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FINAL REGULATORY EVALUATION, REGULATORY FLEXIBILITY ANALYSIS, TRADE IMPACT ASSESSMENT, AND UNFUNDED MANDATES ACT DETERMINATION

FOR

FINAL RULE:

TRANSPORT AIRPLANE FUEL TANK SYSTEM DESIGN REVIEW, AND INSPECTION AND MAINTENANCE REQUIREMENTS

OFFICE OF AVIATION POLICY AND PLANS
AIRCRAFT REGULATORY ANALYSIS BRANCH, APO-320

Allen A. Mattes

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EXECUTIVE SUMMARY

In the past 12 years there have been two fuel tank explosions that were likely caused by an internal ignition source: (1) the July 17, 1996, B-747 TWA Flight 800 mid-air explosion causing 230 fatalities; and (2) the May 11, 1990, B-737 Philippine Airlines on-the-ground explosion in Manila causing 8 fatalities and 30 injuries among the 120 passengers and crew.

Based on the previous 12 years of world-side fuel tank explosion history, the FAA anticipates that one to two fuel tank explosions (the statistical expected value is 1.21) from an internal ignition source event will occur to a U.S.-registered airplane during the ten year timeframe of 2004 - 2013. The FAA determined that the present value of the losses from these projected accidents discounted to 2001 by seven percent is between $234 million and $400 million.

The Federal Aviation Administration's (FAA) new part 21 Special Federal Aviation Regulation (SFAR) No. __, the parts 91, 121, 125, and 129 operational rules changes, and the part 25 certification changes will reduce the potential of a fuel tank explosion from an ignition event in the fuel tank.

The SFAR affects all design approval holders of part 25 type certificates (TC), all holders of supplementary type certificates (STC) for part 25 fuel tank systems, and holders of part 25 non-fuel tank system STCs that may affect the fuel tank system. Within 18 months of the final rule's effective date they must complete a safety review of the fuel tank system design to determine that it meets the requirements of sections 25.901 and 25.981(a) and (b). On the basis of that review, they must develop any design changes necessary to meet these requirements and they must develop maintenance and inspection instructions to preclude an ignition source within the fuel tank system. This review may also result in future service bulletins as well as provide data to support future FAA fuel tank system Airworthiness Directives (ADs).

The parts 91, 121, 125, and 129 operational rules changes require operators to incorporate these instructions into their fuel tank system maintenance manuals within 36 months of the final rule's effective date.

The part 25 changes require holders of future new TCs and holders of future new STCs for fuel tank systems to design the fuel tank system to minimize the amount of time the fuel tank would have an explosive atmosphere.

The final rule will affect 10 manufacturers holding 40 part 25 TCs and 31 part 25 "derivative" TCs, 42 manufacturers, repair stations, and airlines holding 79 fuel tank system STCs, and holders of 325 non-fuel-tank-system STCs that may affect fuel tank systems. It will affect 6,971 airplanes (as of the end of 1999).

The costs of compliance do not include the costs to comply with the 40 existing fuel tank system ADs, or the costs to comply with any future ADs or with any future service bulletins that may be developed based on the fuel tank system reviews. In addition, consistent with the approach used in the aging aircraft rule, the compliance costs do not include the costs to repair and replace equipment and wiring that is found to need repair or replacement during the inspection. Although these costs may be substantial, they are attributable to existing FAA regulations that require such repairs and replacements be made to ensure the airplane's continued airworthiness.

For the design approval holders, the primary sources of compliance costs with the rule are the engineering hours to complete the fuel tank system design review.

For the operators of these airplanes, the costs of compliance arise from the fuel tank system alterations required in response to the fuel tank system review by the TC or STC holder. Increased costs also arise from the increased frequency of fuel tank inspections, and the increased amount of time to more completely inspect and maintain the fuel tank system and associated wiring components.

Finally, the costs of compliance to holders of future part 25 TCs and fuel tank system STCs are the engineering costs associated with designing fuel tank systems in certain future airplane models that will differ from the existing designs.

Table 1 lists the significant differences in the assumptions made, data used, and the different requirements between the proposal and the final rule.

TABLE 1

SIGNIFICANT DIFFERENCES IN ASSUMPTIONS AND VALUES BETWEEN THE PRELIMINARY REGULATORY EVALUATION AND THE FINAL REGULATORY EVALUATION

Assumption or Value	**Preliminary Regulatory Analysis**	**Final Regulatory Analysis**
Number of Airplanes	6,006 (in 1996)	6,971 (in 1999)
Timeframe for Analysis	2000 - 2011	2001-2013

Net Rate of Fleet Growth	4.3 percent	3.0 percent
Hourly Compensation: Engineer; Mechanic	$100; $70	$110; $75
Number of Fuel Tank System TC Reviews	36	71 (40 "full-scale" and 31 "derivative")
Num Eng Yrs for TC Review	0.4 to 2.5	0.5 to 4
Number of Fuel Tank System STC Reviews	64	74
Num Eng Yrs for Fuel Tank System STC Review	0.35	0.15
Number of Non-Fuel-Tank-System STC Reviews	None (Asked for Comments)	325
Num Eng Yrs for Non-Fuel-Tank-System STC Review	None (Asked for Comments)	0.0375
Operator Paper Review of Airplane Fuel Tank System-Field Approvals/STCs	None	1 engineer day per existing airplane
Number Months to Complete Safety Review Fuel Tanks	12	18
Number Months to Revise Maintenance Manual (After Review)	6	18
Number Years to Complete Initial Inspection (After Manual Revision)	3 years (Completed between 2002 and 2004)	2 years (Completed during 2004 and 2005)
Determinants of Number Inspection Hours	Airplane Model	Airplane Model plus Year Manufactured
Time before Initial Inspections Begin	18 months	36 months
Number Years to Complete Initial Inspection	3 years	2 years
Number Labor Hours for Initial Inspection	50-198	49-218
Number Days Out-of-Service for Initial Inspection	0-4 (40 percent inspections done at "C" checks)	0-4 (60 percent of inspections done at "C" checks)
Year Reinspections Start	2004 (immediately after initial inspections)	2008 (2 years after initial inspections)
Reinspection Frequency	Every 3 years (Some done during "C" checks)	Every 5 years (All done during "D" checks)
Number Hours for Reinspection	40-160	25-87
Reduced Inspection Hours Due to ADs Already Issued	All B-747 hours not included; 50 hours for B-737s not included	No adjustment

Number Days Out-of-Service for Reinspection	0-3 (40 percent of reinspections done at "C" checks)	0 (All reinspections done at "D" checks)

Table 2 summarizes the compliance cost estimated by the FAA for the proposed rule. For that proposal, the FAA had estimated that the discounted present value of the compliance costs with the proposal during the time period 2000 - 2009 would have been $168.9 million ($9.5 million for TC holders, $6.4 million for STC holders, and $153 million for operators).

TABLE 2

PRESENT VALUE IN 1999 OF THE COSTS OF COMPLIANCE WITH THE PROPOSED RULE
(As estimated in the Preliminary Regulatory Evaluation)

Source of Cost	**Present Value in 1999 of the Compliance Costs (in 1998 $ millions)**
Fuel Tank Review (Total)	15.9
(For TC Holders)	(9.5)
(For STC Holders)	(6.4)
Maintenance and Inspection	100.0
Lost Net Revenue	35.6
Additional Recordkeeping	17.4
TOTAL	168.9

However, based on the public comments and the changes in assumptions and values listed in Table 1, the FAA determined that the present value of the compliance costs with the rule over the time period 2001 - 2013 are $165.1 million ($27.1 million for TC holders, $2.8 million for fuel tank system STC holders, $2.5 million for non-fuel-tank-system STC holders, and $132.5 million for operators).

TABLE 3

PRESENT VALUE OF THE COSTS OF COMPLIANCE WITH THE FINAL RULE

Source of Cost	Present Value in 2001 of the Compliance Costs (in 2000 $ millions)
Part 25 Fuel Tank Design	0.315
(For TC Airplanes)	Minimal
(For Fuel Tank STC Holders)	(0.315)
Fuel Tank Review (Total)	38.157
(For TC Holders)	(27.107)
(For Fuel Tank STC Holders)	(2.522)
(For Non-Fuel-Tank STC Holders)	(2.594)
(For Operators)	(5.934)
Maintenance and Inspection	92.043
Lost Net Revenue	24.224
Additional Recordkeeping	10.338
TOTAL	165.077

In the NPRM, the FAA had stated that the fuel tank system design changes that would be required for future part 25 airplanes and future fuel tank system STCs would have imposed minimal costs. The FAA similarly determines that the final part 25 rule changes also impose minimal costs on future part 25 TC airplanes and fuel tank system STCs issued under part 25.

The quantifiable losses from a catastrophic in-flight fuel tank explosion are $400 million for a typical commercial aviation flight. However, the potential benefits from this rule are difficult to quantify because this rulemaking is one of several actions being undertaken by the FAA to prevent future fuel tank explosions. Nevertheless, the FAA determined that the final rule will be cost beneficial if it were to prevent one such accident by the year 2013.

The final rule is a "significant regulatory action." As the initial inspection costs per airplane to an operator are between $7,000 and

$20,000 the rule has a significant economic impact upon a substantial number of small entities. It has minimal effects on international trade. It does not contain a significant intergovernmental or private sector mandate of more than $100 million in any one year.

I. INTRODUCTION

A. BACKGROUND

In the past 12 years, there have been two fuel tank explosions whose probable ignition sources were internal to the fuel tank. On May 11, 1990, a Philippines Air Lines B-737 exploded on the ground in Manila, causing 8 fatalities and injuring 30 of the 120 passengers and crew. Six years later, on July 17, 1996, Trans World Airlines (TWA) Flight 800, a B-747, exploded, causing the deaths of all 230 aboard.

During the past 40 years, there have been 15 fuel tank explosions (including the two mentioned in the preceding paragraph). Of the eight explosions that occurred during operations, six were caused by outside ignition sources (i.e., lightning, engine separation, or a bomb). The seven non-operational explosions occurred during refueling or maintenance activities. The FAA has reacted to these 13 explosions with rules to prevent these types of ignition sources from causing other fuel tank explosions.

Briefly, there are two necessary conditions for a fuel tank explosion. The first condition is that the fuel tank have an explosive atmosphere. The second condition is that there be an ignition source.

With respect to preventing an explosive atmosphere in the fuel tank, an Aviation Rulemaking Advisory Committee (ARAC) Fuel Tank Harmonization Working Group (FTHWG) studied airplane fuel tank system design and associated airplane operating issues and provided its recommendations to the Federal Aviation Administration (FAA) on July 21, 1998. A version of these recommendations is incorporated into the part 25 changes that require future type certificated airplanes and future fuel tank systems STC to minimize the potential for a flammable atmosphere in the fuel tank or to ensure continued safe flight and landing should the fuel vapors ignite in the fuel tank.

In addition, a second ARAC group has been formed to evaluate the potential feasibility of inerting the fuel tank atmosphere to prevent the development of an explosive atmosphere. This group is scheduled to present its recommendations to the FAA by September 2001.

With respect to preventing an internal ignition source, the FAA has always taken the conservative position that fuel tanks are considered to be explosive at all times and, therefore, no ignition event can ever be allowed in the fuel tank. However, the two fuel tank explosions that were probably caused by an internal ignition event indicate there is a potential for a future fuel tank explosion caused by an internal ignition source.

As part of its program to eliminate the potential for a fuel tank explosion, the FAA has issued 40 Airworthiness Directives (ADs) addressing fuel tank systems. One result from these ADs is that recent inspections of the B-737 boost fuel pump wiring have uncovered 2 instances when arcing through the cable occurred.

In light of these findings, the FAA published a proposed rule on October 29, 1999, to cover all transport category airplanes with a maximum capacity of at least 31 passengers. The FAA received 47 comments about its proposal from the industry and general public.

II. FINAL RULE AND THE CHANGES FROM THE PROPOSED RULE

A. FINAL SPECIAL FEDERAL AVIATION REGULATION (SFAR), OPERATIONAL RULE CHANGES, AND PART 25 TYPE CERTIFICATE CHANGES

The final SFAR and operational rules changes apply to all turbine-powered transport category airplanes with a TC issued after January 1, 1958, and a maximum certificated passenger capacity of 30 or more, or a maximum certificated payload capacity of 7,500 pounds or more operated under parts 91, 121, 125, or 129. The final rule requires three actions for compliance. The first action, the SFAR, requires all design approval holders of TCs and STCs for fuel tank systems or other systems that may affect the fuel tank system: (1) to complete a fuel tank system design review that may generate future service bulletins and to provide data to support any needed FAA fuel tank system ADs; and, (2) on the basis of the review, provide operators with recommendations and instructions for fuel tank system inspections, testing, and maintenance within 24 months of the rule's effective date. The second action, the final operational rules changes, requires that operators incorporate these recommendations and instructions (or their equivalents) into their fuel tank system maintenance manuals within 36 months of the final rule's effective date.

The third change is associated with three amendments to the airworthiness standards for future part 25 airplanes. This change affects no existing airplanes or airplanes being produced under an existing part 25 TC. The first amendment defines new requirements for demonstrating that ignition sources could not be present in fuel tanks when failure conditions are considered. The second amendment requires that any safety critical fuel tank system maintenance actions be identified. The third amendment requires a means to minimize the development of flammable vapors in fuel tanks or a means to prevent catastrophic damage if ignition does occur.

B. DIFFERENCES BETWEEN THE FINAL RULE AND THE PROPOSED RULE

The primary difference between the final rule and the proposed rule is a change in the compliance dates. The FAA had initially proposed a one-year time period for design approval holders to comply with the SFAR by completing the fuel tank system review and providing operators with their recommended changes in fuel tank system inspections and maintenance. The FAA had proposed that operators then be given six months after that one year to modify their maintenance manuals to incorporate these design approval holders recommendations.

The ATA commented that the FAA had substantially underestimated both the amount of engineering time needed by the design approval holders to complete their reviews and the amount of time needed for operators to revise their manuals and to obtain approval for those revisions from the FAA.

The FAA agrees with these comments. As a result, in the final rule, the FAA allows the design approval holders 18 months to complete their fuel tank system design reviews, rather than the proposed one year. In addition, the FAA allows the operators another 18 months, rather than the proposed six months, to revise their maintenance manuals to incorporate the recommendations provided by the design approval holders.

III. BENEFITS

A. INTRODUCTION AND BACKGROUND

Within the past 11 years in the worldwide fleet, there have been 2 fuel tank explosions for which an internal fuel tank ignition event was the probable cause of the explosion. In the first, on May 11, 1990, in Manila, a Philippine Airlines B-737's fuel tank exploded while the airplane was on the ground, resulting in 8 fatalities and 30 injuries among the 120 passengers and crew. In the second, on July 17, 1996, a B-747 (TWA Flight 800) fuel tank exploded in flight, resulting in the deaths of all 230 passengers and crew.

The expected benefit of this rule is that it will significantly reduce the risk of future fuel tank explosions. The rule requires that all affected fuel tank systems designs receive an engineering review to determine what, if any, factors in the design can be altered or improved to eliminate the possibility of an internal ignition source. Until these reviews are completed, the FAA cannot determine the particular fuel tank system improvements that will be derived from this review and many of them will be specific to individual fuel tank designs. In addition to taking a new look at fuel tank designs, the rule requires TC and STC holders to reevaluate fuel tank system maintenance and inspection procedures and inform operators of improvements in those procedures that will reduce the potential for an internal ignition event. In other words, the purpose of the rule is to discover potential problems and develop corrective actions to prevent a fuel tank explosion before another such accident occurs.

B. SOURCE OF BENEFITS FROM THE PART 25 RULE CHANGE

In general, there are 2 necessary conditions that must simultaneously exist to have a fuel tank explosion. The first condition is that the fuel tank must have an explosive atmosphere. The second condition is that there be a source (either external or internal to the fuel tank) to ignite that explosive atmosphere. Consequently, the FAA is acting to minimize the potential that either of these two conditions exists at any point in time in a fuel tank.

With respect to preventing the first condition of an explosive atmosphere, the ARAC FTHWG had studied airplane fuel tank system designs and airplane operating issues. Its recommendations were made to the FAA on July 21, 1998, and one of them was for the FAA to revise part 25 for future TC airplanes to require their fuel tank system designs to allow flammable conditions less than 7 percent of the operational time. The FAA revised this recommendation to require the fuel tank system designs of future new TC airplanes and future fuel tank system STCs minimize the potential for a flammable atmosphere in the fuel tank.

The FAA anticipates that minimizing the potential for a flammable fuel tank atmosphere in future part 25 TC airplanes will most likely involve design changes to prevent outside heat sources from raising fuel tank temperature. Reducing the fuel temperature in the tank reduces the fuel evaporation rate, which, therefore, reduces the amount of time a fuel tank could have an explosive atmosphere. If that type of design change were to be impractical, part 25 will allow the use of alternative methods either to suppress the explosion or to minimize the potential that an ignition could cause an explosion. The potential benefits from this part 25 change will occur as new airplane models are type certificated and manufactured. Consequently, although the potential benefits from the part 25 change for new type certificated airplanes will be minimal in the immediate future, the benefits will increase as new airplane models are added to the fleet. At this time, it is not clear what changes may be incorporated into future airplane designs to minimize the risk of fuel tank explosions, nor how much the risk may be reduced by future design changes. Accordingly, the FAA had not attempted to quantify those benefits in this analysis. Nevertheless, the agency is optimistic that improved future fuel tank designs resulting from this rule will contribute to reducing the risk.

The part 25 change also requires that the potential for a flammable atmosphere to develop in a future part 25 fuel tank system STC be minimized. Although many future fuel tank system STCs will not be affected by the part 25 changes (e.g., those changing the model of a fuel boost pump), other fuel tank system STCs will be affected (e.g., those adding one or more auxiliary fuel tanks for a freighter conversion). However, as is the case for trying to quantify the benefits of the part 25 change for future TC airplanes, the FAA cannot quantify the benefits of the part 25 change for future fuel tank system STCs.

C. SOURCE OF BENEFITS FROM THE SFAR AND THE OPERATIONAL RULES CHANGES

The fact that there have been two explosions caused by an unknown internal fuel tank ignition event indicates that the event can happen in existing fuel tank systems. As described in the Preliminary Regulatory Evaluation, further evidence of this potential was uncovered in the results from an AD requiring the inspection of fuel boost pump wires in the center wing tank of all B-737s with more than 30,000 flight hours. Of the 599 airplanes inspected as of July 29, 1998, 273 had noticeable chafing to wire insulation, 33 had significant (>50 percent) insulation chafing, 8 had arcing on the cable but not through the conduit, while 2 had arcing through the conduit.

The purpose of this SFAR and operational rules changes is to significantly reduce the risk of fuel tank ignition event. The approach taken in the final rule closely follows recent multinational cooperative industry efforts, recent service bulletins, and recent ADs by requiring that individual fuel tank systems and equipment as well as airplane wiring be evaluated for its potential to cause an ignition event in a fuel tank. Both the SFAR and the operational rules changes, although separate actions, work in concert to attain this risk reduction.

The SFAR requires the design approval holder to complete a fuel tank system review within 18 months to establish the means to reduce the probability of an ignition event. This review may produce recommendations for operators to retrofit certain safety equipment in the fuel tank system (i.e., flame arrestors on fuel pumps) or for operators to reroute or separately bundle wiring. The operator will also receive recommendations and instructions concerning fuel tank system inspections, equipment and wiring testing, and other fuel tank maintenance. In addition, the review will provide the basis for future service bulletins and, possibly, data for the FAA to issue future ADs.

The operational rules changes require the operator to incorporate these recommendations into the maintenance and maintenance manuals and procedures within 36 months of the final rule's publication date. As noted in the preceding paragraph, these recommendations may require retrofitting safety equipment or rerouting or rebundling wiring. In addition these recommendations may affect the amount of fuel tank system maintenance and the frequency of inspections.

D. QUANTIFYING THE DOLLAR LOSSES FROM A MID-AIR EXPLOSION

D.1. Assumptions

In the Preliminary Regulatory Evaluation, the FAA had made the following assumptions to quantify the potential losses associated with future in-flight fuel tank explosions:

1. A critical determinant of these potential losses is that the estimated benefits were limited to the time period 2000 through 2009 on the grounds that, as time proceeds, the assumptions used and projections made become less tenable or reliable. In addition, the compliance costs had been limited to this same ten-year time period.

2. The worldwide fuel tank explosion rate for the period 1989 through 1998 has provided an accurate model for the future fuel tank explosion rate if no additional actions are taken to prevent these explosions. The FAA had noted the recent fuel tank wiring problems found in B-737s and the likely wiring deterioration in the aging fleet, and had stated that this accident rate assumption may result in a conservative estimate.

3. This observed explosion rate is based on only the accidents that were likely caused by an internal fuel tank ignition event. Fuel tank explosions ignited by lightning strikes, engine separations, bombs, fueling accidents, etc. are not included. Consequently, TWA Flight 800 and the Philippine Airlines explosions are the universe of past explosions. In other words, the estimated potential losses from future fuel tank explosions did not include explosions that would have been

prevented by compliance with other FAA safety standards or security requirements.

4. Based on an FAA forecast, the average annual rate of growth in U.S. commercial airplane operations would have been 4.3 percent over the next 10 years.[1]

5. The benefit of preventing a statistical fatality is represented by $2.7 million for the purpose of comparing costs and benefits.

6. The average value of a destroyed airplane would be $20 million - noting that this is an average value that includes both new and older airplanes of different sizes that could have a fuel tank explosion.

7. Based on the Lockerbie, Scotland investigation updated to 1997 dollars, the FAA estimates that an in-flight airplane explosion investigation would cost the U.S. government about $30 million. Although the cost of the TWA Flight 800 accident investigation was more than $30 million, that accident investigation cost was compounded by its location in the Atlantic Ocean.

8. A 7 percent discount rate had been used to calculate the present value of the dollar losses.

Although there were no direct comments on the methodology, one commenter noted that the FAA had instituted many fuel tank ADs (40, at the last count) since the TWA Flight 800 accident and their impacts on the future explosion rate had not been considered. The logical implication of this comment is that, to the extent that the most likely internal fuel tank ignition events have been mitigated by these ADs, an explosion rate based on the pre-AD historical rate will, implicitly overestimate the future accident rate.

[1] Federal Aviation Administration, FAA Aerospace Forecasts Fiscal Years 1998-2009, March 1998 Table 21, p. X-23.

The FAA agrees in principle with this comment. The difficulty in practice is that the amount of risk reduction resulting from the ADs cannot be quantified because the actual ignition events that caused the two accidents are not clearly understood and the FAA does not know with certainty that the fuel tank ADs have addressed these causes. Further, there is an offsetting argument, as illustrated by the findings of the aforementioned B-737 fuel pump wiring inspections, that the conditions leading to these accidents may be becoming more prevalent. Thus, the historical fuel tank explosion rate may underestimate the future fuel tank explosion rate. Given that the ignition sources for the two accidents are not known with certainty, the past rate at least provides a reasonable basis for estimating the number of future fuel tank explosions if this rule were not implemented.

There were no other comments on these assumptions. However, in the light of more recent data, the FAA has updated the following estimates:

1. **Most of the benefits from the final rule will not begin until the fuel tank systems are inspected and appropriate maintenance and corrective actions are completed.**[2] **As a result, the period of time during which benefits are analyzed is the years 2004 through 2013, which is the period of time that the operational rules compliance costs are calculated. In addition, the benefits from the Part 25 revisions will extend beyond 2013 and gradually increase as new TC airplanes are added to the fleet.**

2. Two years have passed in which there were no fuel tank explosions since the Preliminary Regulatory Evaluation was begun. As a

[2] There is a potential that some fuel tank system reviews will uncover unsafe conditions that will result in immediate issuances of ADs, which

result, the fuel tank explosion rate used in this final rule analysis is based on the last 12 years (1989 through 2000) of operations, rather than the 10 years (1989 through 1998).

3. The appropriate baseline on which to calculate the risk is the number of departures rather than the number of flight hours. The ARAC FTHWG report concluded that an airplane faces the greatest risk of a fuel tank explosion during take-off and climb-out when the fuel is at its warmest and has not been cooled by the outside temperature. The distinction between number of departures and the number of flight hours is important because the commercial aviation industry trend has been that the annual growth rate in the number of flight hours is higher than the annual growth rate in the number of airplane departures. As a consequence, in this Final Regulatory Evaluation, the FAA uses data from a source that directly collects departure data for all U.S. air carriers that fill out Form 41.[3] Those data[4] reported that there were 9.165 million departures by U.S. carriers between May 1999 and May 2000. In order to account for the airplanes not in commercial service that are affected by the final rule, the FAA increased the number of commercial flights by 10 percent to account for those uncounted flights. Finally, the growth rate in the number of departures was 3.6 percent from May 1998 to May 1999.

4. The value of the TWA airplane has been reduced from $20 million to $3.9 million - today's value of a 25 year old B-747-100.[5]

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would require compliance before 2004 and, thereby, increase fuel tank system safety prior to the fuel tank system inspections.

[3] U.S. Department of Transportation Bureau of Transportation Statistics' Form 41 must be reported by every U.S. major, national, large regional, and medium regional air carrier. It requires that both scheduled and non-scheduled operations be reported.

[4] U.S. Department of Transportation, Bureau of Transportation Statistics, Office of Airline Information, Air Carrier Traffic Statistics Monthly, May 2000/1999, May 2000, p.1.

[5] Avitas, BlueBook of Jet Aircraft Values, 2000 2nd Half, 2000, p. BO-33.

[5] U.S. Department of Transportation, Bureau of Transportation Statistics, Office of Airline Information, Air Carrier Traffic Statistics Monthly, May 2000/1999, May 2000, p.1.

5. The cost of an accident investigation is adjusted to $31 million in year 2000 dollars.

6. In the Preliminary Regulatory Evaluation, the FAA did not include a value for the potential ground collateral damage in the Preliminary Regulatory Evaluation. As was used in the Final Regulatory Evaluation for the revised B-737 Digital Flight Data Recorder Rulemaking, the FAA assigns a value of $5 million per accident, which includes a value for the potential number of non-passenger fatalities on the ground.

E. CALCULATED EXPLOSION RATE AND ESTIMATED NUMBER OF FUTURE U.S. AIRPLANE FUEL TANK ACCIDENTS

In the Preliminary Regulatory Evaluation, the FAA had estimated that about 149 million worldwide commercial airplane departures had occurred during the preceding 10 years. Dividing that number into the 2 fuel tank explosions generated an estimated internal ignition event fuel tank explosion rate of 1.34 E-8 explosions per commercial airplane departure. Assuming that 40 percent of the worldwide commercial airplane departures have historically been in the United States, the FAA had then estimated that about 61 million departures in the United States occurred during that time period. Using a cumulative number of 61 million departures during 1989 through 1998 and an annual growth rate of 4.3 percent resulted in the FAA's calculation of 7.8 million departures in 1998 and a resulting estimate that 93 million departures would occur between 2000 and 2009. Multiplying the calculated fuel tank explosion rate (1.34 E-8) by the number of total departures (93) generated an estimate of between 1 and 2 (the statistical expected number was 1.25) fuel tank explosions to U.S.-registered airplanes between 2000 and 2009 if no additional preventive action were to be taken.

In the Final Regulatory Evaluation, however, the FAA applied a 3.6 percent annual growth rate (not 4.3 percent) to the reported 9.165 million departures by U.S. air carriers in 2000 (adjusting it upward by 10 percent for non-air carrier departures for a total of 10.082 million departures) between May 1999 and May 2000. The FAA then worked backward through time to estimate the total number of U.S. departures and determined that it had underestimated the U.S. and world-wide number of flights between 1989 and 1998 in its Preliminary Regulatory Evaluation. As seen in Table III-1, based on its revised data, the FAA calculated that there were 250.8 million U.S. departures between 1989 and 2000. Therefore, the recalculated fuel tank explosion rate over the last 12 years is 0.797 E-8 fuel tank explosions per departure, rather than the previously estimated 1.25 E-8 fuel tank explosions per commercial aviation departure.

A factor that partially offsets the reduction in the calculated fuel tank explosion rate is that more flights will occur in the United States between 2004 and 2013 than between 2000 and 2009. In addition, using a base of 10.082 million departures in the year 2000 and the annual growth rate of 3.6 percent produces a total of 136.9 million U.S. operations between 2004 and 2013 rather than the 93 million U.S. departures between 2000 and 2009 as estimated in the Preliminary Regulatory Evaluation.

Therefore, multiplying the total number of departures (136.9 million) by the calculated fuel tank accident explosion rate (0.797 E-8) results in 1 to 2 such accidents with a statistical expected value of 1.09 will likely occur to U.S.-registered airplanes between 2004 and 2013.

TABLE III-1	
NUMBER OF U.S. AND WORLD FLIGHTS (1989-2000) (In Millions)	
YEAR	**NUMBER OF U.S. FLIGHTS**
2000	10.082
1999	9.732
1998	9.393
1997	9.067
1996	8.752
1995	8.448
1994	8.154
1993	7.871
1992	7.597
1991	7.333
1990	7.079
1989	6.833
U.S. TOTAL	100.342
WORLD TOTAL	250.854

F. QUANTIFIED POTENTIAL ESTIMATED LOSSES ASSOCIATED WITH FUEL TANK EXPLOSIONS

F.1. Introduction

In the Preliminary Regulatory Evaluation, the FAA had estimated the potential number of fatalities using two methodologies. The first methodology was to use the TWA accident as the "representative" accident. On the basis of its 230 fatalities, the predicted one to two explosions were then projected to result in 230 to 460 fatalities. If the statistically expected number of 1.25 explosions were used, the projected estimate would have been 288 fatalities.

The second methodology was to construct a "representative" commercial aviation flight transporting an average number of passengers. Using FAA data, the average number of air carrier passenger seats per airplane was projected to increase to 175 by 2009.[6] Using the projected load factor of 70 percent[7] and a 7-member crew resulted in an average of 130 passengers and crew per flight. On that basis, the predicted one to two explosions were projected to result in 130 to 260 fatalities. If the statistically expected value of 1.25 explosions were used, the projected estimate was 163 fatalities.

In the Final Regulatory Evaluation, the statistically expected number of accidents is reduced from 1.25 to 1.09. Thus, for a TWA type accident, the statistically expected number of fatalities is 251. In addition, the most recent FAA predictions about the number of future passengers in a "representative" commercial airline flight indicate that the average

[6] U.S. Department of Transportation, Office of Aviation Policy and Plans, FAA Aviation Forecasts Fiscal Years 1998 - 2009, March 1998, p. IX-8.

number of seats will increase by the year 2010 to 169[8] (rather than the previously estimated 175 seats) and the load factor increases to 71.5 percent,[9] resulting in an average of 128, rather than 130, passengers and crew. On that basis, the projected one to two explosions will produce 128 to 256 fatalities. If the statistically expected value of 1.09 explosions is used, the projected estimate is 140 fatalities.

F.2. Undiscounted Quantified Losses

In the Preliminary Regulatory Evaluation using the TWA accident, the FAA had estimated that the total losses over the 10 year period (in undiscounted terms) would have been $671 million for one accident and $1.342 billion for two accidents, with the losses of $839 million for the statistically expected 1.25 accidents. Using the "representative" accident, the FAA had estimated that the total losses over the 10 year period (in undiscounted terms) would have been $401 million for one accident and $802 million for two accidents, with the losses of $564 million for the statistically expected 1.25 accidents.

In the Final Regulatory Evaluation as seen in Table III-2, using those numbers for the TWA accident, the FAA determined that the undiscounted losses from one such accident are $660.9 million, from two such accidents are $1.322 billion, and from the statistically expected number of 1.09 accidents are $720.381 million. Similarly, using those numbers for a "representative" accident, the undiscounted losses from one such accident are $401.6 million, from two such accidents are $803.2 million,

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[7] Ibid., p. IX-16.
[8] U.S. Department of Transportation, Federal Aviation Administration, Office of Aviation Policy & Plans, FAA Aerospace Forecast Fiscal Years 2000 - 2011, March 2000, Table 6, p. X-8.
[9] Ibid., Table 14, p. X-16.

TABLE III-2

UNDISCOUNTED LOSSES FROM A MID-AIR EXPLOSION BY TYPE OF LOSS AND AIRPLANE
(In $ Millions)

CATEGORY OF LOSS	"REPRESENTATIVE" ACCIDENT	TWA ACCIDENT
NUMBER OF FATALITIES	128	230
VALUE OF FATALITIES	345.6	621
VALUE OF AIRPLANE	20	3.9
COST OF INVESTIGATION	31	31
GROUND DAMAGE	5	5
OTHER	0	0
TOTAL (1 ACCIDENT)	401.6	660.9
TOTAL (1.09 ACCIDENTS)	437.744	720.381
TOTAL (2 ACCIDENTS)	803.2	1321.8

and from the statistically expected number of 1.09 accidents are $437.74 million.

F.3. Discounted Quantified Losses

The impact of discounting on the value of the quantified losses critically depends upon when the explosion would have occurred. For example, discounting's impact would be minimal if the prevented explosion would have occurred in 2004. Similarly, discounting's impact is at its greatest if the prevented explosion would have occurred in 2013.

An appropriate statistical approach to estimate the most likely year of a future mid-air explosion is to first calculate the probability that a fuel tank explosion will occur in each year and then sum those individual year probabilities over time. The year in which the cumulative probability reaches 0.5 is the year at which the probability that the first explosion accident would occur on or before that year is the same as the probability that the first accident would occur after that year. In the Preliminary Regulatory Evaluation, the FAA had used that methodology to estimate that if there were to be one explosion during the 10-year time period, it would have occurred by the sixth year (2005). If the statistically expected value of 1.25 explosions were to be used, the FAA had estimated that the first explosion would have occurred by the fifth year (2004). Finally, if there were to be 2 explosions, the first explosion would have occurred in the fourth year (2003) and the second explosion would have occurred in the eighth year (2007).

Thus, as seen in Table III-3, in the Preliminary Regulatory Evaluation the FAA had estimated that the present value of the potential losses over the 10 years 2000 through 2009 discounted at 7 percent had been estimated to range from $267 million to $907 million.

TABLE III-3

PRESENT VALUE OF THE POTENTIAL LOSSES FROM A FUEL TANK EXPLOSION
(As calculated in the Preliminary Regulatory Evaluation)
(in $ millions)

TYPE OF AIRPLANE CATEGORY	PRESENT VALUE OF DISCOUNTED LOSSES — NUMBER OF ACCIDENTS: ONE ACCIDENT	1.25 ACCIDENTS	TWO ACCIDENTS
TWA	448	479	903
"Representative"	267	286	539

However, in the Final Regulatory Evaluation the FAA uses a different accident rate, a different number of future U.S. flights, and the 2004 through 2013 timeframe to calculate revised probabilities for a fuel tank explosion accident. As seen in Table III-4, the FAA determined that if there were one accident, there is a 50 percent chance that it would occur between 2004 and 2008 and a 50 percent chance that it would occur between 2008 and 2012. On that basis, the FAA determined that the year 2008 represents the most appropriate year to place the potential accident for the purpose of determining the present value of the quantified losses. Similarly, if there were to be two accidents, the most appropriate years to place them are in the years 2008 and 2013. Using that same logic for the statistically expected value of 1.09 accidents, the most appropriate approach is to place the first accident in the year 2008 and assume that there is a 9 percent probability that a second accident would occur by the year 2013.

TABLE III-4			
PROBABILITY OF A U.S. AIRPLANE MID-AIR EXPLOSION BETWEEN 2004 AND 2013			
YEAR	NUMBER OF FLIGHTS (In Millions)	STATISTICAL NUMBER OF POTENTIAL MID-AIR EXPLOSIONS IN YEAR	CUMULATIVE NUMBER OF POTENTIAL MID-AIR EXPLOSIONS
2000	10.082		
2001	10.444	0.0833	0.0000
2002	10.820	0.0863	0.0000
2003	11.210	0.0894	0.0000
2004	11.614	0.0926	0.0926
2005	12.032	0.0959	0.1885
2006	12.465	0.0994	0.2879
2007	12.913	0.1030	0.3909
2008	13.378	0.1067	0.4975
2009	13.860	0.1105	0.6080
2010	14.359	0.1145	0.7225
2011	14.876	0.1186	0.8411
2012	15.411	0.1229	0.9640
2013	15.966	0.1273	1.0913
TOTAL	136.874	1.0913	

Thus, as shown in Table III-5, the FAA calculated that the present value of the losses associated with one TWA-type accident is $384.65 million, the present value of the losses associated with two accidents are $658.9 million, and the present value of the losses associated with the statistically expected 1.09 accidents are $409.61 million.

As shown in Table III-6, the FAA calculated that the present value of the losses associated with one "representative" accident, the present value of the losses associated with one accident is $233.73 million, the present value of the losses associated with two accidents are $400.38 million, and the present value of the losses associated with the statistically expected 1.09 accidents are $248.50 million.

The comparative results of these two different types of accidents are presented in Table III-7.

TABLE III-7

PRESENT VALUE OF THE POTENTIAL LOSSES FROM A FUEL TANK EXPLOSION
(As calculated in the Final Regulatory Evaluation)
(in $ millions)

	PRESENT VALUE OF DISCOUNTED LOSSES		
TYPE OF AIRPLANE CATEGORY	NUMBER OF ACCIDENTS		
	ONE ACCIDENT	1.09 ACCIDENTS	TWO ACCIDENTS
TWA	384.65	409.61	658.90
"Average"	233.73	248.50	400.38

G. CONCLUSION

An effort was made in the preceding sections to quantitatively estimate the total potential benefits from preventing any more fuel tank explosion accidents in U.S. air carrier service. That effort yielded an

TABLE III-5			
PRESENT VALUE OF THE LOSSES FROM FUTURE MID-AIR EXPLOSIONS BASED ON THE TWA ACCIDENT			
	LOSSES FROM ACCIDENTS (in $ Millions)		
NUMBER OF ACCIDENTS	1	2	1.091
YEAR			
2000			
2001	$0.00	$0.00	$0.00
2002	$0.00	$0.00	$0.00
2003	$0.00	$0.00	$0.00
2004	$0.00	$0.00	$0.00
2005	$0.00	$0.00	$0.00
2006	$0.00	$0.00	$0.00
2007	$0.00	$0.00	$0.00
2008	$660.90	$660.90	$660.90
2009	$0.00	$0.00	$0.00
2010	$0.00	$0.00	$0.00
2011	$0.00	$0.00	$0.00
2012	$0.00	$0.00	$0.00
2013	$0.00	$660.90	$60.14
P.V. TOTAL ACCIDENT LOSSES	$384.65	$658.90	$409.61

TABLE III-6			
PRESENT VALUE OF THE LOSSES FROM FUTURE MID-AIR EXPLOSIONS BASED ON A "REPRESENTATIVE" ACCIDENT			
	LOSSES FROM ACCIDENTS (in $ Millions)		
NUMBER OF ACCIDENTS	1	2	1.091
YEAR			
2000			
2001	$0.00	$0.00	$0.00
2002	$0.00	$0.00	$0.00
2003	$0.00	$0.00	$0.00
2004	$0.00	$0.00	$0.00
2005	$0.00	$0.00	$0.00
2006	$0.00	$0.00	$0.00
2007	$0.00	$0.00	$0.00
2008	$401.60	$401.60	$401.60
2009	$0.00	$0.00	$0.00
2010	$0.00	$0.00	$0.00
2011	$0.00	$0.00	$0.00
2012	$0.00	$0.00	$0.00
2013	$0.00	$401.60	$36.55
P.V. TOTAL ACCIDENT LOSSES	$233.73	$400.38	$248.90

estimated that was on the order of $230 million, and it could range up to $400 million or even more if as many as 2 accidents were prevented involving the largest air carrier airplanes.

The difficult question that now need to be addressed is; What fraction of these benefits can be assigned to this rule? The FAA has already issued 40 ADs aimed at taking immediate action that may reduce the risk of another fuel tank explosion. Conditions discovered as a result of this rule may require further rulemaking or other action - again designed to reduce the same risk. Also, future steps may be taken to reduce the volatility of vapors within airplane fuel tanks. This would also be designed to reduce the same risk.

When the NPRM for this rule was issued, the FAA estimated that it may be 75 percent to 90 percent effective in preventing fuel tank explosions. This was an estimate based on a judgment of what was known at that time and made for the purpose of arriving at a quantified estimated of the potential benefits of the rule.

Upon further consideration, the agency determined that a quantified estimate of the reduced risk resulting from just this rule cannot be made. At this time the FAA is not certain of the exact cause of the two accidents that have occurred. Accordingly, the agency has taken and is taking and perhaps will take future actions designed to solve the problem. The FAA is confident, however, that this rule is the best next action to take following up on the ADs already issued, and is confident that the rule will play a critically important role in identifying the problem. Once the problem is known with a high degree of certainty, it may be discovered that actions already taken were effective in eliminating the risks as much as possible. If further actions appear necessary, they will be taken.

In any event, the agency is convinced that action is necessary to assure that the risks of fuel tank explosions is minimized and that this SFAR and operational rules changes are necessary to achieve that goal.

Once the risk is minimized, the benefits will extend indefinitely beyond the time period analyzed. As a final point, the FAA makes the observation that just the statistically expected loss during this timeframe exceeds the present value of the estimated cost of the rule by 55 percent.

IV. COMPLIANCE COSTS

A. INTRODUCTION

The FAA's analysis in the Preliminary Regulatory Evaluation was based on its determination that three parts of the proposed rule could impose costs on various sectors of the aviation industry. The first part, the proposed change in future part 25 type certificates, would be incurred by future design approval holders (both TC and fuel tank system STC holders). The second part, the proposed SFAR, would be incurred by current design approval holders (TC, fuel tank system STC, and certain non-fuel-tank-system STC holders) and by operators that have received field approvals for fuel tank system modifications. The third part, the proposed changes to the operations rules, would be incurred by current and future operators. As the proposed rule and the final rule do not differ on these general requirements, the FAA uses the same analytical approach in the Final Regulatory Evaluation.

B. PUBLIC RESPONSES TO THE FAA REQUEST FOR COMMENTS AND DATA

In the Preliminary Regulatory Evaluation and in the NPRM, the FAA had requested public comments on its methodology, assumptions, data used, and resulting estimates. Of the 48 public comments submitted to the Public Docket, several addressed economic issues and their general tenor was that the FAA had underestimated several important unit costs and had underestimated the numbers of affected airplanes and fuel tank systems. The only quantitative estimates were supplied by the United Parcel Service (UPS), the General Aviation Manufacturing Association (GAMA), the Federal Express (Fed Ex), and the Air Transport Association (ATA) comments. The FAA evaluated this submitted information and has accepted some, but not all of these data. Rather than addressing the comments in their entirety at this point in the text, the FAA addresses each comment concerning a specific estimate in the section of the text where that estimate is discussed.

C. SUMMARY OF THE COSTS OF COMPLIANCE WITH THE PROPOSED RULE

In accordance with the requirements of Executive Order 12866, the Regulatory Flexibility Act of 1980, and the Unfunded Mandates Reform Act of 1995, the FAA had completed a Preliminary Regulatory Evaluation of the estimated economic and safety impacts of the proposal and a Initial Regulatory Flexibility Analysis of its potential economic impacts upon small entities. A summary of these evaluations was published in the October 29, 1999, NPRM.

As summarized in Table IV-1, the FAA had estimated in the Preliminary Regulatory Evaluation that, during the 10-year period of 2000 through 2009, the present value (in year 1999) of the costs to comply with the proposed rule would have been $168.9 million (in 1998 dollars). Of this $168.9 million, $15.9 million would have been for the initial fuel tank system reviews by the design approval holders ($9.5 million for the TC holders and $6.4 million for fuel tank system STC holders), $100 million would have been for operators and repair stations to revise their maintenance manuals and to perform more frequent and more thorough fuel tank system inspections and maintenance, and $17.4 million would have been for the operators to create and maintain additional records. On the basis that the compliance costs did not exceed $100 million in any one year, the FAA had concluded that the proposed rule would not have been a "significant regulatory action."

TABLE IV-1

PRESENT VALUE IN 1999 OF THE COSTS OF COMPLIANCE WITH THE PROPOSED RULE
(As estimated in the Preliminary Regulatory Evaluation)

Source of Cost	Present Value in 1999 of the Compliance Costs (in 1998 $ millions)
Fuel Tank Review (Total)	15.9
(For TC Holders)	(9.5)
(For STC Holders)	(6.4)
Maintenance and Inspection	100.0
Lost Net Revenue	35.6
Additional Recordkeeping	17.4
TOTAL	168.9

D. SUMMARY OF THE COSTS OF COMPLIANCE WITH THE FINAL RULE

After incorporating some of the data from the comments and updating the unit cost and fleet data, the FAA determined that, as summarized in Table IV-2 the present value (in year 2001) of the total costs to comply with the final rule between the years 2001 and 2013 are $165.1 million (in 2000 dollars). Of this $165.1 million, $38.2 million are for the initial fuel tank system reviews by the design approval holders ($27.1 million for TC holders, $2.5 million for fuel tank system STC holders, $2.6 million for non-fuel-tank-system STC holders, and $5.9 million for operators); $92.0 million are for operators and repair stations to revise their maintenance manuals and to perform more frequent and more thorough fuel tank system inspections and maintenance; $24.2 million are for the lost net revenue from additional airplane out-of-service time; and $10.4 million are for operators and repair stations to create and maintain additional records. Although the highest costs in any one year is $61 million (in year 2000 dollars), the extent of the public interest in this rulemaking leads the FAA to conclude that the final rule is a "significant regulatory action."

TABLE IV-2

PRESENT VALUE IN 2001 OF THE COSTS OF COMPLIANCE WITH THE FINAL RULE

Source of Cost	Present Value in 2001 of the Compliance Costs (in 2000 $ millions)
Part 25 Fuel Tank Design	0.315
(For TC Airplanes)	Minimal
(For Fuel Tank STC Holders)	(0.315)
Fuel Tank Review (Total)	38.157
(For TC Holders)	(27.107)
(For Fuel Tank STC Holders)	(2.522)
(For Non-Fuel-Tank STC Holders)	(2.594)
(For Operators)	(5.934)
Maintenance and Inspection	92.043
Lost Net Revenue	24.224
Additional Recordkeeping	10.338
TOTAL	165.077

E. SIGNIFICANT DIFFERENCES IN ASSUMPTIONS AND VALUES BETWEEN THE PRELIMINARY AND FINAL REGULATORY EVALUATIONS

Table IV-3 lists the significant differences in assumptions made and data and values between those used in the Preliminary Regulatory Evaluation and those used in the Final Regulatory Evaluation. The specific impacts that each difference has on the revised compliance costs are discussed in the individual compliance cost sections. Although there are other differences that have altered the calculated costs, the differences listed in Table IV-3 are the significant ones.

TABLE IV-3

SIGNIFICANT DIFFERENCES IN ASSUMPTIONS AND VALUES BETWEEN THE PRELIMINARY REGULATORY EVALUATION AND THE FINAL REGULATORY EVALUATION

Assumption or Value	Preliminary Regulatory Analysis	Final Regulatory Analysis
Number of Airplanes	6,006 (in 1996)	6,971 (in 1999)
Timeframe for Analysis	2000 - 2011	2001-2013
Net Rate of Fleet Growth	4.3 percent	3.0 percent
Hourly Compensation: Engineer; Mechanic	\$100; \$70	\$110; \$75
Number of Fuel Tank System TC Reviews	36	71 (40 "full-scale" and 31 "derivative")
Num Eng Yrs for TC Review	0.4 to 2.5	0.5 to 4
Number of Fuel Tank System STC Reviews	64	74
Num Eng Yrs for Fuel Tank System STC Review	0.35	0.15
Number of Non-Fuel-Tank-System STC Reviews	None (Asked for Comments)	325
Num Eng Yrs for Non-Fuel-Tank-System STC Review	None (Asked for Comments)	0.0375
Operator Paper Review of Airplane Fuel Tank System-Field Approvals/STCs	None	1 engineer day per existing airplane
Number Months to Complete Safety Review Fuel Tanks	12	18
Number Months to Revise Maintenance Manual (After Review)	6	18
Number Years to Complete Initial Inspection (After Manual Revision)	3 years (Completed between 2002 and 2004)	2 years (Completed during 2004 and 2005)
Determinants of Number Inspection Hours	Airplane Model	Airplane Model plus Year Manufactured
Time before Initial Inspections Begin	18 months	36 months
Number Years to Complete Initial Inspection	3 years	2 years
Number Labor Hours for Initial Inspection	50-198	49-218
Number Days Out-of-Service for Initial Inspection	0-4 (40 percent inspections done at "C" checks)	0-4 (60 percent of inspections done at "C" checks)
Year Reinspections Start	2004 (immediately after initial inspections)	2008 (2 years after initial inspections)
Reinspection Frequency	Every 3 years (40 percent done during "C" checks)	Every 5 years (All done during "D" checks)
Number Hours for Reinspection	40-160	25-87
Reduced Inspection	All B-747 hours not	No adjustment

Hours Due to ADs Already Issued	included; 50 hours for B-737s not included	
Number Days Out-of-Service for Reinspection	0-3 (40 percent of reinspections done at "C" checks)	0 (All reinspections done at "D" checks)

F. BASELINES, METHODOLOGY, AND DATA SOURCES USED TO CALCULATE THE COMPLIANCE COSTS OF THE FINAL RULE

F.1. Baselines

The baselines used in the Preliminary Regulatory Evaluation to compute the incremental compliance costs were: (1) current industry practice; (2) that the industry will fully comply with the 40 fuel tank system ADs that the FAA has issued since 1997; and (3) expected future industry practices if a final rule were not promulgated. As there were no adverse comments on these baselines, the FAA uses them for the Final Regulatory Evaluation.

F.2. Methodology

In the Preliminary Regulatory Evaluation, the FAA had stated that the costs of complying with any future service bulletins or future ADs issued by the FAA subsequent to the fuel tank system review would not be a cost of complying with the proposed SFAR. Those future costs would be estimated for each individual AD when the FAA would propose it.

The ATA both agreed and disagreed with this approach. They agreed that, in general, design changes are outside the scope of the proposed SFAR. However, they disagreed in that "where new rules are created that go beyond existing rules, essentially raising the bar, the cost of any design change driven by these new rules should be considered as part of the total cost of this rulemaking. A specific example of such a new rule is section 25.981(a)(3), which proposes new, more-stringent requirements associated with evaluating the effects of latent failures. . ." The FAA disagrees with this second comment. The requirement for a fuel tank system design change will be established in the AD, at which point the public can comment on whether or not the AD is appropriate for the problem identified.

In addition, the FAA had determined that the costs of complying with the proposed operational rule changes would not include the costs of making repairs or replacing equipment due to the enhanced fuel tank system inspections. While the FAA had explicitly recognized that the resulting expenditures on such corrective actions may be substantial, these expenditures are not attributed to the operational rule changes because the corrective actions are required by existing FAA regulations that assure the airplane's continued airworthiness. In other words, the costs to correct an existing problem are due to the existing regulations. The fact that the problem was discovered by the enhanced fuel tank system inspection does not mean that the costs of the corrective action are due to the inspection. This logic is identical to the logic used for estimating the costs of complying with the aging aircraft rule.

In order to be consistent with the benefits analysis, the FAA had used a 10-year time frame (from 2000 through 2009) as the basis for its compliance cost estimates in the Preliminary Regulatory Evaluation. There were no comments on this time frame. However, the fact that the final rule allows operators 3 years (rather than 18 months) before their maintenance manuals need to be in compliance affects the appropriate timeframe to analyze the future benefits and costs. As discussed in the

Benefits Chapter III, the benefits from the final rule will not start until the enhanced fuel tank system inspections begin. However, the costs start before the fuel tank system inspections begin. For the final rule, the compliance costs are incurred along the following timeline: the design approval holders begin their fuel tank system reviews in mid-2000, completing them by end of 2001; the operators begin to revise their maintenance manuals in early 2002, completing them by mid-2003; the first enhanced fuel tank inspections begin in mid-2003 and are concluded in mid-2005. In order to minimize computational complexity in calculating the discounted future benefits and costs, the FAA determined that these cost and benefits timelines effectively start on January 1, 2001. Basing the fuel tank system inspections costs on a 10 year time frame results in these costs occurring in the years 2004 through 2013. Thus, the total costs of compliance with the final rule are based on a year 2001 through 2013 timeframe.

In the Preliminary Regulatory Evaluation, the FAA had used the discounted present value as the basis of its compliance cost estimates because most of the costs would have been incurred early in the 10-year time frame. Using an annualized cost would have been misleading because an annualized cost gives the impression that these expenditures could be spread out evenly over the entire 10-year time-period when that is not a realistic possibility. As 80 percent of the costs occur in the years 2001 through 2005, the FAA determined that the present value approach is more appropriate than the annualized cost approach to express the compliance costs. As there were no adverse comments on using the present value estimate, the FAA uses it in the Final Regulatory Evaluation.

Finally, the rate of return is a critical factor affecting the present value calculations. In both the Preliminary Regulatory Evaluation and the Final Regulatory Evaluation, the FAA used a 7 percent rate of return because, in order to ensure consistency among Federal regulatory agencies, the Office of Management and Budget (OMB) has mandated that Federal agencies use a 7 percent discount rate when evaluating regulatory actions.

F.3. Affected Airplanes and Aviation Sectors

In the NPRM, the FAA, using 1996 data, estimated that the proposal would have affected 6,006 airplanes, of which 5,700 airplanes were operated by 114 air carriers under part 121 service, 193 airplanes were operated by 7 carriers that operated under both part 121 and part 135, 22 airplanes were operated by 10 carriers under part 125 service, and 91 airplanes were operated by 23 carriers operating U.S.-registered airplanes under part 129. At that time, the FAA did not have information on airplanes operating under part 91 that would have been affected by the proposal; however, the FAA had stated its belief that very few airplanes operating under part 91 would have been affected by the proposal.

The FAA also estimated that the proposed rule would have affected 12 manufacturers holding 35 part 25 type certificates (TCs) and 26 manufacturers, airlines, and repair stations holding 168 supplemental type certificates (STCs) for part 25 fuel tank systems, of which 69 were for different modifications. The proposed rule also would have affected manufacturers of future, new part 25 type certificated airplane models and holders of future, new part 25 STCs for new fuel tank systems. At that time, the FAA was unable to predict the number of new airplane TCs but, based on the average of the previous 10 years, the FAA had anticipated that 17 new fuel tank system STCs would be granted annually. The FAA had requested comments on these estimates.

In order to update the aviation industry data, the FAA used a different data base than it used for the analysis of the proposed rule. However, as this more current data base does not report the same information as that reported in the previous data base, an exact comparison between the two data bases is not possible. Consequently, as seen in Table IV-5, using 1999 data, the FAA determined that the final rule affects 6,971 airplanes, of which 6,255 are turbojets and 712 are turboprops. Of these 6,971 airplanes, 6,485 (5,802 turbojets and 683 turboprops) are operated by 119 scheduled and non-scheduled air carriers, 117 are operated by 90 private operators (primarily corporations), and 369 are currently held by 116 manufacturers and brokers and leasing companies.

The FAA also determined that the final rule affects 13 manufacturers holding 37 part 25 type certificates (TCs) and 46 manufacturers, airlines, and repair stations holding 173 supplemental type certificates (STCs) for part 25 fuel tank systems, of which 79 are for different fuel tank system modifications. It also affects 325 non-fuel-tank-system STC holders that will need to evaluate their STCs to determine their impacts on fuel tank systems. The final rule also affects manufacturers of future, new part 25 type certificated airplane models and holders of future, new part 25 STCs for new fuel tank systems. Based on the previous 10 years, the FAA projects that there will be between two and four new part 25 TC airplane models during the next ten years. Using the same methodology, the FAA projects that there will be three to four new fuel tank system STCs annually granted during the next ten years.

TABLE IV-4

NUMBER OF AIRPLANES BY MODEL AND MANUFACTURING DATE IN U.S. FLEET IN YEARS 1999 AND 2004

	1999				2004			
Airplane Model	Total Num. of Airplanes	Num. Airplanes (1960-1980)	Num. Airplanes (1981-1995)	Num. Airplanes (Post 1996)	Total Num. of Airplanes	Num. Airplanes (1960-1980)	Num. Airplanes (1981-1995)	Num. Airplanes (Post 1996)
A300-200/200F	37	15	22	0	35	13	22	0
A300-600R	71	0	48	23	91	0	48	43
A310-300	45	0	45	0	45	0	45	0
A319	76	0	0	76	143	0	0	143
A320	188	0	110	78	256	0	110	146
A321	0	0	0	0	0	0	0	0
A330	0	0	0	0	0	0	0	0
A340	0	0	0	0	0	0	0	0
B707-720	21	0	21	0	21	0	21	0
B717	8	0	0	8	15	0	0	15
B727-100	194	194	0	0	168	168	0	0
B727-200 Adv	694	604	90	0	614	524	90	0
B737-100/200	323	123	200	0	307	107	200	0
B737-300/400/500	811	0	712	99	898	0	712	186
B737-600/700/800/900	205	0	0	205	385	0	0	385
B747-100/200/300	171	137	34	0	153	119	34	0
B747-400	61	0	34	27	85	0	34	51
B757	573	0	432	141	697	0	432	265
B767	299	0	222	77	367	0	222	145
B777	72	0	8	64	128	0	8	120
DC8-20/30/40/50	26	26	0	0	23	23	0	0
DC8-60	95	95	0	0	82	82	0	0
DC8-70	94	94	0	0	82	82	0	0
DC9-10/20	55	55	0	0	48	48	0	0
DC9-30/40/50	435	404	21	0	372	351	21	0
DC10-10/15	111	103	8	0	97	89	8	0
DC10-30/40	136	59	77	0	128	51	77	0
MD11	57	0	45	12	68	0	45	23
MD80	684	1	640	43	722	1	640	81
MD90	21	0	11	10	30	0	11	19
L 1011	126	89	37	0	114	77	37	0
Avro RJ85	29	0	0	29	54	0	0	54
BAC 1-11	16	16	0	0	14	14	0	0
BAe146-200	22	0	22	0	22	0	22	0

Can RJ-100/200	211	0	37	174	364	0	37	327
Emb RJ-135/145	131	0	0	131	246	0	0	246
F 28	24	5	19	0	23	4	19	0
F100	123	0	123	0	123	0	123	0
Fair Dorn 328 Jet	7	0	0	7	13	0	0	13
SAAB 340	283	0	219	64	339	0	219	120
ATR72	68	0	50	18	84	0	50	34
ATR42	73	0	73	0	73	0	73	0
Shorts 360	16	0	16	0	16	0	16	0
Dornier 328 Turboprop	47	0	40	7	53	0	40	13
F27	35	27	8	0	31	23	8	0
DHC-7	6	3	3	0	6	3	3	0
DHC-8	178	0	121	57	228	0	121	107
YS-11	2	2	0	0	2	2	0	0
L188	11	11	0	0	11	11	0	0
TOTAL	6971	2063	3548	1350	7875	1792	3548	2534

F.4. Data Sources Used to Estimate Unit Compliance Costs

In the Preliminary Regulatory Evaluation, the FAA had used cost data from other FAA Regulatory Evaluations, discussions with the industry, service bulletins, and its own expertise. For the Final Regulatory Evaluation, the FAA used those same sources plus some of the data provided in the comments.

F.5. Unit Labor Costs

F.5.a. Unit Labor Costs for an Aerospace Engineer

In the Preliminary Regulatory Evaluation, the FAA had determined that a standard level of engineering competence is required to complete a fuel tank system review and that there is an average aerospace engineer's hourly wage rate across all companies. This average engineer's hourly wage rate was then adjusted to account for fringe benefits, which transformed it into an hourly total compensation rate. This hourly total compensation rate was then further adjusted to account for the compensation paid for the supervisory, clerical, administrative, legal, etc. time associated with a fuel tank system review because those non-engineering hours were not directly estimated in the Preliminary Regulatory Evaluation. On that basis, the FAA had calculated that the adjusted engineer hourly total compensation rate would have been $100. As the FAA had determined that the average engineer work year would encompass 2,000 hours, the adjusted engineer year labor cost was calculated to be $200,000. However, since the Preliminary Regulatory Evaluation, the FAA has reevaluated its adjusted hourly total compensation rate for an aerospace engineer and has increased it to

$110, which generates an adjusted engineer year labor cost of $220,000 in the Final Regulatory Evaluation.

F.5.b. Unit Labor Costs for an Airplane Mechanic

The FAA had followed that same approach in the Preliminary Regulatory Evaluation to establish an adjusted hourly total compensation rate of $70 for the airplane mechanics that included an adjustment for fringe benefits and for the numbers of additional supervisory, clerical, administrative, etc. hours that would be required to complete the particular task. As the FAA had determined that the average airplane mechanic work year would encompass 2,000 hours, the adjusted airplane mechanic year labor cost was calculated to be $140,000. However, since the Preliminary Regulatory Evaluation, the FAA has reevaluated its adjusted hourly total compensation rate for an airplane mechanic and has increased it to $75, which generates an adjusted airplane mechanic year labor cost of $150,000 in the Final Regulatory Evaluation.

G. COST OF COMPLIANCE WITH PART 25 FOR FUTURE TC AND STC HOLDERS

G.1. Introduction

One of difficult aspects of costing this design change is that the final rule does not specify a particular design or technology - it allows the airplane manufacturer to use the design that is best suited to the future airplane's overall needs. While this design flexibility is an aid to the manufacturer, it plays havoc with determining potential compliance costs. In this case, the final rule only mandates, in effect, that the air conditioning packs be moved away from the fuel tanks. Several existing airplane models (all McDonnell Douglas models and the L-1011) do not have the air conditioning packs near the center wing fuel tank.

The ATA noted that the proposed rule stated that the body tanks should "cool at a rate equivalent to that of a wing tank." The FAA determined that, under current technology, this rate can be approximated by directed ventilation of the center wing fuel tank, cooling the center wing fuel tank with ground air conditioning when the airplane is at the gate, or directing cold air to the center wing tank from the air conditioning packs during take-off and climb. A manufacturer can likely meet the requirement using those methods or by developing other methods; perhaps some method yet to be engineered. The difficulty in calculating the costs is that the method that will be used will differ by future airplane model and may not be selected for 5 or 10 years.

G.2. Cost of Compliance to Future TC Holders

In the Preliminary Regulatory Evaluation, the FAA had concluded that the proposed changes to part 25 would impose minimal compliance costs on future type certificated airplane models. The FAA had determined that the amount of engineering time to incorporate this fuel tank system requirement into a future airplane's design at the beginning of its development would not be significantly greater than the amount of engineering time that would have been spent to develop a fuel tank system under the existing rule. Further, the FAA had noted that to the extent there would be measurable costs, these costs would be incurred far in the future and their resulting present values would be minimal. As a result, the FAA had anticipated that the proposed part 25 change would not have required the manufacturer to add equipment and make other changes that would make the future airplane substantially more expensive or would have a significantly adverse impact upon its performance.

The ATA disagreed with the FAA conclusion that the proposed part 25 changes would impose minimal compliance costs on future TC airplane models. They stated that the language in paragraph 25.981(c)(1) "means to minimize the development of flammable vapors in the fuel tanks" would effectively require future designs to include a directed ventilation system on the center wing fuel tank. On that basis, they cited the ARAC FTHWG Final Report that the development costs to direct ventilation to the center wing fuel tank would be $2.8 million per airplane design, the installation costs per production airplane would be $21,200, and the per airplane additional operational costs would be $30,408 for a small airplane, $39,295 for a medium-sized airplane, and $50,518 for a large airplane.

The FAA partially agrees with this comment. It agrees that the revised part 25 will impose compliance costs on future TC designs. It disagrees with the magnitudes reported by the ATA. In particular, the ARAC FTHWG estimate is based on the amount of time to change an existing design to allow for directed ventilation on the center wing fuel tank. However, the more appropriate analytical basis is to start the new TC airplane model from the proverbial (for engineers anyway) "blank sheet of paper." In other words, the incremental fuel tank system design costs would be the difference between the engineering time to design a ventilated fuel tank system versus the engineering time to design a non-ventilated fuel tank system. On that basis, the FAA concluded that the ARAC FTHWG estimate is an upper bound of the engineering design costs.

The FAA agrees with the ATA on its $21,200 estimate of the equipment and installation costs per future manufactured airplane to allow directed ventilation. Updating the labor costs to current rates results in an estimate of $21,500 per airplane.

The FAA disagrees with the ATA on its estimates of the annual increase operational costs. In the ARAC FTHWG estimate, nearly 95 percent of the increased operational costs are due to 8 hours of "operational delays" (valued at $23,000 for all airplanes) and "lost revenue due to down time" (1 day at a cost of $6,700 for a small airplane, $15,350 for a medium-sized airplane, and $26,600 for a large airplane). In reviewing these estimates, the FAA is unclear what the term "operational delays"[10] means because it is not specified in the ARAC FTHWG report. In addition, the reason why directed fuel tank ventilation would create any down time is not specified and, as noted in the Preliminary Regulatory Evaluation, the cost to the aviation system of an airplane's down time is not the lost net revenue from an individual airplane because the vast majority of passengers that would have flown on that out-of-service airplane would fly on another airplane. Hence, the increase in some other airline's net revenue would offset the lost net revenue from the out-of-service airplane. As a result, the FAA concluded that the FTHWG significantly overestimated the annual operational costs from directed fuel tank ventilation for future TC airplane models.

In conclusion, the FAA determined that although directed fuel tank ventilation will increase the design, manufacturing, and operational costs, these costs are less than reported by the ATA. Additionally, these airplanes will not be manufactured for many years and the present value in the year 2001 of these future costs will be minimal.

G.3. Cost of Compliance to Future Fuel Tank System STC Holders

In the Preliminary Regulatory Evaluation, the FAA had noted that the proposed change to part 25 could impose some compliance costs on future part 25 fuel tank system STCs. However, the FAA had anticipated that the proposed change reflected current industry practices. On that basis, the FAA had determined that the costs to future fuel tank system STC designs to comply with the proposed rule would have been minimal.

There were no comments on this estimate. Nevertheless, the FAA expects that the final rule to require future fuel tank system STC holders to complete a more detailed engineering evaluation than previously performed of the modification's impact on the potential ignition sources in the fuel tank. The FAA determined that this additional analysis will take an average of 80 engineer hours, for a per STC system cost of $8,800. Based on the previous 20 years, there is an average of 4 fuel tank system STCs granted per year. Thus, the FAA calculated that the annual additional cost will be $35,200 resulting in a present value of $315,000 of the costs during the years 2001 through 2013.

G.4. Cost of Compliance to Future Fuel Tank System STC Holders

In the Preliminary Regulatory Evaluation, the FAA had noted that the proposed change to part 25 may impose some compliance costs on future part 25 non-fuel-tank-system STC holders. However, the FAA did not have data to estimate these potential future costs and had requested public comment on these potential costs. There were no public comments on this topic. After careful review of the likely impact of the final rule on

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[10] One possibility is that it may represent the costs of increased drag

these STC holders, the FAA determined that the additional costs to them will be minimal.

G.5. Cost of Compliance to Future Fuel Tank System Field Approval Holders

In the Preliminary Regulatory Evaluation, the FAA had noted that the proposed change to part 25 may impose some compliance costs on future part 25 fuel tank system field approvals. However, the FAA did not have any data to estimate these potential future costs and had requested public comment. There were no public comments on this topic. After careful review of the likely impact of the final rule on these field approvals, the FAA determined that the additional costs to them will be minimal. In general, if a potential fuel tank system field approval will affect the potential flammability of the system, it should receive an STC, not a field approval.

G.6. Cost of Compliance to Future Non-Fuel-Tank-System Field Approval Holders

In the Preliminary Regulatory Evaluation, the FAA had noted that the proposed change to part 25 may impose some compliance costs on future part 25 non-fuel-tank-system field approvals. However, the FAA did not have any data to estimate these potential future costs and had requested public comment. There were no public comments on this topic. After careful review of the likely impact of the final rule on these field approvals, the FAA determined that the additional costs to them will be minimal.

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due to increasing the amount of intake air.

H. COST OF COMPLIANCE WITH THE SFAR

H.1. Introduction

As was the case for the proposed SFAR, the final SFAR imposes compliance costs on current part 25 design approval holders (all TC and certain STC holders). These organizations are required: (1) to comprehensively review their fuel tank systems to determine that the design precludes the existence of ignition sources within the fuel tanks; and (2) then to develop and disseminate specific fuel tank system inspection and maintenance instructions to assure the continuing safety of the fuel tank system. The second action also requires these design approval holders, as necessary, to generate service bulletins and to provide data to the FAA for it to issue any ADs that may be needed to correct any unsafe fuel tank system conditions discovered during the review. Finally, the SFAR also requires that the operator of an airplane that has received a field approval for a fuel tank system modification to perform a fuel tank system review for that modification.

Thus, the cost of compliance with the SFAR for design approval holders is the engineering time to complete the fuel tank system review and to develop the subsequent recommended changes.

The FAA also reiterates at this point in the text its position that any future costs of complying with ADs issued as a result of the fuel tank system reviews are not included as a cost of complying with the proposed SFAR. Those future costs would be estimated for each individual AD when the FAA proposes it.

H.2. Responsibility for Compliance

As noted, the design approval holder is required to perform the fuel tank system review in order for it to maintain the TC or STC. However, some design approval holders may have gone out of business, thereby creating "orphan" TCs or STCs. Some other design approval holders may decide that the economic payoff would be insufficient for them to make the expenditure to review certain fuel tank systems (e.g., those of older TCs or STCs that cover only a few airplanes still in operation) and they would rather surrender the TC or STC. If the design approval holder does not perform the fuel tank system review, then it becomes the airplane operator's responsibility to demonstrate that the airplane meets the airworthiness standards. In that case, either the operator, or an outside engineering firm, or a designated engineering representative (DER) will perform the fuel tank system review (or the airplane will be retired or sold outside the United States).

In the Preliminary Regulatory Evaluation, the FAA had stated its belief that few design approval holders would not perform the review and, consequently, surrender the TC or STC. Consequently, the FAA had calculated the compliance costs on the assumption that each TC or STC holder would complete the review.

Although no commenter provided a potential number of these "orphan" TCs and STCs, the ATA noted that this issue could be more significant than the FAA had recognized and that the FAA assumption that each design approval holder will complete the review may not be valid. By way of support, the Lockheed-Martin comment indicated that they may not complete the fuel tank system review for the few remaining L-188s Electras (11 with a U.S. registration) due to the expense of trying to unearth and then upgrade 40 year old certification data that they believe the FAA would, in all probability, consider to provide inadequate documentation.

In response, the FAA agrees with these comments that some adjustment should be made for these "orphan" TCs and STCs. The difficulty in making such a quantitative adjustment is that the FAA would be predicting manufacturers' behaviors without any factual basis. Consequently, as no quantitative estimate of the potential numbers of these "orphan" airplanes and systems was provided, the FAA cannot quantify a separate cost for them. However, the FAA does qualitatively disagree with the implication that these "orphan" airplanes and systems will either be numerous or represent a significant additional cost, although a few operators may be adversely affected if they had to pay for the review.

H.3. Compliance Costs of Fuel Tank System Reviews

H.3.a. TC Holders

H.3.a.i. Number of TC Fuel Tank System Reviews

In order to prevent any potential confusion due to terminology, for the purposes of this analysis the FAA defines "model" to be the overall airplane designation and defines "series" to be an individual version of that model. That is, a B-737 and a B-757 are two "models" while a B-737-300 and a B-737-400 are two series within the B-737 model. Often, although not always, each series within a model is certificated under an Amended Type Certificate (ATC).

In the Preliminary Regulatory Evaluation, the FAA had assumed that each model would have required one fuel tank system review. On that basis, the FAA had determined that TC holders would have needed to complete 36 fuel tank system reviews. The FAA had believed that the fuel tank systems in the various series would be sufficiently similar to each other that one general fuel tank system review for a model would largely suffice to cover all of its series. The FAA had also assumed, however, that a model with several different series would have required additional review time. Therefore, the FAA had determined that the fuel tank system reviews of the B-737 and MD-80 models would have been taken more time than would have been taken for other similar-sized airplanes.

The ATA commented that the FAA had substantially underestimated the number of these reviews. They stated that there often were significant differences between the early series and later series in a model. As a result, each series would require an individual fuel tank system review.

The FAA partially agrees with this comment. The FAA agrees that its adjustments in the Preliminary Regulatory Evaluation that varied the amount of time for a model containing several series were insufficient and underestimated the actual review time. However, the FAA does not agree that a fuel tank system review requires an equal amount of time for each individual series within a model. There is a substantial amount of commonality among the fuel tank systems of different series within a model and much of the analysis of one series can be applied to the analyses of the other series. In light of that commonality, the FAA defines the first fuel tank review of a model to be a "full-scale" review and defines subsequent reviews of other series within the model (or derivatives of the model) as "derivative" reviews. In determining whether a series is a "derivative" (in the terms of this analysis) or is the same as another series with minor modifications not requiring additional fuel tank system review, the FAA decided that all "extended versions" and all "freighters" qualify as "derivative" models because those series involve fuel tank system modifications. Finally, with the exception of the Airbus 321, 330, and 340 models, all of the airplane series had to have at least 3 airplanes with U.S. registration to be included in the list of series that will need a fuel tank system review.

On that bases, the FAA determined in the Final Regulatory Evaluation that there will be 46 "full-scale" fuel tank system reviews and 52 "derivative" fuel tank system reviews. A complete list is provided in Appendix A.[11]

H.3.a.ii. Amount of Time to Complete the TC Fuel Tank System Reviews

H.3.a.ii.a. Introduction

In the Preliminary Regulatory Evaluation, the FAA had determined that the one-time costs to comply with the proposed SFAR would have been due to: (1) the time to complete the initial fuel tank system assessment (including computer simulations or other modeling costs); (2) any physical testing needed for the design review; (3) the time to create and develop the revised inspection and testing procedures that would be incorporated into an operator's maintenance manual; and (4) the time to interact with the FAA to obtain FAA approval. The FAA had then estimated individual costs for each of those 4 actions.

[11] It needs to be noted that the lists in Appendix A and in the tables of the text do not exactly match. The differences are a result of the different data sources available for the various calculations. However, the Appendix A categories are used as the basis for the fuel tank system review compliance costs.

The ATA's comment of the amount of time to comply with the proposed SFAR, however, was based on: (1) a total number of hours for the review; and (2) an additional amount of time to develop inspection and maintenance instructions based on a percentage of the amount of time to complete the review. The FAA agrees with this general approach and, rather than estimating engineering hours for each of the 4 actions, combines those hours into two numbers to represent the total time for a TC holder to comply with the SFAR in the Final Regulatory Evaluation.

H.3.a.ii.b. TC Fuel Tank System Reviews

In the Preliminary Regulatory Evaluation, the FAA had estimated that the fuel tank system review would have required 1.5 engineer years for each of the two B-747 series, 1.5 engineer years for another manufacturer's large jet, 1.5 engineer years for the B-737 model, 1.5 engineer years for an MD-80 model, 1 engineer year for other Boeing jets, 0.75 engineer years for other manufacturer's jets, 0.75 engineer years for large turboprops, and 0.5 years for small turboprops. Further, in order not to underestimate the potential compliance costs for other models, the FAA had not credited the engineer time to comply with the recently issued fuel tank system ADs as a potential reduction in the engineering time for the review.

The ATA commented that the FAA had underestimated the amount of engineering time needed to perform the fuel tank system reviews. In particular, they stated that the proposed SFAR would have required recertification of older airplanes' fuel tanks to show compliance with the quantitative system safety assessment requirements in section 25.1309 of amendment 25-23. They and Lockheed-Martin also remarked that such quantitative risk analysis data are not generally available for those older airplane models certificated prior to the FAA's promulgation of section 25.1309. The majority of these airplanes would be affected by this requirement because that amendment was issued in May 1970, but the specific methods of compliance were not issued until 1988. In addition, the ATA estimated that it will take between 2 and 4 engineering years to complete these reviews rather than the FAA's estimated 0.5 to 3 engineering years.

The FAA disagrees with the comment that compliance with the SFAR will require a quantitative risk analysis. The rule requires that applicants "conduct a safety review" of the airplane's fuel tank system but does not specify any particular method of review. A qualitative assessment will be acceptable under the appropriate circumstances.

However, the FAA agrees that it had underestimated the amount of engineering time for the review, but not by the amount suggested by the ATA. The ATA arguments also imply that the primary basis for determining the amount of engineering time is the date of the airplane's certification and a secondary basis is the complexity and size of the fuel tank system. The FAA agrees that the date of certification is an important (but not the only) determinant of the number of hours necessary for the fuel tank system review and, consequently, modified its estimated number of hours to incorporate an adjustment for the date the model was certificated. In the Final Regulatory Evaluation the FAA characterized the number of engineering hours into 4 general airplane categories: (1) large turbojets; (2) regional jets; (3) large turboprops (> 50 seats); and smaller turbojets and turboprops (< 50 seats). In addition, the FAA further divided the category of large turbojets into the 3 sub-categories of models certificated during the years: (1) 1969-

1980; (2) 1980-1988; and (3) post 1988. On that basis, the FAA determined that the number of engineering hours to complete the fuel tank system reviews (with some exceptions)[12] are as follows:

3 years for large turbojets (1969-1980)
2 years for large turbojets (1980-1988)
1 year for large turbojets (post 1988)
0.5 to 0.75 years for regional jets
0.5 to 0.75 years for large turboprops
0.5 years for small turbojets and turboprops

With respect to the "derivative" fuel tank system reviews, the FAA determined that these range between 0.5 and 1.0 years for large turbojets depending upon their certification date and would be 0.5 years for regional turbojets and for turboprops.

The ATA also commented that there is a shortage of qualified engineers (i.e., engineers who have had experience working on fuel tank systems) for manufacturers that will need to complete several fuel tank system reviews during the 12-month time frame allocated by the proposed rule. They stated that these reviews could not necessarily be conducted in a completely parallel fashion.

The FAA agrees with this comment that more time is needed for the TC holder to complete these fuel tank system reviews, which is the reason for extending the compliance time from 12 months to 18 months. The FAA disagrees with this comment to the extent that it determined that more of these reviews could be conducted in parallel than stated in the comment. Further, the "derivative" fuel tank system reviews will not take as much time as a "full-scale" review and can use data from the

[12] In particular, the FAA determined that it will take 4 years for an engineering review of the B-707 and the L-188 because the age of the data used for their initial certifications will require more detailed analysis of these models' fuel tank systems.

first review in that model to more rapidly complete "derivative" fuel tank system reviews.

H.3.a.ii.c. Development of TC Recommendations for Maintenance Manuals

Although the FAA did not discuss the amount of time to develop the inspection and maintenance recommendations in the text of the Preliminary Regulatory Evaluation, those hours had been estimated as a separate fuel tank system review component (as shown in Table IV-1 of that report). The FAA had estimated that it would have taken from 0.2 years to 1 year (with the vast majority being between 0.25 and 0.5 years) to develop these recommendations for the various airplane models. On a percentage basis, these estimates were between 25 and 50 percent of the number of engineering hours to review the fuel tank system.

The ATA commented that, in order to comply with the proposed SFAR, developing these recommendations will add 20 to 30 percent of the number of engineering hours needed to review the fuel tank system. After considering this comment, the FAA determined that its original estimates had been too high and, for the Final Regulatory Evaluation, uses a value of 20 percent, although it should be noted that the base numbers of engineering years to review fuel tank system are larger than they were in the Preliminary Regulatory Evaluation.

In the Preliminary Regulatory Evaluation, the FAA had also determined that operators would have needed to consult with TC holders in order for the operators to fully understand and successfully implement the recommendations. However, in the Final Regulatory Evaluation, this time is included in the overall amount of time for the TC holder to develop its recommendations.

H.3.a.iii. Cost to Complete the TC Fuel Tank System Reviews

Thus, as seen in its Table IV-1 of the Preliminary Regulatory Evaluation, the FAA had estimated that the initial fuel tank system review and the development of the recommendations would cost $608,000 for a B-747 model, $408,000 for another manufacturer's large turbojet, $458,000 for the B-737 series, $408,000 for the MD-80 series, $304,000 for a different Boeing turbojet, $204,000 for a non-Boeing small turbojet, $151,000 for a large turboprop, $141,000 for a small turboprop, plus a total of $231,000 for engineering consultation. The total one-time cost to TC holders of compliance with the SFAR was estimated to be $9.5 million.

The ATA estimated that the proposed rule could have cost TC holders an additional $180 million to $330 million for the fuel tank system review. As discussed, $42 million to $66 million of this cost is based on the 2 to 4 engineering hour estimate to review each TC and its variations, $6.4 million for additional out-of-service time due to the 12-month compliance time, $10 million to develop recommendations for the maintenance manuals, and $100 million to $200 million to retrofit design changes based on the new, more stringent requirements associated with evaluating the effects of latent failures.

As discussed in the text, the FAA disagrees with the magnitude of most of these estimates and further disagrees that the costs of any future design changes that will be enacted through ADs are a cost of this rule.

On that basis, the FAA determined that the compliance costs will be as follows. In calculating the present value of these one-time compliance costs for the Final Regulatory Evaluation, the FAA determined that 50 percent of the engineering time for the review will be spent in 2001 and 50 percent of the engineering time for the review will be spent in 2002. In addition, all of the engineering time to develop the recommendations will be spent in 2002 because the recommendations cannot be made until the reviews are completed.

As seen in Table IV-5, the FAA determined that the present value of the compliance costs for the initial fuel tank system review and the development of the recommendations for turbojets will cost between $200,000 and $1.525 million depending upon the airplane model. Most of these costs are between $500,000 and $800,000. For turboprops, these costs will average about $125,000.

Therefore, as seen in Table IV-5, the FAA calculated that the present value of the total one-time cost of compliance with the SFAR for TC holders will be $27.107 million. Of this $27.107 million, $22.717 million will be to review the fuel tank system while $4.390 million will be to develop recommendations for the maintenance manuals.

H.3.b. Fuel Tank System STC Holders

H.3.b.i. Number of STC Fuel Tank System Reviews

As previously described, many fuel tank system STCs have been issued on an individual airplane basis. As a result, one STC holder may have several STCs for, basically, the same modification made to different

TABLE IV-5

COST OF COMPLIANCE WITH THE SFAR

irplane Model	Eng. Yrs. for Review	Undiscounted Review Cost	Review Cost (Yr. 2001)	P.V. Review Cost (Yr. 2002)	P.V. Total Review Cost	Eng. Yrs. for Rec.	Reccomd Cost (Yr. 2001)	P.V. Recomd Cost (Yr. 2002)	Total Eng.Yrs. For SFAR	Total P Cost fo SFAR
300-200F	3	$660,000	$330,000	$308,411	$638,411	0.6	$132,000	$123,364	3.6	$76
300-600R/600F	1	$220,000	$110,000	$102,804	$212,804	0.2	$44,000	$41,121	1.2	$25
310-300	2	$440,000	$220,000	$205,607	$425,607	0.4	$88,000	$82,243	2.4	$50
319	1	$220,000	$110,000	$102,804	$212,804	0.2	$44,000	$41,121	1.2	$25
320	1	$220,000	$110,000	$102,804	$212,804	0.2	$44,000	$41,121	1.2	$25
321	1	$220,000	$110,000	$102,804	$212,804	0.2	$44,000	$41,121	1.2	$25
330	1	$220,000	$110,000	$102,804	$212,804	0.2	$44,000	$41,121	1.2	$25
340	1	$220,000	$110,000	$102,804	$212,804	0.2	$44,000	$41,121	1.2	$25
707/720	4	$880,000	$440,000	$411,215	$851,215	0.8	$176,000	$164,486	4.8	$1,01
717	1	$220,000	$110,000	$102,804	$212,804	0.2	$44,000	$41,121	1.2	$25
727-100	3	$660,000	$330,000	$308,411	$638,411	0.6	$132,000	$123,364	3.6	$76
727-200 Adv	3	$660,000	$330,000	$308,411	$638,411	0.6	$132,000	$123,364	3.6	$76
737-100/200/200Adv	4	$880,000	$440,000	$411,215	$851,215	0.8	$176,000	$164,486	4.8	$1,01
737-300/400/500	3.5	$770,000	$385,000	$359,813	$744,813	0.7	$154,000	$143,925	4.2	$88
737-600/700/800/900	3	$660,000	$330,000	$308,411	$638,411	0.6	$132,000	$123,364	3.6	$76
747-100/200/300	6	$1,320,000	$660,000	$616,822	$1,276,822	1.2	$264,000	$246,729	7.2	$1,52
747-400	2	$440,000	$220,000	$205,607	$425,607	0.4	$88,000	$82,243	2.4	$50
757-200	2	$440,000	$220,000	$205,607	$425,607	0.4	$88,000	$82,243	2.4	$50
757-200ER	0.75	$165,000	$82,500	$77,103	$159,603	0.15	$33,000	$30,841	0.9	$19
757-300	1	$220,000	$110,000	$102,804	$212,804	0.2	$44,000	$41,121	1.2	$25
767-200	2	$440,000	$220,000	$205,607	$425,607	0.4	$88,000	$82,243	2.4	$50
767-200ER	1	$220,000	$110,000	$102,804	$212,804	0.2	$44,000	$41,121	1.2	$25
767-300	2	$440,000	$220,000	$205,607	$425,607	0.4	$88,000	$82,243	2.4	$50
767-300ER	1	$220,000	$110,000	$102,804	$212,804	0.2	$44,000	$41,121	1.2	$25
767-400ER	0.75	$165,000	$82,500	$77,103	$159,603	0.15	$33,000	$30,841	0.9	$19
777-200	1	$220,000	$110,000	$102,804	$212,804	0.2	$44,000	$41,121	1.2	$25
777-200ER	0.75	$165,000	$82,500	$77,103	$159,603	0.15	$33,000	$30,841	0.9	$19
777-300	0.5	$110,000	$55,000	$51,402	$106,402	0.1	$22,000	$20,561	0.6	$12
C8-20/30/40/50	4	$880,000	$440,000	$411,215	$851,215	0.8	$176,000	$164,486	4.8	$1,01
C8-60	1	$220,000	$110,000	$102,804	$212,804	0.2	$44,000	$41,121	1.2	$25
C8-70	1	$220,000	$110,000	$102,804	$212,804	0.2	$44,000	$41,121	1.2	$25
C9-10/20	4	$880,000	$440,000	$411,215	$851,215	0.8	$176,000	$164,486	4.8	$1,01
C9-30/40	3	$660,000	$330,000	$308,411	$638,411	0.6	$132,000	$123,364	3.6	$76
C9-50	2	$440,000	$220,000	$205,607	$425,607	0.4	$88,000	$82,243	2.4	$50
C10-10/15	3	$660,000	$330,000	$308,411	$638,411	0.6	$132,000	$123,364	3.6	$76
C10-30/40	3	$660,000	$330,000	$308,411	$638,411	0.6	$132,000	$123,364	3.6	$76

D11	1.75	$385,000	$192,500	$179,907	$372,407	0.35	$77,000	$71,963	2.1	$44
D80	5	$1,100,000	$550,000	$514,019	$1,064,019	1	$220,000	$205,607	6	$1,26
D90	1	$220,000	$110,000	$102,804	$212,804	0.2	$44,000	$41,121	1.2	$25
1011	6	$1,320,000	$660,000	$616,822	$1,276,822	1.2	$264,000	$246,729	7.2	$1,52
vro RJ85	0.75	$165,000	$82,500	$77,103	$159,603	0.15	$33,000	$30,841	0.9	$19
AC 1-11	2	$440,000	$220,000	$205,607	$425,607	0.4	$88,000	$82,243	2.4	$50
Ae146-200	2	$440,000	$220,000	$205,607	$425,607	0.4	$88,000	$82,243	2.4	$50
an RJ-100/200	1.5	$330,000	$165,000	$154,206	$319,206	0.3	$66,000	$61,682	1.8	$38
mb RJ-135/145	1.5	$330,000	$165,000	$154,206	$319,206	0.3	$66,000	$61,682	1.8	$38
28	2	$440,000	$220,000	$205,607	$425,607	0.4	$88,000	$82,243	2.4	$50
00	1	$220,000	$110,000	$102,804	$212,804	0.2	$44,000	$41,121	1.2	$25
ir Dorn 328 Jet	0.75	$165,000	$82,500	$77,103	$159,603	0.15	$33,000	$30,841	0.9	$19
AAB 340	0.5	$110,000	$55,000	$51,402	$106,402	0.1	$22,000	$20,561	0.6	$12
TR72	0.75	$165,000	$82,500	$77,103	$159,603	0.15	$33,000	$30,841	0.9	$19
TR42	0.5	$110,000	$55,000	$51,402	$106,402	0.1	$22,000	$20,561	0.6	$12
horts 360	0.5	$110,000	$55,000	$51,402	$106,402	0.1	$22,000	$20,561	0.6	$12
ornier 328 Turboprop	0.5	$110,000	$55,000	$51,402	$106,402	0.1	$22,000	$20,561	0.6	$12
MB 120	0.5	$110,000	$55,000	$51,402	$106,402	0.1	$22,000	$20,561	0.6	$12
188	4	$880,000	$440,000	$411,215	$851,215	0.8	$176,000	$164,486	4.8	$1,01
TOTAL		$23,485,000	$11,742,500	$10,974,299	$22,716,799	21.35	$4,697,000	$4,389,720		$27,10
el Tank STCs	0.15	$2,607,000	$1,303,500	$1,218,224	$2,521,724					
urrent Non-Fuel Tank TCs	0.0375	$2,681,250	$1,340,625	$1,252,921	$2,593,546					
TC TOTAL		$5,288,250	$2,644,125	$2,471,145	$5,115,270					
ECOMMEND. COST		$4,697,000	$0	$4,389,720	$4,389,720					
TAL		$33,470,250	$14,386,625	$17,835,164	$32,221,789					$32,22

airplanes of the same model. For example, an operator or repair station adding supplementary fuel tanks to a B-747 freighter can receive a different STC for each modified airplane even if the same basic modification is made on each airplane. For that modification, the FAA determined that those multiple STCs will require only one fuel tank system review. On the other hand, an STC holder may have received one STC for a fuel tank system modification for several different series within one airplane model.

In the Preliminary Regulatory Evaluation, the FAA had reviewed 173 fuel tank system STCs that were in its available data base and had determined that the proposed SFAR would have required an independent fuel tank system review for 68 of them.

The ATA commented that the FAA had underestimated the number of fuel tank system STCs, and, as supporting evidence, noted that the FAA had reported no fuel tank system STCs for Airbus, Bombardier, and Fokker airplanes.

In response, the FAA researched its data bases and found that one fuel tank system STC has been issued for an Airbus airplane and one for a Bombardier airplane. In addition, the FAA found two more fuel tank system STCs for B-767 airplanes and one more fuel tank system STC for a B-757 airplane. In addition, the FAA reevaluated the 173 fuel tank system STCs and determined that these represent 74 (not 68) individual STCs. Therefore, the FAA determined that 79 individual fuel tank system STCs will need to be reviewed.

H.3.b.ii. <u>Amount of Time to Complete the STC Fuel Tank System Reviews</u>

In the Preliminary Regulatory Evaluation, the FAA had assumed that many fuel tank system STCs add auxiliary fuel tanks, or substitute a different FQI or a different fuel booster pump for those approved in the original TCs, or increase the maximum zero fuel weight. As a result, many STC holders would not need to complete a full-scale fuel tank system review (although some would need to do so), but, rather, a more limited review of the modification they installed in the fuel tank system. In the Preliminary Regulatory Evaluation, the FAA had assumed that it would require an average of 0.25 engineer years to complete the "typical" fuel tank system STC review and an average of 0.1 engineer years to develop any recommendations for the maintenance manuals.

The ATA did not directly comment on this estimated amount of time to review a fuel tank system STC. However, they did comment that they did not believe that the fuel tank system STC holders would be able to use the TC holders' data for their reviews because of the proprietary nature of those data. By implication, then, the ATA indicated the FAA had underestimated the amount of engineering time required for these fuel tank system STC reviews.

In response, the FAA noted that the applicant for a fuel tank system STC had to complete a substantial amount of engineering review in order for its STC to have been approved by the FAA. The FAA reevaluated its assumptions and determined that most fuel tank system STC holders have already completed this substantial amount of fuel tank system engineering review. As a result, the FAA concluded that it had, in fact, overestimated the average amount of engineering time to complete a fuel tank system STC review. In addition, the FAA determined that fuel tank system STC holders will need very little time to develop recommendations for maintenance manuals. In light of those conclusions, the FAA determined that the total amount of engineering time for an STC fuel tank system review (including the time to develop recommended changes for the maintenance manuals) is 0.15 years.

H.3.b.iii. Cost to Complete the STC Fuel Tank System Reviews

In the Preliminary Regulatory Evaluation, the FAA had estimated that the average one-time cost for a fuel tank system STC holder review would have been $71,000. Based on the anticipated number of fuel tank system reviews that would have been needed, the FAA had estimated that the total one-time cost to complete the initial fuel tank system STC review and the development of the recommendations would have cost fuel tank system STC holders $4.9 million.

For the Final Regulatory Evaluation, the FAA determined that the average one-time engineering review cost for a fuel tank system STC holder is $33,000. As the FAA assumed that 50 percent of the engineering time for the fuel tank system STC review will be spent in 2001 and 50 percent of the engineering time for the review will be spent in 2002, the FAA calculated, as seen in Table IV-5, that the present value of the one-time costs to review existing fuel tank system STCs will be $2.522 million.

H.3.c. Non-Fuel-Tank-System STC Holders

The proposed SFAR would have required non-fuel-tank-system STC holders to determine the impact that their STCs would have on the fuel tank system. In the Preliminary Regulatory Evaluation, the FAA had stated that only a few of these other STC holders would have needed to perform a detailed analysis because most of them would not affect the fuel tank system. Further, for those STC holders that would perform an analysis, the FAA had anticipated that their analyses would take much less time than it would take for a fuel tank system TC or STC review. However, at the time of the Preliminary Regulatory Evaluation, the FAA was unable to determine the number of these STCs that would have needed to be reviewed. As a result, the FAA did not estimate a cost of compliance for these STC holders but had requested comments on these potential numbers.

The ATA commented that there could be a substantial number of these non-fuel-tank-system STCs whose impact on the fuel tank system would need to be analyzed. They stated that a strict interpretation of the proposed rule indicates that any airplane modification involving wiring (e.g., power ports, in-flight video, etc.) would need to be reviewed for its impact on the fuel tank system. However, no commenter provided an estimate of the number of these STCs or the amount of engineering time to complete these reviews.

The FAA disagrees with this interpretation because the rule is not intended to require that every remote wiring be given a "full-scale" engineering review for its impact on the fuel tank system. The FAA reviewed the non-fuel-tank-system STCs and determined that approximately 3,850 non-fuel-tank-system STCs have been granted for Aerospatiale, Fokker, Airbus, Bombardier, and Boeing airplanes. On that basis, the FAA estimates that there are about 6,500 non-fuel-tank-system STCs on all airplanes affected by the final rule. Based on the ratio of 2 STCs granted for each individual STC for fuel tank systems (79 individual fuel tank system STCs represent 178 fuel tank system STCs), about one-half of these 6,500 STCs (or 3,250) represent individual, different STCs. Based on a sample of non-fuel-tank-system STCs, the FAA determined that 10 percent of the 3,250 non-fuel-tank-system STCs will need to be analyzed in some detail for their impacts on the fuel tank system. On that basis, the FAA determined for the Final Regulatory Evaluation that 325 non-fuel-tank-system STCs will need to be reviewed for their impacts on fuel tank systems.

As most of these STCs will likely not affect the fuel tank system, the FAA determined that the amount of engineering time to review these STCs will be, on average, one quarter (or 0.0375 engineering years) of the amount of engineering time it will take to review a fuel tank system STC. Thus, the average cost to a non-fuel-tank-system STC holder that will complete an engineering review is $8,250. As was true for the fuel tank system STC review, the FAA determined that 50 percent of the non-fuel-tank-system STC reviews will be done in 2001 and 50 percent will be done in 2002. Therefore, as seen in Table IV-5, the FAA calculated that the present value of the one-time costs to review existing non-fuel-tank-system STCs will be $2.594 million.

H.3.d. Field Approvals

The proposed SFAR would have required operators of airplanes that have received field approvals for fuel tank systems modifications to review the impact of those field approvals on the fuel tank system. Similarly, the proposed SFAR would have required operators of airplanes that have received field approvals for non-fuel-tank-systems modifications to evaluate those field approvals for their potential impacts on the fuel tank system. As a field approval is an airplane specific modification, the operator will bear the costs associated with their analyses. The complicating factor is that, for an airplane that has had several owners, the current operator may not have immediate knowledge of all the field approvals that may have been issued on that airplane.

In the Preliminary Regulatory Evaluation, the FAA had stated that, although it did not know how many (or what kinds) of field approvals had been granted, these affected operators would likely incur minimal compliance costs. Consequently, the FAA was unable to estimate these potential costs and had requested public comment about the magnitude of this potential cost.

In a review of a sample of airplanes, the FAA found no field approvals for fuel tank system modifications. This was not an unexpected result because fuel tank system modifications would generally be considered to be "major" modifications and, hence, should not have been eligible for field approval considerations. Consequently, although there is a possibility that some field approvals have been issued for fuel tank system modifications, the FAA concluded that these will be few and the resultant costs for their reviews will be minimal.

Similarly, the FAA also concluded that the costs to review non-fuel-tank-system field approvals that may affect the fuel tank system will be minimal.

However, the FAA is not completely ignoring these potential costs. Rather than estimating them as a separate category, they are considered to be part of the operators' costs to comply with the SFAR, which is estimated in the next section.

H.3.e. <u>Operator's Compliance Cost for the Fuel Tank System Review</u>

The FAA had not estimated any compliance costs in the Preliminary Regulatory Evaluation for operators to review their airplanes' fuel tank systems. However, the ATA indicated that compliance with the proposed SFAR would have required operators to analyze all of their airplanes to determine whether they possess any "orphan" fuel tank system STCs or any fuel tank system field approvals that would need to be reviewed.

The FAA partially agrees with this comment. The FAA agrees to the extent that a paper review of the airplane's service history is likely to be needed to comply with the proposed SFAR. The FAA disagrees to the extent that the comment implies that the operator will need to perform a complete physical inspection of the fuel tank.

Clearly, the amount of effort to complete this paper review will vary across airplanes. Newer airplanes and airplanes that have had only one or two owners will be relatively easy to review whereas older airplanes or those that have had several owners/operators will require more effort. The FAA used an "average" number of 1 engineering day (a cost of $880 per airplane) for an operator to complete this paper review for every existing airplane. The basis for this "average" value is that the majority of these airplanes are operated by major, national, and regional airlines that should possess well-documented maintenance history records so that it will take them less than a day to complete the paper reviews for the vast majority of airplanes. Offsetting that factor is that there will be smaller operators that may need to spend more time to trace their airplanes' maintenance histories.

In order to meet the 36 month compliance date, operators will need to discover if their airplanes have any "orphan" TCs or STCs or if there are any field approvals on their airplanes that affect the fuel tank system. Completing these paper reviews within the first 18 months will then give the operators 18 months to complete any additional fuel tank system engineering reviews and to make the resultant changes to their maintenance manuals.

Therefore, as seen in Table IV-6, in the Final Regulatory Evaluation the FAA determined that the per airplane compliance cost will be $880. Assuming that half of these reviews will be completed in 2001 and half in 2002, the FAA calculated that the present value of those one-time airplane paper review costs will be $5.934 million.

TABLE IV-6

Cost to Operators of Paper Review of Their Airplanes

Number of Airplanes (in 1999)	Paper Review Cost per Airplane	P.V. Total Paper Review Cost (Yr. 2001)	P.V. Total Paper Review Cost (Yr. 2001)	P.V. Total Paper Review Cost
6,971	$880	$3.067 million	$2.867 million	$5.934 million

There is also the potential that this "paper review" will reveal a field approval or an "orphan" STC that affects the safety of the fuel tank system. In that case, the operator would be responsible for the engineering review and for developing inspection and maintenance procedures for the maintenance manual. The FAA did not receive any data on this factor but contends that it is likely to infrequently occur and, further, the amount of engineering needed would be relatively minor.

H.e.6. Fuel Tank System Review Cost of Compliance

In the Preliminary Regulatory Evaluation, the FAA had estimated that current design approval holders would have incurred $14.3 million in one-time costs of performing the fuel tank system reviews. Of this $14.3 million, $9.4 million would have been incurred by TC holders and $4.9 million would have been incurred by STC holders.

As seen in Table IV-7, based on the comments and updated information, the FAA calculated in the Final Regulatory Evaluation that the present value of the costs to comply with the SFAR for current design approval holders will be $32.223 million to perform the fuel tank system reviews. Of this $27.107 million, $24.440 million will be incurred by current TC holders, $2.522 million will be incurred by current holders of fuel tank system STCs, and $2.594 million will be incurred by current holders of non-fuel-tank-system STCs. The present value of the costs to comply with the SFAR for operators will be $5.934 million to perform a paper review of their current airplanes' fuel tank systems.

Thus, the FAA calculated that the present value of the total costs to comply with the SFAR will be $38.157 million.

TABLE IV-7

PRESENT VALUE OF COSTS TO COMPLY WITH THE SFAR

Aviation Sector	**P.V. Compliance Cost (In $Millions)**
Design Approval Holders	32.223
TC Holders	(27.107)
Fuel Tank System STC Holders	(2.522)
Non-Fuel-Tank-System STC Holders	(2.594)
Operators	5.934
TOTAL	38.157

I. COST OF COMPLIANCE WITH OPERATIONAL RULES CHANGES

I.1. Introduction

As was the case for the proposed rule, the final rule imposes compliance on current and future operators that do their own maintenance or that contract their maintenance to third-party repair stations. As these repair stations will pass any compliance costs to their clients, for the purpose of this analysis, the FAA uses the term "operator" to include repair stations. The proposed and final rule require operators: (1) to incorporate the fuel tank system inspection and maintenance procedures and intervals recommended by the design approval holders into their maintenance manuals; and (2) to use these recommended procedures in future fuel tank system inspections and maintenance.

The proposed rule would have required operators to incorporate these recommendations into their manuals within 18 months of its effective date. However, the final rule requires operators to incorporate these recommendations into their maintenance manuals within 36 months of its effective date.

At this point in the text, the FAA reiterates that the compliance costs attributed to the operational rule changes do not include expenditures for repairs or equipment replacements that are found to be necessary as a result of the enhanced fuel tank system inspections and equipment and wiring testing. While the FAA continues to recognize that such repairs and equipment replacements will likely constitute a significant expense, these costs are attributed to the existing FAA regulations that require such corrective actions to be taken to assure the airplane's continued airworthiness. In other words, if the enhanced fuel tank system inspection reveals problems that would not otherwise have been revealed, then those repair costs are due to the regulations governing that equipment -- not to the fact that the inspection has become more effective in discovering problems that need corrective action.

In the Preliminary Regulatory Evaluation, the FAA had reported that the incremental cost of complying with the proposed operational rules changes would arise from 4 actions: (1) the time needed to incorporate the recommendations into the maintenance manuals; (2) the labor hours needed to perform the enhanced fuel tank system inspection, which includes testing of fuel tank system equipment and wiring; (3) the lost net revenue from an airplane's additional out-of-service time needed to complete the enhanced fuel tank system inspection; and (4) the labor costs needed to provide the increased documentation, recording, and reporting of the additional fuel tank system inspections, tests, and subsequent findings.

As commenters offered no other potential types of costs and did not adversely comment on these 4 types of costs, the FAA uses them in the Final Regulatory Evaluation.

I.2. Compliance Costs to Incorporate Design Approval Holders' Recommendations into Maintenance Manuals

I.2.a. Costs from TC Holders Recommendations

The initial compliance costs incurred by operators and repair stations under the operational rules changes are those incurred from incorporating the TC holders' recommendations into the maintenance manuals. These recommendations will need to be read, understood, discussed with the TC holder's engineers, and, finally, written into the operator's maintenance manual's procedures. In the Preliminary Regulatory Evaluation, the FAA had assumed that this cost is based on the overall airplane model rather than on the individual airplane series. The FAA had estimated that it would take 5 engineer days to fully integrate the TC holder recommendations into the manuals for each airplane model owned by an operator. On that basis, the FAA had estimated that the one-time cost of compliance for this compliance activity would be $4,000 per airplane model per operator, which resulted in a total cost of $1.16 million for the estimated 290 existing individual model/operator combinations. As those expenses would have been incurred in the second year, the FAA had estimated a present value of $1.084 million for this cost.

Since the Preliminary Regulatory Evaluation, the FAA has learned that most airlines with fewer than 20 airplanes in their fleet do not perform their own major maintenance checks. Consequently, the FAA determined that for the purposes of this analysis only those 40 airlines with 20 or more airplanes will perform their own major maintenance checks. On that basis, the FAA determined that for the Final Regulatory Evaluation (as listed in Appendix B) there are 156 individual turbojet model/operator combinations that have their own maintenance manuals. In addition, the FAA determined that there are 9 individual turboprop model/operator combinations that have their own maintenance manuals. Applying the revised total labor costs of $4,400 for 5 engineer days to those 165 maintenance manuals results in a compliance cost of $726,400. However, as those modifications must be made after the operators receive the TC holders recommendations, the FAA determined that these manual modifications will not be made until the year 2003. On that basis, the FAA calculated that the present value of these compliance costs will be $635,000.

Those operators with 19 or fewer airplanes will use third party repair stations for their major maintenance checks. The FAA determined that 15 repair stations will perform these fuel tank system inspections for those operators and that each repair station, on average, will perform these inspections for 10 different airplane models.[13] On that basis, the FAA calculated that the total cost for repair stations to modify their maintenance manuals will be $660,000. As was the case for the operators that do their own maintenance, the FAA determined that these expenditures will occur in the year 2003 so that the present value of these compliance costs will be $576,475.

Therefore, the FAA calculated that the present value of the costs to modify maintenance manuals in accordance with the TC holders' recommendations will be $1.212 million.

I.2.b. Costs for STC Holder Recommendations

In the Preliminary Regulatory Evaluation, the FAA had not estimated a compliance cost for operators and repair stations to modify their maintenance manuals to incorporate recommendations made by fuel tank system STC holders. Although there were no comments on this omitted cost, the FAA determined that some fuel tank system STC holders will make some fuel tank system inspection recommendations and operators and repair stations will need to incorporate into their maintenance manuals. As the majority of fuel tank system STCs affect only a part of the fuel tank system, many of these STC holder reviews will not result in

[13] The FAA recognizes that much of the fuel tank system inspections are subcontracted to fuel tank maintenance specialists that have the necessary equipment and expertise to perform this work in accordance with Environmental Protection Agency requirements for disposing of

recommendations and those recommendations that will be provided will involve less extensive changes than those changes recommended by the TC holders. On that basis, the FAA determined that each maintenance manual modification due to an STC holder recommendation will take 1 engineer day - for a cost of $880. The FAA determined that, on average, the recommendations from each of the 79 different fuel tank system STCs will affect the maintenance manuals of two operators and third party repair stations. Thus, the FAA calculated that the 79 fuel tank system STCs will cost operators and third party repair stations $139,000. As this expenditure will not occur until the year 2003, the FAA calculated that the present value of these costs is $121,450.

With respect to non-fuel-tank-system STC holders reviews, the FAA found that these reviews will provide few recommendations for fuel tank system inspections and maintenance procedures. Consequently, the FAA determined that these reviews will impose minimal compliance costs for maintenance manual modifications.

I.2.c. Total Costs for Maintenance Manual Modifications Due to Design Approval Holders Recommendations

Thus, as seen in Table IV-8, the FAA determined that the present value of the costs for operators and repair stations to modify their maintenance manuals is $1.333 million, of which $1.212 million is due to TC holders recommendations and $121,000 is due to fuel tank system STC holders recommendations.

TABLE IV-8

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hazardous substances and Occupational Safety and Health Administration requirements for working with hazardous substances in confined spaces.

PRESENT VALUE OF THE COSTS TO MODIFY MAINTENANCE MANUALS IN REPONSE TO DESIGN APPROVAL HOLDERS RECOMMENCATIONS

Source of Recommendation	P.V. Compliance Costs (in $Millions)	Compliance Costs in Yr. 2003
TC Holders	1.212	1.386
Operators	(0.635)	(0.726)
Repair Stations	(0.577)	(0.660)
STC Holders	0.121	0.139
TOTAL	1.333	1.525

I.3. Labor Cost for Enhanced Fuel Tank System Inspections and Testing

I.3.a. Frequency of Fuel Tank System Inspections

The proposed rule and the final rule give operators some flexibility in completing the initial fuel tank inspections by allowing them to be performed during the first regularly scheduled "major" maintenance check after the maintenance manuals have been modified to incorporate the design approval holders recommendations. In the proposed rule, maintenance manuals would have been modified 18 months after the rule's effective date whereas in the final rule, this date is 36 months after the rule's effective date.

The FAA has defined a "major" maintenance check as a "C" or a "D" check or their equivalents. In the Preliminary Regulatory Evaluation, the FAA had assumed that the average airplane would undergo a "C" check every 3 years and a "D" check every 5 years. The FAA had determined that the proposed rule would have required an initial inspection or a reinspection to occur only during a "major" maintenance check. On that basis, the FAA had calculated an annual cost of fuel tank system inspections in any year to be one-third of the total cost for all of the inspections.

The ATA commented that the FAA analysis of these inspection costs critically depends upon the assumption that the inspections will coincide with an airline's regularly scheduled major maintenance checks. They stated that if compliance were to result in fuel tank inspections occurring more frequently than the scheduled major maintenance checks, then the FAA would have significantly underestimated the compliance costs. More frequent fuel tank system reinspections would require not only more labor hours, but also additional lost net revenue because airplanes would have to be taken out of service more often and for longer periods of time.

The FAA agrees with this comment that if the final rule were to require more frequent reinspections, then the FAA would have significantly underestimated the frequency and the resultant costs of these reinspections. However, the FAA anticipates that compliance with the final rule will not require airlines to take airplanes out of service at times other than their regularly scheduled maintenance schedules. As a result, the FAA determined that it did not substantially underestimate the inspection compliance costs.

Federal Express commented that its "D" check, which is when the fuel tank is opened and purged, occurs every 8 years, not every 5 years as the FAA had estimated. In response, the FAA notes that the accumulated flight hours is the primary determinant of the frequency of regularly scheduled maintenance checks. In the Preliminary Regulatory Evaluation, the FAA had used an average interval of 3 years for a "C" check and an average interval of 5 years for a "D" check. However, for cargo airplanes or other airplanes that fly fewer hours and cycles, their scheduled major maintenance checks would occur less frequently and the FAA had assumed that their fuel tank system reinspections would similarly occur less frequently.

Since then, the FAA has learned that "C" checks are typically scheduled every 12 to 24 months, depending upon the airplane model and its flight hours and cycles. Consequently, in the Final Regulatory Evaluation, the FAA determined that all of the initial fuel tank system inspections will occur during the years 2004 and 2005. That is, they will occur within a 2 year time period after the 3 years allowed for the maintenance manuals to be modified rather than within a 3 year period after the 18 months proposed for the maintenance manuals to be modified.

In reviewing its assumptions about the frequency of the fuel tank system reinspections, the FAA determined that its expectations concerning the type of recommendations likely to be made by the design approval holders needed to be altered. As a result, the FAA determined in the Final Regulatory Evaluation that fuel tank system reinspections, will not need to be performed at every "C" check but, rather, will be performed at every "D" check. The FAA determined that the corrective repairs and maintenance resulting from the initial fuel tank inspection will generally provide a permanent fix and thereby reduce the number of future reinspections. Based on a sample of manufacturer recommendations (See Appendix D for the recommendations in the sample used by the FAA.) that a "D" check be performed every 13,300 to 25,000 flight hours, the FAA used a 5 year frequency for a "D" check.

I.3.b. <u>Number of Labor Hours per Fuel Tank System Inpsection</u>

In the Preliminary Regulatory Evaluation, the FAA had established that the initial fuel tank system inspection would require more incremental labor hours to complete than would a reinspection. Many individual inspection activities performed during the initial fuel tank system inspection would not need to be repeated at every later reinspection because most corrected problems generally do not require as much inspection. Thus, the initial fuel tank system inspection will take more labor hours than those needed for reinspections, although those reinspections will take more labor hours than would have been expended under the current rules.

As there were no comments asserting that the initial fuel tank system inspection will take the same amount of time as the fuel tank system reinspections, the FAA uses this logic in the Final Regulatory Analysis.

Based on its experience with fuel tank system analyses, the FAA had determined in the Preliminary Regulatory Evaluation that the design approval holders recommendations would likely require that the fuel tank pumps, the FQIS wiring, and the wiring inside the fuel tank be inspected and tested more thoroughly (or for the first time) than had been done. Although the costs of new and replacement equipment and wiring are not attributed to the final rule, the labor time to reinstall equipment and wiring is a cost of compliance. For example, inspecting fuel boost pump wiring requires it to be pulled from the fuel tank, inspected and tested, and then reinstalled in the fuel tank. Regardless of whether the original wiring is reinstalled or replacement wiring is installed, the reinstallation time is a cost of complying with the final rule, but, the cost of any new wiring is attributed to maintaining the airplane in an airworthy condition and is not a cost of complying with the operational rules changes. The FAA had based its estimates of the labor hours to perform each of these specific inspections on its technical review of the individual fuel tank systems and on the labor hours estimated in representative fuel tank system service bulletins. Thus, the FAA had estimated that the initial fuel tank system inspection would have taken between 50 and 198 additional mechanic hours, depending upon the airplane model. The FAA had also estimated that fuel tank system reinspections would have taken between 40 and 160 additional mechanic hours.

After review of the comments and the analysis in the Preliminary Regulatory Evaluation, the FAA adjusted some of its assumptions concerning these hours. For the first adjustment, the FAA noted that its estimates in the Preliminary Regulatory Evaluation for specific numbers of hours to inspect certain components did not allow for unanticipated inspection recommendations. As the FAA probably did not anticipate every potential fuel tank system inspection areas for every fuel tank system, the FAA added 20 labor hours to the initial inspection times for all airplanes to account for any unanticipated inspection areas.

The second adjustment is that the FAA realized that older airplanes of an airplane model will require, on average, more labor hours for the initial fuel tank system inspection than will be required for a newer airplane. Older airplanes are more likely to have had fuel tank system repairs or modifications or to have older fuel tank system technology and equipment and these factors will take more time to inspect. Therefore, the FAA separated airplanes into 3 categories based on the date the airplane was manufactured. The FAA determined that the number of labor hours estimated in the Preliminary Regulatory Evaluation for the initial fuel tank system inspection (plus 20 hours) apply to airplanes manufactured between 1960 and 1980. Airplanes manufactured between 1981 and 1995 will require 20 percent fewer labor hours than those for the oldest airplane category. Finally, airplanes manufactured between 1995 and 2003 will require 30 percent fewer labor hours than those for the oldest airplane category.

The third adjustment is that the FAA determined that the number of labor hours to reinspect fuel tank systems is one-half the number of labor hours for the initial fuel tank system inspection based on the last year that model was manufactured. That is, if an airplane model was manufactured between 1970 and 1985, the number of labor hours to reinspect the fuel tank system for all of those airplanes will be one-half of the number of labor hours to perform the initial inspection of that model based on the 1980 to 1995 category. For example, the number of labor hours to reinspect a B-737-500 are one-half of the number of labor hours for an initial inspection of a B-737-500 in the post-1995 category.

The fourth adjustment is that the number of labor hours to reinspect future manufactured airplanes is the same as the number of labor hour for reinspections of the most recent series of that airplane model.

On that basis, as seen in Table IV-9, the FAA determined for the Final Regulatory Evaluation that the it will take between 49 and 218 labor hours to complete an airplane's initial fuel tank system inspection and it will take between 25 and 108 labor hours to complete an airplane's fuel tank system reinspection.

I.3.c. Labor Cost of Fuel Tank System Inspections

Based on a $70 hourly compensation rate for an airplane mechanic and an estimated 50 to 198 labor inspection hours, the FAA had estimated in the

TABLE IV-9					
NUMBER OF LABOR HOURS TO COMPLETE INITIAL AIRPLANE INSPECTION AND REINSPECTIONS					
Airplane Model	Labor Insp Hrs per A/C (PrelimRE)	Labor Initial Insp Hrs per A/C (1960-1980)	Labor Initial Insp Hrs per A/C (1980-1995)	Labor Initial Insp Hrs per A/C (Post 1995)	Labor ReInsp. Hrs. per A/C
A300-200/200F	156	176	141	123	70
A300-600R	156	176	141	123	62
A310-300	156	176	141	123	70
A319	156	176	141	123	62
A320	156	176	141	123	62
A321	156	176	141	123	62
A330	156	176	141	123	62
A340	156	176	141	123	62
B707/720	198	218	174	153	87
B717	132	152	122	106	53
B727-100	198	218	174	153	109
B727-200 Adv	198	218	174	153	87
B737-100/200	174	194	155	136	68
B737-300/400/500	174	194	155	136	68
B737-600/700/800/900	174	194	155	136	68
B747-100/200/300	198	218	174	153	87
B747-400	198	218	174	153	76
B757	174	194	155	136	68
B767	174	194	155	136	68
B777	132	152	122	106	53
DC8-20/30/40/50	150	170	136	119	85
DC8-60	150	170	136	119	85
DC8-70	150	170	136	119	85
DC9-10/20	150	170	136	119	85
DC9-30/40/50	150	170	136	119	68
DC10-10/15	174	194	155	136	78
DC10-30/40	174	194	155	136	78
MD11	174	194	155	136	68
MD80	150	170	136	119	60
MD90	150	170	136	119	60
L 1011	174	194	155	136	78
Avro RJ85	75	95	76	67	33

BAC 1-11	50	70	56	49	35
BAe146-200	86	106	85	74	42
Can RJ-100/200	60	80	64	56	28
Emb RJ-135/145	60	80	64	56	28
F 28	120	140	112	98	56
F100	96	116	93	81	46
Fair Dorn 328 Jet	60	80	64	56	28
SAAB 340	52	72	58	50	25
ATR72	72	92	74	64	32
ATR42	50	70	56	49	28
Shorts 360	72	92	74	64	37
Dornier 328 Turboprop	50	70	56	49	25
F27	50	70	56	49	28
DHC-7	50	70	56	49	28
DHC-8	50	70	56	49	25
YS-11	50	70	56	49	35
L188	0	92	74	64	0

Preliminary Regulatory Evaluation that the actual cost of a fuel tank system initial inspection would have been between $3,500 and $13,680 per airplane. Similarly, the FAA had estimated that a reinspection would have had a labor cost of between $2,800 and $11,200.

The FAA had estimated in the Preliminary Regulatory Evaluation that, based on 6,006 airplanes in the first year of compliance, the total annual labor cost would have been $21.1 million in the first year, increasing by 4.3 percent per year (the assumed rate of growth of the fleet) until the fourth year. In the fourth year, it would have become $10.1 million, again increasing by 4.3 percent each year thereafter. Thus, the FAA had estimated that the present value of the total labor cost from the enhanced fuel tank system inspections and maintenance discounted at 7 percent over a 10 year period would have been $100 million.

After review of the comments and the Preliminary Regulatory Evaluation as well as obtaining more current data, the FAA made the following adjustments in its assumptions, methodology, and data for the Final Regulatory Evaluation.

1. An airplane mechanic's hourly compensation is $75 rather than $70.
2. There are 7,872 airplanes at the start of year 2004 rather than 6,006 airplanes at the start of year 1998.
3. The first fuel tank inspection labor costs will be incurred in 2004 - 3 years after the effective date of the final rule - rather than in 2002.
4. The first "C" or "D" check will be completed within the first 2 years (2004 and 2005) for all airplanes rather than over the 3 year timeframe of 2002 - 2004.

5. The fuel tank systems of airplanes manufactured after 2003 will be in compliance and will not need to be inspected until the airplane's first "D" check.
6. There will be a two-year time span (the years 2006 and 2007) after the initial fuel tank system inspections during which there will be a minimal number of reinspections because the initial inspections will still be valid. Thus, beginning in the year 2008, all airplanes in the system will have their fuel tank systems reinspected every 5 years during a regularly scheduled "D" check.
7. Operators will not perform initial fuel tank inspections on airplanes they intend to retire in the years 2003, 2004, and 2005. The FAA determined that the annual fleet retirement rate is 1 percent.[14] The FAA also determined that all retirements in the years 2003 through 2005 will occur to the oldest airplanes in the fleet. However, the FAA did not adjust future reinspections to account for the fact that airplanes scheduled to be retired in 2008, 2009, etc. will not undergo a fuel tank system reinspection. Predicting which airplanes will be retired at what dates is beyond the scope of this analysis. However, the FAA concluded that any reinspection cost overestimate would be relatively minor.
8. Recent data project that the net growth rate of the fleet is 3 percent rather than the 4.3 percent used in the Preliminary Regulatory Evaluation.
9. Finally, in the Preliminary Regulatory Evaluation, the FAA had excluded the inspection costs for B-747 airplanes because the FAA had assumed that most of the enhanced fuel tank inspections

[14] Boeing web site (October 7, 2000) based on a 4 percent annual rate of production growth and its conclusion that one fourth of production is to replace existing capacity.

had already been required by ADs. Although there were no comments on excluding these costs, the FAA reviewed this assumption and determined that the fuel tank system design reviews of B-747 airplanes will include elements of the fuel tank system that have not been covered by the ADs. Therefore, the FAA does not exclude the costs for fuel tank system inspections of B-747 airplanes in the Final Regulatory Evaluation.

Therefore, the revised labor costs for an airplane's initial fuel tank system inspection range between $3,625 and $16,350 and the revised labor costs for an airplane's fuel tank system reinspection range between $1,875 and $8,100.

As seen in Table IV-10, the FAA calculated that the present value of the labor cost for the initial fuel tank system inspections is $33.095 million in 2004, $30.929 million in 2005, $0 in 2006 and 2007, $5.126 million in 2008, and then decreasing by 3.7 percent (the annual net rate of fleet increase (3 percent) divided by the discount rate (7 percent)) per year. The present value of the total labor cost for the period 2004 through 2013 is $92.043 million.

I.4. Lost Net Revenue from Time Out-of-Service

In the Preliminary Regulatory Evaluation, the FAA had established that the proposed rule would have resulted in airplanes being out-of-service longer than would be normal for a "C" check. Due to an airplane's physical space restrictions, there is a limited number of airplane mechanics who can simultaneously inspect a fuel tank system. Thus, although more airplane mechanics can be added to inspect the fuel tank

TABLE IV-10		
PRESENT VALUE OF COSTS TO INSPECT FUEL TANK SYSTEMS		
Year	**Present Value Inspection Costs**	**Undiscounted Inspection Costs**
2004	$33,094,566	$40,542,267
2005	$30,929,501	$40,542,267
2006	$0	$0
2007	$0	$0
2008	$5,125,723	$8,230,792
2009	$4,934,108	$8,477,715
2010	$4,749,655	$8,732,047
2011	$4,572,098	$8,994,008
2012	$4,401,178	$9,263,829
2013	$4,236,648	$9,541,743
TOTAL	$92,043,477	$134,324,668

system during a "C" check, the operator cannot completely avoid an increase in out-of-service time.

In the Preliminary Regulatory Evaluation, the FAA had estimated that this additional out-of-service time would have been between 34.5 hours and 96 hours per airplane for the initial fuel tank system inspection. Similarly, the additional out-of-service time would have been between 27 and 75 hours for a reinspection. The economic cost of out-of-service time had been computed using a 7 percent average annual after tax risk-free rate of return on the average value of each airplane model.

The average value of the airplane model had been based on the reported values in the AVITAS 2nd half 1997 Jet Aircraft Values and the AVITAS 2nd half 1997 Commercial Turboprop Aircraft Values. For models that had several different series, the average reported value was a weighted average of the values of the various series based on the number of airplanes in each series in the fleet.

Thus, the FAA had estimated in the Preliminary Regulatory Evaluation that the annual average out-of-service lost net revenue per initial fuel tank inspection would have ranged between $160 and $78,000 per airplane while the average lost net revenue per reinspection would have ranged from $125 to $58,500. On that basis, the FAA had estimated that, the total annual lost net revenue would have been $6.4 million in the first year, increasing by 4.3 percent per year (the assumed rate of growth of the fleet) until the fourth year. In the fourth year, it would have become $2.95 million, again increasing by 4.3 percent each year thereafter. The present value of the total lost net revenue discounted at 7 percent over a 10 year period would have been $35.6 million.

After review of the comments and its Preliminary Regulatory Evaluation, the FAA made the following adjustments in its assumptions and methodology and used more current data for the Final Regulatory Evaluation. Many of these adjustments are similar to those made to estimate the labor costs of the fuel tank system inspections.

1. There is no additional out-of-service time if the fuel tank system inspection is performed during a "D" check. A "D" check is, typically, a two to three week airplane maintenance check and the FAA determined that a fuel tank system inspection can be completed during that amount of scheduled out-of-service time without any additional time out-of-service.
2. Assuming a "D" check occurs every 5 years, an average of 20 percent of the fleet undergoes a "D" check every year. Consequently, a total of 40 percent of the initial fuel tank system inspections performed in the years 2004 and 2005 will be performed during "D" checks.
3. All lost net revenue from additional out-of-service time will be incurred only in the years 2004 and 2005 because all reinspections are expected to occur during "D" checks.
4. The number of additional out-of-service days depends upon the number of labor hours to perform the initial fuel tank system inspection. The FAA determined that two mechanics can simultaneously work on an initial fuel tank system inspection. Assuming that airplane maintenance is scheduled for 24 hours a day and that a "C" check is a two-day check, the FAA determined that no additional out-of-service days would occur for 1 to 48 additional labor hours. Each additional 48 labor hours after the first 48 labor hours will add one day to the out-of-service

additional recordkeeping hours would have been between 9 and 24 hours for the initial fuel tank system inspection and would then have been 4 to 10 hours for each reinspection.

On that basis, the FAA had estimated in the Preliminary Regulatory Evaluation that the annual increased recordkeeping cost per airplane would have been between $150 and $850 during the first 3 years and then would have become $100 to $540 in each year thereafter. Thus, the total annual recordkeeping cost would have been $2.6 million in the first year, increasing by 4.3 percent until the fourth year when it would have become $1.7 million, and then increasing by 4.3 percent each year (the assumed rate of growth of the fleet) thereafter. The present value of the total recordkeeping cost over a 10 year period discounted at 7 percent would have been $17.4 million.

Although there were no comments on the methodology and the assumed estimated times to calculate the recordkeeping hours, the FAA reviewed its assumptions and determined that while the assumption for the initial inspections is correct, the FAA had overestimated the number of recordkeeping hours for reinspections. For the Final Regulatory Evaluation, the FAA determined that each 12 additional labor hours for reinspections will produce one additional hour of recordkeeping.

The FAA used those assumptions and the revised number of additional fuel tank system inspection labor hours, the number of airplanes in the fleet, the different time period, etc., to calculate the recordkeeping costs. On that basis, as seen in Table IV-12, the FAA calculated that the present value of the recordkeeping costs for the initial inspections is $4.137 million in the year 2004 and $3.866 million in the year 2005. The present value of the recordkeeping costs for the reinspections is $0

TABLE IV-12		
PRESENT VALUE OF RECORDKEEPING COSTS FOR FUEL TANK INSPECTIONS		
Year	Present Value Recordkeeping Costs	Undiscounted Recordkeeping Costs
2004	$4,136,820	$5,067,783
2005	$3,866,187	$5,067,783
2006	$0	$0
2007	$0	$0
2008	$427,143	$685,899
2009	$411,175	$706,476
2010	$395,804	$727,670
2011	$381,008	$749,500
2012	$366,764	$771,985
2013	$353,054	$795,145
TOTAL	$10,337,959	$14,572,244

in the years 2006 and 2007, $427,000 in the year 2008 decreasing at a rate of 3.7 percent (the annual rate of growth of the fleet (3 percent) divided by the annual discount rate (7 percent)) in each succeeding year. The present value of the total recordkeeping costs discounted at 7 percent for the period 2004 through 2013 is $10.338 million.

I.5. Total Compliance Costs for the Enhanced Inspections

In the Preliminary Regulatory Evaluation, the FAA had estimated that the total annual compliance cost plus the lost net revenue with the proposed operational rules changes would have been $31 million during the first year, increasing by 4.3 percent per year until the fourth year when it would have declined to $8 million but increasing by 4.3 percent each year thereafter. The present value of the compliance cost and net lost revenue over a 10 year period discounted at 7 percent would have been $134 million.

In the Final Regulatory Evaluation, as seen in Table IV-13, the FAA determined that the present value of the inspection costs plus the lost net revenue are $49.753 million in the year 2004, $46.498 million in the year 2005, $0 in the years 2006 and 2007, and $5.553 million in the year 2008 but decreasing by 3.7 percent each year thereafter. The present value of the inspection labor costs and net lost revenue during the years 2004 through 2013 discounted at 7 percent are $126.606 million.

J. TOTAL COMPLIANCE COST AND LOST NET REVENUE DUE TO THE FINAL RULE

In the Preliminary Regulatory Evaluation the FAA had estimated that the total annual compliance cost for both the fuel tank system review and

TABLE IV-14		
PRESENT VALUE OF INSPECTION COSTS PLUS RECORDKEEPING COSTS PLUS LOST NET REVENUE		
Year	**Present Value Inspection Costs Plus Lost Net Revenue**	**Undiscounted Inspection Costs Plus Lost Net Revenue**
2004	$49,753,047	$60,949,622
2005	$46,498,175	$60,949,622
2006	$0	$0
2007	$0	$0
2008	$5,552,867	$8,916,691
2009	$5,345,283	$9,184,192
2010	$5,145,460	$9,459,717
2011	$4,953,106	$9,743,509
2012	$4,767,943	$10,035,814
2013	$4,589,702	$10,336,889
TOTAL	$126,605,582	$179,576,056

the enhanced fuel tank system inspection and equipment and wiring testing plus the lost net revenue with the proposal would have been $44.3 million during the first year, increasing by 4.3 percent per year (the assumed growth rate of the fleet) until the fourth year when it would have declined to $8.2 million, increasing by 4.3 percent each year thereafter. The present value of these compliance costs and net lost revenue over a 10 year period discounted at 7 percent would have been $149 million.

In the Final Regulatory Evaluation, as seen in Table IV-14, the FAA determined that the total annual compliance cost for the fuel tank system reviews, the enhanced fuel tank system inspections and recordkeeping; and the lost net revenue are $17.489 million in 2001, $20.735 million in 2002, $30,750 in 2003, $49.782 million in 2004, $46.525 million in 2005, $25,100 in 2006, $23,450 in 2007, $5.575 million in 2008, increasing by 4.3 percent per year thereafter. The present value of these compliance costs and net lost revenue over the period 2001 through 2013 discounted at 7 percent are $165.076 million.

TABLE IV-14		
PRESENT VALUE OF TOTAL COSTS OF COMPLIANCE		
Year	Present Value of Compliance Costs	Undiscounted Compliance Costs
2001	$17,489,065	$19,837,565
2002	$20,734,640	$24,534,565
2003	$30,745	$35,200
2004	$49,781,780	$60,984,822
2005	$46,525,028	$60,984,822
2006	$25,097	$35,200
2007	$23,455	$35,200
2008	$5,574,788	$8,951,891
2009	$5,365,770	$9,219,392
2010	$5,164,606	$9,494,917
2011	$4,971,000	$9,778,709
2012	$4,784,666	$10,071,014
2013	$4,605,331	$10,372,089
TOTAL	$165,075,973	$224,335,386

V. BENEFIT-COST COMPARISON

As reported in the Benefits Chapter III, the FAA has not quantified the potential benefits from this final rule because there is uncertainty about the actual ignition sources in the two fuel tanks. However, using a "representative" commercial airplane, the FAA calculated that the losses from a mid-air explosion would be $401.6 million.

As reported in the Compliance Cost Chapter IV, the FAA determined that the present value of the compliance costs are $165.1 million.

If the final rule would prevent one such accident by the year 2014, the present value of the prevented losses would be greater than the present value of the compliance costs.

Therefore, based on these factors and analysis, the FAA believes that the final rule is cost-beneficial.

VI. REGULATORY FLEXIBILITY ANALYSIS

A. INTRODUCTION

The Regulatory Flexibility Act of 1980 (RFA) establishes "as a principle of regulatory issuance that agencies shall endeavor, consistent with the objective of the rule and of applicable statutes, to fit regulatory and informational requirements to the scale of the business, organizations, and governmental jurisdictions subject to regulation." To achieve that principle, the RFA requires agencies to solicit and consider flexible regulatory proposals and to explain the rationale for their actions. 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 proposed or final rule will have a significant economic impact on a substantial number of small entities. If the determination finds that it will, the agency must prepare a Regulatory Flexibility Analysis as described in the RFA.

However, if an agency determines that a proposed or final rule is not expected to have a significant economic impact on a substantial number of small entities, section 605(b) of the 1980 act provides that the head of the agency may so certify, and a Regulatory Flexibility Analysis is not required. The certification must include a statement providing the factual basis for this determination, and the reasoning should be clear.

B. INITIAL REGULATORY FLEXIBILITY ANALYSIS

In the Preliminary Regulatory Evaluation, the FAA had determined that the proposed rule would have resulted in a significant impact on a substantial number of small entities. As a result, the FAA had conducted an Initial Regulatory Flexibility Analysis that formed the basis for the Agency's conclusion. In the Preliminary Regulatory Evaluation and in the NPRM, the FAA had specifically requested comment on the potential impact of the proposed rule on small entities

C. FINAL REGULATORY FLEXIBILITY ANALYSIS

C.1. Need for and Objectives of the Rule

The final rule is being considered in order to reduce the risk of a mid-air airplane fuel tank explosion with the resultant loss of life (as evidenced by TWA Flight 800). Existing fuel tank system inspections have not provided comprehensive, systematic prevention and control of ignition sources in airplane fuel tanks, thereby allowing a small, but unacceptable risk of a fuel tank explosion.

The objective of the final rule is to ensure the continuing airworthiness of airplanes certificated with 30 or more passengers or with a payload of more than 7,500 pounds. Design approval holders (including TC, fuel tank system STC holders, and holders of certain non-fuel-tank-system STCs) will be required to complete a fuel tank system design review and to provide recommendations and instructions to operators and repair stations concerning fuel tank system inspections and equipment and wiring testing. This review may result in the development of service bulletins and ADs. All operators covered by parts 91, 121, and 125 and all U.S.-registered airplanes used in scheduled operations under part 129 will be required to incorporate these recommendations into their maintenance manuals and to perform the inspections and tests as required. In addition, repair stations that are contracted to perform maintenance are also required to comply with these requirements.

C.2. <u>Summary of Comments Made in Response to the Initial Regulatory Flexibility Analysis</u>

There were two commenters that indirectly discussed issues of concern in the Initial Regulatory Flexibility Analysis.

The General Aviation Manufacturing Association (GAMA) supported the FAA's decision to exclude airplanes certificated for 30 passengers or fewer from the final rule. Although they did not address the small business aspect of this decision, nearly every operator of these excluded airplanes is a small entity. However, GAMA opposed the proposed part 25 future design requirements as not appropriate for business jets and stated that these airplanes should be excluded from the part 25 requirements. The FAA disagreed with this comment because a future business jet that has a 7,500 pound payload is a large airplane and its fuel tank system faces the same potential for explosion as other large transport category airplanes.

The Regional Airline Association (RAA) supported the FAA's decision to exclude airplanes certificated for 30 passengers or fewer from the final rule. They, too, did not directly address the small business aspect of this decision. However, they opposed the FAA's decision to include airplanes certificated for fewer than 60 passengers or for less than a 15,000 pound payload. Their primary argument in favor of this exclusion is that these airplanes do not have a history of these types of accidents. The FAA disagreed with this comment because it contends

C.4. Reporting and Recordkeeping Requirements

The final rule requires that operators maintain a record of the results of the fuel tank system inspections and maintenance done on the airplane. For the small operators that contract their maintenance to third party repair stations (nearly all of the small airlines and other operators), they will be required to keep a copy of the report that the repair station will give them. Small entities will not need to acquire additional professional skills to prepare these reports.

C.5. Description of the Alternatives Evaluated

In the Initial Regulatory Flexibility Analysis, the FAA had evaluated three alternatives to the proposed rule. The first alternative was to require all airplanes with 10 or more seats be covered by the proposed rule. The second alternative was to require all airplanes with 30 or more seats and all airplanes with 10 or more seats in commercial service be covered by the proposal. The third alternative was to require only turbojet airplanes in commercial service be covered by the proposal. As there were no comments supporting these alternatives, the FAA's evaluation in the Initial Regulatory Flexibility Analysis can be used for the Final Regulatory Analysis.

C.6. Differences between the Proposed Rule and the Final Rule Requirements

The primary change from the proposed rule is that the final rule allows operators 36 months to comply whereas the proposed rule had required compliance within 18 months. In addition, the FAA determined that fewer fuel tank reinspections will be needed than the FAA had estimated in the Preliminary Regulatory Evaluation. As a result, the present value of the costs to operators will be approximately 20 percent less per airplane under the final rule than they would have been under the proposed rule.

C.7. Conclusion

Both the proposed and final rule will have a significant impact on a substantial number of small entities. Consistent with SBA guidance, the FAA conducted an initial regulatory flexibility analysis (IRFA) and a final regulatory flexibility analysis (FRFA). The initial regulatory flexibility analysis provided a detailed analysis of the impact on small entities. The FRFA directly addresses five requirements. While no comments specifically addressed the IRFA, the FAA addresses comments related to small entities. As published in the NPRM, the FAA did not require fuel tank inspections for aircraft with a payload under 7,500 pounds. The primary difference between the proposed rule and the final rule is that the FAA extended operator compliance time from 18 to 36 months. In addition, the FAA determined that fewer fuel tank re-inspections will be needed than originally estimated in the NPRM. As a result of these changes, the present value of the costs to operators is estimated to be 20 percent less per airplane under the final rule than that under the proposed rule.

VII. INTERNATIONAL TRADE IMPACT ASSESSMENT

The Trade Agreement Act of 1979 prohibits Federal agencies from engaging in any standards or related activities that create unnecessary obstacles to the foreign commerce of the United States. Legitimate domestic objectives, such as safety, are not considered unnecessary obstacles. The statute also requires consideration of international standards and where appropriate, that they be the basis for U.S. standards. In addition, consistent with the Administration's belief in the general superiority and desirability of free trade, it is the policy of the Administration to remove or diminish to the extent feasible, barriers to international trade, including both barriers affecting the export of American goods and services to foreign countries and barriers affecting the import of foreign goods and services into the United States.

In accordance with the above statute and policy, the FAA assessed the potential effect of this final rule and determined that it will have only a domestic impact and, therefore, a minimal affect on any trade-sensitive activity.

VIII. UNFUNDED MANDATES ASSESSMENT

The Unfunded Mandates Reform Act of 1995 (the Act), enacted as Pub. L. 104-4 on March 22, 1995, is intended, among other things, to curb the practice of imposing unfunded Federal mandates on State, local, and tribal governments.

Title II of the Act 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 a $100 million or more expenditure (adjusted annually for inflation) 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."

As seen in Table IV-14, this final rule does not contain such a mandate. Therefore, the requirements of Title II of the Unfunded Mandates Reform Act of 1995 do not apply.

APPENDIX A

NUMBER OF AIRPLANE MODELS AND THEIR DERIVATIVES NEEDING A FUEL TANK SYSTEM REVIEW

Airplane Model	Derivatives
A300-200	200F;600R;600F;
A310-300	200F
A319-100	
A320-200	
A321	
A330	
A340	
B707	720
B717	
B727-100	
B727-200 Adv	200ADV F
B737-200	200ADV
B737-300 (Classic)	400;500
B737-600 (Next Generation)	700;800;900
B747-100	100F;200;200F
B747-400	400F
B757-200	200ER;300
B767-200	200ER;300;300ER;400ER
B777-200	200ER;300
DC8-20/30/40/50	
DC8-60	
DC8-70	71F;73F
DC9-10	10F
DC9-30	30F;40;40F;50
DC10	10F;30;30ER;30F;40;40F
MD11	11F
MD81	82;83;87;88;90-30
L 1011-1	100;200;200F;250;50;500
Avro RJ85	
BAC 1-11	
BAe146-200	300
Can RJ-100ER/200ER	100LR/200LR
Emb RJ-135LR/145LR	145

F 28-400	
F100	
Fair Dorn 328 Jet	
SAAB 340	
ATR72	
ATR42	
Shorts 360	
Dornier 328 Turboprop	
F27	
DHC-7	
DHC-8	
YS-11	
L188	
TOTAL NUMBER 46	**TOTAL NUMBER 52**

APPENDIX B

NUMBER OF TURBOJET MODEL/OPERATOR COMINBATIONS

Count of Series			
Operator	**Number of Airplanes**	**Number of Models**	**Number Models/Operator**
ACCESSAIR	2	1	0
AIR TRANSPORT INT'L	12	1	0
AIR WISCONSIN	22	2	2
AIRBORNE EXPRESS	119	3	3
AIRTRAN AIRWAYS	47	3	3
ALASKA AIRLINES	89	4	4
ALLEGIANT AIR	3	1	0
ALOHA	21	1	1
AMERICA WEST	126	6	6
AMERICAN AIRLINES	703	11	11
AMERICAN EAGLE	54	2	2
AMERICAN TRANS AIR	54	2	2
AMERIJET INT'L	12	1	0
ARROW AIR	13	2	0
ASIA PACIFIC AIRLINES (USA)	3	1	0
ATLANTIC COAST AIRLINES	22	1	1
ATLANTIC SOUTHEAST	30	1	1
ATLAS AIR	18	1	0
BAX GLOBAL	17	2	0
CALIFORNIA AIRCRAFT & ENGINES	2	1	0
CAPITAL CARGO INT'L AIRLINES	8	1	0
CARNIVAL AIR LINES	1	1	0
CASINO EXPRESS	4	1	0
CHALLENGE AIR CARGO	4	2	0
CHAMPION AIR	13	1	0
CHARTER AMERICA	5	1	0
CHAUTAUQUA AIRLINES	4	1	0
COMAIR INC	87	1	1
CONTINENTAL	374	9	9
CONTINENTAL EXPRESS	64	2	2
CONTINENTAL MICRONESIA	7	1	0
CUSTOM AIR TRANSPORT	21	2	2
DELTA AIR LINES	612	12	12
DHL AIRWAYS	50	5	5
DISCOVERY AIRLINES	4	1	0
EAGLE AIRLINES	1	1	0

EMERY WORLDWIDE	67	3	3
EVERGREEN INT'L	23	3	3
EXPRESS ONE INT'L	22	2	2
FALCON AIR EXPRESS	3	1	0
FEDEX	356	7	7
FINE AIR	11	2	0
FLORIDA WEST	1	1	0
FRONTIER AIRLINES	20	1	1
GEMINI AIR CARGO	11	1	0
HAWAIIAN AIR	30	2	2
HORIZON AIR	22	1	1
JETBLUE AIRWAYS	1	1	0
KITTY HAWK AIR CARGO	42	3	3
KITTY HAWK INTERNATIONAL	40	4	4
LEGEND AIRLINES	3	1	0
LORAIR	1	1	0
MESA AIRLINES	29	1	1
MESABA AIRLINES	29	1	1
METROJET	34	1	1
MIAMI AIR INT'L	7	1	0
MIDWAY AIRLINES	27	3	3
MIDWEST EXPRESS	34	2	2
NATIONAL AIRLINES	11	1	0
NEXT CENTURY AIR	1	1	0
NORTH AMERICAN	4	2	0
NORTHERN AIR CARGO	3	1	0
NORTHWEST	425	9	9
OLYMPIA AVIATION	1	1	0
OMNI AIR INTERNATIONAL	4	1	0
OZARK AIR LINES	2	1	0
PACE AIRLINES	2	1	0
PACE CARGO	5	1	0
PAN AMERICAN	7	1	0
PLANET AIRWAYS	1	1	0
POLAR AIR CARGO	11	1	0
PRO AIR	6	1	0
PUERTO RICO AIRWAYS	1	1	0
REEVE ALEUTIAN	2	1	0
RELIANT AIRLINES	3	1	0
RYAN INT'L AIRLINES	21	4	4
SIERRA PACIFIC	2	1	0
SKYSERVICE USA	3	2	0

SKYWAY AIRLINES	5	1	0
SKYWEST AIRLINES	11	1	0
SOUTHEAST AIRLINES	2	1	0
SOUTHERN AIR	1	1	0
SOUTHWEST AIRLINES	313	3	3
SPIRIT AIRLINES	26	2	2
SUN COUNTRY	17	2	0
SUN PACIFIC INT'L	2	1	0
SUNWORLD INT'L AIRLINES	2	1	0
TOWER AIR	16	1	0
TRADEWINDS AIRLINES	6	2	0
TRANS CONTINENTAL	5	2	0
TRANS STATES AIRLINES	9	1	0
TRANSMERIDIAN AIRLINES	4	2	0
TWA	186	6	6
UNITED AIRLINES	608	12	12
UNITED EXPRESS	3	2	0
UNITED PARCEL SERVICE	222	5	5
US AIRWAYS	359	10	10
US AIRWAYS SHUTTLE	23	4	4
USA JET AIRLINES	8	1	0
VANGUARD AIRLINES	11	1	0
WINAIR	1	1	0
WORLD AIRWAYS	4	2	0
ZANTOP INT'L	2	1	0
Grand Total			
Grand Total	5802	231	156