making fuel tanks less likely to be flammable).

b. Cargo operators do not typically run air conditioning packs prior to takeoff as many passenger operators do.

c. The CAA members typically operate one to two round trips each day, which is a lower utilization rate than most passenger airplanes.

The CAA stated that costs to various airline industry segments should be considered when proposing any new regulation. The CAA supported establishing a safety baseline which allows different operations to meet the baseline in different ways. Based on the factors articulated above, the CAA maintained the cost/benefit analysis does not justify its application to cargo airplanes.

FedEx commented that there is a finite amount of safety dollars and it is important to use them effectively. As the cost/benefit analysis does not justify inclusion of all-cargo airplanes, FedEx claimed it is not permissible to include them under FAA rulemaking authority. ATA stated that the proposed rule should not apply to all-cargo airplanes, other than the design rules proposed to prevent modifications that could increase the flammability exposure of a fuel tank. ABX agreed with ATA, and noted that the ignition prevention measures of SFAR 88 provide an acceptable level of safety for these airplanes. Finally, Airbus and UPS based their support for our proposal to exclude cargo airplanes on the reasons stated in the NPRM.

On the other hand, the National Transportation Safety Board (NTSB), the Independent Pilots Association (IPA), the Air Line Pilots Association (ALPA), the EASA, the Coalition of Airline Pilots Association (CAPA), Singapore and the National Air Traffic Controllers Association (NATCA) do not agree that all-cargo airplanes should be excluded from this rulemaking. While the NTSB, IPA and NATCA acknowledged that cargo airplanes typically carry fewer people, they pointed out that these airplanes regularly use airports in densely populated areas where an accident could have a catastrophic effect for people on the ground. The NTSB and IPA also cited a recent DC–8 cargo fire accident where an inerting system might have prevented or substantially reduced the magnitude of the fire, and a C–5A accident at Dover Air Force Base where the presence of an inerting system may have been the reason many lives were saved.

The IPA also stated that there should be one level of safety for all part 25 airplanes, and noted that all-cargo airplanes are typically older (which makes them more susceptible to ignition sources within the tank). In addition, ADs are being issued on even the newer models to restrict operations for flammability/ignition concerns.

ALPA commented that all-cargo airplanes should not be excluded from critical safety improvements simply because there are fewer fatalities in a typical crash. ALPA recommended that we apply a firm deadline for the manufacturers to complete a flammability analysis on all-cargo airplanes compared to the passenger versions of the same airplane model.

EASA did not agree with introducing a new distinction among part 25 products. In EASA's view, the justification for excluding all-cargo airplanes has yet to be substantiated. CAPA thought the logic of excluding all-cargo airplanes could be extended to each individual operator or to all airplanes with differing passenger capacities. For example, CAPA questioned whether, if operator ''A'' had many more Boeing 737 airplanes than operator ''B'', would we require Operator ''A'' to use FRM while Operator ''B'' would not have to. CAPA stated that this same type of flawed logic is being applied to all-cargo airplanes. In its opinion, the value of pilot lives should not depend on what is in the back of the airplane. Finally, NATCA commented that confidence in flying would be diminished if there were a cargo airplane accident, and we should not set a precedent that sets a different safety standard based on the intended operation of the airplane.

Boeing stated that its safety philosophy is to not differentiate between passenger and cargo airplanes in managing fleet-wide airplane risk and therefore, did not exclude airplanes designed solely for cargo operations in their proposed revision to § 25.981(b).

After reviewing these comments, we have decided that we will not require existing all-cargo airplanes to meet the retrofit requirements in this final rule. We did not receive any data on the costs, benefits or risks for all-cargo airplanes in response to our request in the NPRM, and we do not have any new data to justify requiring retrofit of FRM or IMM on the current fleet of all-cargo airplanes. We will continue to gather additional data regarding these factors and may initiate further rulemaking action if the flammability of these airplanes is found to be excessive.

However, we will require compliance with the requirements of this final rule for (i) future designs; (ii) the conversion of any passenger airplane with an FRM or IMM to all-cargo use; and (iii) future production of all-cargo airplanes. We agree with NATCA and other commenters with respect to removing the exclusion from § 25.981 of airplanes designed solely for all-cargo operations. The airworthiness standards of part 25 do not impose different requirements depending on the intended use of the airplane. 49 U.S.C. 44701 requires that we adopt such minimum airworthiness standards as are necessary, and historically we have recognized that those minimum standards should be the same for all transport category airplanes, regardless of their intended use. There are practical reasons for this approach, since the intended use can change quickly based on business considerations unrelated to safety. Therefore, we agree that the proposed new design standards in part 25 should not distinguish between all-cargo and passenger airplanes.

The rationale for including a production cut-in for all-cargo airplanes is based upon the long-term goal of fleet-wide reduction in flammability exposure to eliminate the likelihood of fuel tank explosions. In addition to the immediate effects of an accident, we believe a fuel tank explosion on an all-cargo airplane could have a significant impact on the aviation industry due to public sensitivity to terrorist actions. The cost of installing FRM in new production airplanes is less than the cost of to retrofit airplanes, because the installation can be efficiently integrated into the production process. In most cases, this integration will be done for the passenger version of the same airplane, so additional engineering work will be minimal. The benefits of production cut-in are also higher than for retrofit since the new airplane has a longer life and reduced flammability will provide safety benefits for the life of the airplane.

As for conversion airplanes, when older airplanes can no longer be operated competitively in passenger service, it is common for them to be converted to all-cargo service. Since many passenger airplanes will have FRM or IMM already installed as a result of this rule, operators may be inclined to deactivate or remove the FRM or IMM to reduce operational costs, if these airplanes are converted to all-cargo airplanes in the future. We do not believe it would be in the public interest to allow previously installed systems to be deactivated because the capital cost to install the systems would already have been incurred, and the safety benefits of retaining the system would outweigh any cost savings that might result from deactivating them. Accordingly, we have revised the operational rules to prohibit deactivation or removal of FRM or IMM under this scenario.

The regulatory evaluation for this final rule has been revised to address these factors and concludes that imposing these requirements on all-cargo airplanes is cost effective for new designs and newly produced all-cargo airplanes. Prohibiting deactivation of FRM or IMM on converted airplanes is also cost effective.

4. Specific Airplane Models

Proposed § 25.1815(j) listed specific airplane models that would be excluded from the requirements of proposed § 25.1815 (now § 26.33). These are airplane models that, because of their advanced age and small numbers, would likely make compliance economically impractical. In the NPRM, we asked for comments on other airplane models that may present unique compliance challenges and should be excluded from the requirements of this rule. In response to this request, we received several comments requesting that additional specific airplane models be excluded from this rule. Given the number of models identified, we have decided it makes more sense to ''grandfather'' all models manufactured before a certain date. Based on these comments, we have changed the applicability of the design approval holder requirements in proposed § 25.1815(a) (now § 26.33(a)) from those airplanes type certificated after January 1, 1958 to those airplanes produced on or after January 1, 1992.

a. Out-of-Production/Low Service Life Remaining Models

Boeing and Airbus recommended that the rule only apply to airplane models and auxiliary tanks currently in production, or recently out-of-production, that have significant numbers in service and will continue in service well beyond the date when 100 percent compliance is achieved. Based on this standard, Boeing submitted a list of airplane models and auxiliary tanks to add to the excluded models in proposed § 25.1815(j), including the DC–8, DC–9, DC–10, MD–80, MD–90, MD–11, Boeing 707, 720, 727, 737–100/–200, 747–100/–200/–300 and associated derivatives, and 737–300/–400/–500 (auxiliary tanks only). Airbus requested that the Airbus A300/A310 series airplanes be added to the list based on this standard.

We acknowledge that there is no reason to require design approval holders (DAHs) to develop design changes for airplanes that will be retired before FRM or IMM installation is required by this rule. Conducting the flammability assessments and developing design modifications for those airplanes would require significant engineering resources. More importantly, these airplanes would not benefit from the development of FRM or IMM, since they would be retired or converted to cargo operations before the installation of these systems is required. Therefore, we have limited the applicability of the DAH requirements in the final rule (proposed § 25.1815(a), now § 26.33(a)) to airplanes produced on or after January 1, 1992.

The youngest of the airplanes produced before then would be more than 25 years old by the time operators would be required to modify them. We agree with the commenters that the vast majority of these airplanes would either be retired or converted to cargo service before they reach that age. This is consistent with current practice. This limitation has the effect of excluding the Boeing 707, 727, 737–100/200 and 747–100/200/300; the McDonnell Douglas DC–8, DC–9, DC–10, and KC–10/KDC–10; and the Lockheed L–1011. Airplanes of the other models that Boeing, Airbus and ATA requested be excluded have been produced on or after January 1, 1992. For airplanes produced on or after January 1, 1992, the remaining life and likelihood of their continued operation in passenger service is sufficient to require compliance with the requirements of this rule.

To clearly differentiate between airplanes produced before and after this date, we changed proposed § 25.1815(a) (now § 26.33(a)) to refer to the date when ''the State of Manufacture issued the original certificate of airworthiness or export airworthiness approval.'' This information is readily available to the TC holders who applied for these approvals. We also added a provision to proposed § 25.1815(d) (now § 26.33(d)) to require the service information describing FRM or IMM to identify the airplanes that must be modified under this rule. This will make it readily apparent to operators which of their airplanes are subject to the retrofit requirements.

For airplanes with high flammability tanks produced before 1992, instead of requiring operators to retrofit these airplanes, we have added a provision in the operational rules prohibiting passenger operations of these airplanes after the date by which an operator's airplanes that are subject to the retrofit requirement must be retrofitted.[13] This enables operators to convert these airplanes to cargo service rather than to retrofit them. If operators of these airplanes choose to operate them in passenger service past this date, they could contract with the DAH or a STC vendor to develop an FRM or IMM to meet the safety requirements of this rule. Without this provision, the exclusion of airplanes produced before 1992 could have the unintended consequence of encouraging operators to continue to operate these airplanes with high flammability tanks in passenger service, since the retrofit and operating costs of FRM or IMM would not have to be incurred.

These changes to the DAH and operational rules have the effect of making the applicability of these requirements different. The DAH requirements now only apply to airplanes produced on or after January 1, 1992, but the operational rules still apply to all airplanes meeting the applicability criteria proposed in the NPRM.[14] Therefore, we have revised the applicability provisions of the operational rule sections to incorporate these criteria, rather than referencing the applicability of the DAH rules.

As for Boeing's request to exempt certain auxiliary fuel tanks, as discussed

[13] As discussed later, we are also adding a provision that allows operators under parts 121 and 129 to extend the compliance date by one year based on use of ground conditioned air. Operators using this extension will be able to operate these pre-1992 airplanes in passenger service until they are required to have all of their post-1991 airplanes retrofitted.

[14] With certain listed exceptions, transport category turbine-powered airplanes type certificated after January 1, 1958, with a maximum passenger capacity of 30 or more or a maximum payload capacity of 7,500 pounds or more.

later in more detail, we have retained the requirement to conduct flammability assessments and impact assessments for auxiliary fuel tanks. However, we have delayed any action to require retrofit of IMM or FRM for auxiliary fuel tanks installed under STCs and field approvals until additional information can be gathered. We agree with Boeing that any auxiliary fuel tank installed in pre-1992 airplane models should also be excluded from the need to conduct flammability assessments, since we have determined we would not take action against any tank in these airplane models due to their advanced age.

b. Limited U.S. Inventory Models

Airbus requested that airplanes having a limited U.S. inventory be excluded from this rule, because the operators of these airplanes would shoulder a disproportionate impact of non-recurring engineering expenses needed to design and develop FRM systems. Under this standard, Airbus asked that the A330–200 (only 11 N-registered airplanes) and the A340 (no N-registered airplanes) be added to proposed § 25.1818(j). We cannot agree with the Airbus suggested approach. We have no way to predict future market conditions in the United States for the A330–200 and A340 model airplanes. Airbus continues to sell these models and lessors continue to offer them for lease. Based on market conditions, U.S. operators may add these models to their fleets in larger numbers and we see no reason why persons flying on these airplanes should be exposed to a greater risk of a fuel tank explosion. Therefore, we are not excluding these airplane models from the requirements of this final rule.

c. Airbus A321

Airbus and ATA suggested the A321 should be excluded because this model does not have fuel pumps in the center wing tank, reducing the risk of a fuel tank explosion. The lack of fuel pumps does not adequately mitigate the risk of an explosion. There are numerous potential ignition sources inside fuel tanks that can result from failure of various components, including the fuel quantity indication system, motor driven valves, fuel level sensors, and electrical bonds. In addition, heating of the fuel tank walls by external heat sources introduces a concern that the hot surface could ignite the vapors in the tank. The justification provided for excluding this model (because the center tank does not have motor driven pumps located in the tank) does not address the overall fuel tank safety issue and would only have merit if fuel pump failures were the only potential ignition sources. Therefore, we are not excluding this airplane model from the requirements of this final rule.

d. Airplanes With Low Flammability Tanks

The proposed retrofit limit for an acceptable fleet-wide average flammability exposure was 7 percent. We determined that fuel tanks having a flammability exposure greater than 7 percent are high flammability tanks that present a greater risk for fuel tank explosion. American Trans Air commented that, we stated in the NPRM that some airplanes have center tanks with a fleet average flammability exposure that does not exceed 7 percent, including ''the Lockheed L–1011, and Boeing MD–11, DC10, MD80, and Boeing 727, and Fokker F28 MK100.'' American Trans Air stated that this implies that we have information in our possession indicating that these airplane models already meet the proposed flammability limits, and asked that we add these models to the list of excluded airplanes in proposed § 25.1815(j) (now § 26.33).[15]

The statement quoted by American Trans Air from the NPRM was based on previous flammability assessments provided to us for SFAR 88 compliance. These assessments were based upon simplified assessment methods. For airplanes produced after January 1, 1992, we have retained the requirement to conduct flammability assessments on these airplanes to ensure that the earlier assessments are correct and that design changes for these tanks are not necessary. Once the assessment has been made, a manufacturer or operator may not need to make any change to the airplane. This is because the flammability risk assessment may disclose a level of risk below the threshold required for modification. As discussed earlier, we are allowing a qualitative assessment for conventional unheated aluminum wing tanks, which will substantially reduce the burden for completing the flammability assessments.

5. Wing Tanks

a. General

Proposed § 25.981 does not apply the same flammability standard to all fuel tanks, and requires lower flammability limits for ''fuel tanks that are normally emptied and located within the fuselage contour.'' The NTSB expressed concern that wing fuel tanks have exploded, and noted that its safety recommendations were not limited to:

(1) Certain types of fuel tanks,

(2) Tanks with specific types of exposure, or

(3) Tanks with explosive risks that vary or lessen over time.

The NTSB stated that we should take action to prevent all tanks from having flammable fuel-air mixtures in the ullage. The NATCA agreed, and stated that, to achieve an acceptable level of safety, the requirements of § 25.981 that apply to new airplanes should establish the same flammability standard for all fuel tanks regardless of location. The NATCA supported this suggestion by referencing the ARAC accident summaries that showed 8 out of 17 fuel tank explosions have involved wing tanks. The ALPA also expressed concern that certain wing designs and system installations may result in internal heating of the wing structure and ultimately the wing fuel tanks. The ALPA stated that we must insist that those specific installations fall under the requirements of this rule and that no unsafe flammability exposure exist in those wing tanks.

In contrast, Embraer, Bombardier Aerospace (Bombardier), and American Trans Air opposed incorporation of new flammability standards for conventional wing tanks. Embraer stated the benefits would be negligible and would not justify the costs. Embraer maintained that service history provides ample evidence that conventionally designed wing tanks inherently provide sufficient protection from fuel tank ignition when conventional fuels are used and that the current requirements are adequate. American Trans Air commented that many twin engine airplane type designs utilize a common fuel system operational concept that results in low exposure to high energy ignition sources in the main wing tanks. This exposure is further reduced in airplanes operated in extended-range twin-engine operations (ETOPS) service, due to the increased fuel reserves required in these operations.

The service history of conventional unheated aluminum wing tanks that contain Jet A fuel indicates that there would be little safety benefit by further limiting the flammability of these tanks. While NATCA and the NTSB expressed concern because accidents have occurred in wing fuel tanks, they did not differentiate service experience based on fuel type used (JP–4 versus Jet

[15] As we discussed above, we have limited the applicability of the DAH requirements in § 26.33 to airplane models produced on or after January 1, 1992. This date excludes the Boeing Model 727, DC–10 and the Lockheed L–1011. The other airplane models mentioned by the commenter have airplanes produced after 1991 and would be covered by this rule.

A). Our review of the nine[16] wing tank ignition events shows that 5 of the 9 airplanes were using JP–4 fuel and this type fuel is no longer used except on an emergency basis in the U.S. Three of the remaining four events were caused by external heating of the wing by engine fires, and the remaining event occurred on the ground during maintenance. To date, there have been no fuel tank explosions in conventional unheated aluminum wing tanks fueled with Jet A fuel that have resulted in any fatalities. The flammability characteristics of JP–4 fuel results in the fuel tanks being flammable a significant portion of the time when an airplane is in flight. This is not the case for wing tanks containing Jet A fuel. Therefore, a conventional unheated aluminum wing tank (that quickly cools in an airplane model approved for Jet A fuel) would not require FRM or IMM.

As proposed, § 25.981(b) maintained the intended flammability standards for wing tanks that were introduced in 2001, as part of Amendment 25–102 to part 25.[17] The proposed text clarified the existing term ''means to minimize the development of flammable vapors'' by including references to a conventional unheated aluminum wing tank, or 3 percent average flammability. Therefore, no new flammability standards are introduced for conventional wing tanks. Fuel tanks manufactured from materials other than aluminum, or that have unique features that would not allow cooling of the fuel tank (such as a small surface area exposed to the air stream) or that are heated (such as by having warm fuel transferred from another tank) may need FRM to comply with the previously issued requirements.

b. Use of Composite Materials

Airbus pointed to the industry trend towards the use of composite materials, which tend to have a lower heat transfer coefficient than aluminum. These materials act as insulators, slowing down any heating or cooling effects. Therefore, new TC designs using composite structures will have a natural flammability exposure greater than an equivalent conventional unheated aluminum wing tank, and designers will be forced to implement FRM. The NATCA noted that, with increased use of composites in wing designs, the assumption that wing tanks cool adequately may be incorrect.

We agree that composite materials may act as an insulator that will not allow fuel tank cooling, resulting in increased flammability. Limiting fuel tank flammability using FRM may be needed to meet the flammability exposure of a ''conventional unheated aluminum wing tank'' that is required by § 25.981. Airbus's suggestion that it is impractical for the rule to mandate the use of inerting for wing fuel tanks on airplanes with composite fuel tanks is not supported by recent events. While this rule is performance based and means other than inerting could be used, inerting has been found to be one means that is both technically feasible and economically viable. For example, the Boeing 787 will have wing fuel tanks constructed of composites, and FRM using nitrogen has been incorporated into the design to reduce the fuel tank flammability below that of a conventional aluminum wing tank.

6. Auxiliary Fuel Tanks

a. Definition

In the NPRM, we described auxiliary fuel tanks as tanks that are installed to permit airplanes to fly for longer periods of time by increasing the amount of available fuel. The proposed rule defined an auxiliary fuel tank as one that is normally emptied and has been installed pursuant to an STC or field approval to make additional fuel available. We also stated that auxiliary fuel tanks are ''aftermarket'' installations not contemplated by the original manufacturer of the airplane.

Airbus and AEA suggested the definition of auxiliary fuel tank should be clarified. They recommended that we use the generally accepted definition that is in AC 25.981–2. Boeing also requested that the definition of an auxiliary fuel tank be revised to more generally state that it is a fuel tank added to an airplane to increase range instead of referencing it as one installed pursuant to an STC or field approval. Boeing noted that an airplane might be delivered with an Original Equipment Manufacturer designed, manufactured and type certified auxiliary fuel tank.

Changes to the regulatory text in proposed subpart I (now part 26) resulted in eliminating the need for this definition in the final rule. Therefore, we have deleted the definition of auxiliary fuel tank from proposed § 25.1803(a) (now § 26.31(a)) and will maintain the definition in AC 25.981–2.

b. Existing Auxiliary Tanks

Boeing, Airbus, AEA, and ATA commented that older auxiliary fuel tanks should be exempt from the requirements of this rule since the benefits would be small compared to the cost of the retrofits. Boeing stated by the year 2016, most of the airplanes with auxiliary tanks installed during production would be over 30 years old. Future service life is generally thought to be minimal for these older airplanes. Boeing also commented, based upon feedback received from some operators, that these operators would deactivate their auxiliary fuel tanks rather than install FRM or IMM. The ATA added that the favorable service history (no operational accidents caused by auxiliary tank overpressures or explosions), operating environment (minimal exposure to flammable conditions), and proximity to retirement for many of these tanks makes it unnecessary to include auxiliary tanks in the applicability of this rule. Finally, Embraer commented that only auxiliary fuel tanks located close to heat sources and lacking free stream cooling require the special attention that the rule proposes.

As discussed previously, we changed the language in proposed § 25.1815 (now § 26.33), which applies to TC holders, to limit its applicability to airplanes produced on or after January 1, 1992, and this would include any auxiliary fuel tanks installed by the original TC holder. Since § 26.35 (formerly § 25.1817) applies only to design changes to airplanes subject to § 26.33, this change from the NPRM has the effect of excluding most of the older auxiliary tank designs installed by STC or field approval, which were approved for installation on airplanes no longer subject to this rule.

For those auxiliary tanks approved under STCs or field approvals (if any) that are still covered under the rule, we believe that most of these tanks transfer fuel by pressurizing the tank with cabin air. The increased pressure results in reduced flammability that could be considered an FRM if the minimum flammability performance requirements are met. However, we have limited data on the number of these tanks currently in operation and their age. We currently do not have adequate information on the flammability exposure or the number and the type of auxiliary fuel tanks installed under STCs or field approvals to determine whether to subject them to the requirements of this final rule. Based upon these limited data, we cannot predict the number of high flammability auxiliary fuel tanks that

[16] As discussed previously, on May 6, 2006, a ninth wing tank ignition event occurred.

[17] As discussed in the NPRM, Amendment 25–102 revised § 25.981 to require that fuel tank flammability exposure be ''minimized.'' As explained in the preamble to that final rule, the objective of this requirement is to reduce the flammability exposure to that of an unheated aluminum wing tank.

will be in service in 2016 or the number of airplanes with auxiliary fuel tanks installed by STC or field approvals that could still be operational for some period of time past the year 2016.

While no conclusive evidence has been presented, the commenters have raised issues worthy of further study. To prevent delaying the safety benefits of compliance with this rule, we have elected to defer the portion of this rulemaking that would have required development and installation of an FRM or IMM for auxiliary fuel tanks installed by STC or field approvals for further study. We have removed these proposed requirements from both the DAH and operational rules.

To assess the possible safety benefits and costs more accurately, we are requesting further comments regarding information needed to determine if future action should be taken to address auxiliary fuel tanks installed by STC or field approvals. The rule retains the requirements for STC holders to conduct a flammability assessment of auxiliary fuel tank designs, to conduct an impact assessment of the auxiliary tank on any FRM or IMM, and to develop the modifications for any adverse impact that is found. These requirements are still necessary both to assess the need for further rulemaking and to prevent increasing the flammability exposure of tanks into which the auxiliary tanks feed fuel. This could potentially defeat the purpose of requiring reduced flammability for these tanks. To limit the scope and cost of the requirement to perform impact assessments, this requirement only applies to auxiliary tanks approved for installation on Boeing and Airbus airplanes that we currently are aware will be required to have FRM or IMM installed.

c. Future Installation of Auxiliary Tanks

While we are foregoing action to require retrofit of existing auxiliary fuel tanks, we recognize that this decision could allow installation of currently approved auxiliary fuel tanks indefinitely, even if their flammability exposure exceeds those allowed under this rule. Therefore, we have added a new paragraph to the operational rule sections [18] in this final rule to prohibit installation of any auxiliary tank after the retrofit compliance date (nine years after the effective date) unless we have certified that the tank complies with § 25.981, as amended by this rule.

[18] §§ 121.1117(n), 125.509(n), and 129.117(n).

d. Request for Comments

As discussed previously, we have concluded that additional information is needed before we can determine whether it would be cost effective to apply the requirements of this final rule to auxiliary fuel tanks installed under STCs or field approvals. The FAA, therefore, requests additional comments addressing the following specific questions:

1. Which airplanes produced on or after January 1, 1992, with 30 passengers or more or a payload of 7500 pounds, have auxiliary fuel tanks installed by STC or field approval?
2. What are the U.S. registration tail numbers of the airplanes with the tanks installed?
3. How many of these tanks are installed in airplanes used in all-cargo operations?
4. What is the STC holder's name and what are the STC numbers for these tanks?
5. How many of these tanks are installed under the Form 337 field approval process?
6. Are the tanks operational or deactivated?
7. How many engineering hours would be required to develop an FRM or IMM for these tanks?
8. How much would the parts cost for an FRM or IMM for these tanks?
9. What would the labor costs be for installing an FRM or IMM in these tanks?
10. How many days would it take to install an FRM or IMM in the affected airplane?
11. If the FAA required operators to install FRM or IMM, would those operators modify those tanks accordingly, or would they comply by simply deactivating those tanks? Please be model-specific for both passenger and all-cargo airplanes, if possible.
12. What would be the economic consequences to the operator of deactivating an auxiliary fuel tank?

Comments should be submitted to Docket No. FAA–2005–22997 by January 20, 2009. Comments may be submitted to the docket using any of the means listed in the **ADDRESSES** section later in the document.

7. Existing Horizontal Stabilizer Fuel Tanks

In the NPRM, we stated that horizontal stabilizer fuel tanks are fuel tanks that may be required to be retrofitted with FRM or IMM. We understood that these tanks may not cool rapidly, since a large portion of the fuel tank surface is located within the fuselage contour. Airbus stated that they do not believe the rule should apply to horizontal stabilizer fuel tanks, because these types of fuel tanks are low flammability and, if these tanks are treated as high flammability, the rule would impose significant additional costs to install FRM or IMM for these tanks. Therefore, Airbus concluded that we should either review these additional engineering complications and associated costs (particularly with respect to retrofit) or apply the same requirements to these tanks as those proposed for wing tanks not in the fuselage contour.

The retrofit requirement of this rule only applies to fuel tanks that have an average flammability exposure above 7 percent. To the extent the risk analysis indicates a particular fuel tank actually is a low risk tank, no further requirements would apply. Some horizontal stabilizers, including those made by Airbus, are manufactured from composite material that acts as an insulator. These tanks may also be used to maintain airplane center of gravity, so warmer fuel may be transferred into them during flight. These features may result in flammability exposure that exceeds the 7 percent limit that is used to establish whether retrofit of an FRM or IMM is required. Tanks constructed of composites may also exceed the flammability exposure established for new designs in § 25.981(b).

The analysis required by this rule will establish the flammability exposure and determine the need for an FRM or IMM in horizontal stabilizer fuel tanks. If fuel tanks located within the horizontal stabilizer are not high flammability tanks, then no FRM or IMM would be needed and no additional cost would be incurred for retrofit. However, if an FRM or IMM is required because the tank is determined to be high flammability, it should be possible, using standard design methods, to address the technical issues. For example, the pressure drop mentioned by Airbus can be addressed by using a properly sized and designed FRM so that adequate nitrogen can be supplied to any affected tank. This can be done using available technology and with costs that are consistent with those for other tanks considered in the regulatory evaluation. Airbus provided no technical justification for its assertion to the contrary.

8. Foreign Persons/Air Carriers Operating U.S. Registered Airplanes

Airbus, EASA, and the UK Civil Aviation Authority (UKCAA) requested a change to the wording of proposed § 129.117(a). This change would clarify that the applicability of this rule is limited to foreign persons and foreign air carriers operating U.S. registered transport category, turbine powered airplanes for which development of an IMM, FRM or Flammability Impact Mitigation Means (FIMM) is required under proposed §§ 25.1815, 25.1817 or 25.1819 (now §§ 26.33, 26.35, and 26.37). Their understanding is that the paragraph is not intended to apply to airplanes registered outside of the United States.

As provided in §§ 129.1(b) and 129.101(a), the commenters are correct that § 129.117 would not apply to aircraft registered outside the United States. To clarify our intent, we have revised § 129.117(a) to include the words ''U.S. registered.''

9. Airplanes Operated Under § 121.153

In the proposed rule, the FAA requested comments on whether categories of airplane operations other than all-cargo operations should be excluded. In response to our request, AEA and Airbus noted that § 121.153 permits the operation, by U.S. airlines, of airplanes registered in another International Civil Aviation Organization (ICAO) member states under specified circumstances. They said that, while history shows that the use of the § 121.153 provisions is relatively rare, it can provide important flexibility when unusual circumstances dictate the urgent need of replacement airplanes for U.S. carriers. Given the small effect of excluding airplanes leased under the provisions of § 121.153 from any requirements of the proposed rule, the commenters recommend that they be excluded from applicability provisions of the proposed rule. Otherwise, they said, if compliance with the proposed retrofit requirements are applied as proposed, § 121.153 would preclude this practice for airplanes that have not been retrofitted with FRM. These commenters argued that this result would present a burden to both U.S. operators (who would lose the flexibility provided by § 121.153) and non-U.S. operators (for whom the value of their unmodified airplanes would be reduced).

Section 121.153(c) does not relate to a ''category of operation,'' such as all-cargo operations. Rather, it permits certificate holders to operate foreign registered airplanes for any type of operation, as long as the airplanes meet all applicable regulations. Allowing the operation of foreign registered airplanes that do not comply with this rule would be contrary to the intent of both § 121.153(c) and this rulemaking. It would also subject a certificate holder's passengers to differing levels of safety based on the registry of the airplane. This is not acceptable and we did not make the change proposed by the commenters in the final rule. However, as discussed later in more detail, we are working with foreign authorities to establish harmonized flammability reduction standards. If we achieve that objective, the ''burdens'' suggested by the commenters would disappear.

10. International Aspects of Production Requirements

The AEA and Airbus disagreed with the proposed requirement to incorporate FRM or IMM into all new production airplanes. They stated that existing procedures for exporting airplanes from the United States allow the importing country to accept specific non-compliances on the export certificate of airworthiness. The AEA also asked for clarification of the discussion of FAA authority over airplanes produced outside the United States. Likewise, Embraer asked that the requirement to incorporate FRM or IMM into all new production airplanes be dropped from the proposal. Embraer pointed out that foreign regulatory authorities do not currently have certification standards for FRM or IMM, so Embraer is unclear how airplanes with such systems would be approved by the importing country. The ATA questioned the FAA contention (by context) that the proposed rulemaking has no international (ICAO) implications. It asked for the proposal to be reviewed by relevant international law experts for compatibility with the principles of sovereignty and authority in ICAO International Standards and Recommended Practices, Annex 8 to the Convention on International Civil Aviation, Airworthiness of Aircraft.

As discussed in the NPRM, we intend for the proposed new production requirements to apply to any manufacturer over which the FAA has jurisdiction under ICAO Annex 8. For this reason, we used the same language as Annex 8 to define the applicability of those requirements. Under that annex (and under this rule), we have jurisdiction over organizations to which we issue production approvals, including production certificates. This may include organizations that accomplish final assembly outside the United States. While no affected U.S. production certificate holders currently accomplish final assembly outside the United States, it is possible that they might in the future. For example, if Boeing were to perform final assembly of a future version of the Boeing 737 in another country, those airplanes would still be subject to the production cut-in requirements of this final rule as long as Boeing produces them under Boeing's U.S. production certificate.

Regarding the comment that current procedures allow the importing country to accept specific non-compliances on the export certificate of airworthiness, the commenters are referring to the waiver provisions of § 21.327(e)(4). The non-compliances referenced in that section relate to the requirements for issuance of an export airworthiness approval.[19] The production cut-in requirement of this rule is unrelated to those requirements. Rather, it requires that affected airplanes produced under U.S. production approvals must conform to an approved type design that meets the fuel tank flammability requirements of this rule. Therefore, while a foreign authority may be able to waive the requirements for issuing airworthiness approvals, it does not have the authority under ICAO Annex 8 to override our requirements, imposed as the State of Manufacture, for our production approval holders.

Finally, in addition to meeting the requirements of this rule, any airplane produced for export would also have to meet all other requirements applicable to the production certificate holder (such as the requirement to maintain its quality control system in accordance with its FAA approval). These requirements cannot be waived under the provisions of § 21.327(e)(4). Therefore, we are not aware of any basis for a foreign authority to object to our requirement for production cut-in. Of course, once the airplane is placed into operation by a foreign operator, the operator would have to comply with the requirements of its authority for operation and maintenance of the airplane, which may or may not include requirements relating to fuel tank flammability. As discussed later in more detail, we are currently working with foreign authorities to harmonize our requirements with theirs.

*D. Requirements for Manufacturers and Holders of Type Certificates, Supplemental Type Certificates and Field Approvals*

1. General Comments About Design Approval Holder (DAH) Requirements

We received a number of general comments responding to the concept of DAH requirements rather than to the DAH requirements in this specific

[19] For example, § 21.327(e)(4) references § 21.329, which in turn references § 21.183 for the requirements for a standard U.S. airworthiness certificate. For new airplanes, § 21.183 requires that the product conform to its approved type design and is in condition for safe operation.

rulemaking. We responded to these types of comments in the comment disposition document accompanying our policy statement titled ''Safety—A Shared Responsibility—New Direction for Addressing Airworthiness Issues for Transport Airplanes.'' Both were published in the **Federal Register** on July 12, 2005 (70 FR 40168 AND 70 FR 40166, respectively). We received similar comments on our NPRM on Enhanced Airworthiness Program for Airplane Systems (70 FR 58508, October 6, 2005, RIN 2120–AI31). As a result, we will not respond to such comments again here.

2. Flammability Exposure Requirements for New Airplane Designs

As proposed, the rule requires those airplanes incorporating FRM to limit the fleet average flammability exposure to 3 percent, and to limit warm day exposure to 3 percent, for all normally emptied fuel tanks located, in whole or in part, in the fuselage. All other fuel tanks can either meet the 3 percent average flammability exposure limitation or have a flammability exposure that is not higher than the exposure in a conventional unheated aluminum wing tank that is cooled by exposure to ambient temperatures during flight.

a. General Comments About Applicability to New Production Airplanes

The NACA and its member airlines fully support the requirement for incorporation of either an FRM or IMM to provide fuel tank inerting for all new production airplanes, including those that already have an approved TC or STC. Airbus, AEA, AAPA, and EASA also commented that installation of FRM during an airplane manufacturing process may be appropriate. The EASA expressed its support for production cut-in and plans to amend its rules to a harmonized approach that requires production incorporation.

As we stated in the NPRM, ''The safety objective of these proposed rules is to have the required modifications installed and operational at the earliest opportunity.'' [20] For U.S.-manufactured airplanes, we proposed to meet this objective by requiring affected production approval holders to incorporate these changes by the compliance date for developing FRM or IMM service information. Recognizing that we do not have similar authority over affected foreign manufacturers, we did not propose a similar requirement for them. However, as noted by the commenters, our safety objective still applies to those airplanes, and it is equally feasible for FRM or IMM to be incorporated on new foreign-manufactured airplanes after the necessary design changes are developed. Further, as stated by EASA, it has agreed to harmonize requirements for new production airplanes. Including FRM or IMM in production is more efficient and less costly than retrofitting these airplanes, which is also required under the NPRM.

Based on these factors, we had assumed that FRM or IMM would be incorporated on all airplanes produced by both domestic and foreign manufacturers after designs were developed within two years after the effective date of this final rule. Given the reluctance of foreign manufacturers to commit to developing these design changes within the prescribed period (as discussed later), we now recognize that an operational requirement is needed to effectuate our intent. Accordingly, operators may not operate affected airplanes produced after September 20, 2010 unless they are equipped with FRM or IMM. Because we had intended that all airplanes delivered after these design changes had been developed would include these safety improvements, this requirement is a logical outgrowth of the NPRM.

b. Flammability Analysis Using the Monte Carlo Method

For all fuel tanks, an analysis must be performed to determine whether the fuel tank, as originally designed, meets the fleet average flammability exposure limits discussed above. To determine the flammability exposure of fuel tanks, the ARAC used a specific methodology incorporating a Monte Carlo analysis.[21] As proposed, any analysis of a fuel tank must be performed in accordance with this methodology (as detailed in proposed appendix L, now appendix N, and in the draft FAA document, Fuel Tank Flammability Assessment Method User's Manual).[22] We considered approving alternative methodologies in lieu of Appendix N, but we found that no other alternative considered all factors that influence fuel tank flammability exposure (which is the safety objective of this rule).

The ATA proposed upgrading the Monte Carlo method or developing a similar method that would be used to evaluate airplane risk of a fuel tank explosion. The method proposed by ATA would include not only fuel tank flammability, but also the risk of ignition sources developing in a fuel tank based upon the specific airplane design.

The Monte Carlo method is intended to be used to determine fuel tank flammability alone, not the overall likelihood of a fuel tank explosion. While the ATA's suggestion is intriguing, we do not believe there is presently a method of accurately predicting the risk of an ignition source developing in a fuel tank. With this final rule, we are implementing a balanced approach to prevent fuel tank explosions: By addressing both ignition prevention (as defined in the requirements of § 25.981(a) and SFAR 88) and flammability reduction (as defined in this rule). Compliance with both standards ensures that fuel tank explosion risk is acceptable.

The EASA also expressed concerns about the proposed methodology since it is complex and allows variations in fuel tank flammability to be introduced by variations in the input parameters used in the analysis. Although EASA welcomed the improvements to the Monte Carlo method proposed in the NPRM that set the majority of the input parameters, EASA expressed concern that the method does not adequately address heat transfer and the assumptions retained do not allow proper quantification of the exposure.

We share the concern expressed by EASA that, unless properly controlled, variation in the DAH input parameters used in the flammability assessment could result in significant differences between various DAHs. Fuel tank thermal modeling, including heat transfer, is the one major variable parameter provided by the user. Appendix N25.3(e) requires that substantiating data for the fuel tank thermal model, along with other input parameters, be submitted with the analysis. Therefore, we believe that Appendix N does adequately address heat transfer and provides a method that allows for proper quantification of flammability exposure.

Finally, Parker Hannifin Corporation noted an error in the Monte Carlo computer code that mistakenly added the time prior to flight and utilized the flight time constants rather than ground time constants in certain calculations. This error could produce two counter-

[20] 70 FR at 70940.

[21] This methodology determines the fuel tank flammability exposure for numerous simulated airplane flights during which various parameters such as ambient temperature, flight length, fuel flash point are randomly selected. The results of these simulations are averaged together to determine the fleet average fuel tank flammability exposure.

[22] As indicated in the proposed Appendix L (now Appendix N), we are incorporating the User's Manual by reference into the final rule. This was incorporated by reference in the final rule by creating a new § 25.5.

acting effects. In some circumstances, it could produce higher flammability exposure when the tank-full time constant is used longer than actually required. In other circumstances, it tends to reduce the flammability exposure by using the tank empty-time constant earlier than actually warranted. Overall this has the net effect of slightly underestimating the actual fuel tank flammability exposure so assessments using the revised computer code would produce slightly higher flammability values. We addressed this error in the final rule and the computer code is now correct.

c. Definition of ''Normally Emptied Tank''

As defined in proposed § 25.1803(d) (now § 26.31(b)), ''normally emptied tank'' refers to a fuel tank that is emptied of fuel during the course of a flight and, therefore, can contain a substantial vapor space during a significant portion of the airplane operating time. Boeing requested that the definition for ''normally emptied'' be removed. Boeing based this request on the fact that heat input to the tank and the heat rejection rate (i.e., the rate of heat transfer from the tank) play more of a factor in a tank's flammability than whether it is normally emptied.

While we acknowledge that the heat input to the fuel tank and heat rejection from the tank are major factors in fuel tank flammability, the reason we are concerned about tanks that are normally emptied is not related to their flammability. As stated in the preamble to the NPRM, normally emptied fuel tanks can contain a substantial fuel vapor space that could expose potential ignition sources to the fuel vapor for an extended period of time. Fuel in tanks that are not normally emptied covers potential ignition sources more often than fuel in normally emptied tanks. This prevents ignition sources from igniting fuel vapors in the tank. Therefore, normally emptied fuel tanks have a higher likelihood of exposing flammable vapor to ignition sources than tanks that are not normally emptied. This rule specifically differentiates between fuel tanks that are normally emptied and other fuel tanks by requiring reduced fuel tank flammability because of the increased risk of an explosion in normally emptied tanks.

d. Fixed Numerical Standard

For new airplane designs, we requested comments on whether the reference to a conventional unheated aluminum wing tank or a fixed numerical standard for the requirements of § 25.981(b) would be more workable and effective. The safety objective of a ''conventional unheated aluminum wing tank'' is consistent with the ARAC recommendation and § 25.981(c) (amendment 102). However, it does not provide a numerical standard to apply in future type certification programs. In certain cases, the compliance demonstration would be simplified if a fixed numerical standard were provided in the regulation, because there would be no analysis needed to establish the flammability exposure of a conventional unheated aluminum wing tank that is the alternative flammability exposure. We believe this approach has implementation advantages and should achieve the safety level intended by the ARAC recommendation and the current approach in § 25.981(c) (amendment 102).

Transport Canada, Boeing, Airbus, and ATA agreed that including a fixed numerical standard was preferred. Several of them suggested that we needed to provide further justification for the selection of a 3 percent fixed value and proposed different numerical values. These commenters did not agree with the inclusion of a variable standard of equivalence to a conventional unheated aluminum wing tank.

Airbus stated that a numerical value within the level recommended by ARAC (i.e., 7 percent) would be more practical and potentially safer than a flammability equivalency to a hypothetical wing fuel tank. While the 3 percent limit should be considered an acceptable goal if FRM is used, Airbus suggested that for fuel tanks that have a base flammability exposure less than 7 percent, there should not be a requirement to use FRM. The existing minimization of heat sources, as required by EASA, should be adequate. Airbus concluded that establishing a standard of 7 percent for fuel tank flammability exposure would ensure that FRM would provide a significant benefit (at least a 50 percent reduction in flammability) and remove the potential to actually reduce the overall safety as a result of increased ignition risk potential due to hazards associated with adding new FRM or IMM to the airplanes.

These commenters did not provide any compelling reasons to change the proposed 3 percent average flammability exposure or to eliminate the provision for showing equivalence to a conventional unheated aluminum wing tank. The reason for including the fixed 3 percent flammability exposure is to simplify the compliance demonstration. The reason for allowing for equivalence to a conventional unheated aluminum wing tank is to give flexibility to designers who are willing to perform the required evaluations. The proposal from Airbus and other commenters to increase the flammability exposure value to 7 percent would allow a significant increase in fuel tank flammability over that permitted by § 25.981. The fleet of airplanes that ARAC determined had achieved an acceptable level of safety was made up of airplanes with conventional unheated aluminum wing tanks with flammability exposures that varied from very low levels of around 1.5 percent for outboard wing fuel tanks to the highest values below 6 percent for some larger inboard wing tanks. These numerical values would all be lower if calculated today, consistent with the lower values now calculated by manufacturers for HCWTs.

Therefore, in this final rule, we adopted a flammability standard that includes showing a fuel tank is equivalent to a conventional unheated aluminum wing tank or 3 percent, whichever is greater. For purposes of this final rule, a conventional unheated aluminum wing tank is a conventional aluminum structure, integral tank of a subsonic transport airplane wing, with minimal heating from airplane systems or other fuel tanks and cooled by ambient airflow during flight. Heat sources that have the potential for significantly increasing the flammability exposure of a fuel tank would preclude the tank from being considered ''unheated.'' Examples of such heat sources that may have this effect are heat exchangers, adjacent heated fuel tanks, transfer of fuel from a warmer tank, and adjacent air conditioning equipment. Thermal anti-ice systems and thermal anti-ice blankets typically do not significantly increase flammability of fuel tanks.

e. Tanks Located Within the Fuselage Contour

Boeing disagreed with the distinction in proposed § 25.981 between tanks located within the fuselage contour that are normally emptied and other tanks. Boeing suggested that main tanks and tanks not partially within the fuselage do not represent all the tanks with low flammability exposure and acceptable safety records. Boeing stated that on the other hand it is possible to design a main or wing tank with exceptional heat sources and/or minimal cooling. It is also possible to design a normally emptied tank that is partially within the contour of the fuselage which is low flammability (3 percent or less).

Bombardier did not understand the justification for introducing a maximum

3 percent fuel tank flammability exposure for wing tanks with a portion of the tank located within the fuselage. Bombardier stated that there is an inconsistency in requiring wing tanks to have flammability exposure of between 2 percent and 5 percent, while requiring fuselage tanks to be below 3 percent. Bombardier concluded that keeping all tanks below a 7 percent flammability exposure level should be considered acceptable, and recommended that tanks with less than 7 percent flammability exposure not be required to have FRM.

The distinction in flammability exposures in the rule between tanks located within the fuselage contour that are normally emptied and other tanks was made because the former generally have an increased risk of explosion. The location within the fuselage typically results in little or no cooling of the tank and, in some cases, actually heats the tank. Tanks that are normally emptied operate much of the time empty. Therefore, components that could be potential ignition sources are exposed to the tank ullage. We agree with Boeing on the possibility that fuel tanks located in the wing can be high flammability if the tank is heated or does not cool due to tank design features. However, the rule limits fuel tank flammability in these tanks to 3 percent or equivalent to a conventional unheated aluminum wing tank, addressing that risk.

For fuel tanks located outside the fuselage contour, § 25.981, as amended by this final rule, retains the flammability limits 3 percent or equivalent to a conventional unheated aluminum wing tank. Only if any portion of the fuel tank is located within the fuselage contour, and if the tank is normally emptied, is it required to meet the 3 percent average and 3 percent warm day requirement. If an applicant chooses to locate a portion of a main fuel tank inside the fuselage, the rule requires that the fuel tank meet the same standard as a main fuel tank located solely outside of the fuselage contour (i.e., 3 percent or equivalent to a conventional unheated aluminum wing tank wing).

Since existing airplane types with main fuel tanks that go from the wing into the fuselage are not normally emptied, FRM or IMM is required for these tanks only if the tank flammability exposure exceeds 7 percent (proposed § 25.1815 (now § 26.33)). For future designs using similar architecture, these types of designs would need to show that the main tank that extends into the fuselage meets the standard of equivalent to a conventional unheated aluminum wing tank or 3 percent.

f. Compliance Demonstration

Boeing, Airbus, and BAE requested that applicants be allowed to use design review to determine that an aluminum fuel tank is equivalent to the low flammability standard fuel tank as defined by ARAC. This would be in lieu of a detailed Monte Carlo based flammability analysis. The BAE stated that performing a cumbersome and expensive Monte Carlo analysis for metallic wing tanks of conventional design is unnecessary and adds no value. For other types of tanks, or wing tanks with a substantial heat input, BAE believes the use of alternative analytical methods may be appropriate and suggested a qualitative assessment of the design and the installation should be adequate to determine whether a given tank has a low flammability exposure. Finally, BAE recommended a simple set of objective criteria be allowed for establishing fuel tank flammability in these tanks.

Boeing requested that we:

- Revise proposed § 25.981(b) to allow a simplified flammability analysis for fuel tanks shown by design review to be a Conventional Unheated Aluminum Wing Tank.
- Delete proposed § 25.981(b)(1) and (b)(2), which reference Appendixes N and M for the flammability analysis methodology and flammability exposure criteria, respectively.
- Revise the definition of conventional unheated aluminum wing tanks to consider allowing some minimal heat sources (i.e., hydraulic systems) and significant cooling which results in low flammability exposure and a satisfactory level of safety.

We agree with the commenters' assertion that a simplified qualitative flammability analysis for conventional unheated aluminum wing tanks is appropriate and have modified Appendix N to permit this. Our intent is to limit the quantitative analysis for aluminum wing tanks with unique or unconventional designs that are heated or designed such that minimal cooling occurs. For example, a quantitative flammability analysis would be necessary for a wing tank that has a relatively small surface area, thereby minimizing surface cooling effects, a composite tank or a tank that has equipment inducing heat into the fuel tank greater than a small amount.

We have also added guidance to AC 25.981–2 that describes how to conduct a qualitative analysis to establish equivalency to a conventional unheated aluminum wing tank. This guidance provides examples of allowable heat sources and cooling characteristics for a fuel tank to be considered a ''conventional unheated aluminum wing tank,'' so that the safety standard established by the ARAC definition for a conventional unheated aluminum wing tank is maintained. For compliance with § 25.981(d), the guidance also includes a discussion of how Critical Design Configuration Control Limitations (CDCCL) would need to be developed to define any critical features of the fuel tank design needed to limit the flammability to that of a conventional unheated aluminum wing tank.

As for Boeing's specific changes to § 25.981, we do not agree that § 25.981(b)(1) and (b)(2) should be deleted because Appendix N provides necessary definitions and methods for establishing Fleet Average Flammability Exposure and Appendix M establishes performance standards for FRM. These appendices, and the references to them in § 25.981(b)(1) and (b)(2), are necessary to achieve the safety objectives of this rulemaking. We have not adopted Boeing's suggestion to modify the definition of ''Equivalent Conventional Unheated Aluminum Wing.'' However, we do agree with the comment to allow some minimal heating of tanks such as that from a hydraulic heat exchanger that does minimal heating. We have revised the term ''Conventional Unheated Aluminum Wing'' used in § 25.981 to ''Conventional Unheated Aluminum Wing Tank'' to clarify that the flammability of the fuel tank is the standard. Since some minimal degree of heating typically occurs in many of these tanks, this change recognizes that such minimal heating is permissible.

g. Heat Sources Located in or Near Fuel Tanks

Transport Canada and the UK Air Safety Group suggested we prohibit the placement of heat sources within or near fuel tanks. Transport Canada questioned why we would allow such an undesirable design practice to continue. The UK Air Safety Group contended the NPRM failed to address the contribution of high fuel tank temperature to fuel tank explosions. The commenter noted that the Boeing 737 and 747 have air conditioning units that raise the fuel tanks' temperature well above the outside ambient temperature because these units are located beneath the center fuel tanks.

We agree with the commenters' underlying concern about controlling fuel tank temperature. While locating heat sources in or near fuel tanks increases the tanks' flammability, specifically prohibiting this design practice may not be the most efficient and effective way to address the problem. This rule is performance-based and is seeking innovative design solutions which could permit locating heat sources near or in fuel tanks. For example, designers may wish to develop an FRM based upon managing the fuel tank temperature by transferring heat between tanks. These designs may provide flammability exposures well below that of a tank that complied with the proposal made by the commenters. Risk is directly proportionate to the flammability exposure of a tank. Therefore, we have developed a flammability performance standard that is independent of the design details of a tank installation.

h. Effects of Systems Failures on Flammability

The CAPA requested that we ensure the effects of any system failures that might increase the fuel tank flammability above the acceptable limit be considered and properly evaluated prior to issuing the final rule.

The flammability analysis required by § 25.981 includes a requirement to show that flammability exposure does not exceed minimum levels. It also requires that the overall flammability exposure analysis includes consideration of system failures when demonstrating that the FRM meets the reliability requirements of this rule. In addition, the analysis required by § 25.981(d) that determines the CDCCL and airworthiness limitations includes consideration of possible critical design features that must be maintained and may not be altered to assure the flammability limits are achieved. We have provided additional guidance and clarification in AC 25.981–2 regarding reliability assessments and establishing CDCCL and airworthiness limitations for FRM and IMM. Accordingly, we believe the commenter's concerns are already addressed by the proposed language, and no change was made to the final rule.

i. Move Flammability Exposure Method to Advisory Circular

The EASA, Transport Canada, Boeing, and Bombardier commented that the Monte Carlo method should not be defined in the rule as the method for determining fuel tank flammability. Instead, it would be more appropriately included in advisory material.

We do not agree with these commenters. The Monte Carlo method is specified in the rule to ensure standardization of the methodology for determining fuel tank flammability across all airplane models so a uniform level of safety is achieved. Advisory circulars (ACs) provide guidance for methods, procedures, or practices that are acceptable to us for complying with regulations. ACs are only one means of demonstrating compliance, and we cannot require their use. Specifying Monte Carlo analysis in an AC could result in numerous methodologies and input parameters being used to determine flammability exposure, and we believe that this could result in differing flammability exposures in the fleet that may allow some fuel tanks to have greater flammability than intended by the rule. To ensure that all DAHs reach comparable conclusions from their assessments, it is necessary to require that they use the same methodology. This can only be accomplished through the rulemaking process.

However, to accommodate minor revisions that would not appreciably affect analytical results, we have included a provision in Appendix N25.1(c) permitting use of alternative methods if approved by the FAA. This is similar to the flexibility provided in § 25.853 for alternative test methods to those defined in Appendix F of part 25.

3. Flammability Exposure Requirements for Current Airplane Designs

Proposed § 25.1821 (now § 26.39) contains the fuel tank flammability safety requirements for newly produced airplanes. Paragraph (b) sets forth the criteria that, when met by any fuel tank, requires that fuel tank to have an FRM or IMM meeting the new requirements of § 25.981. Paragraph (c) contains the requirements for all other fuel tanks that exceed a Fleet Average Flammability Exposure of 7 percent.

a. Same Standards for New and Current Airplane Designs

Boeing asked that we revise proposed § 25.1821(b) to state ''any fuel tank not shown by design review to be a Conventional Unheated Aluminum Wing Tank, must meet the requirements of § 25.981 in effect on [effective date of final rule].'' In conjunction with this change, paragraph (c) would be deleted. Boeing stated that new production airplanes should meet the same requirements as new airplane designs, since the criteria for tanks at risk should be a function of heating and cooling, not whether the fuel tank is normally emptied and located partially within the fuselage.

We do not agree with Boeing. As discussed earlier, tanks that are normally emptied and located at least partially within the fuselage are generally more susceptible to explosion because of both increased ullage and operating at higher temperatures. We have determined that the 7 percent flammability exposure limit recommended by ARAC is an adequate standard to determine which fuel tanks in newly produced airplanes need an FRM or IMM. If the fleet average flammability exposure is above 7 percent for fuel tanks normally emptied and located within the fuselage contour, these fuel tanks will be required to be flammable no more than 3 percent on average and 3 percent for warm day operations. We expect that the vast majority of large transport category airplanes will have a fleet average flammability exposure above 7 percent for these specific fuel tanks and will be required to comply with § 25.981 for production airplanes affected by the DAH requirement.

Other tanks on newly produced airplanes also may not exceed the 7 percent flammability exposure limit, but the final rule would allow reduction to that level by various methods of FRM described in AC 25.981–2 that would not necessarily require the added complexity and cost of a nitrogen inerting based FRM. We believe this requirement is sufficient to provide an acceptable level of safety for current production airplanes because these tanks have significantly lower risk of fuel tank explosions, as demonstrated by their service history. Therefore, we do not believe the safety improvements from redesign of these tanks to meet the new requirements of § 25.981 are sufficient to justify the resulting costs.

b. 7 Percent Exposure Flammability Questioned

In the NPRM, we stated that fuel tanks that have a flammability exposure higher than 7 percent are unduly dangerous. American Trans Air commented that this statement is arbitrary, based on flawed analysis, and cannot be supported. Bombardier expressed its opinion that the NPRM and its supporting data did not adequately substantiate the declared 7 percent exposure. Although Bombardier considered that achieving 7 percent exposure is feasible with reasonable design precautions, Bombardier stated that this is not an acceptable reason for creating a standard. Bombardier also quoted information shared among the airline industry and authorities that heated tanks may vary between 8 percent to as high as 40 percent in flammability exposure.

Boeing did not agree with the proposed flammability requirements for newly produced airplanes, because fuel tanks other than those located within the fuselage contour that are normally emptied would be allowed to have flammability of up to 7 percent. Boeing commented that this flammability is more than twice that of what is allowed for similar tanks in new designs. Boeing noted that the first ARAC determination that 7 percent flammability exposure is acceptable was based on the original coarse ARAC flammability analysis which determined that unheated tanks had a flammability level of approximately 5 percent. Two percent was added for potential variation resulting in the 7 percent proposal. Boeing pointed out that the Monte Carlo analysis has been significantly refined since the first ARAC report, and the estimated flammability exposure of 5 percent (7 percent with potential variation) has been reduced to be in the range of 3 percent (4 percent with potential variation) or less for the same fuel tanks.

We have determined that the 7 percent or less fleet average flammability exposure recommended by ARAC is an adequate value that can be used to identify those airplane models that need to be retrofitted with an FRM or IMM. The fuel tank flammability limits established for newly produced airplanes (subject to the production cut-in requirements) are the same as those for retrofit of the existing fleet (proposed § 25.1815 (now § 26.33)). We determined this flammability exposure achieves the desired safety benefits, since currently produced airplanes generally have conventional unheated aluminum wing tanks, the tanks ARAC determined to have adequate safety level, with flammability exposures below 7 percent.

We agree with Boeing that newly produced airplanes should not be allowed to have fuel tank flammability that is twice that of new designs, and this is not what we intended. The intent of this rule is to apply its safety improvements to the fuel tanks that have been shown to have an increased risk of explosion, not to require modifications to conventional unheated aluminum wing tanks, or other fuel tanks that have significantly lower flammability. Data we have available for currently produced airplanes indicate the flammability of tanks located outside the fuselage contour have flammability below 7 percent and further reduction in flammability exposure as recommended by Boeing would add significant cost to the rule, since a number of fuel tanks would be required to have an FRM or IMM to meet the suggested flammability values of 3 to 4 percent.

Recognizing that, based on the applicability criteria of proposed § 25.1821(a) (now § 26.39), this section only applies to current production Boeing models. We have revised paragraph (a) to specifically identify those models. As discussed previously, we have also added a requirement to the operational rules that operators must meet these requirements for any airplane subject to this rule that is produced more than two years after the effective date.

4. Continued Airworthiness and Safety Improvements

a. 7 Percent Standard Should Apply to All Tanks

Boeing requested that § 25.1815(c)(1) be modified to state that, for fuel tanks with flammability exposure exceeding 7 percent that require an FRM, ''a means must be provided to reduce the fuel tank flammability exposure to meet the criteria of Appendix M of this part.'' In addition, Boeing recommended that we delete § 25.1815(c)(1)(i) and (ii). Boeing stated that any fuel tank that has significant heat loads, regardless of the location on the airplane, should meet the requirements of Appendix M if an FRM is selected as the design modification.

We do not concur with Boeing's comment that the flammability requirements of Appendix M should apply to any fuel tank that exceeds 7 percent average flammability. As discussed previously, the reason we are adopting more stringent requirements for fuel tanks that are normally emptied and located within the fuselage contour is that those tanks both have higher flammability exposure and are more likely to have ullage exposed to ignition sources. For other fuel tanks where the fleet average flammability exposure exceeds 7 percent, the requirements of Appendix M apply with the exception that the flammability requirements of M25.1(a) and (b) are replaced by the requirement that fleet average flammability exposure must not exceed 7 percent. We believe this is acceptable for these tanks on existing airplanes. Since most of these tanks are not ''normally emptied,'' the risk that flammable vapors will be exposed to ignition sources is generally much lower.

b. Compliance Planning

Airbus requested that the compliance planning requirements contained in § 25.1815 be removed because they are unnecessary. Airbus believes the only important compliance date is the final date for DAHs to submit the data and documents necessary to support operator compliance. Airbus commented that the compliance plan requirements in §§ 25.1815(g), (h) and (i) add constraints on the manufacturer with no safety benefit. Airbus stated these documents should not be subject to a requirement with respect to the DAH documentation delivery date. However, if the delivery dates for these documents are mandated, Airbus requested that they be expressed in the format of a duration tied to the date of approval of the previous submittal.

Boeing recommended we remove the § 25.1815(g)(3) requirement to identify deviations to methods of compliance identified in FAA advisory material, because the proposed means of compliance should not be compared to other means. Instead, they should be evaluated on their own merits.

While we understand the commenters' concerns, these documents will provide assurance that the required flammability exposure analyses and, if applicable, proposed design changes, are being addressed in a timely fashion. As stated in the NPRM, the resolution of fuel tank safety issues needs to be handled in a ''uniform and expeditious'' manner. Providing compliance times based on the dates of our previous approvals would result in various compliance times, depending upon whether DAHs' submissions are acceptable. It would have the undesirable effect of providing more time for those manufacturers submitting deficient documents.

Compliance planning will promote communication between the affected manufacturer and us. It will also provide sufficient time to discuss any concerns with respect to how the affected manufacturer proposes to analyze fleet average flammability exposure or certify design changes. Compliance planning will also help to ensure that the affected manufacturer is able to meet the required compliance times of the rule for accomplishing the submittal of the flammability exposure analysis, design changes, and service instructions, if applicable (proposed § 25.1815 (now § 26.33) and proposed § 25.1817 (now § 26.35)). We intend to closely monitor compliance status and take appropriate action, if necessary.

However, we do acknowledge that some provisions of proposed § 25.1815(g), (h) and (i) could be removed without adversely affecting our ability to facilitate TC holder compliance. Specifically, proposed paragraph (g)(3) would require TC holders to identify intended means of compliance that differ from those described in FAA advisory materials.

While this is still a desirable element of any compliance plan, we now believe that an explicit requirement is unnecessary and it is not included in the final rule. As with normal type certification planning, we expect that TC holders will identify differences and fully discuss them with the FAA Oversight Office early in the compliance period to ensure that these differences will ultimately not jeopardize full and timely compliance. Because we believe that timely review and approval is beneficial and will save both DAH and FAA resources, the advisory material will recommend that if the DAH proposes a compliance means differing from that described in the advisory material, the DAH should provide a detailed explanation of how it will demonstrate compliance with this section. The FAA Oversight Office will evaluate these differences on their merits, and not by comparison with FAA advisory material.

Similarly, proposed § 25.1815(i) contains provisions that would have authorized the FAA Oversight Office to identify deficiencies in a compliance plan, or the TC holder's implementation of the plan, and require specified corrective actions to remedy those deficiencies. While we anticipate that this process will still occur in the event of potential non-compliance, we have concluded that it is unnecessary to adopt explicit requirements to correct deficiencies and have removed them from the final rule. Ultimately, TC holders are responsible for submitting compliant FRM or IMM by the date specified. This section retains the requirements to submit a compliance plan and to implement the approved plan. If the FAA Oversight Office determines that the TC holder is at risk of not submitting compliant FRM or IMM by the compliance date because of deficiencies in either the compliance plan or the TC holder's implementation of the plan, the FAA Oversight Office will document the deficiencies and request TC holder corrective action. Failure to implement proper corrective action under these circumstances, while not constituting a separate violation, will be considered in determining appropriate enforcement action if the TC holder ultimately fails to meet the requirements of this section.

Finally, we realized that the rule text could more clearly state our intent to allow DAHs flexibility to modify their approved plan if necessary. Accordingly, we changed proposed § 25.1815 (now § 26.33(i)) to read: ''Each affected type certificate holder must implement the compliance plans, or later revisions, * * *''

c. Changes to Type Certificates Affecting Flammability

Proposed § 25.1817 (now § 26.35) addressed changes to TCs that could affect fuel tank flammability. This section proposed to require that a flammability exposure analysis be accomplished in accordance with Appendix N for all affected fuel tanks installed under an STC, amended TC, or field approval within 12 months after the effective date of the final rule. An impact assessment that identifies any features of the design change that compromise any CDCCL applicable to any airplane with high flammability tanks for which CDCCL are required must also be submitted to the FAA Oversight Office. This section also proposed a requirement to develop service instructions to correct designs that compromise airworthiness limitations, defined by the TC holder under proposed § 25.1815 (now § 26.33), within 48 months after the final rule's effective date.

Airbus proposed we restrict the application of any proposed changes to § 25.981 to new TCs and significant design changes (i.e., new fuel tanks). For minor design changes such as relocating a fuel level sensor or a small increase in tank capacity, the TC holder should only be required to show no degradation in the flammability under the criteria proposed by § 25.1815. Airbus stated that the cross-reference between what is in the preamble and § 25.1815, and what is required by § 25.1817, is misleading.

We agree with Airbus, and have revised proposed § 25.1817 (now § 26.35) to require compliance with the new § 25.981 only for new fuel tanks. Other design changes that increase capacity of existing fuel tanks must comply with § 26.33. Design changes that affect the flammability exposure of existing tanks equipped with FRM or IMM must comply with CDCCLs for those tanks. This will ensure that these design changes do not degrade the level of safety required by this rule.

d. Combine §§ 25.1815 and 25.1817

Boeing requested that we combine proposed §§ 25.1815 and 25.1817 into one section. We do not agree with this suggestion, since it would not achieve the goals of this rulemaking. As proposed, §§ 25.1815 (now § 26.33) and 25.1817 (now § 26.35) would apply to different entities. Section 25.1815 (now § 26.33) would apply to TC holders of transport category airplanes, and § 25.1817 (now § 26.35) to auxiliary tank STC holders and future applicants for design changes. The STC holders have distinctly different compliance dates because information such as CDCCL developed by the DAHs under proposed § 25.1815 (now § 26.33) is needed before the STC holders can comply with proposed § 25.1817 (now § 26.35). Separate sections provide a clear statement of the requirements for each situation so affected persons can more easily understand what is needed to comply with the rules applicable to them. Therefore, the final rule retains the language as proposed with no change.

e. Pending Type Certification Projects

Proposed § 25.1819 contains the requirements for pending TC projects. As proposed, this section contains different requirements for those transport category airplanes based on whether the application was made before or on/after June 6, 2001 (the effective date of Amendment 25–102). Boeing requested that this section be deleted because it saw no reason to differentiate among designs based on the date of application.

We partially agree with Boeing and have revised this section. In the final rule, any pending certification projects that have not received type certification by the effective date of this rule will be required to meet the requirements of § 25.981, as amended by this rule. Since there are no longer any ongoing TC projects where the application was received prior to June 6, 2001, there is no reason for this distinction and we have removed proposed § 25.1819(c). However, we have received applications for type certification projects after June 6, 2001, that are still pending (e.g., the Boeing 787 and Airbus A350), and we have determined that a specific requirement in § 25.1819 is needed to address these projects. We do not believe this section should be completely deleted, as requested, because these projects (and future design changes to these airplanes), would not otherwise be required to comply with § 25.981, as amended by this final rule. The change to the rule will maintain the requirement that pending projects meet the same flammability standards as required for new type certificates and that applicants develop CDCCL as proposed in the NPRM.

f. Type Certificates Applied for on or After June 6, 2001

Proposed § 25.1819(d) (now § 26.37(b)) requires that if an application for type certification was made on or after June 6, 2001, the requirements of § 25.981 of this rule apply. Section 25.981 requires, in part, that the fleet average flammability exposure of a fuel tank not exceed 3 percent or that of a conventional unheated aluminum wing tank.

Airbus objected to the setting of a 3 percent flammability limit for all fuel tanks for a pending type certification, if the application was made on or after June 6, 2001. Airbus agreed that a 3 percent flammability limit could be considered as an acceptable goal when FRM is used. However, for fuel tanks that have a base flammability exposure less than 7 percent, there should not be a requirement to impose FRM, and the existing minimization of heat sources should be considered adequate. If initial flammability is between 3 and 7 percent, the safety benefit to reduce it to 3 percent through the use of FRM is not justified, when considering the introduction of new failure conditions, and operational and ownership costs of an FRM.

Airbus apparently misunderstood the effect of the proposed requirements of § 25.1819 (now § 26.37) for TCs for which application was made on or after June 6, 2001. The following is provided to clarify the requirements of the rule and address the concern expressed by Airbus. The flammability requirements for an airplane for which application was made on or after June 6, 2001, would include § 25.981 at Amendment 25–102 for all tanks except normally emptied tanks located within the fuselage contour. As stated earlier in this preamble, the rule text has been changed to clarify that the flammability exposure is equivalent to a conventional unheated aluminum wing tank or 3 percent, at the applicant's option. This flammability exposure is unchanged from Amendment 25–102, which would not have permitted a flammability exposure of 7 percent. This rule adds a new requirement for fuel tanks located within the fuselage contour that are normally emptied. Normally emptied tanks located within the fuselage must meet the 3 percent average and the 3 percent warm day flammability limits defined in Appendix M, which is the same flammability requirement being applied to these types of fuel tanks on existing airplanes.

g. Design Change to Add a Normally Emptied or Auxiliary Fuel Tank

As proposed, § 25.1819(e) would require that any future design change to a TC for which the application is pending when this rule is adopted and that—

• Adds an auxiliary fuel tank, or
• Adds a fuel tank designed to be normally emptied, or
• Increases fuel tank capacity, or
• May increase the flammability exposure of an existing fuel tank must meet the requirements of § 25.981, as amended by this rule. Boeing asked that this paragraph be deleted because it is specifically for ''pending'' type certification projects and, by definition, there is no existing type certificate to change. If the intent of proposed § 25.1819 (now § 26.37) is to define requirements for projects in work at the time of the final rule, then Boeing suggested there is no need for this section. Any change after the new production compliance date would have to meet the new production requirements (§ 25.1821).

Proposed § 25.1819(e) specifically targets potential future changes to certain long-term, pending type certification programs. Under proposed § 25.1819(c), these programs would not be required to comply with § 25.981, as amended by this rule. Our intent was that, although the original TC would not have to comply with the current requirements, any later changes would have to comply. Since we issued the NPRM, all of these projects have been certified, so there are no pending projects for which this paragraph is needed. Therefore, we have removed it from the final rule.

*E. Flammability Exposure Requirements for Airplane Operators*

The proposed operating rules would prohibit the operation of certain transport category airplanes operated under parts 91, 121, 125, and 129 beyond specified compliance dates, unless the operator of those airplanes has incorporated approved IMM, FRM or FIMM modifications and associated airworthiness limitations for the affected fuel tanks. The proposed rules would not apply to airplanes used only in all-cargo or part 135 operations. Finally, the proposed operating rules would also create new subparts that pertain to the support of continued airworthiness and safety improvements.

1. General Comments About Applicability to Existing Airplanes

Airbus, AEA and AAPA believe the retrofit requirement is not cost effective. Our analysis showed that the benefit/cost ratio of the production cut-in and retrofit requirements are similar. This was our rationale for adopting the combined approach of production cut-in and retrofit. However, these commenters believe the 7 percent discount rate used in our cost/benefit analysis is too high and is responsible for the determination that cost/benefit ratios are similar between the production cut-in and retrofit. We infer from their comments that they believe that 3 percent is a more realistic number and supports their contention that retrofit is not justified. The commenters note that an EASA analysis concluded that the retrofit was not justified. A major concern was that the bulk of the retrofit costs (present value terms) will be incurred in about 1/3 of the time (7 years) required for the forward fit costs (22 years). They believe that the cash outlay to retrofit in such a short time, coupled with the small safety benefit, is not justified when compared with the cost/benefit of the production cut-in. They also stated that the high cost of the retrofit over such a short period would place financial stress on an industry that is already financially constrained. In contrast, the cost of production incorporation of FRM in new airplanes will be borne by airlines that are prepared to accept the cost of new airplanes with the FRM included in the ''sticker price.''

Except as discussed previously regarding the exclusion of part 91 operations, we continue to believe that a retrofit requirement is justified. As discussed in the NPRM and earlier in this preamble, the risk of fuel tank explosions on the current fleet of airplanes with high flammability tanks is still significant because, despite our efforts to eliminate ignition sources, they continue to occur. At the same time, we have made a number of changes to the proposed requirements to reduce their cost and improve their cost-effectiveness. As discussed later in this preamble, the final regulatory evaluation (FRE) has been revised to include the benefits of preventing lost revenue to the industry as a whole if another fuel tank explosion were to occur. When these benefits are included, variations in the discount rate do not alter the conclusion that this rule is reasonably cost-effective.

The compliance time for the retrofit requirement allows for incorporation of design modifications over a seven-year period. Operators can spread the costs over this time period. We have also included a provision in the operational rules (discussed later) that allows operators an extension of up to one year after the 50 percent and 100 percent retrofit deadlines for full fleet incorporation of the design modifications if the operator includes requirements in their operations specifications to use ground conditioned air when available. For 50 percent of an operator's fleet, this would allow retrofit to be completed by September 21, 2015 rather than September 19, 2014. Similarly, for 100 percent of an operator's fleet, this would allow retrofit to be completed by

September 19, 2018 rather than September 19, 2017. This provision provides a reduction in the costs to operators because it allows an additional year to install an FRM or IMM. We also adjusted the applicability of the rule so that older airplanes that were produced prior to 1992, which will be nearing the end of their useful life in passenger service, will not be subject to the phase-in-requirement of the rule. The DAH-supported design modifications will only be required on airplanes with significant remaining useful life in passenger service so the benefits of the rule are optimized.

As for the comments on the standard discount rate, the rate that is mandated by the Office of Management and Budget when conducting regulatory evaluations is 7 percent. The Initial Regulatory Evaluation included a sensitivity study where variations in the discount rate (using 3 and 7 percent) were considered. Variations in the discount rate affect both the cost and the benefits of the rulemaking. Thus, using a discount rate of 3 percent (as they recommend) increases the benefits of the rulemaking, because the value of averted future accidents would also have a higher present value.

2. Authority to Operate With an Inoperative FRM, IMM or FIMM

In the NPRM, we requested public comment on the proposal to allow the current Flight Operations Evaluation Board (FOEB) process to establish the Master Minimum Equipment List (MMEL) interval for the FRM or IMM rather than requiring a specific maximum fixed time interval that the FRM can be inoperative. Airbus, Boeing, ATA, AEA and British Airways supported the rule as proposed and generally agreed the FOEB is the appropriate vehicle to establish the approved MMEL interval for inoperative FRM. In contrast, Smith's Aero commented that FRM must be considered a flight critical system, without MMEL relief for the performance of the system to meet the overall intended safety level stated by the FAA in the NPRM. Finally, Frontier asked how long an airplane could be operated with an inoperative FRM system.

As stated in the NPRM, the intent of the rule is to provide an additional layer of protection from having a fuel tank explosion if an ignition source occurs inside a fuel tank. While the FRM system is needed to maintain the safety of a fleet of airplanes, it is not considered flight critical for every flight, since the ignition prevention means required by § 25.981 requires robust fail-safe features that provide an adequate level of safety during short periods of time when the FRM is inoperative under the MMEL (no greater than 1.8 percent of the operating time). We agree with the commenters that ''FRM designers'' should make the design goals for the MMEL relief intervals available and notify the FOEB of their recommendation. The allowable MMEL interval is design dependent and cannot be defined by us until a design is presented and the interval is justified by the system reliability analysis and the FOEB.

Frontier also asked whether en route weather conditions would be a factor with the MEL. At this time, en route weather conditions are not part of the consideration for operation under the operator's MEL. This is one of the considerations in the Monte Carlo assessment, so operation under an operator's MEL during warm days would not be an additional consideration for the MMEL.

3. Availability of Spare Parts

Frontier asked if we had given proper consideration to the fact that there will most likely be an initial spare parts shortage. The compliance time for fleet-wide retrofit of FRM or IMM is nine years after the effective date of this final rule, with 50 percent compliance required within 6 years. Therefore, the manufacturers of components should have the capability to produce needed spares and no shortage of parts is anticipated. We have not included a consideration of parts shortages when establishing the MMEL interval.

4. Requirement That Center Fuel Tank Be Inert Before First Flight of the Day

Frontier requested information on whether the final rule would require that the center fuel tank be inert before the first flight of the day and, if so, if the Auxiliary Power Unit is inoperative, could the inerting system then be inoperative until after main engine start. The final rule does not directly address the operational details of the FRM. These will be determined based on the DAH's design and any operating limitations that may be necessary to meet the performance standards of this final rule.

*F. Appendix M—FRM Specifications*

Appendix M to part 25 contains detailed specifications for all FRMs if they are used to meet the flammability exposure limitations. These specifications are designed to ensure the performance and reliability of FRMs. We received several comments on Appendix M and have made changes to the rule based on some of them.

1. Fleet Average Flammability Exposure Level

Paragraph M25.1(a) requires that the Fleet Average Flammability Exposure of each fuel tank may not exceed 3 percent of the Flammability Exposure Evaluation Time. As discussed previously, as a portion of this 3 percent, if flammability reduction means (FRM) are used, each of the following time periods cannot exceed 1.8 percent of the FEET: (1) When any FRM is operational but the fuel tank is not inert and the tank is flammable; and (2) when any FRM is inoperative and the tank is flammable. Boeing requested a change to this paragraph to clarify that, for both the operational and inoperative requirements, only time periods when the fuel tank is in a flammable state are counted toward each 1.8 percent flammability exposure limit.

We agree that the method of determining these times needs clarification and we have revised paragraph M25.1(a) as requested by Boeing.

2. Inclusion of Ground and Takeoff/Climb Phases of Flight

Paragraph M25.1(b) requires that ground, takeoff and climb phases of flight be included in the fuel tank fleet average flammability exposure analysis. Boeing asked that paragraph M25.1(b) be reworded to exclude a specific reference to the takeoff flight phase. Boeing's justification was that there is no benefit in conducting a separate flammability analysis for the takeoff phase of flight since it is a very short duration. Boeing recommended the takeoff phase be included with the climb phase of flight. Boeing also suggested the rule clarify that the transition from ground to climb phase for this analysis occurs at weight off wheels.

We agree with Boeing and have revised paragraph M25.1(b) in the final rule to remove consideration of the takeoff phase of flight as a separate requirement. These two phases are now required to be considered in combination using the term ''takeoff/climb'' phase. In addition, we added a sentence to paragraph M25.1(b)(2) stating that the transition from ground to takeoff/climb phase for this analysis occurs at weight off wheels.

3. Clarification of Sea Level Ground Ambient Temperature

Paragraph M25.1(b)(1) requires that the fuel tank fleet average flammability exposure analysis, as defined in Appendix N, ''must use the subset of flights starting with a sea level ground ambient temperature of 80°F. (standard day plus 21°F. atmosphere) or more, from the flammability exposure analysis done for overall performance.'' An individual commenter requested that we define the term ''more'' in this statement. We agree that this requirement needs clarification and, in the final rule, paragraph M25.1(b)(1), we replaced the word ''more'' with the word ''above.'' We also replaced the word ''starting'' with ''that begin.''

4. Deletion of Proposed Paragraph M25.2 (Showing Compliance)

Paragraph M25.2 establishes the means for showing compliance with fuel tank flammability requirements. Boeing requested the contents of paragraph M25.2 be moved to Advisory Circular 25.981–2A as it defines a method of compliance and, as such, should be located in an AC.

As discussed previously, ACs provide guidance for methods, procedures, or practices that are acceptable to us for complying with regulations. ACs are only one means of demonstrating compliance, and we cannot require their use. The compliance means in paragraph M25.2 is regulatory in nature to ensure that applicants are providing the data necessary to validate the parameters used in their calculations for fuel tank fleet average flammability exposure (as required by paragraph M25.1), and to substantiate that their system meets these requirements during normal airplane operations for any combination of airplane configuration (as required by paragraph M25.2(b)). We have made no change as a result of this comment.

5. Deletion of ''Fuel Type'' From List of Requirements in Proposed Paragraph M25.2(b)

Boeing also requested that paragraph M25.2(b) be revised to remove ''fuel type'' from the list of requirements and add ''or other relevant airplane system configuration'' to it. Boeing stated the items listed in paragraph M25.2(b) affect the performance of a FRM system that is supplied by engine bleed air, and fuel type does not affect bleed system pressure. We agree with Boeing and have revised this paragraph in the final rule.

6. Latent Failures

Paragraph M25.3(a) requires that reliability indications be provided to identify latent failures of the FRM. These indications are needed to ensure appropriate actions can be taken to maintain the FRM's reliability. An individual commenter asked that we define what is meant by ''reliability indications'' in paragraph M25.3.

In this context, reliability indications are normally computer messages or lights that identify whether components are functioning properly. Reliability indications are likely to be needed for the FRM to meet the reliability requirements in the rule. The type of indications needed will depend on the design and the outcome of the reliability analysis. If a nitrogen inerting FRM were to be developed with no indication of system failures, the system would have significant exposure to long-term operation with latent failures. Maintenance indications would likely be needed so that the minimum reliability of the system could meet the rule.

Boeing requested that paragraph M25.3 be deleted or modified to remove the term ''latent.'' This would be consistent with the special conditions issued for the Boeing 737 and 747 flammability reduction systems. In addition, the term ''latent'' would not be applicable if an indication is provided. An individual commenter agreed, stating that latent failures are not detectable and, hence, cannot be indicated. Embraer commented that both paragraphs M25.3(a) and (b) should be deleted because a literal interpretation would require any latent failure to be detected and indicated. This contradicts the NPRM's preamble, which states that the designer is allowed to make a trade-off between system failure probability and failure detection/ annunciation to show compliance with the system performance requirements. In addition, Embraer maintained that paragraph M25.3(a) is already addressed and should not be repeated here because the requirement for failure detection is inherent in the flammability exposure requirement and in the 1.8 percent limit on system failure contribution to flammability exposure.

On a related topic, Airbus and Embraer commented that the proposed rule is too restrictive and mandates an excessive amount of indication and monitoring. Airbus indicated that the proposed text appears to assume the adoption of an active system to reduce flammability and this may not necessarily be appropriate if a passive system were to be used. Some means of verifying that the passive means is fully functional could be required, but it may be inherent in the design and therefore, no specific action would be required except to ensure that other airplane modifications do not adversely affect the fuel tank flammability.

The FAA agrees with these commenters and has modified paragraph M25.3(a) in the final rule.

This change makes it clear that the intent of the rule is to require only those indications needed to assure any FRM meets the minimum reliability requirements of the rule. The preamble to the NPRM provided a detailed explanation of the intent of these requirements. The need for indications is determined from the system reliability assessment that requires a minimum reliability for any FRM. The type of indications that may be needed to meet the reliability requirements depends upon the details of the design and the outcome of the system reliability analysis. Various design methods may be used to make sure an FRM meets the reliability and performance requirements in this rule. For example, if an FRM based upon nitrogen inerting is developed and no indication of system failures is provided, the system would have significant exposure to long-term operation with latent failures. Maintenance indications would likely be needed so that the minimum reliability of the system could meet the rule. Other designs may use active or passive cooling means for flammability reduction. For these systems, the level of indication required would depend upon the reliability of the cooling system components.

The need for FRM indications and the frequency of checking system performance (maintenance intervals) must be determined based on the results of the FRM fuel tank fleet average flammability exposure analysis. The determination of a proper maintenance interval and procedure will follow completion of the certification testing and the reliability analysis used to establish the system complies with the performance requirements.

7. Identification of Airworthiness Limitations

Paragraph M25.4(a) requires that if FRM is used to comply with paragraph M25.1, airworthiness limitations must be identified for all maintenance or inspection tasks required to identify failures of components within the FRM that are needed to meet paragraph M25.1. Boeing requested that paragraph M25.4(a) be modified to require only airworthiness limitations be identified for ''significant'' maintenance or inspection tasks. Boeing stated that it is overly restrictive to require that all maintenance tasks be identified as airworthiness limitations. It argued that applicants should be granted the flexibility to identify significant tasks as airworthiness limitations and other non-significant tasks as maintenance significant items.

We agree with Boeing that we should not require that all maintenance tasks for FRM be identified as airworthiness limitations. Airworthiness limitations for the FRM system are only required for those FRM components that, in the event of failure, would affect the ability of the fuel tank to meet the Fleet Average Flammability Exposure specified in paragraph M25.1. We regard any task that is necessary to meet this objective as ''significant.'' We recognize that manufacturers are also required to provide other maintenance information for the FRM as part of the instructions for continued airworthiness required by § 25.1529.

8. Catastrophic Failure Modes

EASA noted that Appendix M significantly differs from the harmonized special conditions it used for certifying FRM on some specific airplane models. EASA asked that we explicitly state that catastrophic results must not occur from any single failure or combination of failures not shown to be extremely improbable (for the FRM system) as required in the noted special conditions. We agree that possible catastrophic failure modes of the FRM must be shown to meet the requested standard. However, we do not agree that EASA's change is needed since the regulatory intent is already addressed by other regulations that apply to FRM. For example, the general requirements of § 25.901 that apply to all Subpart E regulations apply to an FRM certificated to meet § 25.981 and Appendix M. Therefore, we did not make any change to Appendix M based on EASA's comment.

9. Reliability Reporting

Paragraph M25.5 requires the applicant to demonstrate an effective means to ensure collection of FRM reliability data and to provide a report to the FAA. We requested comments on the proposal to require DAHs to submit a quarterly report on FRM reliability for 5 years. We consider these reports necessary to determine whether the predicted reliability for these systems is accurate, and to enable us to initiate necessary corrective actions if they are not. We intend for DAHs to gather the needed data from operators using existing reporting systems that are currently used for airplane maintenance, reliability, and warranty claims. The operators would provide this information through existing or new business arrangements between the DAHs and the operators.

The AEA and ATA questioned this reliability reporting process. They stated the current reporting systems may not be equipped to accommodate this new data requirement without additional burden and cost. Airbus also stated the reporting requirement is unclear and without sufficient detail to enable them to fully comment. The AEA and Airbus also contend that the reporting requirement places operators in a position of having an obligation to report this information to the DAHs where such an obligation did not previously exist. They suggested that we not rely on technicalities and recognize the new obligation being imposed on the operators. Finally, Transport Canada commented that the rule appears to require extensive data collecting and reporting and requested more details be provided regarding what this data will be used for.

The purpose of collecting reliability data is to ensure that failures of the system are reviewed and corrected. In this manner, system reliability is enhanced and FRM malfunctions will become very infrequent. The reporting requirement will also provide data necessary to validate that the reliability of the FRM achieved in service meets the values used in the fleet average flammability exposure and reliability analyses so that the actual flammability reduction in service airplanes will achieve the safety goals of this rulemaking.

The reliability reporting requirements in paragraph M25.5 would not add an additional burden or cost to the operators. We also continue to believe that this rule does not directly impose reporting requirements on operators. These reporting requirements are placed upon the DAH, not the operator. The NPRM and proposed AC 25.981–2B provided a description of the level of complexity that was intended in the quarterly reporting requirements. Furthermore, they do not specify that a new reporting system be created. The current reporting system could be used to gather the data and it could then be provided to the DAHs through normal business agreements. The DAH is required to make arrangements to collect sufficient data and provide a report to us. Reporting would be necessary only for a representative sampling of airplanes, as determined by the manufacturer in its compliance plan. Airlines routinely collect and store reliability data from airplane systems for a variety of reasons, such as engine and airplane system reliability data collected for Extended Twin Operations, warranty claims and maintenance planning, and in many cases they report these data to DAHs.

Therefore, DAHs should be able to readily obtain these data through normal business practices. As a practical matter, DAHs will be monitoring the performance of these systems, just as they monitor other systems, both for warranty and liability reasons. Operators will be providing this information to DAHs as normal business practice to obtain DAH support in correcting any problems that occur. Our expectation is that the DAHs' compliance plans will simply state that DAHs will compile this information into periodic reports (which they would normally do for their own use anyway) and provide them to the FAA. No change has been made to the final rule as a result of these comments.

Bombardier requested that paragraph M25.5(b) be revised to allow non-U.S. manufacturers to submit their reports to their national authorities rather than the FAA. While we acknowledge that submitting a report to a foreign manufacturer's national authority might simplify the paperwork exchange, at this time other authorities have not agreed to harmonize with this rule. Therefore, there are no corresponding regulations that would require the submittal of reliability reports to these authorities or to ensure that we will see these reports. We have revised the requirement to allow for FAA approval of alternative reporting procedures, which would include reporting to other authorities with harmonized requirements. The rule also provides that, after the first five years of reporting, if the demonstrated reliability of the FRM meets and will continue to meet the reliability requirements in paragraph M25.1 (not to exceed 1.8 percent of the FEET), other reliability tracking methods could be proposed to us for approval, or possibly reporting could be eliminated.

Boeing requested that M25.5(b) be revised to allow the applicant to suggest alternative methods of reporting and submit the report to us on a yearly basis instead of a quarterly basis. It asserted that a one-year reporting requirement will allow for more statistically significant data to be collected for new systems. We agree that a quarterly requirement may be unduly burdensome, but we believe that a yearly requirement is too long to enable us to initiate timely corrective action to address reliability problems. Therefore, we have modified paragraph M25.5(b) in the final rule to extend the reporting to once every 6 months for the first five years after service introduction of the FRM. This reporting period should allow adequate time to gather data to establish the performance of the FRM and for any needed corrective actions to be taken if the performance of the FRM falls below minimum levels.

Boeing also requested changes be made to allow applicants that have established reporting methods to suggest these as alternative methods of meeting the reporting requirements. We believe the current wording allows the DAH the latitude to develop a reporting system and request FAA approval based upon their business arrangements with operators so long as the reporting system provides sufficient data to the FAA to determine the reliability of the FRM. Allowing the use of alternative reporting methods could lead to disparate reports among manufacturers, making FAA oversight difficult.

### *G. Appendix N—Fuel Tank Flammability Exposure and Reliability Analysis*

1. General

Appendix N to part 25 provides the requirements for conducting the analyses for fleet average fuel tank flammability exposure required to meet § 25.981(b) and Appendix M and to comply with part 26 requirements. Appendix N contains the method for calculating overall and warm day fuel tank flammability exposure values needed to show that the affected airplane's tanks comply with the proposed limitations on flammability exposure.

2. Definitions

Paragraph N25.2 provides specific definitions associated with flammability and analysis terminology used in Appendix N. We received comments requesting clarification on five of these definitions:

a. *Ullage:* Boeing suggested this definition should ensure that all of the ullage space is considered (not just the fuel volume), and we agree. In the final rule, this definition has been revised to clarify that the total ullage space must be considered.

b. *Flammability Exposure Evaluation Time (FEET):* An individual commenter wanted to understand when the evaluation time begins and ends for airplanes using ground conditioned air with the auxiliary power unit (APU)/ ground power unit (GPU) operating or electrical power that is connected to the airplane. The evaluation time would begin as soon as the airplane is prepared for flight, regardless of whether an APU or electrical ground power is used. The time would end as soon as the airplane has landed and passengers and crew have disembarked and payload has been unloaded. In passenger operations where numerous flights may occur each day, this definition would result in all the time between flights also being part of the FEET. The only exception would be the time at the end of the last flight of the day to the point in the next morning when the airplane is being readied for flight. This is consistent with the definition for FEET given in paragraph N25.2(b).

c. *Bulk Average Fuel Temperature:* An individual commenter suggested the definition include the means for determining ''bulk average fuel temperature.'' As we stated in the preamble to the NPRM, the determination of whether the ullage in the fuel tank is flammable is based on the temperature of the fuel in the tank or compartment of interest. This is derived from a fuel tank thermal model, the atmospheric pressure in the tank, and the properties of the fuel. The thermal model is comprised of temperature data acquired from various locations within the fuel tank. In order to express the fuel temperature of the tank as a whole in the fuel tank fleet flammability exposure analysis, a weighted average by volume should be calculated at each point in time since the temperature may vary across the tank or compartments of the tank depending upon the volume of that area. We will provide additional guidance on how to determine Bulk Average Fuel Temperature in AC 25.981–2A.

d. *Flash Point:* An individual commenter asked what the term ''heated sample'' meant in this definition. The standardized methods for determining flash point are ASTM D 56 and ASTM 3828. Both methods place a sample of fuel in a closed cup and heat it at a constant rate. A small flame is introduced into the cup, and the lowest temperature at which ignition is observed is referred to as the flash point. The heated sample is the fuel that is placed in the closed cup when conducting this test.

e. *Inerting:* An individual commenter requested that fuel removal from the ullage mixture be included as an acceptable inerting method. We do not agree with this request. The definition of inerting is based upon oxygen concentration, not fuel content of the ullage. The Monte Carlo method uses the bulk fuel temperature to determine fuel tank flammability, and does not consider transport effects or tank ventilation. However, if an applicant wishes to consider methods for removing fuel from the ullage mixture, it could request a finding of equivalent safety under the provisions of § 21.21. To be equivalent, such a method would have to be shown to provide at least the same level of safety as an FRM meeting the performance requirements of Appendix M.

3. Input Parameters

Paragraph N25.3(c) provides the parameters that are specific to a particular airplane model under evaluation that must be provided as inputs to the Monte Carlo analysis. Boeing had two comments on these parameters.

First, Boeing requested we add a new parameter to paragraph N25.3(c) for airplane utilization. This parameter would require the applicant to provide data supporting the number of flights per day and the number of hours per flight from existing fleet data. Boeing stated that this information is necessary to determine when to apply the diurnal effect that is required by paragraph N25.4(c) based upon the number of flights per day. The number of hours per flight will also provide validation of the mean hours per flight generated by the Monte Carlo analysis.

We agree with Boeing's comment and the final rule includes a new paragraph N25.3(c)(7) for airplane utilization that addresses this comment. Boeing's second comment was a request that the statement ''or for the section of the tank having the highest flammability exposure'' be removed from paragraph N25.3(c)(5). As proposed, paragraph N25.3(c)(5) requires that, for any fuel tank that is subdivided by baffles or compartments, the bulk average fuel temperature inputs must be provided either for each section of the tank or for the section of the tank having the highest flammability exposure. Boeing stated that every region in a fuel tank should be considered in order to establish the total flammability exposure of the tank. If the bulk temperature input only consisted of a section of the fuel tank having the highest flammability exposure, Boeing argued that the total flammability of the tank would not be accurately accounted for because the analysis would not consider regions that were less flammable.

Any fuel tank that is compartmentalized or subdivided into sections by baffles is ''flammable'' under the definition for Appendix N (N25.2(c)) when the bulk average fuel temperature within any section of the tank that is not inert is within the flammable range for the fuel type being used. We agree with Boeing that the clause ''or for the section for the tank having the highest flammability exposure'' in paragraph N25(c)(3) causes confusion, and we have revised paragraph N25.3(c)(5) as requested.

We are providing guidance in AC 25.981–2 on the need to conduct the flammability analysis for each bay or compartment and then sum the time any portion of the tank is flammable in the flammability analysis.

4. Verification of ''Flash Point Temperature''

An individual commenter requested verification of the flash point temperature (120 °F) that is used in Table 1 of Appendix N. We have defined in Table 1 of Appendix N a ''mean fuel flash point temperature'' based upon worldwide survey data that was collected from 1998 through 1999. The Monte Carlo analysis varies the flash point based upon the distribution of possible flash point temperatures for the fuel, similar to what would be expected for a fleet of airplanes where fuels from various refineries and locations are used.

*H. Critical Design Configuration Control Limitations (CDCCLs)*

Past experience has shown that critical features of airplane designs have inadvertently been changed when maintenance actions or alterations to airplanes have been made. For example, critical wiring that was intended to be separated from other wiring to prevent possible unsafe conditions has been modified so new or rerouted wiring was co-routed with the critical wires. These instances revealed the need for airplane designers to identify safety critical features, in this case wiring separations, and for these features to be marked so that maintenance personnel are aware of the critical features.

We proposed adding fuel tank flammability related design features to the existing fuel tank ignition source CDCCL requirements in § 25.981(d) (formerly paragraph (b)). This section requires CDCCL, inspections, or other procedures as necessary, to prevent increasing the flammability exposure of tanks above that permitted by the amended § 25.981(b) and to prevent degradation of the performance and reliability of any means provided for compliance with paragraphs 25.981(a), (b) or (c). We also proposed adding fuel tank flammability to the existing requirements to place visible means of identifying critical features of the design in areas of the airplane where foreseeable maintenance actions, repairs or alterations could compromise the CDCCL. Similar provisions were proposed in § 25.1815(e) for existing type certificates.

1. Remove Requirement

Boeing, Embraer and Bombardier requested that we remove the requirement to establish CDCCLs to prevent the increase of flammability in the fuel tanks and to prevent degradation of the performance and reliability of the FRM. They stated that it is not practical or effective to try to control flammability through the use of CDCCLs. Instead, they argued that the certification process should be used to establish the design's flammability exposure. Bombardier also pointed out that the type certification data sheet is the appropriate means to capture limitations (e.g., fuel type, fuel temperature) that would affect flammability.

The intent of the CDCCL requirement is to define the critical features of the design that could be unintentionally altered in a way that could cause a reduction in fuel tank safety. In the case of IMM or FRM, maintenance or alterations to the airplane could significantly affect fuel tank flammability and the performance of these systems. Since the heating or cooling rate of a fuel tank could be a critical feature, placing a heat exchanger or other heat source in or near the tank or changing the cooling rate by transferring warm fuel to the tank are examples of changes that could result in a significant increase in fuel tank flammability.

The commenters did not provide any substantiating information as to why they believe it is not practical or effective to use CDCCLs to control fuel tank flammability. Our experience with applying the CDCCL concept to fuel tank ignition sources has shown it to be both practical and effective. Locating this information on the TC data sheet, as suggested by Bombardier, would not provide the information to individuals, such as maintenance personnel, who could be responsible for inadvertently changing the system. Accordingly, we do not believe this suggestion would be effective. In contrast, as airworthiness limitations, CDCCLs are clearly defined as maintenance requirements that are routinely complied with by maintenance personnel and that are enforceable under the operational rules (e.g., § 91.403(c)). The intent of applying the CDCCL concept to FRM and IMM is to provide a common location within the maintenance instructions where information on fuel tank safety related critical features are located. Therefore, we have retained the requirement in § 25.981(d) to identify CDCCLs for FRM and IMM.

On a related issue, paragraph (h) of each of the proposed operational rules would have required operators to comply with the CDCCLs. In the NPRM, we inadvertently omitted reference to § 25.981 as one of the sources of requirements for these CDCCLs. Therefore, we have added these references to the final rule. This change is simply clarifying, since operators are required to comply with airworthiness limitations under existing regulations.

2. Clarification on Responsibility for Later Modifications

As proposed, § 25.1817(d) (now § 26.35(d)) would require that modifications made to an airplane comply with any CDCCL applicable to that airplane. The AEA questioned whether this paragraph would require the TC holder or STC applicant applying for a design change to achieve a flammability exposure level equal to or better than that existing on the unmodified airplanes, or if the TC holder or STC applicant will be held to the flammability exposure limits specified in the rule.

The proposed requirement for TC holders to develop CDCCL is contained in proposed § 25.1815(e) (now § 26.33(d)). It would require CDCCL ''to prevent increasing the flammability exposure of the tanks above that permitted under this section and to prevent degradation of the performance of any means provided under paragraph (c)(1) or (c)(2)[23] of this section.'' The AEA has identified an ambiguity and potential conflict in this quoted provision. Specifically, if a TC holder develops FRM whose performance exceeds that required by proposed § 25.1815(c)(1), it is not clear whether the CDCCL would have to maintain the flammability exposure provided by the FRM or whether the rule would allow an increase in flammability exposure up to that permitted (i.e., 3 percent or equivalent to a conventional unheated aluminum wing tank, along with the ''warm day'' requirement).

To eliminate this ambiguity, we have deleted the reference to paragraph (c)(1) in the quoted provision. This revision has the effect of requiring CDCCL for FRM that allow increasing flammability up to that permitted by the rule, but retains the requirement that degradation of performance of IMM is not permitted. Since IMM may be installed on high flammability tanks, degradation of IMM could have serious safety consequences and would not be consistent with the intent of the rule.

[23] Paragraphs (c)(1) and (c)(2) provide for FRM and IMM, respectively.

We note that TC holders may be inclined to develop overly stringent CDCCL for FRM that could potentially make it impossible for holders of auxiliary fuel tank STCs to meet them. This would force operators to deactivate these tanks. This over-stringency would not be consistent with this rule's intent, which is to minimize the burden on operators, consistent with achieving the safety objectives of this rule. This issue is discussed in more detail in AC 25.981–2B.

Proposed § 25.981(d) contained the same ambiguity by requiring CDCCL to prevent degradation of performance and reliability of any means provided according to paragraph (b) of that section (FRM). We have made a similar change to paragraph (d) to allow degradation of FRM as long as the airplane still meets the standard required by paragraph (b).

3. Limit CDCCLs to Fuel Tanks That Require FRM or IMM

Boeing requested that proposed § 25.1815(e) (now § 26.33(e)) be modified to only require CDCCLs that are necessary to prevent the increase of fuel tank flammability for fuel tanks that require an FRM or IMM. Boeing stated that development of CDCCLs for other fuel tanks is not practical, nor is there history to show that changes to the fuel tanks of airplanes in service significantly increase flammability in the tanks. Boeing also requested that the requirement to make critical features of the design visibly identifiable only apply to areas where it is practical to do so.

For existing designs subject to proposed § 25.1815(e) (now § 26.33(e)), we agree with Boeing, and have limited the applicability of the requirement to develop CDCCL to those tanks for which FRM or IMM are required. We recognize that there are many existing modifications that may affect the flammability exposure of existing fuel tanks. We agree with Boeing that, for main tanks and other tanks not incorporating FRM or IMM, it is impractical to impose CDCCLs on these tanks that may result in significant compliance problems for affected operators. For tanks equipped with FRM or IMM, however, we believe CDCCLs are necessary to prevent degradation of these systems below acceptable levels of performance.

We also agree with Boeing that, in many instances, it may not always be practical to mark critical features relating to controlling fuel tank flammability and the proposed rule should be modified to allow the applicant to justify why markings are not needed. We have modified the next to last sentence in § 26.33(e) accordingly.

This change will allow acceptance of designs without markings when the applicant can show that such markings would be impracticable. We intend for applicants to identify any CDCCL that are required and to provide justification for why the marking would be impracticable. Like all CDCCLs, these would still be documented as airworthiness limitations in the instructions for continued airworthiness.

4. STC Holders May Not Have Data to Comply

The AEA and Airbus challenged our statement in the NPRM that operators have access to information that may be needed by STC and field approval holders to perform flammability and impact assessments. The commenters noted that such information is highly proprietary and is rarely provided to operators. AEA added that contractual agreements to obtain TC holder information are difficult, if not impossible, to obtain.

For many years, the FAA and other regulatory authorities (including EASA) have routinely required manufacturers to make available information that they consider proprietary when we determine providing this information is necessary for aviation safety. For example, most ADs reference information that would otherwise be proprietary in the form of service bulletins, which manufacturers are required to make available to operators. Similarly, § 21.50 requires manufacturers to make available instructions for continued airworthiness, which manufacturers would also typically consider proprietary.

In existing § 25.981(b), we required DAHs to define and make available CDCCL to prevent the unintended creation of ignition sources as a result of maintenance or airplane modifications. In proposed § 25.981(e), we required the identification of critical features of a design that cannot be altered without consideration of the effects on safety. As discussed previously in this section, the final rule includes a new requirement for CDCCLs affecting fuel tank flammability.

Some of the data that STC and field approval holders may need are already normally provided to operators in the airplane flight manual, including fuel management information and airplane climb rates. For other necessary data, such as fuel tank thermal characteristics, we believe that the market will promote business agreements where TC holders will make their data available to customers willing to pay for the data. Airbus or other TC holders may make a business decision not to support their customers and provide these data. In these cases, it may be necessary for the operator or STC applicant to acquire the data from other sources. Another option is for applicants to provide a Monte Carlo analysis based on conservative inputs for parameters where no data are available. For example, an applicant could provide thermal characteristics data that are conservative so that detailed testing and confirmation of data from flight testing of an airplane would not be required. Finally, if these approaches are not practical, the information needed to conduct the Monte Carlo analysis could be obtained from in-service airplanes.[24]

*I. Methods of Mitigating the Likelihood of a Fuel Tank Explosion*

1. Alternatives to Inerting

In the IRE, we selected the use of onboard nitrogen inerting to assess the costs of reducing fuel tank flammability. By doing this, several commenters thought we were mandating fuel tank inerting as the only acceptable means of compliance. ATA and Bombardier commented that the proposal is not a performance-based rule, since it ''effectively prescribes the use of fuel tank inerting.'' ATA also stated that they were not aware of any existing or emerging FRM or IMM that would meet the proposed performance-based requirements other than inerting. Frontier Airlines questioned why we focused on FRM and IMM as methods of compliance when the FAA concluded that other solutions were better and more practical.

This rule does not mandate fuel tank inerting as the only acceptable means of compliance. Rather, it establishes performance-based requirements that allow applicants to choose the FRM or IMM that best suits their particular airplane design, so long as it meets the performance requirements of this final rule. While the Initial Regulatory Evaluation is based upon the use of inerting, this technology was chosen because it is considered the most cost-

[24] Most of the STCs that could be affected by this rulemaking are auxiliary fuel tanks that use pressurized air to transfer fuel. In these cases, the inputs needed for the Monte Carlo assessment are simplified because the fuel tank pressure is controlled to provide fuel transfer, and the temperature changes of the fuel tank are limited because the fuel tank is located in the cargo compartment.

effective based upon extensive review by industry experts on the ARAC.

Technology now provides a variety of commercially feasible methods to accomplish the vital safety objectives addressed by this rule. Advisory Circular 25.981–2 discusses a number of technologies other than fuel tank inerting that can be used for demonstrating compliance. For example, many auxiliary tank manufacturers are considering pressurizing the fuel tanks to reduce flammability, and many military airplanes use IMM consisting of polyurethane foam. One recent applicant has proposed FRM incorporating pressurization of the fuel tanks and a fuel recirculation system that circulates fuel to the outboard wing to cool the fuel. Therefore, we believe that other technologies are available.

ATA commented that we should consider convening an industry study group to re-examine the potential of higher flash point fuel as a possible alternative method for reducing flammability and overall airplane level risk. ATA noted that refineries may now be capable of producing higher flash point fuels in the near term in sufficient quantity for commercial aviation use. In addition, Boeing advised ATA that a 10 °F elevation in the flash point standard for Jet A could effect a reduction in flammability exposure rates approximately equivalent to the proposed FRM. While ATA acknowledged the likelihood is not high that this approach would provide a more cost-effective solution than FRM, particularly in the long term, it deserves reconsideration. The UK Air Safety Group, through one of its members, agreed with ATA and suggested the use of higher flash point fuels (such as JP–5) should be investigated as a possible solution.

While we welcome the potential for using various forms of FRM, we do not believe delaying implementation of the rule is in the public's interest. The FAA and industry participated in ARAC activities that provided economic analysis of existing technologies, including inerting and mandatory use of higher flash point fuels. At that time, inerting was found to be a more cost-effective means of showing compliance with the performance-based FRM rule. In contrast, as shown in the ARAC report,[25] using higher flash point fuels was not the most practical means of achieving the desired safety level because of the higher cost of these fuels.

[25] Document Number FAA–22997–7 in the docket for this rulemaking.

If technology and refining capabilities have advanced to the point where higher flash point fuels are available in quantity at a competitive cost, the industry may use that means to show compliance, and this means is discussed in the proposed AC 25.981–2. Flammability assessments with a specified minimum fuel flash point, in conjunction with airplane flight manual limitations requiring use of such fuel, could be used as a means of compliance with this rule. Since the rule is performance-based and does not mandate any particular solution, industry may find innovative ways to show compliance to standards.

2. Inerting Systems Could Create Ignition Sources

Transport Canada expressed concern that adding inerting systems to fuel tanks may create ignition sources and result in additional heating of in-fuselage tanks. It argued the solution may inadvertently increase flammability exposure. Transport Canada recommended the FRM be designed to ensure its reliable operation and minimal maintenance. The UK Air Safety Group, through one of its members, also expressed this concern. The commenter suggested that inerting systems could actually compromise the fuel tank system, that insulation could impede inspections of equipment and structure, and that ventilation could cause performance penalties.

We acknowledge the commenters' concerns that installing FRM could introduce negative safety consequences. However, these potential consequences do not outweigh the safety benefits of flammability reduction. As with all safety equipment, the FRM must comply with the existing applicable airworthiness standards that are intended to prevent system failures from having a negative safety impact. In addition, we have introduced new requirements in this rule to address the possible negative safety impact of using an onboard nitrogen inerting system. Compliance with these combined requirements should produce systems that are reliable, maintainable, and meet the flammability requirements of this rule.

3. Instruments to Monitor Inerting Systems

ATEXA recommended that when a nitrogen dilution system is used, the airplane should be equipped with instruments to verify that the system is functioning as expected. These instruments should record data continuously so the pilot can control the oxygen concentration in the tanks within prescribed limits on the ground, before take-off, and at landing. This data should also be recorded in the flight data recorder so that, should another accident happen, the cause/origin could be identified.

As we stated before, this rule is performance based and allows designers the ability to be innovative. The need for indications and controls is design dependent, and the blanket requirement recommended by ATEXA could be overly stringent. DAHs may choose to provide flight crew indications of FRM status, or they may propose an automated FRM with built-in test to verify proper operation. It would be inappropriate for the rule to mandate specific design features.

As for the suggestion to record data, adding additional parameters to the FDR would be cost-prohibitive. Furthermore, we do not consider this necessary because the functioning of any FRM or IMM would likely not have any direct bearing on determining the cause of an accident. The flammability exposure of the fuel tank is not actually an indicator that a tank has exploded and the determination that a fuel tank explosion caused an accident could be made using physical evidence.

In a related comment, the Shaw Aerospace team (Shaw) commented that failure monitoring of system operation is inadequate. As proposed, the system relies totally on the built-in test to detect when the tanks are not inert due to a failure rather than direct measurement of the fuel tank oxygen concentration to determine if the tank is flammable. Shaw cited factors such as oxygen evolution from the fuel as the airplane climbs and local areas of high oxygen in the tanks because of lack of adequate nitrogen distribution as sources of flammability that will not be detected by monitoring the performance of the FRM, rather than measuring the oxygen concentration in the tank. Shaw stated that if the oxygen concentration in the fuel tank ullage is not monitored and periodically sampled, it would be difficult to prove the effectiveness of the system.

From the Shaw team's comments, we infer that Shaw believes the monitoring requirements should be modified to require ullage sampling to ensure that the tank remains non-flammable. We do not agree that a change to the proposed regulation is needed. Compliance methods are discussed in AC 25.981–2. Applicants may choose to measure fuel tank oxygen concentration directly or infer the concentration through system performance capability and monitoring. Appendix M25.2 requires that localized higher concentrations of oxygen that might result from inadequate distribution of nitrogen, as well as the possible effects of oxygen evolution from the fuel, be addressed in the compliance demonstration.

4. Risk of Nitrogen Asphyxiation

If fuel tank inerting is used to reduce the flammability exposure of a fuel tank, several commenters noted that the introduction of nitrogen enriched air within the fuel tank, and possibly in compartments adjacent to the tank, could create additional risk because of the lack of oxygen in these areas. They believe the risk to maintenance personnel from nitrogen asphyxiation may exceed any safety benefit that fuel tank inerting may provide. To support their position, these commenters cited the Fuel Tank Inerting Harmonization Working Group's (FTIHWG) 2002 Final Report (24–81 lives could be lost between 2005–2020 due to asphyxiation while servicing transport airplanes) and other industrial accident data showing that oxygen depleted atmospheres account for significant loss of life. The commenters are concerned that we have failed to consider this potential loss of life that will result from this rule.

We acknowledge that special precautions are needed for worker entry into confined spaces where fuel vapors or nitrogen enriched air may be present. The standard practice of U.S. industry today is to comply with existing Occupational Safety and Health Administration (OSHA) requirements. These requirements have resulted in ventilating fuel tanks with air and measuring the oxygen concentration before entry into a fuel tank. In addition, persons entering a fuel tank must wear respirators as well as oxygen monitors to alert them should the oxygen concentration be insufficient.

The introduction of nitrogen into a fuel tank does not change the existing requirements for personnel to enter a fuel tank. No new training or changes to fuel tank entry procedures should be needed as a result of this rule. Since there are already specific OSHA requirements for fuel tanks that would prevent any fatalities, any loss of life would be due to non-compliance with OSHA regulations, not this rulemaking. Despite these existing OSHA requirements and the protections they afford, we have added new requirements for markings to notify workers at all access points and areas of the airplane where lack of oxygen could be a hazard. For these reasons, we have not included costs for loss of life due to asphyxiation in the final regulatory evaluation for this rulemaking.

We are also not persuaded by the commenters' reference to the FTIHWG 2002 Final Report. The predicted number of fatalities in that report is based upon application of data from every possible cause of nitrogen asphyxiation that is included in data collected between 1980 and 1989 by the U.S. National Institute of Occupational Safety and Health. The data quotes a total number of fatalities for all causes, including cases such as bottled nitrogen being hooked up to oxygen systems at a nursing home. This bulletin is not based upon data that can easily be applied to the aviation industry and does not provide any data that could be used to predict a rate of fatalities for the specific circumstances relating to airplane fuel tank safety. In addition, we do not think it is appropriate to extrapolate the data from the bulletin without taking into account existing OSHA requirements used in the aviation industry or that the placards required by this rule will heighten awareness to the risks associated with entering fuel tanks.

5. Warning Placards

This rule attempts to reduce the risk of nitrogen asphyxiation by requiring markings on the access doors and panels to the fuel tanks with FRMs, and to any other enclosed areas that could contain hazardous atmosphere. These markings will warn maintenance personnel of the possible presence of a potentially hazardous atmosphere. Bombardier commented that the use of placards and the exact wording proposed is too prescriptive. Bombardier recommended the rule require a general warning, with guidance defining methods of compliance placed in the corresponding AC 25.981–2.

The requirement for placards is based upon methods used throughout aviation and other industries where safety warnings are needed to protect workers from possible harm. Locating the requirements in the regulation rather than in advisory material provides appropriate level of regulatory review of this safety critical information and will result in standardizing the means of warning maintenance personnel. Applicants may apply for a finding of equivalent safety should they wish to propose an alternative means of achieving the level of safety provided by the placard requirement in the rule.

6. Definition of ''Inert''

A fuel tank is considered inert when the bulk average oxygen concentration within each compartment of the tank is 12 percent or less from sea level up to 10,000 feet altitude, then linearly increasing from 12 percent at 10,000 feet to 14.5 percent at 40,000 feet altitude, and extrapolated linearly above that altitude.

Several commenters, including Airbus, AAPA, AEA and Blaze Tech, questioned whether an allowable oxygen concentration of 12 percent would inert a fuel tank. They pointed to comments in an FAA research document stating that ''(f)urther experiments to examine the trend of peak pressure rise as a function of both altitude and oxygen concentration are needed.'' The commenters stated that this is an indication that the 12 percent oxygen concentration limit would not prevent the ignition of fuel vapors from rupturing an airplane fuel tank and that further work is necessary before accepting the 12 percent value. American Trans Air and ATEXA noted that the chemical process industry, as quoted by the French National Institute for Research and Security (INRS, 2004), uses a safety factor of 0.5 for industrial volumes on non-homogenous fuels, and operators must strive to maintain a maximum oxygen content of 5 percent for inerting purposes. Based on this, American Trans Air and ATEXA stated that the 12 percent limit would not be safe.

In 1997, we initiated research activity to determine a maximum oxygen concentration level at which civilian transport category airplane fuel tanks would be inert from ignition sources resulting from airplane system failures and malfunctions. Our testing determined that a maximum value of 12 percent was adequate at sea level. The 12 percent value was initially based on the limited energy sources associated with an electrical arc or thermal sparks that could be generated by airplane system failures and lightning on typical transport airplanes and was not intended to include events such as explosives or hostile fire.[26] As a result of this research, we learned that the quantity of nitrogen needed to inert commercial airplane fuel tanks was less than previously believed. An effective FRM can now be smaller and less complex than earlier systems that were designed to meet the more stringent military standards intended to prevent ignition from high energy battle damage.

The 12 percent value is further substantiated by the results of live fire testing conducted by China Lake Naval Weapons Center that showed a 12 percent oxygen concentration prevents

[26] These test results are available on our Web site: *http://www.fire.tc.faa.gov/pdf/tn02-79.pdf* as FAA Technical Note ''Limiting Oxygen Concentrations Required to Inert Jet Fuel Vapors Existing at Reduced Fuel Tank Pressures,'' report number DOT/FAA/AR–TN02/79.

ignition, even when high energy incendiary rounds were used that had ignition energies well in excess of any source anticipated to occur on a commercial airplane. These data show that 12 percent oxygen concentration for commercial airplanes achieves a comparable level of protection against catastrophic fuel tank explosions as the traditional 9 percent value used by the military for combat airplanes. The suggestion that the oxygen concentration should be limited to 5 percent is impractical for commercial airplanes since a significantly larger flammability reduction system would be needed and, based upon these test results, there would be no appreciable improvement in airplane safety.

Finally, the quoted FAA comment that additional testing is needed was taken out of context. The recommendation for additional testing referred to conditions when the oxygen concentration was between 1 to 1.5 percent greater than the limit of 12 percent. Testing at these higher oxygen concentration values was not extensive since the focus of the testing was to establish the limiting oxygen concentration where ignition was not possible. Our report's suggestion that additional experiments are needed was not an indication that the 12 percent limit was inadequate—quite the opposite. In fact, the next sentence of the report confirms the importance of the study's validation of the 12 percent limit: ''The results contained in this report should be useful in the design, sizing, and optimization of future airplanes inerting systems and add to the overall knowledge base of jet fuel flammability characteristics.'' [27]

7. Use of Carbon Dioxide

An individual commenter stated that inerting a fuel tank with carbon dioxide may introduce new concerns because of the solubility of this gas in fuel and the possible effects on fuel system operation. This commenter also wanted to know what the acceptable level of oxygen would be to consider the fuel tank ullage inert when this gas was used.

We acknowledge the use of carbon dioxide for inerting may require special considerations for fuel feed system performance. The subject of inerting with carbon dioxide is addressed in AC 25.981–2 and we have revised it to highlight these concerns. As for the commenter's specific question about oxygen concentration in the fuel tank, the acceptable level of oxygen is the same as if nitrogen is used.

8. Environmental Impact of FRM

The UK Air Safety Group, Phyre Tech and one individual questioned the environmental impact of using FRM to displace air and fuel vapor from the fuel tanks into the surrounding environment. These commenters expressed concern about increased hydrocarbon emissions into the atmosphere.

The IRE did not include an environmental assessment or analysis because we determined the environmental impact of a FRM or IMM to be negligible. Their installation will not affect the amount of fuel vapors and hydrocarbon emissions that are discharged from fuel tanks during refueling. Currently, fuel tank designs vent fuel vapors and hydrocarbon emissions into the atmosphere when air is exhausted from the fuel tanks during refueling and flight. Data from recent flight tests of a Boeing 737 equipped with a nitrogen-based FRM showed that installation of FRM and related design changes actually reduce the amount of hydrocarbons vented from the tanks during flight.[28] In those test flights, the data indicated that pressure differences from one wing tip to the other wing tip, where the two airplane fuel tank vent outlets are located, resulted in cross flow of air through the fuel tanks including the center wing tank for the original vent configuration. This occurred often in flight and periodically on the ground when any crosswinds were present. As a result, fuel vapors were exhausted from the fuel tanks into the atmosphere. Any air that entered the fuel tank diluted the nitrogen concentration in the tank such that the fuel tank vent outlets needed to be modified to prevent cross flow of air through the vent system. Modification of the vent system resulted in reduced hydrocarbon discharge to the atmosphere.

9. Current FRMs Fail To Meet Requirements

Transport Canada noted that an FRM must meet not only the requirements in this rule, but also the relevant other sections within part 25, in particular § 25.1309. Transport Canada stated that current FRM designs would not meet § 25.1309 because of a lack of system redundancy, a lack of appropriate system performance monitoring and indication, and the allowance of MMEL relief.

We do not agree that existing FRM systems do not meet all the relevant sections of part 25, including § 25.1309. We approved the FRM systems for the Boeing 747–400 and 737NG series airplanes in August 2005, and December 2006, respectively, as showing compliance with all the applicable part 25 regulations. This approval was validated by EASA shortly thereafter. While the commenter is correct that these systems lack redundancy, and limited dispatch with the systems inoperative is allowed under the MMEL, these systems are supplementary safety systems that are intended to work in combination with the ignition prevention features required by § 25.981 to prevent future fuel tank explosions.

10. FRM Based on Immature Technology

Airbus had numerous objections regarding our description of the prototype hybrid onboard inert gas generation system (OBIGGS) that was tested on an Airbus A320 in 2003. Airbus objected to the OBIGGS being called a ''prototype.'' Instead, Airbus would characterize the OBIGGS as ''laboratory demonstration equipment.'' Airbus (and AEA) commented that the OBIGGS was not in an advanced state of development and would require extensive development before it reached a level of maturity suitable for certification and operation. Airbus also stated that we have not identified to Airbus an existing regulation that would require Airbus to develop an FRM, and Airbus is not committed to any such development program. British Airways also expressed concerns that the proposed systems have not been fully tested or developed and operators may find themselves required to install a system that is not yet fully certified.

We acknowledge that the development and certification of a production and retrofit FRM would require significant engineering and development. While the FRM equipment (i.e., FAA-developed prototype OBIGGS) installed and flown on an Airbus airplane had not been certified, an FRM system similar in concept was designed, tested, and certified on Boeing 737 and 747 series airplanes within two years of the Airbus demonstration flights. This certification demonstrates that the technology is mature, and that our proposed two-year compliance is reasonable and achievable. The harmonized certification requirements for the Boeing 737 and 747 FRM, which were nearly identical to those proposed in the NPRM, were published as Special Conditions in 2005 for public comment.

[27] Document FAA–22997–14, Executive Summary.

[28] Data from flight testing on the Boeing 737 (DOT/FAA/AR–01/63, ''Ground and Flight Testing of a Boeing 737 Center Wing Fuel Tank Inerted With Nitrogen-Enriched Air,'' dated August 2001).

This provided the public, including Airbus, with detailed information needed to develop an FRM. In addition, much of the hardware and components needed for an FRM have been developed by aerospace manufacturers and this developmental work should reduce the time needed for Airbus to develop a system.

During development of the NPRM, Airbus provided us with a cost analysis for an FRM that included the cost of engineering, components and operation of the system. We trust that the cost information was based upon initial engineering assessments of FRM and contact with component vendors. We concur with Airbus that, prior to this final rule, there was no regulation that would require a flammability reduction means to be developed and installed. However, since the NPRM was published, two Boeing 737 and two Boeing 747 airplanes have been delivered with operational FRM based upon nitrogen inerting technology. These systems have performed very well and provide an indication that the technology is mature for application to commercial aviation. In addition, in its March 5, 2007, letter, Airbus confirmed information it shared with FAA in November 2006, that Airbus is proceeding with the development of an FRM (Docket No. 22997–149).

*J. Compliance Dates*

The Families of TWA Flight 800 Association, Inc., as well as several members of the public, commented that the compliance times are too long and should be shortened. While we understand the commenters' frustration with the proposed compliance times, the schedules chosen are based on the industry's ability to respond to this rule. Each DAH, operator, and after-market modifier will have to follow a series of steps to make appropriate assessments and develop designs and installation plans. Designing FRM for each affected airplane model will require engineering resources; allowing less than 24 months for developing the design changes is not practical and could result in unintended reduction in airplane safety because of increased likelihood of design errors. Accelerating the retrofit schedule could significantly increase the cost of the program due to the need to introduce FRM into operators' fleets during lengthy out-of-sequence maintenance visits. We believe that the schedules chosen correctly balance the risk of a fuel tank explosion during the compliance period with the industry implementation capability.

1. Part 26 Design Approval Holder Compliance Dates

a. Submitting the Flammability Exposure Analysis

Boeing requested that proposed § 25.1815(b)(1) (now § 26.33(b)(1)) be revised to remove the compliance time (i.e., 150 days after the effective date of the rule) for TC holders to submit the flammability exposure analysis for affected airplane fuel tanks. Boeing stated that a large amount of test data is required to develop the analysis and, as such, a compliance time of 150 days would be inadequate. They believe this requirement is primarily for program planning purposes and that the compliance time in Table 1 of proposed § 25.1815(d) is appropriate for that purpose.

Embraer and Bombardier similarly commented that the 150-day compliance time for submitting the flammability analysis is inadequate. The basis for their comment was that validation of fuel tank thermal models will require developing new flammability tools and flight testing, which will require additional time. Embraer proposed a 24-month compliance time, and Bombardier proposed a 12-month compliance time.

We believe the proposed compliance time is adequate. It will ensure that the flammability exposure analyses are completed for every affected fuel tank in a timeframe we consider acceptable because of the reduced amount of work required for conventional unheated aluminum wing tanks. These analyses will determine if FRM is required for a given fuel tank, and the timeliness of completing the analysis is needed to meet the design and implementation schedule. As discussed earlier, we have revised proposed § 25.1815(b)(2) (now § 26.33(b)(2)(i)) of the final rule to allow TC holders to avoid performing the flammability analysis for particular tanks by stating in their compliance plans that they will treat the tank as high flammability and develop FRM or IMM, as required. In addition, no flammability analysis will likely be required to determine the flammability of the center wing tanks of Boeing and Airbus models, since we have determined from their comments that these models exceed the 7 percent limit. We have also significantly reduced the complexity of fuel tank thermal analyses that will be required by the industry because we modified the analysis requirements to allow a qualitative flammability assessment for conventional unheated aluminum wing tanks. No flight testing would be needed to gather data for conventional unheated aluminum wing tanks.

For the remaining tanks for which a flammability assessment is needed, the DAHs have been aware of the need to address fuel tank flammability and have conducted testing of airplanes to develop fuel tank thermal models. Therefore, additional time should not be needed to develop fuel tank thermal modeling for the majority of fuel tanks in the fleet. We believe 150 days is sufficient to complete the required analyses, and have made no change to the compliance time in the final rule.

b. Submitting a Compliance Plan for Developing Design Changes and Service Instructions

Under proposed § 25.1815(h), each holder of an existing TC would need to submit to the FAA Oversight Office a compliance plan for developing design changes and service instructions within 210 days of the effective date of the rule, which equals 60 days after the compliance date for submitting the flammability analysis. Embraer and Bombardier claimed developing a compliance plan within 60 days of submitting the flammability analysis was impractical. They based their objections on the fact that Boeing and Airbus, who are specifically cited in the NPRM, were already preparing for compliance prior to publication of the NPRM. They claimed that those DAHs not cited in the NPRM are not doing advanced preparation and will need extra time.

While Airbus acknowledged that 210 days is a reasonable timeframe, Airbus was concerned about how this timeframe would accommodate delays caused by our review. For example, if the TC holder delivers a flammability analysis which indicates a value under 7 percent, and, after review, the FAA identifies failings resulting in a value above 7 percent, the TC holder would then have significantly less time to draw up any potential compliance plan. Airbus stated that, in such cases, it could be unreasonable for us to require the TC holder to comply within 210 days. Therefore, Airbus suggested that we consider removing the fixed time period of 210 days and allow 60 days after the FAA and TC holder have agreed that the correct result is greater than 7 percent. It noted the requirements on operators of such airplanes should also be adjusted by a similar time.

We do not agree with this suggestion. Airbus provided comments to the NPRM that its airplane models have HCWT with flammability that ranges between 9 and 16 percent. Boeing has previously provided a statement to the FAA in response to SFAR 88 evaluations that all of its airplane models with HCWT are above the 7 percent value that determines when an FRM or IMM is needed. Based upon this information we have determined that all Boeing and Airbus models specifically listed in proposed § 25.1815 (now § 26.33) have center wing fuel tanks that will require an FRM or IMM. Since the analysis needed to determine whether the affected tanks would require an FRM or IMM is already completed, Airbus and Boeing can begin developing compliance plans for design changes immediately after publication of this final rule. Similarly, if Embraer and Bombardier believe their tanks may be high flammability, they should also begin developing compliance plans for design changes immediately after publication of this final rule.

c. Service Instruction Submittal Dates

Airbus and Boeing recommended that the compliance dates for each airplane model shown in § 25.1815(d), Table 1, be replaced by a specific time period for all airplanes in the table. Boeing suggested the same two-year compliance period be applied to all affected models to allow adequate time to complete design development, validation and certification of flammability reduction systems, and development and validation of service bulletins. Boeing stated that this two-year period would provide the required timing for airline coordination and parts procurement flow time needed to support the beginning of the retrofit period. Airbus suggested 36 months is required to develop the system design and that an additional 6 months should be provided to allow for an in-service evaluation of the FRM so that any problems with the design could be identified and corrected before implementation into the fleet by the operating rules. Embraer requested a compliance time of 48 months to develop the design change. Cathay similarly commented that, while Boeing is making advanced preparations, Airbus is not. Cathay also requested that the compliance time be extended to support a more ‘‘realistic’’ FRM development schedule. Cathay also commented that the FAA states ‘‘the proposed compliance date is based on the premise that the NPRM was to be issued in 2005.’’ The new compliance dates need to be revised to reflect delays in issuing the final rule. Bombardier felt that 24 months for the design changes should only commence once the authorities have accepted the design change plan.

We agree with the commenters that a fixed time for all airplane models should be established. We have determined that a 24-month compliance time for DAH development of the IMM or FRM is adequate for each of the DAHs to complete the task. Since we have determined from the comments that the Airbus and Boeing models listed in Table 1 in the NPRM require FRM or IMM, no flammability analysis is needed before design development begins. The full 24-month time can, therefore, be used by Airbus and Boeing to develop the design and service instructions for our approval.

In addition, Airbus and Boeing have had significant notification of this rulemaking. In February 17, 2004, we made a public announcement of our plans to develop and publish a proposal to require both retrofit and production incorporation of FRM or IMM. The NPRM was issued in November, 2005, and the rulemaking processing time has provided extensive time to develop designs as well as work with suppliers to discuss cost and schedule issues. Special conditions for the Boeing 737 and 747 were published by the FAA and EASA that provided performance standards for FRM in 2005. Many of the components in nitrogen based FRM systems are similar or identical to components used in military applications or pneumatic systems on commercial airplanes. The air separation modules used in these systems are based on technology currently used extensively in other industries. Therefore, we believe Airbus's request to increase the development and certification time from 24 months to 42 months, and Embraer's request for 48 months, are excessive, and we are confident that 24 months provides adequate time for design and service instruction development. Extending this compliance time would delay the operators' installation of these important safety improvements. Therefore, we have not revised the final rule as requested.

2. Operator Fleet Retrofit Compliance Dates

In proposed §§ 91.1509, 121.1117, 125.509 and 129.117, we included a Table 1 that contained the interim and final compliance dates for operators to complete the installations of IMM, FRM or FIMM required by those sections. Table 1 proposed unique compliance dates for those affected Boeing and Airbus models with high flammability fuel tanks. These dates were selected based upon the availability of service instructions and the risk associated with each airplane model.

a. Removal of Unique Compliance Dates for Affected Airplane Models

Boeing stated that, assuming the FAA concludes that retrofit is justified, the compliance time should be 7 years from the date that service instructions are available for all airplane models. Boeing maintained there is no justification for requiring unique compliance times tied to airplane models and recommended deleting Table 1.

We agree and have removed Table 1 from the final rule. This table has been replaced with a standardized compliance date for all affected airplanes. As explained below, the new compliance time for all models is 9 years from the effective date of this rule. We did not link the operators' compliance time to our approval of the service instructions because the length of time it will take us to approve the submission will depend upon the quality of the submission. While the compliance planning provisions are intended to ensure that the submissions are approvable, whether they have that effect is within the control of the DAHs.

b. Increase Compliance Times From 7 to 10 Years

The ATA asked that the compliance times be increased from 7 to 10 years after manufacturers develop the necessary design changes. ATA argued that the accident rate is such that there is little risk of catastrophic in-flight fuel tank explosion during that period. A 10-year compliance time would allow all operators to incorporate the FRM in heavy maintenance visits instead of only 85 percent of them.

We partially agree with ATA. As discussed previously, we are providing a compliance time of 24 months for all affected manufacturers to develop necessary design changes. We have adjusted the compliance times in the operational rules to allow 6 years after the effective date for compliance by 50 percent of an operator's fleet, and 9 years for full implementation, i.e., we are retaining the compliance time of 7 years after the design changes are developed. The compliance period of 7 years for operators to incorporate the design modifications into each fleet was selected to allow the vast majority of the FRM or IMM to be incorporated during airplane heavy checks and to achieve the safety level expected by the public.

Nevertheless, as ATA noted, 15 percent of the airplanes may need to incorporate FRM at a time other than during a heavy check. To address this concern and reduce the costs of this rule, we have revised the operational requirements of parts 121 and 129 to allow a one-year extension for retrofit if the operator elects to use ground conditioned air for all airplanes with high flammability tanks (i.e., Boeing and Airbus models) for ''actual gate times'' exceeding 30 minutes when ground air is available at the gate and operational and the ambient temperature exceeds 60 degrees F. This approach responds to requests for more time to retrofit while providing compensating risk reduction by use of ground conditioned air, which reduces flammability for airplanes on the ground. We are not including this extension provision in part 125, because these airplanes are typically not parked at gates where ground conditioned air is available. Also, these operators typically only operate one or very few airplanes subject to this rule, so they will not encounter the difficulties that ATA identified in scheduling large fleets of airplanes for modifications.

For purposes of this provision, ''actual gate time'' is time when the airplane is parked at a gate for servicing and passenger egress and ingress. If scheduled gate time is 30 minutes or less, but departure is delayed so that airplane is parked for more than 30 minutes, use of ground air is required for any period longer than 30 minutes. This ensures that heating of tanks (and resulting increased flammability) is limited. ''Available'' means installed at the gate. ''Operational'' means working, so that an operator is not in violation simply because ground conditioned air is out of service for maintenance. Ambient temperature is the official temperature at the airport as provided by the U.S. National Weather Service or worldwide METAR [29] weather report system. This provision requires revision of operator's operations specifications and relevant manuals to ensure that the commitment to use of ground air is fully implemented and enforceable. In the near future we will be issuing guidance on compliance with the conditions for this extension.

c. Interim Compliance Dates

We proposed interim compliance dates for operators to incorporate any FRM or IMM into 50 percent of their affected high flammability airplanes within their fleet. Boeing requested we revise §§ 91.1509(d)(1), 121.1117(d)(1), 125.509(d)(1), and 129.117(d)(1) to state:

''IMM, FRM or FIMM, if required by §§ 25.1815, 25.1817, or 25.1819 of this chapter, that are approved by the FAA Oversight Office, are installed in at least 50 percent of the operator's fleet within 4 years from the date service instructions are available. This does not apply for certificate holders with only one airplane in the fleet.''

Boeing stated that newly delivered airplanes should be included in the operator's ''fleet'' for purposes of Table 1. Boeing also commented that Table 1 should not be split by individual airplane model, but should include all airplanes in a given operator's current fleet. The recommended revision to 50 percent of the operator's fleet should also specify if this is 50 percent of their fleet operating on the compliance date, 50 percent of their fleet that is operating at the beginning of the compliance period, or 50 percent of their fleet that will be operating at the end of the compliance period.

We agree that additional clarification is needed on the definition of ''50 percent of fleet.'' We intended that the 50 percent figure be based on all airplanes that are required to be modified under this rule and that are being operated by an operator 6 years after the effective date of this rule. Any airplanes transferred or purchased with high flammability fuel tanks, would be included in the operator's ''fleet.'' Since newly delivered airplanes are not required to be modified, they are not included as part of the 50 percent of the fleet to meet this requirement.

*K. Cost/Benefit Analysis*

As noted in the Regulatory Evaluation Summary, specific comments on the quantitative costs and benefits estimates are more completely discussed in the FRE. In this section, we only address general economic issues that were addressed by the comments.

1. Security Benefits

In the NPRM, we noted that the potential benefits from preventing terrorist-initiated accidents were excluded from consideration in both the ARAC reports and the IRE. While the proposed FRM requirements were not primarily intended to address terrorist-initiated explosions, we invited public comment on possible additional security benefits that inerting fuel tanks may provide. In response to this request, we received several comments, including the following:

• The NTSB and several individuals supported including benefits from prevented consequences of terrorist action in the FRE and suggested we should complete a cost/benefit analysis of inerting all fuel tanks to address terrorist threats. The NTSB noted that, although not intended for missile defense or entirely effective as such, flammability reduction systems could mitigate the results of shrapnel entering fuel tanks during a terrorist act. Therefore, the NTSB recommended that the cost-benefit analysis for the final rule should include estimates of potential missile attacks on airplanes. In addition, these commenters also supported including possible benefits from preventing terrorist actions caused by bombs exploding in the airplane.

• CAPA stated that the United States is at a heightened risk of terrorist attacks. CAPA noted the aviation industry affects nearly 9 percent of the U.S. Gross Domestic Product, and suggested that terrorists will undoubtedly seek ways to attack the aviation infrastructure. CAPA recommended that we should complete a cost benefit analysis of inerting all fuel tanks and make recommendations to the Department of Homeland Security and aviation industry.

• NATCA commented that there would be an adverse effect on the public's confidence in flying if another fuel tank explosion occurred.

• Airbus and AEA stated that, in theory, there may be some benefit to improving security by installing FRM on airplanes. However, they noted that we have no basis for estimating the amount of that benefit and they do not believe it to be substantial.

• ATA and FedEx objected to the FAA's including the Avianca 727 accident in its justification of this rule. They stated that this accident, which resulted from a small bomb placed above the center wing fuel tank on the previous flight, would not have been prevented by the requirements of this rule.

Based upon the comments received and our review of historical evidence, we have not quantified any potential benefits from an FRM system preventing a fuel tank explosion caused by a terrorist missile or an on-board bomb.

We have also not quantified the potential benefits from a fuel tank explosion being misinterpreted as a terrorist-caused event because such an

[29] METAR (from the French, ''message d'observation météorologique régulière pour l'aviation,'') is a format for reporting weather information. METAR means ''aviation routine weather report'' and is predominantly used by pilots in fulfillment of a part of a pre-flight weather briefing, and by meteorologists, who use aggregated METAR information to assist in weather forecasting.

METAR reports usually come from airports. Typically, reports are generated once an hour; however, if conditions change significantly, they may be updated in special reports called SPECI's. Some reports are encoded by an Automated Surface Observing System located at airports, military bases and other sites. Some locations still use augmented observations, which are recorded by digital sensors and encoded via software, but are reviewed by certified weather observers or forecasters prior to being transmitted. Observations may also be taken by trained observers or forecasters who manually observe and encode their observations prior to their being transmitted. Source: Wikipedia, August 2007.

outcome is too speculative to include in the main body of the analysis. However, we have provided a quantified estimate of the possible benefits from preventing this misinterpretation in Appendix A of the FRE.

However, some of the public will cancel or curtail their air travel after they discover that the in-flight accident was caused by an airplane electrical or mechanical malfunction. An in-flight explosion is a catastrophic accident. There is a long history that air travel declines for two to three months after a major catastrophic accident. We use a study by Wong and Yen, ''Impact of Flight Accidents on Passenger Traffic Volume of the Airlines in Taiwan'', in the *Journal of Eastern Asia Society for Transportation Studies*, vol. 5, October 2003, to provide an estimate of the potential demand losses from a fuel tank explosion.

2. Likelihood of Future Explosions in Flight

The IRE assumed that all future accidents caused by fuel tank explosions will occur in flight. This assumption was based upon an evaluation of the flammability exposure times for various flight phases that showed the majority of the time fuel tanks are flammable is during flight. The method used by us in the IRE to estimate the likelihood of future explosions occurring in flight or on the ground was based upon an earlier version of the Monte Carlo model, ''Fuel Tank Flammability Assessment Method User's Manual, DOT/FAA/AR–05/8.'' This earlier model used ground times of 30, 60 and 90 minutes for short, medium, and long-range airplanes. Using this model, we determined 90 percent of the flammability exposure time occurred during flight. We then simplified the IRE by assuming all future accidents would occur in flight.

Our review of recent fleet data collected from in-service airplanes indicates that ground times are longer than used in the earlier version of the Monte Carlo model. This results in a higher percentage of the flammability exposure time being when an airplane is on the ground. In addition, the historical accident rate of one accident out of three occurring in flight is based upon a limited number of events and is not a valid sample size for establishing the future accident rate. Since ignition sources may occur at any time during ground or flight operations, the ARAC fuel tank study concluded that the likelihood of future fuel tank explosions correlates to the flammability exposure of a fuel tank. We agree with this conclusion.

MyTravel Airlines, AEA, Alaska Airlines, ATA, and Airbus stated that, the probabilities of an in-flight explosion and an on-the-ground explosion is the simple extrapolation of the three events; that is, there is a 33.33 percent probability of an in-flight explosion and a 66.67 percent probability of an on-the-ground explosion. Boeing commented that its engineering analysis indicated an 80 percent probability of an in-flight explosion and a 20 percent probability of an on-the-ground explosion and supported its recommendation with a recent flammability assessment using a revised Monte Carlo model. Boeing also recommended that a sensitivity analysis be included in the regulatory evaluation varying the number of in-flight events by values of 33 percent or 50 percent. In the GRA, Incorporated appendix to the ATA comment, they noted that using plausible assumptions in FAA's model, a better estimate of the percentage of time that a tank is flammable would be 78 percent in the air.

We believe that the appropriate method to evaluate the future risk is through a flammability assessment rather than observations of an infrequently occurring event. As a result, we agree with the Boeing analysis and disagree with the ATA and Airbus analyses and revise our risk analysis so that there is an 80 percent probability that an explosion will occur in flight and a 20 percent probability that it will occur on the ground.

Finally, we do not agree with Boeing's recommendation to include in the FRE an assessment of the sensitivity of varying the ground versus flight accidents between 30 and 50 percent. The IRE already included variations in many factors that affect the predicted cost and benefits and adding another sensitivity factor would not provide useful data for determining the need for this rule.

3. Costs to Society of Future Accidents

Several commenters said the cost of future accidents used in the IRE did not include all the costs to society. They said the IRE excluded the costs of investigating the accident, cleanup at the accident scene, replacement and retraining of flight crew, and any design change needed to correct failures of parts or systems on the airplane. They added that an accident would also cause a loss of confidence in the aviation industry leading to the public reducing their airline travel. They requested these additional costs be included in the final rule.

We agree with some of these comments and, as previously discussed, we include quantitative estimates of the potential benefits from the loss of confidence in aviation transport. We disagree that we did not include accident investigation and clean-up costs because the IRE contained a specific $8 million cost for the accident investigation. Although it may occur that design changes will need to be made, these changes would be done via rulemaking or AD and the costs for those specific changes would be estimated when proposed.

4. Value of a Prevented Fatality

AEA and ATA stated that the value of a prevented fatality should be 3 million dollars. AEA stated there is no basis for using a higher value.

Different government entities use different estimates of the value of a prevented fatality. For example, the Environmental Protection Agency uses a value of $7 million and the Department of Transportation has historically used a value of $3 million (which we used in the IRE). There are several different values that have been reported in economic literature and there is no one value on which there is universal or near-universal agreement. The Office of Management and Budget allows agencies to evaluate their cost-benefit analyses using alternative values for a prevented fatality in order to evaluate how sensitive the analytic results are to the assumed values. Therefore, we believe that varying the value to show the range of reasonable effects is appropriate and we have included values of $3 million, $5.5 million, and $8 million to provide a better understanding of the sensitivity of the evaluation to changes in this baseline assumption.

5. Cost Savings if Transient Suppression Units (TSUs) Are Not Required

The NTSB determined that the probable cause of the TWA Flight 800 explosion was ignition of the flammable fuel/air mixture in the center wing fuel tank. Although the ignition source could not be determined with certainty, the NTSB determined that the most likely source was a short circuit outside of the center wing tank that allowed excessive voltage to enter the tank through electrical wiring associated with the fuel quantity indication system (FQIS). We issued ADs mandating separation of the FQIS wiring that enters the fuel tank from high power wires and circuits on the classic Boeing 737 and 747 airplanes after the TWA 800 accident, and this resulted in installation of TSUs as an alternative method of compliance with the ADs.

In the NPRM for this rulemaking, we requested public comment on the possible cost savings that would occur if airlines were not required to install transient suppression units (TSUs) on the fuel quantity gauging systems of the high flammability fuel tanks that would need FRM to comply with this rule. We received the following responses:

- Several commenters stated that we need to clarify the requirements for design changes resulting from SFAR 88, since they believed no additional changes to incorporate TSU would be needed for their fleet.
- According to ATA, the cost avoidances would be minor, compared to the impact of the ignition-prevention ADs and pending SFAR 88 maintenance upgrades.
- AEA stated that TSUs will not be removed, so there is no cost savings. If the TSUs were removed, additional costs would be incurred for certification, service bulletins, manpower, and hangar space.
- Airbus and My Travel Airways commented that they anticipate no significant savings since only a fraction of the fleet is designed with a need for these devices, and the cost of these devices is small, compared to the cost of flammability reduction systems.
- Transport Canada commented that ignition prevention should not be traded off against flammability reduction. Both should be required.
- Qantas stated that, if these devices could be removed from its existing fleet, it would realize a significant cost savings in operations and maintenance. Qantas also said that the cost of these devices is minimal compared to the installation of an FRM, but if the FQIS requires replacement of the fuel gauging system to make the devices effective, it would be similar in cost to an FRM. However, Qantas noted that an FRM may produce a weight penalty such that a FQIS replacement would still be preferred.

Prior to this rule, the findings from the analysis required by SFAR 88 showed that most transport category airplanes with high flammability fuel tanks needed TSUs to prevent electrical energy from airplane wiring from entering the fuel tanks in the event of a latent failure in combination with a single failure. Since this rule requires FRM or IMM to mitigate an unsafe condition by converting these fuel tanks into low flammability fuel tanks, TSUs will no longer be needed. Therefore, we believe it is appropriate to include this as a cost avoidance of this rule. However, based on the comments that installing these TSUs will impose a minimal cost, we did not estimate a cost offset for those airplanes that would have been required to have TSUs installed but are no longer required to do so under this rule.

6. Corrections About Boeing Statements

Boeing stated that the IRE has several statements that should be corrected in the final version. First, Boeing will not provide engineering analyses via service bulletins or provide initial aid to large airlines and independent third party repair stations. Boeing asked that these statements be deleted. Boeing also indicated that it will follow the regulatory requirements for providing service information. Finally, Boeing pointed out that the IRE improperly references STCs where it should be referencing amended TCs.

We agree with Boeing and have revised these issues in the FRE accordingly.

7. 757 Size Category

Boeing noted that the Model 757 was classified as a small airplane in the IRE and suggested that it be included in the medium category. Boeing based this on the fact that the Model 757's fuel tank volume and airplane performance is similar to that of other airplanes categorized as medium-sized by ARAC.

We agree and have included the Boeing 757 in the medium category and have adjusted the weight and cost estimates accordingly.

8. Number of Future Older In-Service Airplanes Overestimated

Alaska Airlines commented that the IRE overestimated the number of older in-service airplanes in future years, which artificially increases the benefits of the FRM retrofit requirements. Alaska Airlines asserted that industry projects a higher proportion of newer airplanes versus older airplanes for the projected benefit period.

The fleet mix in the IRE was based upon our fleet forecast. Therefore, the number of newer airplanes reflected the official FAA fleet projections. In the FRE, we have updated the fleet mix data using the most recent *FAA Aerospace Forecasts Fiscal Years 2006–2017*. This forecast projects higher retirement rates than those forecasted in the FAA Aerospace Forecasts *Fiscal Years 2004–2015*, which we used in the IRE.

9. Revisions to the FRM Kit Costs

ATA, AEA, AAPA, Federal Express, Airbus, and Boeing suggest that we revise the price of the FRM components because the original ARAC estimates had not been fully developed and tested and, subsequent to this additional development, the FRM kit costs are higher.

Boeing has provided new kit costs for its various models, which are revised from its previous component costs. We agree with Boeing and use them in the FRE for production airplanes.

However, United/Shaw Aero Devices/Air Liquide have recently developed an FTI system to retrofit in airplanes and they have reported kit costs. As they have a patent for the system and operational prototypes, we use the United/Shaw Aero Devices/Air Liquide retrofitting kit costs in this analysis.

10. Revisions to the Labor Time To Retrofit FRM Components

Several commenters reported that the labor hours to retrofit an airplane used in the IRE were too low. In its discussions with the airlines, Boeing provided an estimated number of labor hours to retrofit its kits by model. The ATA reviewed these estimated hours and commented that its expected labor hours were approximated 25 percent to 40 percent higher than the preliminary numbers provided by Boeing. Qantas reported that the retrofitting labor hours are 50 percent greater than those in the service bulletins.

However, the United/Shaw Aero Devices/Air Liquide retrofitting kit is different from the retrofitting kit on which the ATA based its reported hours. As a result, just as we use the United/Shaw Aero Devices/Air Liquide retrofitting kit costs, we also use their labor hour estimates to install their system.

However, the labor hours to retrofit these kits will decline over time due to mechanics becoming more familiar with the installation procedures. T.P. Wright found that an 80 percent learning efficiency has been a common occurrence in airplane production. We assume that this 80 percent learning efficiency also applies to retrofitting operations.

11. Retrofitting Costs per Airplane

Cathay Pacific and the AAPA commented that the per airplane retrofitting costs reported by EASA for an Airbus airplane would be between $600,000 to about $1 million (converting Euros into Dollars). Airbus provided similar comments.

In combining the United/Shaw Aero Devices/Air Liquide kit costs and their labor hours costs, we calculate that the per airplane retrofitting costs will initially be $110,000 to $250,000. Over time, these costs will decline by $10,000 to $17,000 per airplane.

12. Percentage of Retrofits Completed During a Heavy Check

Airbus commented that the average time between heavy checks is 10 to 12 years. Thus, 85 percent of the retrofits could not be completed within the proposed 8 year time-frame.

We disagree. Our experience has been that the vast majority of airplanes in commercial passenger service in the United States have some form of a heavy check no later than every 8 years.

The AEA commented that 60 percent of the retrofits would be completed during a heavy check while ATA commented that 85 percent would be completed during a heavy check. In the IRE, we had used 85 percent.

We agree with the ATA comment and use the 85 percent value in the FRE. Operators who choose to take advantage of the extension allowed by use of ground conditioned air will be able to complete the retrofits of an even higher percentage of their fleet during heavy checks.

13. Number of Additional Days of Out-of-Service Time To Complete a Retrofit

The ATA commented that retrofitting FRM during a heavy check would add two days of out-of-service time, AEA commented that it would add two to three days, while Airbus commented that the airlines had told EASA that it would add one day.

In the IRE, we had used two days. We agree with ATA and use two days in the FRE for the out-of-service time if the retrofit is performed during a heavy check.

Airbus commented that retrofitting FRM during a medium check would add 5 days while it would add seven days if completed during a special maintenance visit. In the IRE, we had used four days out-of-service for a retrofit performed during a special maintenance visit based on the ARAC report. Airbus provided no justification for its disagreement with the ARAC conclusion. As we received no comments other than the Airbus comment on this topic, we disagree with Airbus and use four days out-of-service for a special maintenance visit.

14. Economic Losses From an Out-of-Service Day

Airbus and the ATA commented that the losses to an airline from an out-of-service day should be based on the airplane on ground economic loss or the loss in net operating revenue, not a pro-rated monthly lease rate as used in the IRE.

We disagree. While it is true that the loss to air carrier A is greater than the prorated monthly lease rate, most potential air travelers will use alternative air carrier B if air carrier A takes an airplane out of service for a short time. Consequently, alternative air carrier B receives an economic benefit that is not captured by only focusing on the air carrier airplane that is out of service. The FAA's responsibility is to cost the potential loss to the aviation system, not individual air carriers at specific points in time. This is particularly apparent when alternative air carrier B will need to remove an airplane from service and air carrier B's air travelers will use air carrier A that will receive an economic benefit that is not captured by focusing solely on the loss to air carrier B at that specific point in time.

Airbus commented that the FRM cost for its products is underestimated by a factor of two to three. Based upon review of all comments, including those based upon a certificated FRM provided by Boeing, we believe the FAA cost estimates should be revised by a factor of 1.6 and we have adjusted the regulatory evaluation accordingly. We applied the revised retrofitted airplane costs for the certificated FRM systems to all similarly-sized airplane models because we determined that the fuel tank inerting systems will be similar for both manufacturers.

15. Updated FRM Weight Data

Boeing provided updated weight data for the flammability reduction systems that have been or are being developed for its airplane models. Boeing stated that the final weights for the Boeing 747–400 and 737–NG systems are known since the designs have been certified. Boeing estimated the weight for the Boeing 777 system. As for the Boeing 757 and 767 systems, preliminary designs indicate these systems will be similar and Boeing estimated the weights based upon comparison to the other models. Boeing also provided updated estimates for average annual flight hours for Boeing airplanes.

We have revised the weight and annual flight hour data in the FRE for production airplanes based on Boeing's updated information. We also used this updated data for similarly sized Airbus airplane models.

United/Shaw Aero Devices/Air Liquide reported that their retrofitting kits weigh less than the Boeing kits. We used United/Shaw Aero Devices/Air Liquide kit weights for the retrofitted airplanes.

16. Updated Fuel Consumption Data

Boeing also provided revised annual fuel consumption due to the FRM weight and increased bleed flow and ram drag. A GRA, Incorporated report that surveyed several air carriers provided current air carrier fuel consumption per pound of additional weight.

For the annual fuel consumption due to the FRM weight, we have used the GRA values from the air carriers because we believe the air carriers will be more accurate in reflecting their actual usage over a variety of flight mission lengths and conditions than the Boeing engineers would be. We used the Boeing estimates of the additional fuel consumption for increased bleed air flow and ram drag in the FRE. We used these rates for both production and retrofitted airplanes because United/Shaw Aero Devices/Air Liquide did not provide independent estimated rates for their kits.

17. Updated Fuel Cost Data

Several commenters reported that the $1 per gallon aviation fuel cost used in the IRE no longer reflected the economic reality. For a cost per gallon, Frontier suggested $2.11, ATA suggested $1.50, Qantas suggested $2.00, and Airbus suggested $1.50.

We agree that the per gallon price of aviation fuel has increased. Based on our *FAA Aerospace Forecasts Fiscal Years 2008–2025*, we determined that the average future price per gallon will be $2.01. Although this fuel price is based on the most recently published FAA forecast, we recognize that, given the current record high oil prices, this estimate may underestimate the long term aviation fuel cost.

18. Cost of Inspections

Air Safety Group, UK commented that the NPRM does not include any costs associated with the impact of FRM inspections on flight delays and cancellations. The commenter recommended that the cost/benefit analysis be revised to take a more realistic account of these additional operational costs. Boeing's comments included revised estimates of these costs.

With respect to flight delays and cancellations due to these inspections, the DAH requirements allow placing a nonfunctional FRM or IMM on the MEL provided the overall system performance meets the minimum criteria. We agree with the revised costs from Boeing on the costs of delays and cancellations in the FRE and used them for both production and retrofitted airplanes.

19. Inspection and Maintenance Labor Hours

Boeing commented that the annual labor hours for inerting system inspection and maintenance time should be revised to 6 hours for Boeing passenger and all-cargo airplanes. Boeing cited design features and related fault indication systems that will eliminate the need for scheduled maintenance performance checks on the inerting systems. Boeing also reported that unscheduled delays will only occur for failures that require locking the NGS Shutoff Valve closed.

We agree with Boeing's estimates for both production and retrofitted airplanes and use them in the FRE.

20. Daily Check

ATA commented that its estimates for inerting system operational and maintenance costs are much higher than those used by the FAA. ATA stated that 15 maintenance minutes per airplane per day will be required and this was not accounted for by the FAA.

We infer from ATA's comment that ATA believes that our estimated maintenance costs should be revised to include a 15 minute daily check of the FRM. The inerting system certified by the FAA (and validated by EASA) for the Boeing Model 737NG and 747–400 airplanes did not include a daily check. Specific features of the design, in conjunction with indication systems, removed the need for a daily check. We anticipate that Airbus's design will be similar in that the electronic centralized airplane monitor will be utilized for FRM status. This would impose no greater burden on operators than the FRM systems that have been certified to date. As a result, we have not included costs associated to a 15 minute daily check of the FRM in the FRE.

21. Spare Parts Costs

Boeing asked that the inerting system spare parts costs be revised based on its updated costs from suppliers. Boeing estimated that the air separator/filter capacity and life is directly related to the environment in which the airplane is operated. Boeing added that its filter installation includes monitoring for excessive pressure drop that is used to determine when the filter needs to be replaced. Finally, Boeing noted that its expected filter maintenance interval is greater than one year for average environmental conditions.

We agree with the cost information provided by Boeing and used the new cost for the filter element replacement in the FRE. While we acknowledge the filters will be replaced when the pressure across the filter is excessive, Boeing did not provide an expected average filter replacement interval. In general, air separator/filters are expected to last between 1 and 3 years, depending upon the conditions under which the airplane is flown. An annual filter element replacement is a worst case situation. As a result, in the FRE, we use an average filter element replacement interval of every 2 years.

22. Air Separation Module (ASM) Replacement

Boeing asked the FAA to revise the cost of ASMs that would need to be purchased for replacing modules when they reach their design life. The IRE contained estimates ranging from $5,275 to $28,814. Boeing stated the revised costs range from $30,520 to $151,000. As United/Shaw Aero Devices/Air Liquide did not provide an estimate for this cost component, we applied the Boeing estimate to retrofitted airplanes.

Boeing also requested that the ASM replacement costs be evaluated based upon data provided in a table for average annual utilization by Boeing airplane model. Boeing believed this data is more realistic of model specific fleet utilization. While the IRE assumed an average utilization rate of 3,000 flight hours, Boeing's current data for different models range from 3,000 to 4,250 flight hours for passenger carrying airplanes and 1,000 to 4,250 for all-cargo airplanes. Finally, Boeing stated that the design life goal for the ASM remains 27,000 hours. FedEx commented that a manufacturer had told them that the ASMs will need to be replaced every few years.

We agree with Boeing that the design goal of an ASM replacement every 27,000 flight hours will be reached and we use that interval for the ASM replacement frequencies in this Regulatory Evaluation.

*L. Miscellaneous*

1. Harmonization

Several commenters (Boeing, Transport Canada, Alitalia, AAPA, Virgin, Cathay) expressed the need for harmonization of FAA requirements with those of other national aviation authorities. These commenters noted that harmonization with the other major regulatory agencies would benefit the industry and encourage a broader dialogue. We agree that harmonization of the fuel tank flammability safety requirements is usually desirable. Prior to and throughout the development of this rule, we used several avenues to involve other foreign regulatory authorities and industry, including:

- Aviation Rulemaking Advisory Committee (ARAC) working groups comprised of representatives of foreign regulatory authorities and industry and other interested parties were used to review issues and provide recommendations for developing and harmonizing this rule. EASA, Transport Canada and the Brazilian CTA participated in these working groups, which conducted extensive studies of fuel tank safety. These studies included a review of the fleet history as well as evaluating the various options for improving airplane safety through flammability reduction. One working group was created to review fuel tank flammability and methods to reduce flammability in the tanks. This then led to the creation of a second working group that exclusively reviewed fuel tank inerting. The recommendations from these working groups became part of the basis for this proposed rule. The recommendations from the two fuel tank safety ARAC studies guided our rulemaking proposal and this final rule.
- We also participated in an industry and regulatory authority group assembled by EASA to review fuel tank flammability safety and produce an EASA Regulatory Impact Assessment (RIA). This RIA is available on EASA's Web site at (*www.easa.eu.int/doc/Events/fueltanksafety_24062005/easa_fueltanksafety_24062005_qa_summary.pdf*).

EASA's RIA recommended production incorporation of FRM on newly produced airplanes that have high flammability tanks and EASA has indicated that it plans to propose an amendment to their regulations applying to new transport airplane designs in CS–25. We anticipate harmonization of these requirements. However, EASA has not yet determined that FRM retrofit should be required.[30] We believe the fleet operation projections show that the risk of an explosion occurring on existing airplanes and newly produced airplanes is similar. This safety issue needs to be addressed, despite the lack of harmonization, and we have included a FRM retrofit requirement in this final rule.

While we remain committed to the goal of harmonization, our primary objective in this rulemaking is to improve aviation safety. When we determine that the need exists for a certain regulation, and the other regulatory agencies find that a more stringent or lenient requirement is appropriate, we review their findings

[30] EASA has commissioned a study to reconsider the desirability of a retrofit requirement.

and will revise our regulation if our regulatory goals are met, an equivalent level of safety is achieved, and any additional burden imposed on the industry is justified. This is the approach we have taken in drafting this rule.

2. Part 25 Safety Targets

AEA commented that part 25 is missing safety targets and recommended the final rule include a specific target for both ignition and flammability reduction. This target could be achieved by ignition source prevention in combination with flammability reduction. AEA proposed the target be the same as for any other catastrophic event in transport category airplanes: $10^{-9}$ per flight hour.

We do not agree with AEA's proposal to include a safety target in part 25. As discussed previously, because ignition sources are caused by human error and other unpredictable factors, it is impossible to assign an accurate probability value to them. Therefore, § 25.981 is based on a balanced approach for preventing fuel tank explosions. This section provides both ignition prevention plus an additional safety improvement by controlling fuel tank flammability exposure to an acceptable level. Today's rule adds requirements for fuel tanks located in the fuselage contour and extend the mitigation into the fleet of existing airplanes.

## IV. Rulemaking Analyses and Notices

*Paperwork Reduction Act*

As required by the Paperwork Reduction Act of 1995 (44 U.S.C. 3507(d)), the FAA submitted a copy of the new (or amended) information collection requirement(s) in this final rule to the Office of Management and Budget for its review. OMB approved the collection of this information and assigned OMB Control Number 2120–0710.

This rule supports the information needs of the FAA in approving design approval holder and operator compliance with the rule. The likely respondents to this proposed information requirement are the design approval holders such as Boeing, Airbus and several auxiliary fuel tank manufacturers as well as operators. The rule requires the certificate holders to submit a report to the FAA twice each year for a period up to 5 years. Operators who choose to use ground air conditioning would be required to provide a one time statement of their intent to use this option. The burden would consist of the work necessary for:

- DAH to develop flammability analysis reports and the service instructions for installation of IMM or FRM.
- DAH to develop changes and incorporate a maintenance plan into the existing maintenance programs.
- DAH to provide bi-annual reliability reports for FRM for the first 5 years of operation.
- Operators to provide notification to the FAA of their intent to use ground air conditioning.
- Operators to record the results of the installation and maintenance activities.

The largest paperwork burden will be a one-time effort (spread over 3 years) associated with the Design approval holders (TC and STC holders) to develop design changes. Operators will also need to update their maintenance programs, including maintenance manuals, to include the design changes. The basis for these estimates is the industry Aviation Rulemaking Advisory Committee report, which provided hours for each of the 3 major areas of paperwork. Based on an aerospace engineer total compensation rate of $110 an hour, the total burden will be as follows:

| Documents required to show compliance with the final rule | Hours | Total cost (in millions of $2007) |
|---|---|---|
| Application to FAA for Amended TC or STC | 405,000 | 44.550 |
| Documents (Specifications, ICDs, etc.) | 30,900 | 3.399 |
| Revisions to Manuals (Flight Manuals, Operations, and Maintenance) for FRM Systems | 29,500 | 3.245 |
| Total | 465,400 | 51.194 |

As these recordkeeping costs will be spread out evenly over the three years, the yearly burden will be $17.065 million and involve 155,133 hours.

After this initial 3-year period, this rulemaking would result in an annual recordkeeping and reporting burden of 4,000 hours. This burden is based on five (5) design approval holders submitting 40 total reports per year requiring an average of 100 hours to complete each report. All records that will be generated to verify the installation, to record any fuel tank system inerting failures, and to record any maintenance would use forms currently required by the FAA.

The FAA computed the annual recordkeeping (Total Pages) burden by analyzing the necessary paperwork requirements needed to satisfy each process of the rule.

An agency may not collect or sponsor the collection of information, nor may it impose an information collection requirement unless it displays a currently valid Office of Management and Budget (OMB) control number.

*International Compatibility*

In keeping with U.S. obligations under the Convention on International Civil Aviation, it is FAA policy to comply with International Civil Aviation Organization (ICAO) Standards and Recommended Practices to the maximum extent practicable. The FAA has determined that there are no ICAO Standards and Recommended Practices that correspond to these proposed regulations.

*Regulatory Evaluation Summary*

*Regulatory Evaluation, Regulatory Flexibility Determination, International Trade Assessment, and Unfunded Mandates Assessment*

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 (Pub. L. 96–354) requires agencies to analyze the economic impact of regulatory changes on small entities. Third, the Trade Agreements Act (Pub. L. 96–39) prohibits agencies from setting standards that create unnecessary obstacles to the foreign commerce of the United States. In developing U.S. standards, this Trade

Act requires agencies to consider international standards and, where appropriate, that they be the basis of U.S. standards. 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 with base year of 1995). This portion of the preamble summarizes the FAA's analysis of the economic impacts of this final rule. We suggest readers seeking greater detail read the full regulatory evaluation, a copy of which we have placed in the docket for this rulemaking.

In conducting these analyses, the FAA has determined that this final rule: (1) Has benefits that justify its costs, (2) is an economically ''significant regulatory action'' as defined in section 3(f) of Executive Order 12866, (3) is ''significant'' as defined in DOT's Regulatory Policies and Procedures; (4) will have a significant economic impact on a substantial number of small entities; (5) will not create unnecessary obstacles to the foreign commerce of the United States; and (6) will impose an unfunded mandate on state, local, or tribal governments, or on the private sector by exceeding the previously identified threshold. These analyses are summarized as follows.

Aviation Industry Affected

The rule affects Boeing, Airbus, and operators of certain Boeing and Airbus airplanes that have heated center wing tanks (HCWTs).[31]

Disposition of Comments

There were many comments on the Initial Regulatory Evaluation (IRE) associated with FRM. We accepted many of these comments. However, the volume and the technical nature of these comments require a more detailed response than is possible in this summary. As a result, the complete disposition of the economic comments and their effects on the economic analysis are contained in the complete Final Regulatory Evaluation, which is filed separately.

Period of Analysis and Affected Airplanes

The period of analysis begins in 2008 and concludes in 2042. We used a 10-year time period (2008–2017) to calculate the equipment installation costs for airplanes affected by the final rule. The end of the analysis period of 2042 captures the full operative lives of the 2009–2017 production airplanes.

The airplanes affected by the final rule include passenger airplanes with HCWTs manufactured prior to the 2009 production cut-in date. These airplanes will need to be retrofitted with FRM by 2017. In addition, these affected airplanes also include all production passenger and cargo airplanes with HCWTs that will be manufactured between 2009 and 2017 (except the B–787 and A380 that will be manufactured with FRM. Cargo airplanes manufactured before 2009 and cargo airplanes that have been or will be converted from passenger airplanes (conversion cargo airplanes) are not included unless FRM was installed while the airplane was used in passenger service.

Airplanes have an average 25-year life expectancy. Thus, the 2009 production airplanes will be retired in 2033 and the last of the production airplanes in this analysis (those produced in 2017) will be out of service by 2042. Similarly, all of the pre-2009 existing airplanes requiring retrofitting will be retired by 2033 (the 2008 production airplanes will be the last year of production airplanes will not have FRM installed as original equipment). Thus, the maintenance and fuel costs will begin in 2009 and continue to 2042 for production airplanes and will begin in 2010 and continue to 2033 for retrofitted airplanes.

During the analysis period the final rule will affect an estimated 5,110 airplanes, 5,022 retrofitted and production passenger airplanes (2,732 retrofitted and 2,290 production) and 88 production cargo airplanes (see Table 1). These airplanes will fly 370 million hours, 364 million for passenger airplanes and 6 million for production cargo. Of the 364 million passenger airplane flight hours, 303 million will be flown by airplanes with FRM and 61 million will be flown by airplanes without FRM. The airplanes without FRM will be those manufactured prior to 2009 until they are retired or retrofitted between 2008 and 2017.

TABLE 1.—SUMMARY OF THE TOTAL NUMBERS OF AIRPLANES AND FLIGHT HOURS AFFECTED BY THE RULE

| Airplane category | Airplanes | Flight hours (millions) |
|---|---|---|
| PASSENGER PRODUCTION | 2,290 | 199 |
| RETROFITTED WITH FRM | 2,732 | 105 |
| NO FRM | .................... | 61 |
| TOTAL PASSENGER | 5,022 | 364 |
| CARGO PRODUCTION | 88 | 6 |
| TOTAL | 5,110 | 370 |

Risk of a HCWT Explosion

If there were no final rule and no SFAR 88, engineering analysis indicates that there would be 1 explosion for every 100 million HCWT airplane flight hours. Air carrier passenger airplanes would incur 3.64 explosions of which production airplanes would incur 1.99 explosions and retrofitted airplanes would incur 1.65 explosions. Of the retrofitted airplanes, 1.04 would occur to airplanes with FRM and 0.61 would occur to airplanes without FRM. Production cargo airplanes would incur 0.06 explosions. As, obviously, fractions of accidents do not occur, we describe the cumulative probability of the number of accidents in fractions of an accident for analytic purposes. For example, engineering analysis would project that the first accident would occur in 2012, the second one in 2019, the third one in 2026, and the final 0.64 of an accident in 2035. However, care

[31] The following airplane models are not included as HCWT airplanes: B–717; B–727; certain B–767 and B–777 models, A–321, A–330–200 and A380. In addition, the B–787 is not included because it needs FRM to comply with its existing Part 25 certification requirements.

should be taken in assuming that these rare events will necessarily occur in the forecasted year. As an illustration, in a 1,000 Monte Carlo simulation trials, 3 accidents occurred 233 times out of the 1000 trials. For those 3-accident cases, two accidents happened in the same year 25 times.

Number of HCWT Explosions Potentially Affected by the Rule

Our Monte Carlo analysis indicates that we cannot statistically reject the hypothesis that SFAR 88 is 50 percent effective in preventing these accidents. This analysis, in combination with the service history since the implementation of SFAR 88, indicates that a 50 percent SFAR 88 effectiveness rate is appropriate, but we conducted a sensitivity analysis using two other possible SFAR 88 effectiveness rates of 25 percent and 75 percent in the Final Regulatory Evaluation. Using a 50 percent SFAR 88 effectiveness rate, in the absence of this final rule, we calculate that there would be 1.82 HCWT air carrier passenger airplane explosions occurring to the HCWT airplanes during the time period of the analysis. As it will take time to install FRM, 77 percent of the flight hours will be flown by airplanes with FRM while 23 percent of the flight hours will be flown by airplanes without FRM. Thus, 1.52 air carrier passenger airplane HCWT explosions will be prevented by the rule and 0.3 HCWT explosions could occur to airplanes without FRM.

Percentage of In-Flight Explosions

Our engineering analysis determined that eighty percent of the accidents would occur in flight and twenty percent would occur on the ground.

Benefits

There are two types of benefits from preventing an airplane explosion. Direct safety benefits arise from preventing the resulting fatalities and property losses. Secondly, demand benefits arise from preventing the aviation demand losses resulting from the reduction in demand to fly, which will be a consequence of a loss of public confidence in commercial aviation safety following an airplane explosion. Further, the explosion that results from an electrical charge is indistinguishable (until the accident is investigated) from an explosion caused by a terrorist bomb. This uncertainty about the explosion cause may result in costly governmental and industry reactions to a perceived terrorist plot. However, the benefits preventing such a potential reaction is too speculative to provide a definitive quantitative benefit estimate, although we have quantified a possible estimate in Appendix A of the Regulatory Evaluation.

Quantified Demand Benefits

As discussed in the economic literature, there is a direct, immediate, but temporary decrease in air travel in the aftermath of a catastrophic air carrier passenger airplane explosion. We estimate the loss to the aviation industry to be $292 million from such an accident.

Quantified Direct Benefits

Direct Benefits From Preventing a HCWT Explosion—Assumptions and Values

- Final rule is published on January 1, 2008.
- Discount rate is 7 percent.
- Passenger airplanes would be retrofitted between 2010 and 2017.
- No airplane scheduled to be retired before 2018 will be retrofitted.
- Passenger airplanes have a 25-year service life.
- With no SFAR 88 and no FRM rule, a heated center wing tank (HCWT) airplane will have a fuel tank explosion every 100 million flight hours.
- Special Federal Air Regulation (SFAR) 88 will prevent half of the future explosions.
- Boeing and Airbus HCWT airplanes have equal explosion risks.
- 80 percent of the accidents will be catastrophic in-flight accidents; with an average of 142 fatalities for a passenger airplane and 2 fatalities for a cargo airplane.
- 20 percent of the accidents will occur on-the-ground with an average of 14 fatalities for a passenger airplane and no fatalities for a cargo airplane.
- The airplane is destroyed in an HCWT explosion.
- The value of a prevented fatality is $5.5 million.

Direct Benefits From Preventing a HCWT Explosion—Results

- The average undiscounted direct benefits from preventing an air carrier passenger airplane in-flight HCWT explosion will be $841 million, with a range of $628 million to $2.2 billion.
- The average undiscounted direct benefits from preventing an air carrier passenger airplane on-the-ground HCWT explosion will be $115 million, with a range of $77 million to $320 million.
- The average undiscounted direct benefits from preventing an air carrier passenger airplane HCWT explosion weighted by an 80 percent probability of an in-flight accident and a 20 percent probability of an on-the-ground accident will be $696 million.
- The average undiscounted direct benefits from preventing an air carrier cargo airplane HCWT explosion will be $77 million.

Total Benefits

Of great concern to the FAA is that a practical solution now exists for a real threat of an aviation catastrophe. Even though these are low probability accidents, they are high consequence accidents. For example, if a single in-flight catastrophic accident with 190 occupants (235 seats) is prevented by 2012, the present value of the benefits will be greater than the present value of the costs. Using a $5.5 million value for a prevented fatality, the benefits from preventing an in-flight explosion range of $625 million to $750 million for a B–737 or an A–320 family airplane to $1.0 billion to $2.15 billion for all other affected airplanes. The mean of the estimated benefits from preventing an in-flight explosion (weighted by the number of flight hours for each type of affected airplane model) are $840 million.

Thus, the undiscounted total weighted average benefit from preventing an in-flight explosion is $1.130 billion. Adjusting this value for the 20 percent of the accidents that will occur on the ground produces an undiscounted average benefit of about $1 billion.

We calculated that the present value of the weighted average benefits from preventing the 1.5 accidents would be $657 million.

Compliance Cost Assumptions and Values

The compliance costs are based on installing a fuel tank inerting (FTI) system because that is the only FRM system that has been developed. If a future FRM system is developed that competes with FTI then we have likely overestimated the compliance costs.

- Fully burdened aviation engineer labor rate is $110 an hour.
- Fully burdened aviation mechanic labor rate is $80 an hour.
- One-time engineering costs to develop STCs or modified TCs are between $2.2 million to $5.7 million a model.
- Retrofitting kits cost from $77,000 (B–737 and A–320 Family), $120,000–$164,000 (B–757, B–767, and A–300/310), to $165,000–$192,000 (all other airplanes).
- Initial retrofitting labor costs in 2010 will range from $24,000 to $70,000.

• There is a retrofitting labor learning curve of 30 percent such that the retrofitting labor hours (and costs) will be approximately 70 percent of the 2010 labor hours in 2013 and 49 percent of the 2010 labor hours by 2017.

• Retrofitting kit and labor costs in 2010 will range from $100,000 for the B–737 and A–320 Family and $148,000 to $203,000 (for all other airplanes).

• Out-of-Service Losses (Associated with a retrofit during a routine ''D'' check) are $10,000 to $28,000.

• Out-of-Service Losses (Associated with a retrofit during a special maintenance session) are $30,000 to $84,000.

• The same reduction in hours out-of-service for labor hours will apply to the number of out-of-service hours.

• Retrofitting kits weigh 84 pounds (for the B–737 and the A–320 family), 117 pounds to 150 pounds (for the B–757, B–767, and A–300/310), and 182 pounds to 215 pounds for the B–747, B–777, and A–330/340).

• Retrofitted airplane increased annual fuel burn from weight, bleed air intake, and ram drag is 2,000–2,500 gallons (B–737) to 4,000 gallons (A–320 Family) to 4,400 to 6,500 gallons (everything else).

• Production airplane FTI kit costs are $92,000 (B–737 and A–320) to $186,000–$205,000 (for all other airplanes).

• Production airplane labor installation costs are $6,500–$8,000.

• Production kit and labor costs in 2009 will be $100,000 for the B–737 and A–320 Family) and $195,000 to $212,500 (for all other airplanes).

• Production airplane FTI weight is 105 pounds (B–737 and A–30 Family) to 250–300 pounds (for all other airplanes).

• Production airplane increased annual fuel burn from weight, bleed air intake, and ram drag is 2,900 gallons (B–737) to 4,600 gallons (A–320 Family) to 6,300 to 7,100 gallons (everything else).

• Cost of aviation fuel is $2.01 per gallon.

• Additional scheduled and unscheduled maintenance, delays, and water separator/filter replacement costs are $3,250 to $5,150.

• Annual operating costs are between $10,000 (B–737) to $15,000 (A–320 Family) to $17,500–$20,000 (for all other airplanes).

• Air separation module (ASM) replaced every 27,000 flight hours.

• ASM replacement cost is $45,000 (B–737 and A–320 Family) to $135,000–$153,000 (for all other airplanes).

Weighted average compliance costs (excluding the engineering costs) are:

*Retrofitted Passenger Airplanes:* $213,000 ($135,000 for retrofit and $78,000 for operational). *Range:* $144,000 to $395,000.

*Production Passenger Airplanes:* $177,000 ($68,000 for installation and $109,000 for operational). *Range:* $156,000 to 410,000.

Total Compliance Costs

As shown in Table 2, the present value of the total compliance costs is $1.012 billion, of which $975 million will be incurred by air carrier passenger airplane operators, and $37 million will be incurred by air carrier production cargo airplanes.

Of the air carrier passenger airplane present value costs of $975 million, operators of retrofitted airplanes will incur $436 million (43 percent) while operators of production airplanes will incur $539 million (57 percent).

TABLE 2.—COMPLIANCE COSTS BY TYPE OF OPERATION AND TYPE OF AIRPLANE

[In millions of 2007 dollars]

| Operator | Total costs | | |
|---|---|---|---|
| | Undiscounted | Present value (7%) | Present value (3%) |
| AIR CARRIER PASSENGER: | | | |
| RETROFITTED | $839 | $436 | $623 |
| PRODUCTION | 1,237 | 539 | 825 |
| AUXILIARY FUEL TANKS | <1 | <1 | <1 |
| TOTAL | 2,076 | 975 | 1,448 |
| AIR CARRIER CARGO: | | | |
| PRODUCTION | 100 | 37 | 63 |
| TOTAL | 100 | 37 | 63 |
| GRAND TOTAL | 2,176 | 1,012 | 1,511 |

As shown in Table 3, 54 percent of the present value costs (at 7 percent) for retrofitted air carrier passenger airplanes are from the engineering and one-time equipment installation costs while these costs are 47 percent for production airplanes. Similarly, 46 percent of the present value costs for retrofitted airplanes are due to additional fuel, operational, and ASM (air separation module) costs while these costs are 53 percent for production airplanes.

TABLE 3.—COMPLIANCE COSTS FOR AIR CARRIER PASSENGER AIRPLANES

[In millions of 2007 dollars]

| Cost category | Total costs | | |
|---|---|---|---|
| | Undiscounted | Present value (7%) | Present value (3%) |
| RETROFITTED: | | | |
| ENGINEERING | $19 | $16 | $18 |
| INSTALLATION | 346 | 220 | 283 |
| INVENTORY | 9 | 6 | 7 |
| FUEL | 215 | 93 | 149 |
| OPERATIONAL | 113 | 49 | 77 |

TABLE 3.—COMPLIANCE COSTS FOR AIR CARRIER PASSENGER AIRPLANES—Continued

[In millions of 2007 dollars]

| Cost category | Total costs | | |
|---|---|---|---|
| | Undiscounted | Present value (7%) | Present value (3%) |
| ASM REPLACEMENT | 137 | 52 | 89 |
| TOTAL | 839 | 436 | 623 |
| PRODUCTION: | | | |
| ENGINEERING | 107 | 100 | 103 |
| INSTALLATION | 230 | 152 | 191 |
| INVENTORY | 7 | 4 | 5 |
| FUEL | 459 | 149 | 272 |
| OPERATIONAL | 197 | 63 | 116 |
| ASM REPLACEMENT | 237 | 71 | 138 |
| TOTAL | 1,237 | 539 | 825 |
| GRAND TOTAL | 2,076 | 975 | 1,448 |

Benefit Cost Analysis

As previously described, these are low probability, high consequence accidents. If a single in-flight catastrophic accident with 190 occupants (a 235 seat airplane) were to be prevented by 2012, the present value of the benefits will be greater than the present value of the costs. Further, as shown in the Regulatory Evaluation in Appendix IV–7, there is a 26 percent probability that the final rule present value benefits will be greater than its present value costs.

As shown in Table 4, using the weighted average benefits at a 7 percent discount rate, the net benefit losses for the final rule would be $355 million, of which production passenger airplanes would account for $151 million, retrofitted passenger airplanes would account for $167 million and production cargo airplanes would account for $37 million.

TABLE 4.—PRESENT VALUE OF THE RULE BENEFITS AND COSTS

[In millions of 2007 dollars]

| Type of operation | Present value (7%) | | |
|---|---|---|---|
| | Benefits | Costs | Net benefits |
| PASSENGER: | | | |
| RETROFITTED | $271 | $438 | ($167) |
| PRODUCTION | 386 | 537 | (151) |
| TOTAL | 657 | 975 | (318) |
| PRODUCTION CARGO | <1 | 37 | (37) |
| GRAND TOTAL | 657 | 1,012 | (355) |

Sensitivity Analysis of the Rule Costs and Benefits

Table 5 provides a sensitivity analysis for the final rule that, using the weighted by flight hours average benefit value, varies the discount rate (7 and 3 percent), the value of preventing a statistical fatality ($3 million, $5.5 million, and $8 million), and the SFAR 88 effectiveness rate (25, 50, and 75 percent). As is shown, the quantified benefits are greater than the costs when the SFAR 88 effectiveness rate is 25 percent for: (1) An $8 million value of a prevented fatality and; (2) a $5.5 million value of a prevented fatality using a 3 percent discount rate. Net benefits numbers in parentheses are negative.

TABLE 5.—PRESENT VALUES OF THE BENEFITS AND COSTS FOR ALL AFFECTED AIRPLANES BY DISCOUNT RATE, VALUE OF A PREVENTED FATALITY, AND SFAR 88 EFFECTIVENESS RATE

[In millions of 2007 dollars]

| Discount rate | Value of fatality | SFAR 88 effectiveness (percent) | Present values | | |
|---|---|---|---|---|---|
| | | | Benefits | Costs | Net benefits |
| 7% | $5.5 | 50 | $657 | $1,012 | ($355) |
| 7% | 3 | 50 | 469 | 1,012 | (543) |
| 7% | 8 | 50 | 828 | 1,012 | (184) |
| 7% | 5.5 | 25 | 989 | 1,012 | (23) |
| 7% | 3 | 25 | 704 | 1,012 | (308) |

TABLE 5.—PRESENT VALUES OF THE BENEFITS AND COSTS FOR ALL AFFECTED AIRPLANES BY DISCOUNT RATE, VALUE OF A PREVENTED FATALITY, AND SFAR 88 EFFECTIVENESS RATE—Continued

[In millions of 2007 dollars]

| Discount rate | Value of fatality | SFAR 88 effectiveness (percent) | Present values | | |
|---|---|---|---|---|---|
| | | | Benefits | Costs | Net benefits |
| 7% | 8 | 25 | 1,242 | 1,012 | 230 |
| 7% | 5.5 | 75 | 330 | 1,012 | (682) |
| 7% | 3 | 75 | 235 | 1,012 | (777) |
| 7% | 8 | 75 | 414 | 1,012 | (598) |
| 3% | 5.5 | 50 | 1,141 | 1,509 | (368) |
| 3% | 3 | 50 | 842 | 1,509 | (667) |
| 3% | 8 | 50 | 1,434 | 1,509 | (75) |
| 3% | 5.5 | 25 | 1,658 | 1,509 | 149 |
| 3% | 3 | 25 | 1,263 | 1,509 | (246) |
| 3% | 8 | 25 | 2,151 | 1,509 | 642 |
| 3% | 5.5 | 75 | 517 | 1,509 | (992) |
| 3% | 3 | 75 | 421 | 1,509 | (1,088) |
| 3% | 8 | 75 | 717 | 1,509 | (792) |

Differences Between the Initial Regulatory Evaluation (IRE) and Final Regulatory Evaluation (FRE) Assumptions and Unit Values

In the IRE, we had estimated that the present value of the proposed rule's direct benefits would be $495 million and that the present value of the proposed rule's costs would be $808 million. Table 6 provides a summary of the important differences in the assumptions and the unit values between those in the IRE and those used in this FRE. The significant benefits increases are due to the quantification of the demand benefits and the use of $5.5 million for the value of a prevented fatality. In the final rule the benefits and costs were both substantially increased by the inclusion of Boeing production airplanes (except the B–787). In the NPRM analysis we assumed Boeing would voluntarily comply for its production airplanes; we did not assume this for the final rule analysis. The benefits and costs were both decreased by the shorter period of analysis. The significant cost increases are due to the increases in the production FTI kit costs, their annual additional fuel consumption due to the FTI weights and the bleed air and ram drag effects, the increased price of aviation fuel, and the air separation module (ASM) replacement costs (there will be 1 ASM replacement for most retrofitted airplanes and 2 ASM replacements for most production airplanes).

TABLE 6.—DIFFERENCES IN THE ASSUMPTIONS/VALUES IN THE IRE AND IN THE FRE

| Assumptions/values | FRE | IRE |
|---|---|---|
| Time Period of Analysis | 2009–2042 | 2006–2055. |
| Accident Rate | 1 Every 100 Million HCWT Flight Hours | 1 Every 60 Million HCWT Flight Hours. |
| Number of Flight Hours | 370 Million Total<br>364 Million Passenger.<br>6 Million Production Cargo.. | 460 Million. |
| Number of Accidents | 3.7 Total<br>3.64 Passenger.<br>0.06 Cargo. | 7.67. |
| Percentage of In-Flight Accidents | 80% | 100%. |
| Base Year for Dollars | 2007 | 2004. |
| Reduction in Air Travel Demand | $292 Million (annual real growth rate of 3%) | Qualitatively large. |
| Value of a Prevented Fatality | $5.5 Million | $3 Million. |
| Average Number of In-Flight Fatalities | 142 | 142. |
| Average Number of On-the-Ground Fatalities | 14 | 8. |
| Average Accident Value for an In-Flight Explosion (Passenger Airplane). | $841 Million | $505 Million. |
| Average Accident Value for an On-the-Ground Explosion (Passenger Airplane). | $115 Million | Not Estimated. |
| Weighted Average Accident Value (Passenger Airplane) | $696 Million | $505 Million. |
| Weighted Average Accident Value (Production Cargo Airplane). | $77 Million | $75 Million. |
| Hourly Labor Rates | Engineer $110<br>Mechanic $80 | Engineer $115.<br>Mechanic $75. |
| Total Number of Retrofits | Passenger 2,732<br>Boeing 1,780<br>Airbus 952 | Passenger 3,328.<br>Boeing 2,327.<br>Airbus 1,001. |
| Retrofitting Kit Costs | Small $77,000<br>Medium $120,000–$164,000<br>Large $175,000–$192,000 | Small $105,000.<br>Medium $135,000.<br>Large $179,000. |
| Retrofitting Labor Costs (Scheduled Maintenance) | $24,000–$28,000 | $30,000–$35,000. |

TABLE 6.—DIFFERENCES IN THE ASSUMPTIONS/VALUES IN THE IRE AND IN THE FRE—Continued

| Assumptions/values | FRE | IRE |
|---|---|---|
| Number of Out-of-Service Days (Scheduled Maintenance). | 2 | 2. |
| Out-of-Service Costs (Scheduled Maintenance) | Small $10,000 | Small $9,000. |
| | Medium $22,000 | Medium $14,000. |
| | Large $28,000 | Large $13,000. |
| Retrofitting Costs (Scheduled Maintenance) | Small $110,000 | Small $135,000. |
| | Medium $165,000–$215,000 | Medium $170,000. |
| | Large $214,000–$229,000 | Large $214,000. |
| Retrofitting Labor Costs (Dedicated Visit) | $62,000–$70,000 | $40,000–$45,000. |
| Number of Out-of-Service Days (Dedicated Visit) | 6 | 4. |
| Out-of-Service Costs (Dedicated Visit) | Small $30,000 | Small $19,000. |
| | Medium $66,000 | Medium $56,000. |
| | Large $84,000 | Large $53,000. |
| Retrofitting Costs (Dedicated Visit) | Small $137,000 | Small $163,000. |
| | Medium $211,000–$264,000 | Medium $234,000. |
| | Large $289,000–$311,000 | Large $276,000. |
| Fuel Cost per Gallon | $2.01 | $1.00. |
| Retrofitting FTI Weight | Small 84 lbs | Small 95 lbs. |
| | Medium 117–150 lbs | Medium 148 lbs. |
| | Large 182–215 lbs | Large 218 lbs. |
| Annual Retrofitted Passenger Airplane Fuel Consumption (Weight, Bleed Air, and Ram Drag). | Small 2,500–4,000 Gals | Small 1,500–3,900. |
| | Medium 3,000–4,125 Gals | Medium 2,900. |
| | Large 4,500–6,550 Gals | Large 4,800. |
| Annual Retrofitted Passenger Airplane Fuel Cost | Small $5,250–$8,000 | Small $1,500–$3,900. |
| | Medium $6,000–$8,300 | Medium $2,900. |
| | Large $9,000–$13,150 | Large $4,800. |
| Total Number of Production Passenger Airplanes | Total 2,290 (2009–2017) | Total 3,274 (2008–2030). |
| | Boeing 1,268 | Boeing 0. |
| | Airbus 1,022 | Airbus 2,650. |
| Total Number of Production (No Conversion) Cargo Airplanes. | Total 88 (2009–2017) | Total 624 (2008–2030). |
| | Boeing 66 | Boeing 0. |
| | Airbus 22 | Airbus 624 (includes Conversion). |
| Production Kit Costs | Small $92,000 | Small $83,000. |
| | Medium $186,000 | Medium $107,000. |
| | Large $205,000 | Large $137,000. |
| Production Labor Costs | $6,500–$8.000 | $7,000–$8.000. |
| Unit Production Costs | Small $98,000 | Small $90,000. |
| | Medium $194,000 | Medium $115,000. |
| | Large $213,000 | Large $145,000. |
| Production FTI Weight | Small 105 lbs | Small 95 lbs. |
| | Medium 280 lbs | Medium 148 lbs. |
| | Large 300 lbs | Large 218 lbs. |
| Annual Production Passenger Airplane Fuel Consumption (Weight, Bleed Air, and Ram Drag). | Small 2,300–4,625 Gals | Small 1,500–3,900. |
| | Medium 5,600–6,725 Gals | Medium 2,900. |
| | Large 6,850–8,600 Gals | Large 4,800. |
| Annual Production Passenger Airplane Fuel Cost | Small $3,850–$7,625 | Small $1,500–$3,900. |
| | Medium $9,250–$11,100 | Medium $2,900. |
| | Large $11,300–$14,300 | Large $4,800. |
| Maintenance | $3,250–$5,150 | $5,900–$7,500. |
| ASM Replacement Cost (Every 9 Years) | Small $30,500–$45,000 | Small $5,275. |
| | Medium $135,000 | Medium $18,761. |
| | Large $153,000 | Large $28,814. |

Costs and Benefits of Alternatives to the Final Rule

As shown in Table 7, we evaluated the baseline costs and weighted average benefits for the 8 alternatives to the final rule using a value of $5.5 million for a prevented fatality, a 7 percent discount rate, and a 50 percent SFAR 88 effectiveness rate. These expected benefits are based on a rare event mean probability. The date when an avoided accident occurs has a significant impact on the expected benefits.

ALTERNATIVE 1. Cover only air carrier passenger airplanes

ALTERNATIVE 2. Exclude auxiliary fuel tanks

ALTERNATIVE 3. Cover only air carrier retrofitted passenger airplanes

ALTERNATIVE 4. Cover only air carrier production passenger airplanes

ALTERNATIVE 5. Cover only air carrier production passenger and cargo airplanes

ALTERNATIVE 6. Final rule plus part 91 airplanes

ALTERNATIVE 7. Final rule plus conversion cargo airplanes

ALTERNATIVE 8. Final rule plus conversion and retrofitted cargo airplanes

TABLE 7.—BENEFITS AND COST SUMMARIES FOR 8 ALTERNATIVES TO THE FINAL RULE USING A $5.5 MILLION VALUE FOR A PREVENTED FATALITY, A 7 PERCENT DISCOUNT RATE, AND A 50 PERCENT SFAR 88 EFFECTIVENESS RATE

[In millions of 2007 dollars]

| Option | Present value (7%) | | Net benefits |
|---|---|---|---|
| | Benefits | Costs | |
| FINAL RULE | $657 | $1,012 | ($355) |
| ALTERNATIVES: | | | |
| 1. Cover Only Part 121 Passenger Airplanes (excludes Part 121 cargo and Part 91) | 657 | 975 | (318) |
| 2. Cover Only Part 121 Passenger Airplanes but No Auxiliary Tanks | 657 | 975 | (318) |
| 3. Cover Only Part 121 Retrofitted Passenger Airplanes (excludes All Production Passenger, all Cargo, and Part 91 Airplanes) | 271 | 438 | (167) |
| 4. Cover Only Part 121 Production Passenger Airplanes | 386 | 537 | (151) |
| 5. Cover Only Part 121 Production Passenger and Cargo Airplanes | 386 | 574 | (188) |
| 6. Final Rule Plus Part 91 Airplanes | 657 | 1,026 | (369) |
| 7. Final Rule Plus Conversion Cargo Airplanes | 657 | 1,109 | (452) |
| 8. Final Rule Plus Conversion and Retrofitted Cargo Airplanes | 657 | 1,229 | (572) |

Another way to analyze these alternatives is to evaluate them on an incremental cost per life saved; i.e., a cost-effectiveness analysis. For this rule, the effectiveness metric is the number of expected prevented fuel tank explosions, which is then converted into the present value of the number of fatalities prevented. The mid-point of the time-frame in which an accident would happen is 2022 for production airplanes and 2019 for retrofitted airplanes. For all other airplanes, the mid-point would be about 50 years from today, or 2060. In Table 8, the first column lists the specific types of airplanes that could have FRM installed. The second column reports the number of fuel tank explosions that FRM would prevent using an SFAR 88 effectiveness rate of 50 percent. The third column provides the present value of the total costs to install FRM on those airplanes minus the present value of the destroyed airplane and minus the demand benefits weighted by the number of flight hours. The passenger airplane hull value is $50, which gives present values of $19 million for production airplanes and $24 million for retrofitted airplanes. The present value of the demand benefits would be $100 million for retrofitted airplanes and $151 million for production airplanes. The fourth column takes the number of prevented explosions and divides it into the costs to calculate the present value of the cost to prevent one explosion. The fifth column provides the number of fatalities that would be prevented if FRM were installed on the airplane assuming that 80 percent of the explosions would be in-flight and 20 percent would be on the ground. These numbers are then adjusted by the discount rate to reflect the present value of the fatalities for production and retrofitted passenger airplanes. The final column supplies the average present value of the cost for that option to prevent one fatality. As shown in Table 8, the two most cost-effective options would be to install FRM on production passenger airplanes and on existing passenger airplanes. The final rule contains all of the options except conversion cargo airplanes and retrofitted cargo airplanes.

TABLE 8.—INCREMENTAL COST EFFECTIVENESS ANALYSIS OF THE INDIVIDUAL ALTERNATIVES USING A PRESENT VALUE ANALYSIS WITH A 7 PERCENT DISCOUNT RATE AND A 50 PERCENT SFAR 88 EFFECTIVENESS RATE

[Total costs in millions of 2007 dollars]

| Options | Number of explosions prevented | PV | PV | Average No. of fatalities | PV |
|---|---|---|---|---|---|
| | | Costs—hull and demand loss | Cost to prevent one accident | | Cost to prevent 1 statistical fatality |
| Production Passenger Airplanes | 1.00 | $367 | $367 | 46 | $8.000 |
| Production Cargo Airplanes | 0.0385 | 37 | 961 | .055 | 17,473.000 |
| Production Part 91 Airplanes | 0.00082 | 2 | 2,439 | .249 | 9,785.000 |
| Retrofitted Passenger Airplanes | 0.52 | 314 | 604 | 56 | 11.000 |
| Conversion Cargo Airplanes | 0.095 | 83 | 874 | .055 | 15,891.000 |
| Retrofitted Cargo Airplanes | 0.064 | 110 | 1,719 | .055 | 31,255.000 |
| Retrofitted Part 91 Airplanes | 0.0194 | 12 | 6,186 | .249 | 24,843.000 |
| Final Rule | 1.5585 | 741 | 475 | 49 | 10.000 |

## Conclusion

When modeling discrete rare events such as fuel tank explosions, it is important to understand and evaluate the distribution around the mean value rather than to rely only on a single point estimated value. This variability analysis indicates there is a substantial (23 percent) probability that the quantified benefits will be greater than the costs.

The Federal Aviation Administration believes that the correct public policy choice is to eliminate the substantial probability of a high consequence fuel tank explosion accident by proceeding with the final rule.

## Regulatory Flexibility Analysis

### Introduction and Purpose of This Analysis

The Regulatory Flexibility Act of 1980 (Pub. L. 96–354) (RFA) establishes "as a principle of regulatory issuance that agencies shall endeavor, consistent with the objectives of the rule and of applicable statutes, to fit regulatory and informational requirements to the scale of the businesses, organizations, and governmental jurisdictions subject to regulation. To achieve this principle, agencies are required to solicit and consider flexible regulatory proposals and to explain the rationale for their actions to assure that such proposals are given serious consideration.'' The RFA 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 rule will have a significant economic impact on a substantial number of small entities. If the agency determines that it will, the agency must prepare a regulatory flexibility analysis as described in the RFA.

We believe that this final rule will have a significant economic impact on a substantial number of small entities. The purpose of this analysis is to provide the reasoning underlying the FAA determination. The FAA has determined that:

—There will not be a significant impact on a substantial number of manufacturers.
—There will be a significant impact on a substantial number of small operators.

To make this determination in this final rule, we perform a Regulatory Flexibility Analysis (RFA). Under Section 63(b) of the RFA, the analysis must address:

—Description of reasons the agency is considering the action.
—Statement of the legal basis and objectives for the rule.
—Significant issues raised during public comment.
—Description of the recordkeeping and other compliance requirements of the rule.
—All federal rules that may duplicate, overlap, or conflict with the rule.
—Description and an estimated number of small entities.
—Economic impact.
—Describe the alternatives considered.

Description of Reasons the Agency Is Considering the Action

Fuel tank explosions have been a threat with serious aviation safety implications for many years. The explosion of TWA Flight 800 (a Boeing 747) off Long Island, New York in 1996 occurred in-flight with the loss of all 230 on board. Two other explosions on airplanes operated by Philippine Airlines and Thai Airlines occurred on the ground (resulting in nine fatalities). While the accident investigations of the TWA, Philippine Airlines, and Thai Airlines accidents failed to identify the ignition source that caused the explosion, the investigations found several similarities

The requirements contained in this final rule will reduce the likelihood of fuel tank fires, and mitigate the effects of a fire if one occurs.

Statement of the Legal Basis and Objectives for the Rule

The FAA's authority to issue rules regarding aviation safety is found in Title 49 of the United States Code. Subtitle I, Section 106 describes the authority of the FAA Administrator. Subtitle VII, Aviation Programs, describes in more detail the scope of the agency's authority.

This rulemaking is promulgated under the authority described in Subtitle VII, Part A, Subpart III, Section 44701, ''General requirements.'' Under that section, the FAA is charged with promoting safe flight of civil aircraft in air commerce by prescribing minimum standards required in the interest of safety for the design and performance of aircraft; regulations and minimum standards in the interest of aviation safety for inspecting, servicing, and overhauling aircraft; and regulations for other practices, methods, and procedures the Administrator finds necessary for safety in air commerce. This regulation is within the scope of that authority because it prescribes:

• New safety standards for the design of transport category airplanes, and
• New requirements necessary for safety for the design, production, operation and maintenance of those airplanes, and for other practices, methods, and procedures related to those airplanes.

Accordingly, this final rule amends Title 14 of the Code of Federal Regulations and address deficiencies in current regulations regarding airplane designs of the current and future fleet. The rule will require transport category airplanes to minimize flammability of fuel tanks.

Significant Issues Raised During Public Comment

Individuals and companies commented that they will incur costs as a result of the requirements contained in the rule. The National Air Carrier Association (NACA) supports FRM being applied to production passenger airplanes. They oppose applying FRM to existing passenger airplanes and to any cargo airplanes. Their primary concerns were that the cost of retrofitting passenger airplanes was too high for the potential benefits and they believe that cargo airplanes were not at risk. They did not provide specific cost estimates. The Regional Airline Association (RAA) opposes any FRM requirement, although only one of their member airlines has airplanes that will be affected by the final rule.

Description of the Recordkeeping and Other Compliance Requirements of the Rule

We expect no more than minimal new reporting and recordkeeping compliant requirements to result from this rule. The rule will require additional entries in existing required maintenance records to account for either the additional maintenance requirements or the installation of nitrogen-inerting systems and the addition of insulation between heat-generating equipment and fuel tanks.

All Federal Rules That May Duplicate, Overlap, or Conflict With the Rule

SFAR 88 was enacted to ensure no ignition sources exist in the fuel tanks. After that rule was promulgated and the manufacturers' safety analyses were submitted to the regulatory authorities, we continued to find ignition sources that had not been revealed in the safety analyses. Thus, SFAR 88 cannot eliminate all future ignition sources. This rule is designed to work in conjunction with SFAR 88 to prevent future HCWT explosions. We are unaware that the rule will overlap, duplicate or conflict with any other existing Federal Rules.

Description and an Estimated Number of Small Entities

The FAA uses the size standards from the Small Business Administration for Air Transportation and Aircraft Manufacturing specifying companies having less than 1,500 employees as small entities. Boeing is the sole U.S. manufacturer affected by this final rule. As Boeing has more than 1,500 employees and is not considered a small entity, there will not be a significant impact on a substantial number of manufacturers.

We identified a total of 15 U.S. operators who will be affected by this final rule and qualify as small businesses because they have fewer than 1,500 employees. These 15 entities operate a total of 214 airplanes. Once the firms were classified as small entities, we gathered information on their annual revenues.

We obtained the small entities' fleets using data from FAA Flight Standards and BACK Associates Fleet Database. The number of employees and revenues were obtained from the U.S. Department of Transportation Form 41 filings, BTS Office of Airline Information, Hoovers Online, and Thomas Gale Business and Company Resource Center.

Economic Impact

To assess the cost impact to small business part 121 airlines, we estimated the present value retrofit cost for the affected aircraft in the small entities fleet. Table 8 summarizes the cost to retrofit per airplane and the associated model types.

TABLE 8.—RETROFIT COST BY AIRPLANE MODEL

| Model | Present value cost |
|---|---|
| Retrofit Cost Per Model: | |
| B–737–Classic | $137,000 |
| B–737–NG | 121,000 |
| B–757 | 211,000 |
| B–767 | 264,000 |
| B747–100/100/300 | 289,000 |
| B–747–400 | 289,000 |
| B–777 | 311,000 |
| A–320 Family | 137,000 |
| A–330 | 311,000 |

We estimated each operator's compliance cost by multiplying the average retrofit cost per airplane by the total number of each type of airplane the operator currently has. Then we measured the economic impact on small entities by dividing the firms' total estimated present value compliance cost by its annual revenue. We believe that if the retrofit cost exceeds 2% of a firm's annual revenue, then there is a significant economic impact. As shown in the following table, the present value of the retrofitting costs is estimated to be greater than two percent of annual revenues for three small operators. Thus, as the rule will have a significant economic impact on three small operators we determined this final rule will have a significant impact on a substantial number of small entities.

TABLE 9.—TOTAL RETROFITTING COSTS AND THEIR PERCENTAGE OF ANNUAL REVENUES FOR THE AFFECTED SMALL OPERATORS

| Airplane model | Small entity operator | Number of affected aircraft | Cost | Annual revenue | Cost as a percent of revenue |
|---|---|---|---|---|---|
| BOEING 737–700 | ALOHA AIRLINES | 2 | $242,000 | | |
| BOEING 737–700 | ALOHA AIRLINES | 5 | 605,000 | | |
| BOEING 737–700 | ALOHA AIRLINES | 1 | 121,000 | | |
| Total | | | 968,000 | $300,601,582 | 0.32 |
| BOEING 737–300 | ATA AIRLINES | 3 | 411,000 | | |
| BOEING 737–800 | ATA AIRLINES | 11 | 1,331,000 | | |
| BOEING 737–800 | ATA AIRLINES | 1 | 121,000 | | |
| BOEING 757–200 | ATA AIRLINES | 4 | 1,055,000 | | |
| BOEING 757–200 | ATA AIRLINES | 2 | 422,000 | | |
| BOEING 757–300 | ATA AIRLINES | 4 | 844,000 | | |
| Total | | | 4,184,000 | 330,177,135 | 1.27 |
| BOEING 757–200 | EOS AIRLINES | 3 | 633,000 | 1,084,907 | 58.350 |
| AIRBUS A318–100 | FRONTIER AIRLINES [CO-USA] | 8 | 1,096,000 | | |
| AIRBUS A319–100 | FRONTIER AIRLINES [CO-USA] | 39 | 5,343,000 | | |
| AIRBUS A319–100 | FRONTIER AIRLINES [CO-USA] | 10 | 1,370,000 | | |
| Total | | | 7,809,000 | 1,130,837,682 | 0.69 |
| BOEING 767–300 | HAWAIIAN AIRLINES | 4 | 1,056,000 | | |
| BOEING 767–300 | HAWAIIAN AIRLINES | 8 | 2,112,000 | | |
| BOEING 767–300 | HAWAIIAN AIRLINES | 3 | 792,000 | | |
| BOEING 767–300 | HAWAIIAN AIRLINES | 3 | 792,000 | | |
| Total | | | 4,752,000 | 881,599,398 | 0.54 |
| BOEING 767–200 | MAXJET AIRWAYS | 1 | 264,000 | | |
| BOEING 767–200 | MAXJET AIRWAYS | 1 | 264,000 | | |
| BOEING 767–200 | MAXJET AIRWAYS | 1 | 264,000 | | |
| Total | | | 792,000 | 2,422,199 | 32.70 |
| BOEING 737–400 | MIAMI AIR INTERNATIONAL | 2 | 274,000 | | |
| BOEING 737–800 | MIAMI AIR INTERNATIONAL | 3 | 363,000 | | |
| BOEING 737–800 | MIAMI AIR INTERNATIONAL | 1 | 121,000 | | |
| BOEING 737–800 | MIAMI AIR INTERNATIONAL | 1 | 121,000 | | |
| BOEING 737–800 | MIAMI AIR INTERNATIONAL | 2 | 121,000 | | |
| Total | | | 1,000,000 | 73,403,477 | 1.36 |
| BOEING 757–200 | PRIMARIS AIRLINES | 1 | 211,000 | 19,403,658 | 1.09 |
| BOEING 737–300 | RYAN INTERNATIONAL AIRLINES | 1 | 137,000 | | |
| BOEING 737–400 | RYAN INTERNATIONAL AIRLINES | 1 | 137,000 | | |
| BOEING 737–800 | RYAN INTERNATIONAL AIRLINES | 2 | 242,000 | | |
| BOEING 737–800 | RYAN INTERNATIONAL AIRLINES | 1 | 121,000 | | |

TABLE 9.—TOTAL RETROFITTING COSTS AND THEIR PERCENTAGE OF ANNUAL REVENUES FOR THE AFFECTED SMALL OPERATORS—Continued

| Airplane model | Small entity operator | Number of affected aircraft | Cost | Annual revenue | Cost as a percent of revenue |
|---|---|---|---|---|---|
| BOEING 737–800 | RYAN INTERNATIONAL AIRLINES | 1 | 121,000 | | |
| BOEING 757–200 | RYAN INTERNATIONAL AIRLINES | 1 | 211,000 | | |
| BOEING 757–200 | RYAN INTERNATIONAL AIRLINES | 1 | 211,000 | | |
| BOEING 757–200 | RYAN INTERNATIONAL AIRLINES | 2 | 422,000 | | |
| Total | | | 1,602,000 | 101,560,750 | 1.58 |
| AIRBUS A319–100 | SPIRIT AIRLINES [USA] | 30 | 4,100,000 | | |
| AIRBUS A321–100 | SPIRIT AIRLINES [USA] | 6 | 822,000 | | |
| Total | | | 4,922,000 | 540,426,363 | 0.91 |
| BOEING 737–800 | SUN COUNTRY AIRLINES | 2 | 242,000 | | |
| BOEING 737–800 | SUN COUNTRY AIRLINES | 6 | 726,000 | | |
| BOEING 737–800 | SUN COUNTRY AIRLINES | 2 | 242,000 | | |
| BOEING 737–800 | SUN COUNTRY AIRLINES | 3 | 363,000 | | |
| Total | | | 1,573,000 | 225,789,595 | 0.70 |
| AIRBUS A320–100 | USA 3000 AIRLINES | 1 | 137,000 | | |
| AIRBUS A320–100 | USA 3000 AIRLINES | 1 | 137,000 | | |
| AIRBUS A320–100 | USA 3000 AIRLINES | 9 | 1,233,000 | | |
| Total | | | 1,507,000 | 132,077,603 | 1.14 |
| B–737–429 | CASINO EXPRESS | 1 | 137,000 | | |
| B–737–46B | CASINO EXPRESS | 1 | 137,000 | | |
| B–737–4S3 | CASINO EXPRESS | 1 | 137,000 | | |
| B–737–8Q8 | CASINO EXPRESS | 2 | 242,000 | | |
| B–737–8Q8 | CASINO EXPRESS | 1 | 121,000 | | |
| B–737–86N | CASINO EXPRESS | 1 | 121,000 | | |
| Total | | | 895,000 | 34,178,453 | 2.62 |
| B–737–3Y0 | PACE AIRLINES | 1 | 137,000 | | |
| B–757–256 | PACE AIRLINES | 1 | 137,000 | | |
| B–757–236 | PACE AIRLINES | 1 | 137,000 | | |
| Total | | | 411,000 | 40,411,353 | 1.02 |

Describe the Alternatives Considered

As described in the Analysis of Alternatives section, we evaluated the following 8 alternatives to the final rule.

ALTERNATIVE 1. Cover only air carrier passenger airplanes
ALTERNATIVE 2. Exclude auxiliary fuel tanks
ALTERNATIVE 3. Cover only air carrier retrofitted passenger airplanes
ALTERNATIVE 4. Cover only air carrier production passenger airplanes
ALTERNATIVE 5. Cover only air carrier production passenger and cargo airplanes
ALTERNATIVE 6. Final rule plus part 91 airplanes
ALTERNATIVE 7. Final rule plus conversion cargo airplanes
ALTERNATIVE 8. Final rule plus conversion and retrofitted cargo airplanes

Our conclusion was that the final rule provided the best balance of cost and benefits for the United States society. Whether an airplane is flown by a small entity or by a large entity, the risk is largely the same. Consequently, we determined that the final rule should apply to all passenger airplanes and to production cargo airplanes.

Regulatory Flexibility Analysis Summary

As the rule will have a significant economic impact on three small operators, we determined this final rule will have a significant impact on a substantial number of small entities.

International Trade Analysis

The Trade Agreements Act of 1979 (Pub. L. 96–39), as amended by the Uruguay Round Agreements Act (Pub. L. 103–465), prohibits Federal agencies from establishing any standards or engaging in related activities that create unnecessary obstacles to the foreign commerce of the United States. Pursuant to these Acts, the establishment of standards are not considered unnecessary obstacles to the foreign commerce of the United States, when the standards have a legitimate domestic objective, such as the protection of safety, and when the standards do not operate in a manner that excludes imports that meet this objective. The statute also requires consideration of international standards and, where appropriate, that they be the basis for U.S. standards. The FAA notes the purpose of this rule is to ensure the safety of the American public. We have assessed the effects of this rule to ensure that it does not exclude imports that meet this objective. As a result, this rule is not considered as creating unnecessary obstacles to foreign commerce.

Unfunded Mandates Act

Title II of the Unfunded Mandates Reform Act of 1995 (Pub. L. 104–4) requires each Federal agency to prepare a written statement assessing the effects of any Federal mandate in a proposed or final agency rule that may result in an expenditure of $100 million or more (adjusted annually for inflation with the base year 1995) in any one year by State, local, and tribal governments, in the aggregate, or by the private sector; such a mandate is deemed to be a ''significant regulatory action.'' The FAA currently uses an inflation-adjusted value of $136.1 million in lieu of $100 million.

There will be 3 years (2015, 2016, and 2017) in which the undiscounted costs will be greater than $136.1 million. Consequently, in Table 7 of the regulatory evaluation summary, we evaluated the costs and benefits of 8 alternatives to the final rule.

*Executive Order 13132, Federalism*

The FAA has analyzed this rule under the principles and criteria of Executive Order 13132, Federalism. We determined that this action will not have a substantial direct effect on the States, on the relationship between the national Government and the States, or on the distribution of power and responsibilities among the various levels of government, and therefore will not have federalism implications.

*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 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 rule applies to the certification of future designs of transport category airplanes and their subsequent operation, it could affect intrastate aviation in Alaska. Nevertheless, the FAA has determined that it is inappropriate to relieve intrastate aviation interests in Alaska from the requirements of today's rule because of the safety objective served by this rule.

*Environmental Analysis*

FAA Order 1050.1E identifies FAA actions that are categorically excluded from preparation of an environmental assessment or environmental impact statement under the National Environmental Policy Act in the absence of extraordinary circumstances. The FAA has determined this rulemaking action qualifies for the categorical exclusion identified in paragraph 312f and involves no extraordinary circumstances.

*Regulations that Significantly Affect Energy Supply, Distribution, or Use*

The FAA has analyzed this rule under Executive Order 13211, Actions Concerning Regulations that Significantly Affect Energy Supply, Distribution, or Use (May 18, 2001). We have determined that it is not a ''significant energy action'' under the executive order because the rule is not likely to have a significant adverse effect on the supply, distribution, or use of energy.

**Submission of Comments**

*Request for Comments*

Comments should be submitted to Docket No. FAA–2005–22997 by January 20, 2009. Comments may be submitted to the docket using any of the means listed in the Addresses section below.

We will file in the docket all comments we receive, as well as a report summarizing each substantive public contact with FAA personnel concerning this rulemaking. The docket is available for public inspection before and after the comment closing date.

*Privacy Act:* We will post all comments we receive, without change, to *http://www.regulations.gov*, including any personal information you provide. Using the search function of our docket Web site, anyone can find and read the comments received into any of our dockets, including the name of the individual sending the comment (or signing the comment for an association, business, labor union, etc.). You may review DOT's complete Privacy Act Statement in the **Federal Register** published on April 11, 2000 (65 FR 19477–78) or you may visit *http://DocketsInfo.dot.gov*.

*Proprietary or Confidential Business Information*

Do not file in the docket information that you consider to be proprietary or confidential business information. Send or deliver this information directly to the person identified in the **FOR FURTHER INFORMATION CONTACT** section of this document. You must mark the information that you consider proprietary or confidential. If you send the information on a disk or CD ROM, mark the outside of the disk or CD ROM and also identify electronically within the disk or CD ROM the specific information that is proprietary or confidential.

Under 14 CFR 11.35(b), when we are aware of proprietary information filed with a comment, we do not place it in the docket. We hold it in a separate file to which the public does not have access, and we place a note in the docket that we have received it. If we receive a request to examine or copy this information, we treat it as any other request under the Freedom of Information Act (5 U.S.C. 552). We process such a request under the DOT procedures found in 49 CFR part 7.

**ADDRESSES:** You may send comments identified by Docket Number FAA–2004–22997 using any of the following methods:

- *Federal eRulemaking Portal:* Go to *http://www.regulations.gov* and follow the online instructions for sending your comments electronically.
- *Mail:* Send comments to Docket Operations, M–30, U.S. Department of Transportation, 1200 New Jersey Avenue, SE., West Building Ground Floor, Room W12–140, Washington, DC 20590–0001.
- *Fax:* Fax comments to the Docket Operations at 202–493–2251.
- *Hand Delivery or Courier:* Bring comments to Docket Operations in Room W12–140 of the West Building Ground Floor at 1200 New Jersey Avenue, SE., Washington, DC, between 9 a.m. and 5 p.m., Monday through Friday, except Federal holidays.

*Docket:* To read background documents or comments received, go to *http://www.regulations.gov* at any time or to Room W12–140 of the West Building Ground Floor at 1200 New Jersey Avenue, SE., Washington, DC, between 9 a.m. and 5 p.m., Monday through Friday, except Federal holidays.

**Availability of Rulemaking Documents**

You can get an electronic copy using the Internet by:

(1) Searching the Federal eRulemaking Portal (*http://www.regulations.gov*);

(2) Visiting the FAA's Regulations and Policies Web page at *http://www.faa.gov/regulations_policies/*; or

(3) Accessing the Government Printing Office's web page at *http://www.gpoaccess.gov/fr/index.html*.

You can also get a copy by submitting a request to the Federal Aviation Administration, Office of Rulemaking, ARM–1, 800 Independence Avenue, SW., Washington, DC 20591, or by calling (202) 267–9680. Make sure to identify the docket number, or amendment number of this rulemaking.

**Small Business Regulatory Enforcement Fairness Act**

The Small Business Regulatory Enforcement Fairness Act (SFREFA) of 1996 requires FAA to comply with small entity requests for information or advice about compliance with statutes and regulations within its jurisdiction. If you are a small entity and you have a question regarding this document, you may contact its local FAA official, or the person listed under **FOR FURTHER INFORMATION CONTACT**. You can find out more about SBREFA on the Internet at *http://www.faa.gov/regulations_policies/rulemaking/sbre_act/*.

### List of Subjects

*14 CFR part 25*

Aircraft, Aviation safety, Incorporation by reference, Reporting and recordkeeping requirements.

*14 CFR part 26*

Aircraft, Aviation safety, Continued airworthiness.

*14 CFR part 121*

Air carriers, Aircraft, Aviation safety, Reporting and recordkeeping requirements, Safety, Transportation.

*14 CFR part 125*

Aircraft, Aviation safety, Reporting and recordkeeping requirements.

*14 CFR part 129*

Air carriers, Aircraft, Aviation safety, Reporting and recordkeeping requirements, Security measures.

### V. The Amendment

■ In consideration of the foregoing, the Federal Aviation Administration amends Chapter 1 of Title 14, Code of Federal Regulations (CFR) parts 25, 26, 121, 125, and 129, as follows:

## PART 25—AIRWORTHINESS STANDARDS: TRANSPORT CATEGORY AIRPLANES

■ 1. The authority citation for part 25 continues to read as follows:

**Authority:** 49 U.S.C. 106(g), 40113, 44701, 44702 and 44704.

■ 2. Part 25 is amended by adding a new § 25.5 to read as follows:

#### § 25.5 Incorporations by reference.

(a) The materials listed in this section are incorporated by reference in the corresponding sections noted. These incorporations by reference were approved by the Director of the Federal Register in accordance with 5 U.S.C. 552(a) and 1 CFR part 51. These materials are incorporated as they exist on the date of the approval, and notice of any change in these materials will be published in the **Federal Register**. The materials are available for purchase at the corresponding addresses noted below, and all are available for inspection at the National Archives and Records Administration (NARA), and at FAA, Transport Airplane Directorate, Aircraft Certification Service, 1601 Lind Avenue, SW., Renton, Washington 98057–3356. For information on the availability of this material at NARA, call 202–741–6030, or go to: *http://www.archives.gov/federal_register/code_of_federal_regulations/ibr_locations.html*.

(b) The following materials are available for purchase from the following address: The National Technical Information Services (NTIS), Springfield, Virginia 22166.

(1) Fuel Tank Flammability Assessment Method User's Manual, dated May 2008, document number DOT/FAA/AR–05/8, IBR approved for § 25.981 and Appendix N. It can also be obtained at the following Web site: *http://www.fire.tc.faa.gov/systems/fueltank/FTFAM.stm*.

(2) [Reserved]

■ 3. Amend § 25.981 by revising paragraphs (b) and (c) and adding a new paragraph (d) to read as follows:

#### § 25.981 Fuel tank explosion prevention.

* * * * *

(b) Except as provided in paragraphs (b)(2) and (c) of this section, no fuel tank Fleet Average Flammability Exposure on an airplane may exceed three percent of the Flammability Exposure Evaluation Time (FEET) as defined in Appendix N of this part, or that of a fuel tank within the wing of the airplane model being evaluated, whichever is greater. If the wing is not a conventional unheated aluminum wing, the analysis must be based on an assumed Equivalent Conventional Unheated Aluminum Wing Tank.

(1) Fleet Average Flammability Exposure is determined in accordance with Appendix N of this part. The assessment must be done in accordance with the methods and procedures set forth in the Fuel Tank Flammability Assessment Method User's Manual, dated May 2008, document number DOT/FAA/AR–05/8 (incorporated by reference, see § 25.5).

(2) Any fuel tank other than a main fuel tank on an airplane must meet the flammability exposure criteria of Appendix M to this part if any portion of the tank is located within the fuselage contour.

(3) As used in this paragraph,

(i) *Equivalent Conventional Unheated Aluminum Wing Tank* is an integral tank in an unheated semi-monocoque aluminum wing of a subsonic airplane that is equivalent in aerodynamic performance, structural capability, fuel tank capacity and tank configuration to the designed wing.

(ii) *Fleet Average Flammability Exposure* is defined in Appendix N to this part and means the percentage of time each fuel tank ullage is flammable for a fleet of an airplane type operating over the range of flight lengths.

(iii) *Main Fuel Tank* means a fuel tank that feeds fuel directly into one or more engines and holds required fuel reserves continually throughout each flight.

(c) Paragraph (b) of this section does not apply to a fuel tank if means are provided to mitigate the effects of an ignition of fuel vapors within that fuel tank such that no damage caused by an ignition will prevent continued safe flight and landing.

(d) Critical design configuration control limitations (CDCCL), inspections, or other procedures must be established, as necessary, to prevent development of ignition sources within the fuel tank system pursuant to paragraph (a) of this section, to prevent increasing the flammability exposure of the tanks above that permitted under paragraph (b) of this section, and to prevent degradation of the performance and reliability of any means provided according to paragraphs (a) or (c) of this section. These CDCCL, inspections, and procedures must be included in the Airworthiness Limitations section of the instructions for continued airworthiness required by § 25.1529. Visible means of identifying critical features of the design must be placed in areas of the airplane where foreseeable maintenance actions, repairs, or alterations may compromise the critical design configuration control limitations (e.g., color-coding of wire to identify separation limitation). These visible means must also be identified as CDCCL.

■ 4. Part 25 is amended by adding a new APPENDIX M to read as follows:

### APPENDIX M TO PART 25—FUEL TANK SYSTEM FLAMMABILITY REDUCTION MEANS

M25.1 *Fuel tank flammability exposure requirements.*

(a) The Fleet Average Flammability Exposure of each fuel tank, as determined in accordance with Appendix N of this part, may not exceed 3 percent of the Flammability Exposure Evaluation Time (FEET), as defined in Appendix N of this part. As a portion of this 3 percent, if flammability reduction means (FRM) are used, each of the following time periods may not exceed 1.8 percent of the FEET:

(1) When any FRM is operational but the fuel tank is not inert and the tank is flammable; and

(2) When any FRM is inoperative and the tank is flammable.

(b) The Fleet Average Flammability Exposure, as defined in Appendix N of this part, of each fuel tank may not exceed 3 percent of the portion of the FEET occurring during either ground or takeoff/climb phases of flight during warm days. The analysis must consider the following conditions.

(1) The analysis must use the subset of those flights that begin with a sea level ground ambient temperature of 80° F (standard day plus 21° F atmosphere) or above, from the flammability exposure analysis done for overall performance.

(2) For the ground and takeoff/climb phases of flight, the average flammability exposure must be calculated by dividing the time during the specific flight phase the fuel tank is flammable by the total time of the specific flight phase.

(3) Compliance with this paragraph may be shown using only those flights for which the airplane is dispatched with the flammability reduction means operational.

M25.2 *Showing compliance.*

(a) The applicant must provide data from analysis, ground testing, and flight testing, or any combination of these, that:

(1) Validate the parameters used in the analysis required by paragraph M25.1 of this appendix;

(2) Substantiate that the FRM is effective at limiting flammability exposure in all compartments of each tank for which the FRM is used to show compliance with paragraph M25.1 of this appendix; and

(3) Describe the circumstances under which the FRM would not be operated during each phase of flight.

(b) The applicant must validate that the FRM meets the requirements of paragraph M25.1 of this appendix with any airplane or engine configuration affecting the performance of the FRM for which approval is sought.

M25.3 *Reliability indications and maintenance access.*

(a) Reliability indications must be provided to identify failures of the FRM that would otherwise be latent and whose identification is necessary to ensure the fuel tank with an FRM meets the fleet average flammability exposure requirements listed in paragraph M25.1 of this appendix, including when the FRM is inoperative.

(b) Sufficient accessibility to FRM reliability indications must be provided for maintenance personnel or the flightcrew.

(c) The access doors and panels to the fuel tanks with FRMs (including any tanks that communicate with a tank via a vent system), and to any other confined spaces or enclosed areas that could contain hazardous atmosphere under normal conditions or failure conditions, must be permanently stenciled, marked, or placarded to warn maintenance personnel of the possible presence of a potentially hazardous atmosphere.

M25.4 *Airworthiness limitations and procedures.*

(a) If FRM is used to comply with paragraph M25.1 of this appendix, Airworthiness Limitations must be identified for all maintenance or inspection tasks required to identify failures of components within the FRM that are needed to meet paragraph M25.1 of this appendix.

(b) Maintenance procedures must be developed to identify any hazards to be considered during maintenance of the FRM. These procedures must be included in the instructions for continued airworthiness (ICA).

M25.5 *Reliability reporting.*

The effects of airplane component failures on FRM reliability must be assessed on an on-going basis. The applicant/holder must do the following:

(a) Demonstrate effective means to ensure collection of FRM reliability data. The means must provide data affecting FRM reliability, such as component failures.

(b) Unless alternative reporting procedures are approved by the FAA Oversight Office, as defined in part 26 of this subchapter, provide a report to the FAA every six months for the first five years after service introduction. After that period, continued reporting every six months may be replaced with other reliability tracking methods found acceptable to the FAA or eliminated if it is established that the reliability of the FRM meets, and will continue to meet, the exposure requirements of paragraph M25.1 of this appendix.

(c) Develop service instructions or revise the applicable airplane manual, according to a schedule approved by the FAA Oversight Office, as defined in part 26 of this subchapter, to correct any failures of the FRM that occur in service that could increase any fuel tank's Fleet Average Flammability Exposure to more than that required by paragraph M25.1 of this appendix.

■ 5. Part 25 is amended by adding a new APPENDIX N to read as follows:

## APPENDIX N TO PART 25—FUEL TANK FLAMMABILITY EXPOSURE AND RELIABILITY ANALYSIS

N25.1 *General.*

(a) This appendix specifies the requirements for conducting fuel tank fleet average flammability exposure analyses required to meet § 25.981(b) and Appendix M of this part. For fuel tanks installed in aluminum wings, a qualitative assessment is sufficient if it substantiates that the tank is a conventional unheated wing tank.

(b) This appendix defines parameters affecting fuel tank flammability that must be used in performing the analysis. These include parameters that affect all airplanes within the fleet, such as a statistical distribution of ambient temperature, fuel flash point, flight lengths, and airplane descent rate. Demonstration of compliance also requires application of factors specific to the airplane model being evaluated. Factors that need to be included are maximum range, cruise mach number, typical altitude where the airplane begins initial cruise phase of flight, fuel temperature during both ground and flight times, and the performance of a flammability reduction means (FRM) if installed.

(c) The following definitions, input variables, and data tables must be used in the program to determine fleet average flammability exposure for a specific airplane model.

N25.2 *Definitions.*

(a) *Bulk Average Fuel Temperature* means the average fuel temperature within the fuel tank or different sections of the tank if the tank is subdivided by baffles or compartments.

(b) *Flammability Exposure Evaluation Time (FEET).* The time from the start of preparing the airplane for flight, through the flight and landing, until all payload is unloaded, and all passengers and crew have disembarked. In the Monte Carlo program, the flight time is randomly selected from the Flight Length Distribution (Table 2), the pre-flight times are provided as a function of the flight time, and the post-flight time is a constant 30 minutes.

(c) *Flammable.* With respect to a fluid or gas, flammable means susceptible to igniting readily or to exploding (14 CFR Part 1, Definitions). A non-flammable ullage is one where the fuel-air vapor is too lean or too rich to burn or is inert as defined below. For the purposes of this appendix, a fuel tank that is not inert is considered flammable when the bulk average fuel temperature within the tank is within the flammable range for the fuel type being used. For any fuel tank that is subdivided into sections by baffles or compartments, the tank is considered flammable when the bulk average fuel temperature within any section of the tank, that is not inert, is within the flammable range for the fuel type being used.

(d) *Flash Point.* The flash point of a flammable fluid means the lowest temperature at which the application of a flame to a heated sample causes the vapor to ignite momentarily, or ''flash.'' Table 1 of this appendix provides the flash point for the standard fuel to be used in the analysis.

(e) *Fleet average flammability exposure* is the percentage of the flammability exposure evaluation time (FEET) each fuel tank ullage is flammable for a fleet of an airplane type operating over the range of flight lengths in a world-wide range of environmental conditions and fuel properties as defined in this appendix.

(f) *Gaussian Distribution* is another name for the normal distribution, a symmetrical frequency distribution having a precise mathematical formula relating the mean and standard deviation of the samples. Gaussian distributions yield bell-shaped frequency curves having a preponderance of values around the mean with progressively fewer observations as the curve extends outward.

(g) *Hazardous atmosphere.* An atmosphere that may expose maintenance personnel, passengers or flight crew to the risk of death, incapacitation, impairment of ability to self-rescue (that is, escape unaided from a confined space), injury, or acute illness.

(h) *Inert.* For the purpose of this appendix, the tank is considered inert when the bulk average oxygen concentration within each compartment of the tank is 12 percent or less from sea level up to 10,000 feet altitude, then linearly increasing from 12 percent at 10,000 feet to 14.5 percent at 40,000 feet altitude, and extrapolated linearly above that altitude.

(i) *Inerting.* A process where a noncombustible gas is introduced into the ullage of a fuel tank so that the ullage becomes non-flammable.

(j) *Monte Carlo Analysis.* The analytical method that is specified in this appendix as the compliance means for assessing the fleet average flammability exposure time for a fuel tank.

(k) *Oxygen evolution* occurs when oxygen dissolved in the fuel is released into the ullage as the pressure and temperature in the fuel tank are reduced.

(l) *Standard deviation* is a statistical measure of the dispersion or variation in a distribution, equal to the square root of the arithmetic mean of the squares of the deviations from the arithmetic means.

(m) *Transport Effects*. For purposes of this appendix, transport effects are the change in fuel vapor concentration in a fuel tank caused by low fuel conditions and fuel condensation and vaporization.

(n) *Ullage*. The volume within the fuel tank not occupied by liquid fuel.

N25.3 *Fuel tank flammability exposure analysis.*

(a) A flammability exposure analysis must be conducted for the fuel tank under evaluation to determine fleet average flammability exposure for the airplane and fuel types under evaluation. For fuel tanks that are subdivided by baffles or compartments, an analysis must be performed either for each section of the tank, or for the section of the tank having the highest flammability exposure. Consideration of transport effects is not allowed in the analysis. The analysis must be done in accordance with the methods and procedures set forth in the Fuel Tank Flammability Assessment Method User's Manual, dated May 2008, document number DOT/FAA/AR–05/8 (incorporated by reference, see § 25.5). The parameters specified in sections N25.3(b) and (c) of this appendix must be used in the fuel tank flammability exposure ''Monte Carlo'' analysis.

(b) The following parameters are defined in the Monte Carlo analysis and provided in paragraph N25.4 of this appendix:

(1) Cruise Ambient Temperature, as defined in this appendix.

(2) Ground Ambient Temperature, as defined in this appendix.

(3) Fuel Flash Point, as defined in this appendix.

(4) Flight Length Distribution, as defined in Table 2 of this appendix.

(5) Airplane Climb and Descent Profiles, as defined in the Fuel Tank Flammability Assessment Method User's Manual, dated May 2008, document number DOT/FAA/AR–05/8 (incorporated by reference in § 25.5).

(c) Parameters that are specific to the particular airplane model under evaluation that must be provided as inputs to the Monte Carlo analysis are:

(1) Airplane cruise altitude.

(2) Fuel tank quantities. If fuel quantity affects fuel tank flammability, inputs to the Monte Carlo analysis must be provided that represent the actual fuel quantity within the fuel tank or compartment of the fuel tank throughout each of the flights being evaluated. Input values for this data must be obtained from ground and flight test data or the approved FAA fuel management procedures.

(3) Airplane cruise mach number.

(4) Airplane maximum range.

(5) Fuel tank thermal characteristics. If fuel temperature affects fuel tank flammability, inputs to the Monte Carlo analysis must be provided that represent the actual bulk average fuel temperature within the fuel tank at each point in time throughout each of the flights being evaluated. For fuel tanks that are subdivided by baffles or compartments, bulk average fuel temperature inputs must be provided for each section of the tank. Input values for these data must be obtained from ground and flight test data or a thermal model of the tank that has been validated by ground and flight test data.

(6) Maximum airplane operating temperature limit, as defined by any limitations in the airplane flight manual.

(7) Airplane Utilization. The applicant must provide data supporting the number of flights per day and the number of hours per flight for the specific airplane model under evaluation. If there is no existing airplane fleet data to support the airplane being evaluated, the applicant must provide substantiation that the number of flights per day and the number of hours per flight for that airplane model is consistent with the existing fleet data they propose to use.

(d) *Fuel Tank FRM Model*. If FRM is used, an FAA approved Monte Carlo program must be used to show compliance with the flammability requirements of § 25.981 and Appendix M of this part. The program must determine the time periods during each flight phase when the fuel tank or compartment with the FRM would be flammable. The following factors must be considered in establishing these time periods:

(1) Any time periods throughout the flammability exposure evaluation time and under the full range of expected operating conditions, when the FRM is operating properly but fails to maintain a non-flammable fuel tank because of the effects of the fuel tank vent system or other causes,

(2) If dispatch with the system inoperative under the Master Minimum Equipment List (MMEL) is requested, the time period assumed in the reliability analysis (60 flight hours must be used for a 10-day MMEL dispatch limit unless an alternative period has been approved by the Administrator),

(3) Frequency and duration of time periods of FRM inoperability, substantiated by test or analysis acceptable to the FAA, caused by latent or known failures, including airplane system shut-downs and failures that could cause the FRM to shut down or become inoperative.

(4) Effects of failures of the FRM that could increase the flammability exposure of the fuel tank.

(5) If an FRM is used that is affected by oxygen concentrations in the fuel tank, the time periods when oxygen evolution from the fuel results in the fuel tank or compartment exceeding the inert level. The applicant must include any times when oxygen evolution from the fuel in the tank or compartment under evaluation would result in a flammable fuel tank. The oxygen evolution rate that must be used is defined in the Fuel Tank Flammability Assessment Method User's Manual, dated May 2008, document number DOT/FAA/AR–05/8 (incorporated by reference in § 25.5).

(6) If an inerting system FRM is used, the effects of any air that may enter the fuel tank following the last flight of the day due to changes in ambient temperature, as defined in Table 4, during a 12-hour overnight period.

(e) The applicant must submit to the FAA Oversight Office for approval the fuel tank flammability analysis, including the airplane-specific parameters identified under paragraph N25.3(c) of this appendix and any deviations from the parameters identified in paragraph N25.3(b) of this appendix that affect flammability exposure, substantiating data, and any airworthiness limitations and other conditions assumed in the analysis.

N25.4 *Variables and data tables.*

The following data must be used when conducting a flammability exposure analysis to determine the fleet average flammability exposure. Variables used to calculate fleet flammability exposure must include atmospheric ambient temperatures, flight length, flammability exposure evaluation time, fuel flash point, thermal characteristics of the fuel tank, overnight temperature drop, and oxygen evolution from the fuel into the ullage.

(a) Atmospheric Ambient Temperatures and Fuel Properties.

(1) In order to predict flammability exposure during a given flight, the variation of ground ambient temperatures, cruise ambient temperatures, and a method to compute the transition from ground to cruise and back again must be used. The variation of the ground and cruise ambient temperatures and the flash point of the fuel is defined by a Gaussian curve, given by the 50 percent value and a ±1-standard deviation value.

(2) Ambient Temperature: Under the program, the ground and cruise ambient temperatures are linked by a set of assumptions on the atmosphere. The temperature varies with altitude following the International Standard Atmosphere (ISA) rate of change from the ground ambient temperature until the cruise temperature for the flight is reached. Above this altitude, the ambient temperature is fixed at the cruise ambient temperature. This results in a variation in the upper atmospheric temperature. For cold days, an inversion is applied up to 10,000 feet, and then the ISA rate of change is used.

(3) Fuel properties:

(i) For Jet A fuel, the variation of flash point of the fuel is defined by a Gaussian curve, given by the 50 percent value and a ±1-standard deviation, as shown in Table 1 of this appendix.

(ii) The flammability envelope of the fuel that must be used for the flammability exposure analysis is a function of the flash point of the fuel selected by the Monte Carlo for a given flight. The flammability envelope for the fuel is defined by the upper flammability limit (UFL) and lower flammability limit (LFL) as follows:

(A) LFL at sea level = flash point temperature of the fuel at sea level minus 10 ° F. LFL decreases from sea level value with increasing altitude at a rate of 1 °F per 808 feet.

(B) UFL at sea level = flash point temperature of the fuel at sea level plus 63.5 ° F. UFL decreases from the sea level value with increasing altitude at a rate of 1 °F per 512 feet.

(4) For each flight analyzed, a separate random number must be generated for each of the three parameters (ground ambient temperature, cruise ambient temperature, and fuel flash point) using the Gaussian distribution defined in Table 1 of this appendix.

TABLE 1.—GAUSSIAN DISTRIBUTION FOR GROUND AMBIENT TEMPERATURE, CRUISE AMBIENT TEMPERATURE, AND FUEL FLASH POINT

| Parameter | Temperature in deg F | | |
|---|---|---|---|
| | Ground ambient temperature | Cruise ambient temperature | Fuel flash point (FP) |
| Mean Temp | 59.95 | −70 | 120 |
| Neg 1 std dev | 20.14 | 8 | 8 |
| Pos 1 std dev | 17.28 | 8 | 8 |

(b) The Flight Length Distribution defined in Table 2 must be used in the Monte Carlo analysis.

TABLE 2.—FLIGHT LENGTH DISTRIBUTION

| Flight length (NM) | | Airplane maximum range—nautical miles (NM) | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| From | To | 1000 | 2000 | 3000 | 4000 | 5000 | 6000 | 7000 | 8000 | 9000 | 10000 |
| | | Distribution of flight lengths (percentage of total) | | | | | | | | | |
| 0 | 200 | 11.7 | 7.5 | 6.2 | 5.5 | 4.7 | 4.0 | 3.4 | 3.0 | 2.6 | 2.3 |
| 200 | 400 | 27.3 | 19.9 | 17.0 | 15.2 | 13.2 | 11.4 | 9.7 | 8.5 | 7.5 | 6.7 |
| 400 | 600 | 46.3 | 40.0 | 35.7 | 32.6 | 28.5 | 24.9 | 21.2 | 18.7 | 16.4 | 14.8 |
| 600 | 800 | 10.3 | 11.6 | 11.0 | 10.2 | 9.1 | 8.0 | 6.9 | 6.1 | 5.4 | 4.8 |
| 800 | 1000 | 4.4 | 8.5 | 8.6 | 8.2 | 7.4 | 6.6 | 5.7 | 5.0 | 4.5 | 4.0 |
| 1000 | 1200 | 0.0 | 4.8 | 5.3 | 5.3 | 4.8 | 4.3 | 3.8 | 3.3 | 3.0 | 2.7 |
| 1200 | 1400 | 0.0 | 3.6 | 4.4 | 4.5 | 4.2 | 3.8 | 3.3 | 3.0 | 2.7 | 2.4 |
| 1400 | 1600 | 0.0 | 2.2 | 3.3 | 3.5 | 3.3 | 3.1 | 2.7 | 2.4 | 2.2 | 2.0 |
| 1600 | 1800 | 0.0 | 1.2 | 2.3 | 2.6 | 2.5 | 2.4 | 2.1 | 1.9 | 1.7 | 1.6 |
| 1800 | 2000 | 0.0 | 0.7 | 2.2 | 2.6 | 2.6 | 2.5 | 2.2 | 2.0 | 1.8 | 1.7 |
| 2000 | 2200 | 0.0 | 0.0 | 1.6 | 2.1 | 2.2 | 2.1 | 1.9 | 1.7 | 1.6 | 1.4 |
| 2200 | 2400 | 0.0 | 0.0 | 1.1 | 1.6 | 1.7 | 1.7 | 1.6 | 1.4 | 1.3 | 1.2 |
| 2400 | 2600 | 0.0 | 0.0 | 0.7 | 1.2 | 1.4 | 1.4 | 1.3 | 1.2 | 1.1 | 1.0 |
| 2600 | 2800 | 0.0 | 0.0 | 0.4 | 0.9 | 1.0 | 1.1 | 1.0 | 0.9 | 0.9 | 0.8 |
| 2800 | 3000 | 0.0 | 0.0 | 0.2 | 0.6 | 0.7 | 0.8 | 0.7 | 0.7 | 0.6 | 0.6 |
| 3000 | 3200 | 0.0 | 0.0 | 0.0 | 0.6 | 0.8 | 0.8 | 0.8 | 0.8 | 0.7 | 0.7 |
| 3200 | 3400 | 0.0 | 0.0 | 0.0 | 0.7 | 1.1 | 1.2 | 1.2 | 1.1 | 1.1 | 1.0 |
| 3400 | 3600 | 0.0 | 0.0 | 0.0 | 0.7 | 1.3 | 1.6 | 1.6 | 1.5 | 1.5 | 1.4 |
| 3600 | 3800 | 0.0 | 0.0 | 0.0 | 0.9 | 2.2 | 2.7 | 2.8 | 2.7 | 2.6 | 2.5 |
| 3800 | 4000 | 0.0 | 0.0 | 0.0 | 0.5 | 2.0 | 2.6 | 2.8 | 2.8 | 2.7 | 2.6 |
| 4000 | 4200 | 0.0 | 0.0 | 0.0 | 0.0 | 2.1 | 3.0 | 3.2 | 3.3 | 3.2 | 3.1 |
| 4200 | 4400 | 0.0 | 0.0 | 0.0 | 0.0 | 1.4 | 2.2 | 2.5 | 2.6 | 2.6 | 2.5 |
| 4400 | 4600 | 0.0 | 0.0 | 0.0 | 0.0 | 1.0 | 2.0 | 2.3 | 2.5 | 2.5 | 2.4 |
| 4600 | 4800 | 0.0 | 0.0 | 0.0 | 0.0 | 0.6 | 1.5 | 1.8 | 2.0 | 2.0 | 2.0 |
| 4800 | 5000 | 0.0 | 0.0 | 0.0 | 0.0 | 0.2 | 1.0 | 1.4 | 1.5 | 1.6 | 1.5 |
| 5000 | 5200 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.8 | 1.1 | 1.3 | 1.3 | 1.3 |
| 5200 | 5400 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.8 | 1.2 | 1.5 | 1.6 | 1.6 |
| 5400 | 5600 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.9 | 1.7 | 2.1 | 2.2 | 2.3 |
| 5600 | 5800 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.6 | 1.6 | 2.2 | 2.4 | 2.5 |
| 5800 | 6000 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.2 | 1.8 | 2.4 | 2.8 | 2.9 |
| 6000 | 6200 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 1.7 | 2.6 | 3.1 | 3.3 |
| 6200 | 6400 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 1.4 | 2.4 | 2.9 | 3.1 |
| 6400 | 6600 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.9 | 1.8 | 2.2 | 2.5 |
| 6600 | 6800 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.5 | 1.2 | 1.6 | 1.9 |
| 6800 | 7000 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.2 | 0.8 | 1.1 | 1.3 |
| 7000 | 7200 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.4 | 0.7 | 0.8 |
| 7200 | 7400 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.3 | 0.5 | 0.7 |
| 7400 | 7600 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.2 | 0.5 | 0.6 |
| 7600 | 7800 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.1 | 0.5 | 0.7 |
| 7800 | 8000 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.1 | 0.6 | 0.8 |
| 8000 | 8200 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.5 | 0.8 |
| 8200 | 8400 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.5 | 1.0 |
| 8400 | 8600 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.6 | 1.3 |
| 8600 | 8800 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.4 | 1.1 |
| 8800 | 9000 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.2 | 0.8 |
| 9000 | 9200 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.5 |
| 9200 | 9400 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.2 |

TABLE 2.—FLIGHT LENGTH DISTRIBUTION—Continued

| Flight length (NM) | | Airplane maximum range—nautical miles (NM) | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| From | To | 1000 | 2000 | 3000 | 4000 | 5000 | 6000 | 7000 | 8000 | 9000 | 10000 |
| 9400 | 9600 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.1 |
| 9600 | 9800 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.1 |
| 9800 | 10000 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.1 |

(c) Overnight Temperature Drop. For airplanes on which FRM is installed, the overnight temperature drop for this appendix is defined using:

(1) A temperature at the beginning of the overnight period that equals the landing temperature of the previous flight that is a random value based on a Gaussian distribution; and

(2) An overnight temperature drop that is a random value based on a Gaussian distribution.

(3) For any flight that will end with an overnight ground period (one flight per day out of an average number of flights per day, depending on utilization of the particular airplane model being evaluated), the landing outside air temperature (OAT) is to be chosen as a random value from the following Gaussian curve:

TABLE 3.—LANDING OUTSIDE AIR TEMPERATURE

| Parameter | Landing outside air temperature °F |
|---|---|
| Mean Temperature | 58.68 |
| negative 1 std dev | 20.55 |
| positive 1 std dev | 13.21 |

(4) The outside ambient air temperature (OAT) overnight temperature drop is to be chosen as a random value from the following Gaussian curve:

TABLE 4.—OUTSIDE AIR TEMPERATURE (OAT) DROP

| Parameter | OAT drop temperature °F |
|---|---|
| Mean Temp | 12.0 |
| 1 std dev | 6.0 |

(d) Number of Simulated Flights Required in Analysis. In order for the Monte Carlo analysis to be valid for showing compliance with the fleet average and warm day flammability exposure requirements, the applicant must run the analysis for a minimum number of flights to ensure that the fleet average and warm day flammability exposure for the fuel tank under evaluation meets the applicable flammability limits defined in Table 5 of this appendix.

TABLE 5.—FLAMMABILITY EXPOSURE LIMIT

| Minimum number of flights in Monte Carlo analysis | Maximum acceptable Monte Carlo average fuel tank flammability exposure (percent) to meet 3 percent requirements | Maximum acceptable Monte Carlo average fuel tank flammability exposure (percent) to meet 7 percent part 26 requirements |
|---|---|---|
| 10,000 | 2.91 | 6.79 |
| 100,000 | 2.98 | 6.96 |
| 1,000,000 | 3.00 | 7.00 |

## PART 26—CONTINUED AIRWORTHINESS AND SAFETY IMPROVEMENTS FOR TRANSPORT CATEGORY AIRPLANES

■ 6. The authority citation for part 26 continues to read as follows:

**Authority:** 49 U.S.C. 106(g), 40113, 44701, 44702 and 44704.

■ 7. Revise § 26.5 to read as follows:

**§ 26.5 Applicability Table.**

Table 1 of this section provides an overview of the applicability of this part. It provides guidance in identifying what sections apply to various types of entities. The specific applicability of each subpart and section is specified in the regulatory text.

TABLE 1.—APPLICABILITY OF PART 26 RULES

| Effective date of rule | Applicable sections | | |
|---|---|---|---|
| | Subpart B EAPAS/FTS | Subpart D fuel tank flammability | Subpart E damage tolerance data |
| | December 10, 2007 | September 19, 2008 | January 11, 2008 |
| Existing[1] TC Holders | 26.11 | 26.33 | 26.43, 26.45, 26.49 |
| Pending[1] TC Applicants | 26.11 | 26.37 | 26.43, 26.45 |
| Existing[1] STC Holders | N/A | 26.35 | 26.47, 26.49 |
| Pending[1] STC/ATC Applicants | 26.11 | 26.35 | 26.45, 26.47, 26.49 |
| Future[2] STC/ATC Applicants | 26.11 | 26.35 | 26.45, 26.47, 26.49 |
| Manufacturers | N/A | 26.39 | N/A |

[1] As of the effective date of the identified rule.

[2] Application made after the effective date of the identified rule.

■ 8. Amend part 26 by adding a new subpart D to read as follows:

**Subpart D—FUEL TANK FLAMMABILITY**

**General**



## Subpart D—Fuel Tank Flammability

### General

#### § 26.31 Definitions.

For purposes of this subpart—

(a) *Fleet Average Flammability Exposure* has the meaning defined in Appendix N of part 25 of this chapter.

(b) *Normally Emptied* means a fuel tank other than a Main Fuel Tank. Main Fuel Tank is defined in 14 CFR 25.981(b).

#### § 26.33 Holders of type certificates: Fuel tank flammability.

(a) *Applicability.* This section applies to U.S. type certificated transport category, turbine-powered airplanes, other than those designed solely for all-cargo operations, for which the State of Manufacture issued the original certificate of airworthiness or export airworthiness approval on or after January 1, 1992, that, as a result of original type certification or later increase in capacity have:

(1) A maximum type-certificated passenger capacity of 30 or more, or

(2) A maximum payload capacity of 7,500 pounds or more.

(b) *Flammability Exposure Analysis.* (1) *General.* Within 150 days after September 19, 2008, holders of type certificates must submit for approval to the FAA Oversight Office a flammability exposure analysis of all fuel tanks defined in the type design, as well as all design variations approved under the type certificate that affect flammability exposure. This analysis must be conducted in accordance with Appendix N of part 25 of this chapter.

(2) *Exception.* This paragraph (b) does not apply to—

(i) Fuel tanks for which the type certificate holder has notified the FAA under paragraph (g) of this section that it will provide design changes and service instructions for Flammability Reduction Means or an Ignition Mitigation Means (IMM) meeting the requirements of paragraph (c) of this section.

(ii) Fuel tanks substantiated to be conventional unheated aluminum wing tanks.

(c) *Design Changes.* For fuel tanks with a Fleet Average Flammability Exposure exceeding 7 percent, one of the following design changes must be made.

(1) *Flammability Reduction Means (FRM).* A means must be provided to reduce the fuel tank flammability.

(i) Fuel tanks that are designed to be Normally Emptied must meet the flammability exposure criteria of Appendix M of part 25 of this chapter if any portion of the tank is located within the fuselage contour.

(ii) For all other fuel tanks, the FRM must meet all of the requirements of Appendix M of part 25 of this chapter, except, instead of complying with paragraph M25.1 of this appendix, the Fleet Average Flammability Exposure may not exceed 7 percent.

(2) *Ignition Mitigation Means (IMM).* A means must be provided to mitigate the effects of an ignition of fuel vapors within the fuel tank such that no damage caused by an ignition will prevent continued safe flight and landing.

(d) *Service Instructions.* No later than September 20, 2010, holders of type certificates required by paragraph (c) of this section to make design changes must meet the requirements specified in either paragraph (d)(1) or (d)(2) of this section. The required service instructions must identify each airplane subject to the applicability provisions of paragraph (a) of this section.

(1) *FRM.* The type certificate holder must submit for approval by the FAA Oversight Office design changes and service instructions for installation of fuel tank flammability reduction means (FRM) meeting the criteria of paragraph (c) of this section.

(2) *IMM.* The type certificate holder must submit for approval by the FAA Oversight Office design changes and service instructions for installation of fuel tank IMM that comply with 14 CFR 25.981(c) in effect on September 19, 2008.

(e) *Instructions for Continued Airworthiness (ICA).* No later than September 20, 2010, holders of type certificates required by paragraph (c) of this section to make design changes must submit for approval by the FAA Oversight Office, critical design configuration control limitations (CDCCL), inspections, or other procedures to prevent increasing the flammability exposure of any tanks equipped with FRM above that permitted under paragraph (c)(1) of this section and to prevent degradation of the performance of any IMM provided under paragraph (c)(2) of this section. These CDCCL, inspections, and procedures must be included in the Airworthiness Limitations Section (ALS) of the ICA required by 14 CFR 25.1529 or paragraph (f) of this section. Unless shown to be impracticable, visible means to identify critical features of the design must be placed in areas of the airplane where foreseeable maintenance actions, repairs, or alterations may compromise the critical design configuration limitations. These visible means must also be identified as a CDCCL.

(f) *Airworthiness Limitations.* Unless previously accomplished, no later than September 20, 2010, holders of type certificates affected by this section must establish an ALS of the maintenance manual or ICA for each airplane configuration evaluated under paragraph (b)(1) of this section and submit it to the FAA Oversight Office for approval. The ALS must include a section that contains the CDCCL, inspections, or other procedures developed under paragraph (e) of this section.

(g) *Compliance Plan for Flammability Exposure Analysis.* Within 90 days after September 19, 2008, each holder of a type certificate required to comply with paragraph (b) of this section must submit to the FAA Oversight Office a compliance plan consisting of the following:

(1) A proposed project schedule for submitting the required analysis, or a determination that compliance with paragraph (b) of this section is not required because design changes and service instructions for FRM or IMM will be developed and made available as required by this section.

(2) A proposed means of compliance with paragraph (b) of this section, if applicable.

(h) *Compliance Plan for Design Changes and Service Instructions.* Within 210 days after September 19, 2008, each holder of a type certificate required to comply with paragraph (d) of this section must submit to the FAA Oversight Office a compliance plan consisting of the following:

(1) A proposed project schedule, identifying all major milestones, for meeting the compliance dates specified in paragraphs (d), (e) and (f) of this section.

(2) A proposed means of compliance with paragraphs (d), (e) and (f) of this section.

(3) A proposal for submitting a draft of all compliance items required by paragraphs (d), (e) and (f) of this section for review by the FAA Oversight Office

not less than 60 days before the compliance times specified in those paragraphs.

(4) A proposal for how the approved service information and any necessary modification parts will be made available to affected persons.

(i) Each affected type certificate holder must implement the compliance plans, or later revisions, as approved under paragraph (g) and (h) of this section.

**§ 26.35 Changes to type certificates affecting fuel tank flammability.**

(a) *Applicability.* This section applies to holders and applicants for approvals of the following design changes to any airplane subject to 14 CFR 26.33(a):

(1) Any fuel tank designed to be Normally Emptied if the fuel tank installation was approved pursuant to a supplemental type certificate or a field approval before September 19, 2008;

(2) Any fuel tank designed to be Normally Emptied if an application for a supplemental type certificate or an amendment to a type certificate was made before September 19, 2008 and if the approval was not issued before September 19, 2008; and

(3) If an application for a supplemental type certificate or an amendment to a type certificate is made on or September 19, 2008, any of the following design changes:

(i) Installation of a fuel tank designed to be Normally Emptied,

(ii) Changes to existing fuel tank capacity, or

(iii) Changes that may increase the flammability exposure of an existing fuel tank for which FRM or IMM is required by § 26.33(c).

(b) *Flammability Exposure Analysis*—(1) *General.* By the times specified in paragraphs (b)(1)(i) and (b)(1)(ii) of this section, each person subject to this section must submit for approval a flammability exposure analysis of the auxiliary fuel tanks or other affected fuel tanks, as defined in the type design, to the FAA Oversight Office. This analysis must be conducted in accordance with Appendix N of part 25 of this chapter.

(i) Holders of supplemental type certificates and field approvals: Within 12 months of September 19, 2008,

(ii) Applicants for supplemental type certificates and for amendments to type certificates: Within 12 months after September 19, 2008, or before the certificate is issued, whichever occurs later.

(2) *Exception.* This paragraph does not apply to—

(i) Fuel tanks for which the type certificate holder, supplemental type certificate holder, or field approval holder has notified the FAA under paragraph (f) of this section that it will provide design changes and service instructions for an IMM meeting the requirements of § 25.981(c) in effect September 19, 2008; and

(ii) Fuel tanks substantiated to be conventional unheated aluminum wing tanks.

(c) *Impact Assessment.* By the times specified in paragraphs (c)(1) and (c)(2) of this section, each person subject to paragraph (a)(1) of this section holding an approval for installation of a Normally Emptied fuel tank on an airplane model listed in Table 1 of this section, and each person subject to paragraph (a)(3)(iii) of this section, must submit for approval to the FAA Oversight Office an assessment of the fuel tank system, as modified by their design change. The assessment must identify any features of the design change that compromise any critical design configuration control limitation (CDCCL) applicable to any airplane on which the design change is eligible for installation.

(1) Holders of supplemental type certificates and field approvals: Before March 21, 2011.

(2) Applicants for supplemental type certificates and for amendments to type certificates: Before March 21, 2011 or before the certificate is issued, whichever occurs later.

TABLE 1

| Model—Boeing |
| --- |
| 747 Series |
| 737 Series |
| 777 Series |
| 767 Series |
| 757 Series |
| **Model—Airbus** |
| A318, A319, A320, A321 Series |
| A300, A310 Series |
| A330, A340 Series |

(d) *Design Changes and Service Instructions.* By the times specified in paragraph (e) of this section, each person subject to this section must meet the requirements of paragraphs (d)(1) or (d)(2) of this section, as applicable.

(1) For holders and applicants subject to paragraph (a)(1) or (a)(3)(iii) of this section, if the assessment required by paragraph (c) of this section identifies any features of the design change that compromise any CDCCL applicable to any airplane on which the design change is eligible for installation, the holder or applicant must submit for approval by the FAA Oversight Office design changes and service instructions for Flammability Impact Mitigation Means (FIMM) that would bring the design change into compliance with the CDCCL. Any fuel tank modified as required by this paragraph must also be evaluated as required by paragraph (b) of this section.

(2) Applicants subject to paragraph (a)(2), or (a)(3)(i) of this section must comply with the requirements of 14 CFR 25.981, in effect on September 19, 2008.

(3) Applicants subject to paragraph (a)(3)(ii) of this section must comply with the requirements of 14 CFR 26.33.

(e) *Compliance Times for Design Changes and Service Instructions.* The following persons subject to this section must comply with the requirements of paragraph (d) of this section at the specified times.

(1) Holders of supplemental type certificates and field approvals: Before September 19, 2012.

(2) Applicants for supplemental type certificates and for amendments to type certificates: Before September 19, 2012, or before the certificate is issued, whichever occurs later.

(f) *Compliance Planning.* By the applicable date specified in Table 2 of this section, each person subject to paragraph (a)(1) of this section must submit for approval by the FAA Oversight Office compliance plans for the flammability exposure analysis required by paragraph (b) of this section, the impact assessment required by paragraph (c) of this section, and the design changes and service instructions required by paragraph (d) of this section. Each person's compliance plans must include the following:

(1) A proposed project schedule for submitting the required analysis or impact assessment.

(2) A proposed means of compliance with paragraph (d) of this section.

(3) For the requirements of paragraph (d) of this section, a proposal for submitting a draft of all design changes, if any are required, and Airworthiness Limitations (including CDCCLs) for review by the FAA Oversight Office not less than 60 days before the compliance time specified in paragraph (e) of this section.

(4) For the requirements of paragraph (d) of this section, a proposal for how the approved service information and any necessary modification parts will be made available to affected persons.

TABLE 2.—COMPLIANCE PLANNING DATES

| | Flammability exposure analysis plan | Impact assessment plan | Design changes and service instructions plan |
|---|---|---|---|
| STC and Field Approval Holders ... | December 18, 2008 ..................... | November 19, 2010 ..................... | May 19, 2011. |

(g) Each person subject to this section must implement the compliance plans, or later revisions, as approved under paragraph (f) of this section.

**§ 26.37 Pending type certification projects: Fuel tank flammability.**

(a) *Applicability.* This section applies to any new type certificate for a transport category airplane, if the application was made before September 19, 2008, and if the certificate was not issued September 19, 2008. This section applies only if the airplane would have—

(1) A maximum type-certificated passenger capacity of 30 or more, or

(2) A maximum payload capacity of 7,500 pounds or more.

(b) If the application was made on or after June 6, 2001, the requirements of 14 CFR 25.981 in effect on September 19, 2008, apply.

**§ 26.39 Newly produced airplanes: Fuel tank flammability.**

(a) *Applicability:* This section applies to Boeing model airplanes specified in Table 1 of this section, including passenger and cargo versions of each model, when application is made for original certificates of airworthiness or export airworthiness approvals after September 20, 2010.

TABLE 1

| Model—Boeing |
|---|
| 747 Series |
| 737 Series |
| 777 Series |
| 767 Series |

(b) Any fuel tank meeting all of the criteria stated in paragraphs (b)(1), (b)(2) and (b)(3) of this section must have flammability reduction means (FRM) or ignition mitigation means (IMM) that meet the requirements of 14 CFR 25.981 in effect on September 19, 2008.

(1) The fuel tank is Normally Emptied.

(2) Any portion of the fuel tank is located within the fuselage contour.

(3) The fuel tank exceeds a Fleet Average Flammability Exposure of 7 percent.

(c) All other fuel tanks that exceed an Fleet Average Flammability Exposure of 7 percent must have an IMM that meets 14 CFR 25.981(d) in effect on September 19, 2008, or an FRM that meets all of the requirements of Appendix M to this part, except instead of complying with paragraph M25.1 of that appendix, the Fleet Average Flammability Exposure may not exceed 7 percent.

## PART 121—OPERATING REQUIREMENTS: DOMESTIC, FLAG, AND SUPPLEMENTAL OPERATIONS

■ 9. The authority citation for part 121 continues to read as follows:

**Authority:** 49 U.S.C. 106(g), 40113, 40119, 41706, 44101, 44701–44702, 44705, 44709–44711, 44713, 44716–44717, 44722, 44901, 44903–44904, 44012, 46105, 46301.

■ 10. Amend part 121 by adding a new § 121.1117, to read as follows:

**§ 121.1117 Flammability reduction means.**

(a) *Applicability.* Except as provided in paragraph (o) of this section, this section applies to transport category, turbine-powered airplanes with a type certificate issued after January 1, 1958, that, as a result of original type certification or later increase in capacity have:

(1) A maximum type-certificated passenger capacity of 30 or more, or

(2) A maximum payload capacity of 7,500 pounds or more.

(b) *New Production Airplanes.* Except in accordance with § 121.628, no certificate holder may operate an airplane identified in Table 1 of this section (including all-cargo airplanes) for which the State of Manufacture issued the original certificate of airworthiness or export airworthiness approval after September 20, 2010 unless an Ignition Mitigation Means (IMM) or Flammability Reduction Means (FRM) meeting the requirements of § 26.33 of this chapter is operational.

TABLE 1

| Model—Boeing | Model—Airbus |
|---|---|
| 747 Series | A318, A319, A320, A321 Series |
| 737 Series | A330, A340 Series |
| 777 Series | |
| 767 Series | |

(c) *Auxiliary Fuel Tanks.* After the applicable date stated in paragraph (e) of this section, no certificate holder may operate any airplane subject to § 26.33 of this chapter that has an Auxiliary Fuel Tank installed pursuant to a field approval, unless the following requirements are met:

(1) The certificate holder complies with 14 CFR 26.35 by the applicable date stated in that section.

(2) The certificate holder installs Flammability Impact Mitigation Means (FIMM), if applicable, that is approved by the FAA Oversight Office.

(3) Except in accordance with § 121.628, the FIMM, if applicable, is operational.

(d) *Retrofit.* Except as provided in paragraphs (j), (k), and (l) of this section, after the dates specified in paragraph (e) of this section, no certificate holder may operate an airplane to which this section applies unless the requirements of paragraphs (d)(1) and (d)(2) of this section are met.

(1) IMM, FRM or FIMM, if required by §§ 26.33, 26.35, or 26.37 of this chapter, that are approved by the FAA Oversight Office, are installed within the compliance times specified in paragraph (e) of this section.

(2) Except in accordance with § 121.628, the IMM, FRM or FIMM, as applicable, are operational.

(e) *Compliance Times.* Except as provided in paragraphs (k) and (l) of this section, the installations required by paragraph (d) of this section must be accomplished no later than the applicable dates specified in paragraph (e)(1), (e)(2), or (e)(3) of this section.

(1) Fifty percent of each certificate holder's fleet identified in paragraph (d)(1) of this section must be modified no later than September 19, 2014.

(2) One hundred percent of each certificate holder's fleet identified in paragraph (d)(1) of this section must be modified no later than September 19, 2017.

(3) For those certificate holders that have only one airplane of a model identified in Table 1 of this section, the airplane must be modified no later than September 19, 2017.

(f) *Compliance After Installation.* Except in accordance with § 121.628, no certificate holder may—

(1) Operate an airplane on which IMM or FRM has been installed before the dates specified in paragraph (e) of this section unless the IMM or FRM is operational, or

(2) Deactivate or remove an IMM or FRM once installed unless it is replaced

by a means that complies with paragraph (d) of this section.

(g) *Maintenance Program Revisions*. No certificate holder may operate an airplane for which airworthiness limitations have been approved by the FAA Oversight Office in accordance with §§ 26.33, 26.35, or 26.37 of this chapter after the airplane is modified in accordance with paragraph (d) of this section unless the maintenance program for that airplane is revised to include those applicable airworthiness limitations.

(h) After the maintenance program is revised as required by paragraph (g) of this section, before returning an airplane to service after any alteration for which airworthiness limitations are required by §§ 25.981, 26.33, or 26.37 of this chapter, the certificate holder must revise the maintenance program for the airplane to include those airworthiness limitations.

(i) The maintenance program changes identified in paragraphs (g) and (h) of this section must be submitted to the operator's Principal Maintenance Inspector responsible for review and approval prior to incorporation.

(j) The requirements of paragraph (d) of this section do not apply to airplanes operated in all-cargo service, but those airplanes are subject to paragraph (f) of this section.

(k) The compliance dates specified in paragraph (e) of this section may be extended by one year, provided that—

(1) No later than December 18, 2008, the certificate holder notifies its assigned Flight Standards Office or Principal Inspector that it intends to comply with this paragraph;

(2) No later than March 18, 2009, the certificate holder applies for an amendment to its operations specification in accordance with § 119.51 of this chapter and revises the manual required by § 121.133 to include a requirement for the airplane models specified in Table 2 of this section to use ground air conditioning systems for actual gate times of more than 30 minutes, when available at the gate and operational, whenever the ambient temperature exceeds 60 degrees Fahrenheit; and

(3) Thereafter, the certificate holder uses ground air conditioning systems as described in paragraph (k)(2) of this section on each airplane subject to the extension.

TABLE 2

| Model—Boeing | Model—Airbus |
|---|---|
| 747 Series | A318, A319, A320, A321 Series |
| 737 Series | A300, A310 Series |
| 777 Series | A330, A340 Series |
| 767 Series | |
| 757 Series | |

(l) For any certificate holder for which the operating certificate is issued after September 19, 2008, the compliance date specified in paragraph (e) of this section may be extended by one year, provided that the certificate holder meets the requirements of paragraph (k)(2) of this section when its initial operations specifications are issued and, thereafter, uses ground air conditioning systems as described in paragraph (k)(2) of this section on each airplane subject to the extension.

(m) After the date by which any person is required by this section to modify 100 percent of the affected fleet, no certificate holder may operate in passenger service any airplane model specified in Table 2 of this section unless the airplane has been modified to comply with § 26.33(c) of this chapter.

(n) No certificate holder may operate any airplane on which an auxiliary fuel tank is installed after September 19, 2017 unless the FAA has certified the tank as compliant with § 25.981 of this chapter, in effect on September 19, 2008.

(o) *Exclusions*. The requirements of this section do not apply to the following airplane models:

(1) Convair CV–240, 340, 440, including turbine powered conversions.

(2) Lockheed L–188 Electra.

(3) Vickers Armstrong Viscount.

(4) Douglas DC–3, including turbine powered conversions.

(5) Bombardier CL–44.

(6) Mitsubishi YS–11.

(7) BAC 1–11.

(8) Concorde.

(9) deHavilland D.H. 106 Comet 4C.

(10) VFW—Vereinigte Flugtechnische VFW–614.

(11) Illyushin Aviation IL 96T.

(12) Vickers Armstrong Viscount.

(13) Bristol Aircraft Britannia 305.

(14) Handley Page Handley Page Herald Type 300.

(15) Avions Marcel Dassault—Breguet Aviation Mercure 100C.

(16) Airbus Caravelle.

(17) Fokker F–27/Fairchild Hiller FH–227.

(18) Lockheed L–300.

## 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; AND RULES GOVERNING PERSONS ON BOARD SUCH AIRCRAFT

■ 11. The authority citation for part 125 continues to read as follows:

**Authority:** 49 U.S.C. 106(g), 40113, 44701–44702, 44705, 44710–44711, 44713, 44716–44717, 44722.

■ 12. Amend part 125 by adding a new § 125.509 to read as follows:

**§ 125.509 Flammability reduction means.**

(a) *Applicability*. Except as provided in paragraph (m) of this section, this section applies to transport category, turbine-powered airplanes with a type certificate issued after January 1, 1958, that, as a result of original type certification or later increase in capacity have:

(1) A maximum type-certificated passenger capacity of 30 or more, or

(2) A maximum payload capacity of 7,500 pounds or more.

(b) *New Production Airplanes*. Except in accordance with § 125.201, no person may operate an airplane identified in Table 1 of this section (including all-cargo airplanes) for which the State of Manufacture issued the original certificate of airworthiness or export airworthiness approval after September 20, 2010 unless an Ignition Mitigation Means (IMM) or Flammability Reduction Means (FRM) meeting the requirements of § 26.33 of this chapter is operational.

TABLE 1

| Model—Boeing | Model—Airbus |
|---|---|
| 747 Series | A318, A319, A320, A321 Series |
| 737 Series | A330, A340 Series |
| 777 Series | |
| 767 Series | |

(c) *Auxiliary Fuel Tanks*. After the applicable date stated in paragraph (e) of this section, no person may operate any airplane subject to § 26.33 of this chapter that has an Auxiliary Fuel Tank installed pursuant to a field approval, unless the following requirements are met:

(1) The person complies with 14 CFR 26.35 by the applicable date stated in that section.

(2) The person installs Flammability Impact Mitigation Means (FIMM), if applicable, that is approved by the FAA Oversight Office.

(3) Except in accordance with § 125.201, the FIMM, if applicable, are operational.

(d) *Retrofit*. Except as provided in paragraph (j) of this section, after the dates specified in paragraph (e) of this section, no person may operate an airplane to which this section applies unless the requirements of paragraphs (d)(1) and (d)(2) of this section are met.

(1) Ignition Mitigation Means (IMM), Flammability Reduction Means (FRM), or FIMM, if required by §§ 26.33, 26.35, or 26.37 of this chapter, that are approved by the FAA Oversight Office, are installed within the compliance times specified in paragraph (e) of this section.

(2) Except in accordance with § 125.201 of this part, the IMM, FRM or FIMM, as applicable, are operational.

(e) *Compliance Times*. The installations required by paragraph (d) of this section must be accomplished no later than the applicable dates specified in paragraph (e)(1), (e)(2) or (e)(3) of this section.

(1) Fifty percent of each person's fleet of airplanes subject to paragraph (d)(1) of this section must be modified no later than September 19, 2014.

(2) One hundred percent of each person's fleet of airplanes subject to paragraph (d)(1) of this section must be modified no later than September 19, 2017.

(3) For those persons that have only one airplane of a model identified in Table 1 of this section, the airplane must be modified no later than September 19, 2017.

(f) *Compliance after Installation*. Except in accordance with § 125.201, no person may—

(1) Operate an airplane on which IMM or FRM has been installed before the dates specified in paragraph (e) of this section unless the IMM or FRM is operational, or

(2) Deactivate or remove an IMM or FRM once installed unless it is replaced by a means that complies with paragraph (d) of this section.

(g) *Inspection Program Revisions*. No person may operate an airplane for which airworthiness limitations have been approved by the FAA Oversight Office in accordance with §§ 26.33, 26.35, or 26.37 of this chapter after the airplane is modified in accordance with paragraph (d) of this section unless the inspection program for that airplane is revised to include those applicable airworthiness limitations.

(h) After the inspection program is revised as required by paragraph (g) of this section, before returning an airplane to service after any alteration for which airworthiness limitations are required by §§ 25.981, 26.33, 26.35, or 26.37 of this chapter, the person must revise the inspection program for the airplane to include those airworthiness limitations.

(i) The inspection program changes identified in paragraphs (g) and (h) of this section must be submitted to the operator's assigned Flight Standards Office responsible for review and approval prior to incorporation.

(j) The requirements of paragraph (d) of this section do not apply to airplanes operated in all-cargo service, but those airplanes are subject to paragraph (f) of this section.

(k) After the date by which any person is required by this section to modify 100 percent of the affected fleet, no person may operate in passenger service any airplane model specified in Table 2 of this section unless the airplane has been modified to comply with § 26.33(c) of this chapter.

(l) No person may operate any airplane on which an auxiliary fuel tank is installed after September 19, 2017 unless the FAA has certified the tank as compliant with § 25.981 of this chapter, in effect on September 19, 2008.

(m) *Exclusions*. The requirements of this section do not apply to the following airplane models:

(1) Convair CV–240, 340, 440, including turbine powered conversions.
(2) Lockheed L–188 Electra.
(3) Vickers Armstrong Viscount.
(4) Douglas DC–3, including turbine powered conversions.
(5) Bombardier CL–44.
(6) Mitsubishi YS–11.
(7) BAC 1–11.
(8) Concorde.
(9) deHavilland D.H. 106 Comet 4C.
(10) VFW—Vereinigte Flugtechnische VFW–614.
(11) Illyushin Aviation IL 96T.
(12) Vickers Armstrong Viscount.
(13) Bristol Aircraft Britannia 305.
(14) Handley Page Handley Page Herald Type 300.
(15) Avions Marcel Dassault—Breguet Aviation Mercure 100C.
(16) Airbus Caravelle.
(17) Fokker F–27/Fairchild Hiller FH–227.
(18) Lockheed L–300.

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

■ 13. The authority citation for part 129 continues to read as follows:

**Authority:** 49 U.S.C. 1372, 49113, 440119, 44101, 44701–44702, 447–5, 44709–44711, 44713, 44716–44717, 44722, 44901–44904, 44906, 44912, 44105, Pub. L. 107–71 sec. 104.

■ 14. Amend part 129 by adding a new § 129.117 to read as follows:

**§ 129.117 Flammability reduction means.**

(a) *Applicability*. Except as provided in paragraph (o) of this section, this section applies to U.S.-registered transport category, turbine-powered airplanes with a type certificate issued after January 1, 1958, that as a result of original type certification or later increase in capacity have:

(1) A maximum type-certificated passenger capacity of 30 or more, or

(2) A maximum payload capacity of 7,500 pounds or more.

(b) *New Production Airplanes*. Except in accordance with § 129.14, no foreign air carrier or foreign person may operate an airplane identified in Table 1 of this section (including all-cargo airplanes) for which application is made for original certificate of airworthiness or export airworthiness approval after September 20, 2010 unless an Ignition Mitigation Means (IMM) or Flammability Reduction Means (FRM) meeting the requirements of § 26.33 of this chapter is operational.

TABLE 1

| Model—Boeing | Model—Airbus |
|---|---|
| 747 Series | A318, A319, A320, A321 Series |
| 737 Series | A330, A340 Series |
| 777 Series | |
| 767 Series | |

(c) *Auxiliary Fuel Tanks*. After the applicable date stated in paragraph (e) of this section, no foreign air carrier or foreign person may operate any airplane subject § 26.33 of this chapter that has an Auxiliary Fuel Tank installed pursuant to a field approval, unless the following requirements are met:

(1) The foreign air carrier or foreign person complies with 14 CFR 26.35 by the applicable date stated in that section.

(2) The foreign air carrier or foreign person installs Flammability Impact Mitigation Means (FIMM), if applicable, that are approved by the FAA Oversight Office.

(3) Except in accordance with § 129.14, the FIMM, if applicable, are operational.

(d) *Retrofit*. After the dates specified in paragraphs (j), (k), and (l) of this section, after the dates specified in paragraph (e) of this section, no foreign air carrier or foreign person may operate an airplane to which this section applies unless the requirements of paragraphs (d)(1) and (d)(2) of this section are met.

(1) IMM, FRM or FIMM, if required by §§ 26.33, 26.35, or 26.37 of this chapter,

that are approved by the FAA Oversight Office, are installed within the compliance times specified in paragraph (e) of this section.

(2) Except in accordance with § 129.14, the IMM, FRM or FIMM, as applicable, are operational.

(e) *Compliance Times.* Except as provided in paragraphs (k) and (l) of this section, the installations required by paragraph (d) of this section must be accomplished no later than the applicable dates specified in paragraph (e)(1) or (e)(2) of this section.

(1) Fifty percent of each foreign air carrier or foreign person's fleet identified in paragraph (d)(1) of this section must be modified no later than September 19, 2014.

(2) One hundred percent of each foreign air carrier or foreign person's fleet of airplanes subject to paragraph (d)(1) or this section must be modified no later than September 19, 2017.

(3) For those foreign air carriers or foreign persons that have only one airplane for a model identified in Table 1, the airplane must be modified no later than September 19, 2017.

(f) *Compliance after Installation.* Except in accordance with § 129.14, no person may—

(1) Operate an airplane on which IMM or FRM has been installed before the dates specified in paragraph (e) of this section unless the IMM or FRM is operational.

(2) Deactivate or remove an IMM or FRM once installed unless it is replaced by a means that complies with paragraph (d) of this section.

(g) *Maintenance Program Revisions.* No foreign air carrier or foreign person may operate an airplane for which airworthiness limitations have been approved by the FAA Oversight Office in accordance with §§ 26.33, 26.35, or 26.37 of this chapter after the airplane is modified in accordance with paragraph (d) of this section unless the maintenance program for that airplane is revised to include those applicable airworthiness limitations.

(h) After the maintenance program is revised as required by paragraph (g) of this section, before returning an airplane to service after any alteration for which airworthiness limitations are required by §§ 25.981, 26.33, 26.35, or 26.37 of this chapter, the foreign person or foreign air carrier must revise the maintenance program for the airplane to include those airworthiness limitations.

(i) The maintenance program changes identified in paragraphs (g) and (h) of this section must be submitted to the operator's assigned Flight Standards Office or Principal Inspector for review and approval prior to incorporation.

(j) The requirements of paragraph (d) of this section do not apply to airplanes operated in all-cargo service, but those airplanes are subject to paragraph (f) of this section.

(k) The compliance dates specified in paragraph (e) of this section may be extended by one year, provided that—

(1) No later than December 18, 2008, the foreign air carrier or foreign person notifies its assigned Flight Standards Office or Principal Inspector that it intends to comply with this paragraph;

(2) No later than March 18, 2009, the foreign air carrier or foreign person applies for an amendment to its operations specifications in accordance with § 129.11 to include a requirement for the airplane models specified in Table 2 of this section to use ground air conditioning systems for actual gate times of more than 30 minutes, when available at the gate and operational, whenever the ambient temperature exceeds 60 degrees Fahrenheit; and

(3) Thereafter, the certificate holder uses ground air conditioning systems as described in paragraph (k)(2) of this section on each airplane subject to the extension.

TABLE 2

| Model—Boeing | Model—Airbus |
|---|---|
| 747 Series | A318, A319, A320, A321 Series |
| 737 Series | A300, A310 Series |
| 777 Series | A330, A340 Series |
| 767 Series | |
| 757 Series | |

(l) For any foreign air carrier or foreign person for which the operating certificate is issued after September 19, 2008, the compliance date specified in paragraph (e) of this section may be extended by one year, provided that the foreign air carrier or foreign person meets the requirements of paragraph (k)(2) of this section when its initial operations specifications are issued and, thereafter, uses ground air conditioning systems as described in paragraph (k)(2) of this section on each airplane subject to the extension.

(m) After the date by which any person is required by this section to modify 100 percent of the affected fleet, no person may operate in passenger service any airplane model specified in Table 2 of this section unless the airplane has been modified to comply with § 26.33(c) of this chapter.

TABLE 3

| Model—Boeing | Model—Airbus |
|---|---|
| 747 Series | A318, A319, A320, A321 Series |
| 737 Series | A300, A310 Series |
| 777 Series | A330, A340 Series |
| 767 Series | |
| 757 Series | |
| 707/720 Series | |

(n) No foreign air carrier or foreign person may operate any airplane on which an auxiliary fuel tank is installed after September 19, 2017 unless the FAA has certified the tank as compliant with § 25.981 of this chapter, in effect on September 19, 2008.

(o) *Exclusions.* The requirements of this section do not apply to the following airplane models:

(1) Convair CV–240, 340, 440, including turbine powered conversions.

(2) Lockheed L–188 Electra.

(3) Vickers Armstrong Viscount.

(4) Douglas DC–3, including turbine powered conversions.

(5) Bombardier CL–44.

(6) Mitsubishi YS–11.

(7) BAC 1–11.

(8) Concorde.

(9) deHavilland D.H. 106 Comet 4C.

(10) VFW—Vereinigte Flugtechnische VFW–614.

(11) Illyushin Aviation IL 96T.

(12) Vickers Armstrong Viscount.

(13) Bristol Aircraft Britannia 305.

(14) Handley Page Handley Page Herald Type 300.

(15) Avions Marcel Dassault—Breguet Aviation Mercure 100C.

(16) Airbus Caravelle.

(17) Fokker F–27/Fairchild Hiller FH–227.

(18) Lockheed L–300.

Issued in Washington, DC, on July 9, 2008.

**Robert A. Sturgell,**

*Acting Administrator.*

[FR Doc. E8–16084 Filed 7–16–08; 10:30 am]

**BILLING CODE 4910–13–P**