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14 CFR Parts 91, 121, 125, and 135
Flight Recorders and Cockpit Voice Recorders; Final Rule

DEPARTMENT OF TRANSPORTATION

Federal Aviation Administration

14 CFR Parts 91, 121, 125, and 135

[Docket No. 24418; Amendment Nos. 91-199, 121-191, 125-8, and 135-23]

Flight Recorders and Cockpit Voice Recorders

AGENCY: Federal Aviation Administration (FAA), DOT.

ACTION: Final rule.

SUMMARY: This amendment requires improved (digital) flight recorders with additional data parameters for airplanes type certificated before 1969 and operated in Part 121 operations. Review of National Transportation Safety Board accident/incident files for January 1983 to February 1986 revealed the high failure rate of the metal foil flight recorders. The data revealed that 37 recorders (48 percent) had one or more malfunctioning parameters preceding the accident/incident preventing the recording or readout pertinent data. As a result, post-accident flight recorder examination cannot be relied upon to provide accident investigators with sufficient information to accurately assess the causal interrelationship between man, machine, and environment. The requirement of a digital flight recorder with additional data parameters is deemed the minimum standard necessary to ensure that all of the underlying causal factors of an accident are identified. The amendment also requires cockpit voice recorders on newly manufactured multiengine, turbine-powered airplanes certificated to carry six or more passengers, requiring two pilots by type certification or operating rules for those operations conducted under Part 135. The amendment also specifies that for those operators conducting operations under Part 91 and Part 125 that have installed approved cockpit voice recorders, the Administrator will not use the record in any civil penalty or certificate action. These amendments were based on recommendations from a study conducted by Trans Systems Corporation and a number of safety recommendations by the National Transportation Safety Board.

EFFECTIVE DATE: May 26, 1987.

FOR FURTHER INFORMATION CONTACT: Frank Rock, Federal Aviation Administration, Office of Airworthiness, Aircraft Engineering Division, Technical Analysis Branch, AWS-120, 800 Independence Avenue, SW., Washington, DC 20591; telephone (202) 267-9567.

SUPPLEMENTARY INFORMATION:

Regulatory History

These amendments are based on Notice of Proposed Rulemaking (NPRM) No. 85-1, published in the **Federal Register** on January 8, 1985 (50 FR 949). All comments received in response to NPRM No. 85-1 were considered in adopting these amendments.

Background

For those operations conducted under Parts 91 and 125 of the Federal Aviation Regulations (FAR), there are no requirements that either a flight recorder or a cockpit voice recorder (CVR) be installed. However, in the interest of safety, the Federal Aviation Administration (FAA) has always encouraged the installation of approved flight recorders and approved cockpit voice recorders in airplanes used in those operations.

Section 121.343 of the FAR requires operators to equip each turbine-powered airplane and each airplane certificated for operation above 25,000 feet with an approved flight recorder. For airplanes having an original type certificate issued through September 30, 1969, the flight recorder parameters must include time, altitude, airspeed, vertical acceleration, heading, and radio transmission keying. Airplanes having an original type certificate issued after September 30, 1969, are required to have additional flight recorder parameters indicating pitch attitude, roll attitude, side-slip angle or lateral acceleration, pitch-trim position, control column or pitch control surface position, control wheel or lateral control surface position, rudder pedal or yaw control surface position, thrust of each engine, position of each thrust reverser, trailing edge flap, or cockpit flap or cockpit flap control position.

The CVR provisions for Part 121 operators require a CVR for each large turbine-powered or large pressurized airplane with four reciprocating engines.

Part 135 does not require operators to have flight recorders but does require turbojet airplanes configured to carry ten passengers or more to have a cockpit voice recorder installed.

Since these provisions were adopted, there has been a dramatic change in the air carrier industry. Deregulation has contributed to that change by allowing existing Part 121 carriers to pull out of short-to-medium-range markets, thereby creating a demand being filled by a rapidly expanding commuter airline industry. To meet the equipment needs of the expanding commuter airline industry, manufacturers have developed new fuel-efficient airplanes, including derivatives of airplanes type certificated through September 30, 1969. These airplanes have an expected lifespan well into the next century.

The past rule allowed these derivative airlanes to operate with flight recorder technology that dates back to the 1950's. In the past, cockpit voice recorders and flight recorders were not required of the commuter airline industry based on the premise that the level of passenger service was not sufficient to justify installing these recorders. Increased operation of the short-to-medium-range airplanes by the commuter airline industry, however, has placed them actuarially in a more severe operational environment than airplanes type certificated through September 30, 1969, creating the need for additional data collection.

Discussion

This amendment revises § 91.35 and adds a new § 125.202 that specifies that the Administrator will not use the cockpit voice recorder record in any civil penalty or certificate action. The purpose is to encourage operators to voluntarily install cockpit voice recorders in airplanes that are used in those operations where they are not required. The installed equipment must be approved and must continue to meet the airworthiness requirements under which the airplane is type certificated and operated.

This amendment substantively revises §§ 121.343 and 135.151. For operations conducted under Part 121, this rule requires retrofitting all airplanes type certificated through September 30, 1969 (currently using a six-parameter foil-type flight recorder), with a six-parameters digital flight recorder within 2 years from the effective date of the amendment. In addition, these flight recorders must be upgraded to 11-parameter digital flight recorders within 7 years after the effective date of this amendment. The 11 parameters consist of those currently required plus the following: (1) Pitch attitude; (2) roll attitude; (3) longitudinal acceleration; (4) control column or pitch control surface position; and (5) thrust of each engine. They are required to perform within the ranges, accuracies, and recording intervals specified in Appendix B of Part 121.

All newly manufactured airplanes having an original type certificate issued through September 30, 1969, are required to have 17-parameter digital flight recorders installed after 2 years from the effective date of this amendment.

The requirements for airplanes type certificated after September 30, 1969, do not change except for the substitution of

longitudinal acceleration for lateral acceleration.

For those operations conducted under Part 135, the amendment requires the installation of a CVR for all multiengine, turbine-powered airplanes certificated to carry six or more passengers and requiring two pilots by certification or operating rules, that are newly manufactured 2 years from the effective date of this amendment.

"Manufactured" means when the airplane inspection acceptance records reflect that the airplane is complete and meets the FAA-approved type design data. An airplane manufactured and then placed into storage prior to sale is considered manufactured on the date it is completed prior to being placed in storage.

Discussion of Comments

In response to NPRM No. 85–1, the FAA received comments from 29 interested persons. The majority of the comments received express opposition to the proposals based upon the costs involved in complying with the proposed requirements. More specifically, most of the opposition is directed to the digital flight data recorder proposals.

The proposals in NPRM No. 85–1 address three issues: (1) Recorder information to be used only for accident investigation purposes; (2) digital flight data recorders in specific airplanes operated under Part 121 of the FAR; and (3) cockpit voice recorders in specific newly manufactured airplanes operated under Part 135 of the FAR. For discusssion and analysis purposes, each issue will be addressed separately.

In its comments on NPRM No. 85–1, the National Transportation Safety Board (NTSB) states that the FAA has not entirely satisfied the intent of all its safety recommendations made to the FAA concerning enhancement of flight recorder standards required to provide adequate data for accident and incident investigation purposes and identifies six specific shortcomings. All the issues raised by the NTSB in its comments to NPRM No. 85–1 had been forwarded previously to the FAA as NTSB safety recommendations. These issues were considered in the development of the NPRM and have been addressed by FAA formal responses to the recommendations, the NPRM, or the preamble to this rule.

Since 1967, the NTSB has issued a total of 53 recommendations regarding CVR's and flight recorders. Of this total, 38 recommendations were forwarded to the FAA. The remaining 15 recommendations were issued to industry groups such as U.S. air carriers, the Air Line Pilots Association, the Allied Pilots Association, airplane and rotorcraft manufacturers, etc. Of the 15 industry recommendations, 5 remain open (A–82–101 through –105).

Of the 38 NTSB recommendations issued to the FAA, 26 recommendations are "CLOSED" through FAA/NTSB staff coordination and 12 recommendations remain in an "OPEN" status. The FAA is continuing to address these remaining 12 "OPEN" recommendations. The following is a summary of the "OPEN" recommendations that are mentioned in the NTSB's comments to the docket.

Recommendations A–82–067 and –108 recommend requirements for improved CVR's and flight recorders for rotorcraft and are being dealt with under a separate rulemaking action.

Recommendation A–82–106 recommends the development of a technical standard order (TSO) for CVR's and flight recorders. Proposed TSO–C111, which contains standards for CVR and flight recorders and combined CVR's/flight recorders, was published in the Federal Register on April 12, 1985. The final version of the TSO is presently undergoing internal FAA coordination prior to issuance.

Recommendations A–82–064 through –066 recommend that flight recorders currently required on fixed-wing aircraft operated under Part 121 be improved and that such aircraft manufactured after a certain date be equipped for flight recorders with additional parameters.

Recommendations A–82–107 and –109 through –111 recommend that turbojet fixed-wing aircraft certificated for six or more passengers not now required to have CVR's or flight recorders be required to have CVR's and flight recorders with additional parameters.

In its comments to the docket regarding Recommendations A–82–064 through –066, the NTSB requested that the FAA reconsider its action on Recommendation A–82–066 and require 32 parameters for flight recorders on newly manufactured fixed-wing aircraft operated under Part 121. The FAA has determined that an increase in the required parameters to 17 represents an appropriate balance of costs and benefits.

In its comments to the docket on Recommendations A–82–107 and –109 through –111, the NTSB acknowledged that the FAA has satisfied its recommendation with respect to CVR requirements for aircraft operating under Part 135. The NTSB urged the FAA to require flight recorders for all multiengine turbine-powered aircraft operated under Part 135. The FAA agrees with the NTSB that requiring flight recorders on multiengine turbine-powered aircraft operated under Part 135 would provide helpful accident investigation information. However, the FAA continues to believe that the benefits of such regulation would not be commensurate with the associated costs.

In its comments to the docket, the NTSB states that the rule does not provide flexibility to accommodate advancing technology. The FAA agrees that changes in aeronautical technology may at some future date require changes to this rule. However, to issue a rule that includes the degree of flexibility necessary to accommodate future technology that is not presently defined is impracticable. When new design features are identified, the FAA can and will evaluate them during development of the type certification basis and take whatever actions are necessary to maintain the required safety level. If additional parameters or interfaces between electronic systems call for special requirements, they will be issued as appropriate. Consistent with rulemaking policy and as experience is gained with such future novel technologies, consideration will be given to revising the appropriate rules. In the new, fly-by-wire aircraft control system design, the one-to-one correlation from crew input to the resulting control system response does not exist. That, and other new design features, may require the FAA to propose and adopt additional parameters to be recorded, over those currently required by the operating rules.

The NTSB continues to urge that the FAA initiate further rulemaking to require flight recorders in multiengine, turbine-powered, fixed-wing airplanes operated under Part 91 or 125. A careful review of the benefits required to offset the cost of requiring flight recorders in the class of airplanes recommended by the NTSB operating under Part 91 or 125 shows that the anticipated benefits will not support such a requirement. The rule does encourage the installation of such equipment by stating that flight recorder records will not be used by the Administrator in any civil penalty or certificate action.

In its comments to the docket, the NTSB stated that it was disturbed that the FAA has not taken the initiative to propose rulemaking consistent with the standards recently adopted by the International Civil Aviation Organization (ICAO). This amendment is consistent with the recent Amendment 17 to ICAO Annex 6, Part I. The NTSB, in its comments, intermingles ICAO "requirements" and ICAO "recommendations." Requirements are

binding on the ICAO member states, while recommendations are not. This amendment is in full agreement with the ICAO requirements in § 6.3 of Annex 6 and in many respects is in agreement with the ICAO recommendations in that section. Attachment D to ICAO Annex 6, Part I, contains detailed flight recorder guidance to member states. In that attachment, ICAO recommends the 32-parameter flight recorders for certain types of airplanes. The FAA agrees with both ICAO and the NTSB that more data is always preferable and also agrees with the ICAO position that the increased data parameters be recommendations and not required parameters. The FAA believes that the parameters specified in this amendment are sufficient to identify accident probable cause and that the additional parameters (up to 32) have not been shown to be cost beneficial.

Recorder Information for Accident Investigation

One commenter supports the proposed amendments to §§ 91.35 and 125.202. A second commenter opposes the amendments, contending that the FAA should use the data as necessary to improve piloting skills. The FAA does not agree that the Administrator should use the cockpit voice recorder record in any civil penalty or certificate action. As stated in the notice, the purpose is to encourage operators to voluntarily install cockpit voice recorders in airplanes where they are not required. The information from the record is to determine the cause of the accident and not to place blame. Improvement of piloting skills can be obtained by current requirements, such as the biennial flight checks.

Digital Flight Data Recorder

The FAA received seven comments supporting the notice as it relates to the digital flight data recorder proposals.

One commenter contends that any airline retrofit requirement can be satisfied by equipment currently in production and agrees with the FAA's estimates of equipment costs. This commenter asserts that his estimate of maintenance cost savings to airlines which replace foil recorders with digital flight recorders reflects a savings of $600,000 annually based on a 100-airplane fleet.

Another commenter agrees with the requirement to replace metal foil-type recorders with digital types because accident investigation would be simplified and accomplished with greater accuracy but expresses concern that the 2-year period for replacement of existing metal foil-type recorders with digital types may not be realistic. The commenter asserts that the assumption was made that the new digital recorders would be directly interchangeable with existing foil-type recorders in all installations. Although many metal foil-type recorders in service are packaged in rectangular (standard ½ Air Transport Rated (ATR) long) containers, almost 1,400 Lockheed Model 109C metal foil-type recorders packaged in a spherical container have been delivered to customers, and many are still in service today. This commenter also recommends that the two-phase (2-year/7-year) plan be replaced with a single-phase program for incorporation of the 11 parameter recorder and that the time limit for completion be compatible with existing airline maintenance cycles. The FAA recognizes that the Lockheed Model 109C recorder is configured differently from the standard ½ ATR long container but still believes that the 2-year phase-in period, with proper planning, is sufficient to reconfigure the mounting rack for installation of the new recorder.

Two commenters, while supporting the proposed rule, believe that the requirements should be further expanded to maximize the information available from accident investigations and contend there is sufficient justification to require all airplanes operated under Part 121 and type certificated through September 30, 1969, to be upgraded to the 17-parameter digital recorder within 2 years from the effective date of the amendment. The FAA agrees that 17 parameters would derive more information from the accident. However, the 11 parameters required for the aircraft type-certificated through September 30, 1969, via the 2-step program will enhance the accident data available to investigators with minimum cost and out-of-service time for the airplane. The FAA does not believe that the additional 6 parameters will provide the safety benefit necessary to offset the additional cost. Both commenters are of the opinion that all airplanes involved in Part 135 operations should be required to carry the digital flight recorders within 2 years from the adoption of the amendment. One of the commenters also questions the use of a single parameter for measuring engine thrust and believes a more accurate method is to measure the N_1 speed and fuel flow for each engine. The FAA considers these issues to be outside the scope of this current rulemaking action.

One other commenter considers the 17-parameter digital recorder as being too limited and not consistent with recently adopted International Civil Aviation Organization (ICAO) requirements (32 parameters) applicable to airplanes over 60,000 pounds. The FAA evaluated these issues in the Trans Systems study while preparing the notice and concluded that based on the information available at that time, the proposals were the most cost beneficial in terms of accident prevention through accident investigations. It should also be pointed out that the final ICAO document addresses only new certificates of airworthiness issued after 1989. The comment is outside the scope of the notice, and there is insufficient justification by the commenter to issue a supplemental notice that addresses the recent ICAO standards. The FAA concludes that the existing air carrier fleet of 2,000 plus transport category airplanes do need the new digital type 11-parameter recorder, and this regulatory action should proceed.

Another commenter agrees with the proposals and believes they are necessary to ensure that adequate data is available for accident investigations. The commenter contends that in the affected airplanes, there will be adequate room, and little weight penalty for the digital flight recorder to be installed and serviced without difficulty. The FAA agrees with these comments.

One commenter states that the requirement for converting to a 6-parameter digital recorder should be deleted as it is unlikely to enhance accident investigation to any extent and recommends requiring the 11-parameter recorder in 7 years. The FAA does not agree because adequate time has been allotted for foil-type recorders to be replaced and then expanded to the 11-parameter recorder without undue hardship in the airline industry. Research of the National Transportation Safety Board (NTSB) records indicates that 48 percent of the recorders recovered from accidents or incidents were not functioning. The foil-type recorder would likely increase in failure rate over the 7-year period, resulting in increased inspections, decreased time between overhaul, and possible increase in FAR maintenance violations, as well as not having the data available in the event of an accident or incident. There is a definite need to replace the foil recorders as soon as possible.

In addition to the above, the FAA received 18 responses to the notice expressing opposition to the digital flight recorder proposals on the basis of the economic impact of complying with the proposed requirements. Five commenters provided estimated cost figures for retrofitting their CV-580 turbopropeller airplanes to comply with

the proposed requirements. These estimates ranged from $14,000 to $50,000 per airplane modification. Estimated cost figures that were provided for other models of airplanes came within the above low and high estimates per airplane modification. In addition, one commenter notes that the FAA estimated costs in the notice did not consider the loss of value on currently owned flight recorders, and this commenter estimates this value at $6,000 per recorder. With the loss of $6,000 per recorder added to his estimate, this brings the total estimated cost to approximately $9,500 below the average of the low and high estimates above. Another commenter states that he has observed a price increase per flight recorder of approximately $5,000 to $6,000 since the issuance of NPRM No. 85–1. To properly respond to these comments, the FAA has prepared a detailed cost estimate using the latest available information in its Regulatory Evaluation, and the FAA considers these costs the most realistic in determining the cost of compliance with the final rule.

The NTSB suggests the addition of longitudinal acceleration as a parameter. The NTSB contends that longitudinal acceleration is vital for determining the effect of wind shear, braking, and airplane performance and is a much more significant parameter than some others presently recorded. The NTSB is responsible for determining the probable cause of and contributing factors to an accident and is the prime user of the flight recorder data. The FAA agrees with the NTSB that the longitudinal accelerometer is necessary in identifying the contributing factors to an accident or incident, and has changed the requirements for the 11-parameter recorder by substituting longitudinal acceleration for pitch trim for the post-September 30, 1969, certificated airplanes. In addition, the FAA has substituted longitudinal acceleration in place of lateral acceleration for newly manufactured airplanes. The FAA has reviewed type design data for airplanes affected and finds that other than the reconnection of wiring at the tri-axis accelerometers in the post-September 30, 1969 airplane, and the substitution of a longitudinal accelerometer for pitch trim synchro or a potentiometer in the 11-paramater airplane type certificated through September 30, 1969, these changes are not significant.

Another commenter opposes the digital flight recorder proposal but does not operate any airplanes that require modification to comply with the proposal. This commenter did not provide any information or data to support this opposition. The FAA does not agree with this commenter.

One commenter contends the foil-type flight recorders are satisfactory for the older turbopropeller-driven airplanes because their design and operating environment is sufficiently different from that of turbojet-powered airplanes. The FAA does not agree that the foil-type recorder is adequate in the current accident investigation environment because of the inaccuracies that can occur between the routine maintenance times and the operations check before flight. A recent review of NTSB accident files has found the inservice failure rate of the foil recorders to be unacceptable.

Several commenters state that many of the older affected airplanes will likely be retired shortly after the anticipated effective date in early 1987. The FAA does not agree that the older airplanes should be exempted because of a supposed early retirement from service. Certain operators may retire their affected airplanes from their fleets, but these airplanes most likely will be in service with other operators, and the requirements will continue to be applicable. Because the airplanes comply with the new rules, the operator has a more marketable and valuable airplane at the time the airplane is placed on the market. The FAA does agree that an airplane in service for a considerable length of time may be considered to have a low probability of operational and mechanical "surprises." However, unanticipated events such as fatigue may still occur and human factor information is relevant in accident investigations involving old and new airplanes alike. A digital flight recorder as an investigative tool will provide insight into these issues.

One commenter, an all-cargo carrier operating under Part 121 with nine CV–580 airplanes, states that the additional cost to comply with the proposed requirements would create a serious financial hardship on the company. This commenter contends that: The recent accident data for CV–50 airplanes does not justify any need to change the type of flight recorder in use; the CV–580 airplane design and operating environment has not changed in the past 25 years; and, the additional parameters and significant additional cost have not been justified on a cost versus flight safety benefit basis. Furthermore, this commenter contends that the cost to retrofit the digital flight recorder in his CV–580 airplanes could easily run as high as $450,000. The FAA recognizes that this commenter's contention of $50,000 per airplane for complying with the proposed requirement would be significant. However, no information or data was provided to show how this figure was derived. Most prudent operators will not incur these extremely high costs to comply with this final rule. The basis for this conclusion is explained in the section of the regulatory evaluation discussing FAA's response to these comments. A pilot-induced accident can occur any time with any airplane, and the accident history of a specific airplane type should not be a basis for exclusion from this regulation. Every accident must be evaluated to determine the probable cause and related events, and these types of airplanes are operated in sufficient numbers in passenger service to require the same accident investigation tools as other Part 121 airplanes.

One commenter recommends that airplanes type certificated prior to January 1, 1958, be exempt from the proposed requirements. The FAA does not agree with this recommendation, because every accident must be adequately investigated to determined the probable cause and identify actions to prevent accidents of that nature.

One commenter contends that the estimated nonrecurring cost for the proposed 2-phase retrofit of digital flight recorders on its association's member fleet is $49.5 million for 2,000 airplanes, not counting cash loss due to out-of-service time, and contends that the FAA's cost estimates are inconsistent. Furthermore, this commenter asserts that the FAA's stated basis for the proposed rule is based upon erroneous information and speculative estimates of future "unknown hazards" that would be identified by the expanded parameter digital recorders; that the FAA did not present any data that conclusively shows that the probable cause of any U.S. air carrier accident could not be determined because of the use of 6-parameter foil-type recorders; and that properly maintained 6-parameter flight recorders have not served the industry and Government well in developing accident prevention measures. This commenter recommends the notice be withdrawn because of the lack of adquate justification presented by the FAA. In addition, this commenter recommends that if the FAA decides to require the improve flight recorders regardless of the airline safety record, a single-step program that provides at least 7 years for accomplishment would minimize the impact on the airlines. Furthermore, the FAA should reevaluate its cost versus benefit estimates using

economic data presented in this response and by other commenters. The FAA has reevaluated the cost data, and the Regulatory Evaluation reflects these changes. With respect to the basis for this rule change, experience has shown that unexpected accident scenarios and unusual combinations of circumstances will occur.

Another commenter, while not opposing the proposal, recommends deleting the 6-parameter step in the program and recommends going directly to the 11-parameter digital flight recorder requirements, because the 2-year implementation period for retrofit is considered unrealistic. This would permit installations to coincide with maintenance schedules. This commenter also states that the notice assumed that foil-type recorders are apparently interchangeable with digital types in all cases and states that the digital flight recorders and the spherical configured foil-type are not, in fact, directly interchangeable as assumed. As previously stated, the FAA does not agree that the implementation program should be lengthened or that the 2-year implementation program is unrealistic. This commenter presented no information to support this assertion. The FAA has reevaluated the time frames for implementation against the availability of modification kits and/or digital recorders necessary for complying with these requirements and continues to find them achievable and realistic. Further, a slight additional cost for replacing the spherical foil recorder with the rectangular digital recorder is reflected in the revised Regulatory Evaluation.

One commenter recommends that § 121.343(c)(6) and (d)(6) be changed to indicate that radio communication either to or from Air Traffic Control (ATC) is acceptable. The FAA the intent was to record the airplane transmitter keying which would be *to* ATC. The rule has been changed accordingly. This commenter also recommends that the word "large" be added before the words "turbine engine powered" in § 121.343(b) to clarify that the requirement applies only to large airplanes. The FAA does not agree this change is necessary, because all airplanes operated under Part 121 must be type certificated in the transport category and the FAA is not aware of any small airplanes, weighing less than 12,500 pounds maximum certificated takeoff weight, being operated under Part 121. If small airplanes do in the future operate under Part 121, the FAA sees no reason to treat them differently from large airplanes.

Another commenter suggests replacement of the foil-type recorders with digital types on an attrition basis and contends that the price increase of 100 percent in the last 3 years for the foil medium will achieve this objective. The FAA does not agree, because there is no assurance of attrition as suggested, and no assurance that digital flight recorders will be installed within a reasonable period of time. Furthermore, the FAA has no way of controlling flight recorder prices.

These amendments are based on a number of NTSB recommendations and a study conducted by Trans Systems Corporation, completed in May 1983 for the FAA Office of Aviation Safety, entitled "Cockpit Voice and Flight Data Recorder Evaluation." The study evaluated a number of CVR/flight recorder equipment requirements and options, one of which was the adoption of all NTSB recommendations. The Trans Systems study is available in the Public Docket for review. Copies of the FAA replies to NTSB safety recommendations concerning CVR's/flight recorders are available from the FAA Office of Aviation Safety.

Cockpit Voice Recorder

The FAA received 16 comments in response to the cockpit voice recorder proposal, with 9 commenters opposing the proposal and 7 commenters expressing support.

Three commenters contend that the requirements should apply only to those turbined-powered airplanes with a seating configuration of ten or more, excluding pilot seats. One commenter states that no rationale is given to reduce the number to six and that, historically, the dividing line has been ten passenger seats. The FAA does not agree with the increase to ten because of the large number of small airplanes that operate with between six and nine passengers and that are required by Part 135 to have two pilots for conducting Instrument Flight Rules operations with those airplanes.

The NTSB's recommendation, which was used as the basis of the Trans Systems Corporation study, was about the number of accidents involving six-passenger turbine-powered, multiengine airplanes in air taxi and corporate/executive operations in which the accidents circumstances remain unknown.

One commenter asserts that the increased fuel consumption to carry these recorders should be considered in the economic evaluation. The FAA agrees that the increased fuel cost should be added in the analysis, and the economic evaluation addresses the increase.

Another commenter contends that the purpose of cockpit voice recorders is to fix the blame for an accident or incident. The FAA does not agree because the purpose of the recorder is to determine the probable cause of the accident, and this should not be construed to mean "fix the blame." The same commenter asserts that some 80 percent of all accidents are caused by pilot error but provides no basis for this assertion. The FAA does not agree with the 80 percent figure recognizes that a significant number of accidents can be attributed to pilot error. Finding a pilot's action or inaction as a causal factor in an accident or incident is not intended to be the same as "fixing the blame."

One commenter contends that most of the airplanes to which this rule would apply operate in a very limited environment or portion of the airspace and that there is insufficient time to record much voice communication when a problem arises. The commenter further contends that the cause of most accidents in this area is probably pilot error during takeoff and landing and doubts that the addition of CVR's would shed any new light on the cause or circumstances surrounding any accident. The FAA does not agree that there is insufficient time to record meaningful voice communications. It is not the quantity but rather the quality of such data that may determine the cause in the relationship between the pilots, the airplane, and the operating environment at the time of an accident. Also, it is not just the voice communications that are useful in determining a cause but all recorded noise, i.e. switch actuation, engine revolution, aural warnings, etc.

One commenter asserts that the cockpit voice recorder would not add to the level of safety of a flight, and its only benefit, that of aiding accident investigation, is abstract and unproven. The FAA agrees that the CVR does not add to the level of safety of a specific flight but does not agree that the usefulness is abstract and unproven. There are years of experience with cockpit voice recorders in Part 121 aircraft that attest to the benefits to be derived from the recorders.

Another commenter contends the proposed rule is discriminatory since many small multiengine airplanes that not turbine powered are certificated to carry more than six passengers. The FAA does not agree that the rule is discriminatory.

One commenter asserts that an operator should be given the option of

installing a flight recorder instead of the cockpit voice recorder because more information may be obtained from the former. As a regulatory proposal, this comment is outside the scope of the notice.

Three commenters contend that the CVR has proven to be an invaluable tool in accident/incident investigations and that it would be prudent to require a CVR for any multiengine, turbine-powered airplane operating under Part 135 with two pilots and carrying six or more passengers regardless of the date of manufacture of the airplane. The FAA evaluated this issue in the Trans Systems study while preparing this notice but concluded that the estimated costs would exceed the potential benefits if all multiengine airplanes are included.

Regulatory Evaluation

The FAA has completed a detailed regulatory evaluation of the final rule which is available in the regulatory docket. It is similar in form to the regulatory evaluation of NPRM No. 85-1, but many revisions have been made in response to comments that addressed the notice. The evaluation also incorporates more current cost and fleet forecast information.

The major findings of the evaluation of the final rule are summarized below. However, FAA's response to those comments that addressed the regulatory evaluation of the notice is presented in its entirety.

I. Discussion of Comments Addressing the Regulatory Evaluation of the NPRM

Numerous comments were received to NPRM No. 85-1, that addressed the regulatory evaluation of the proposed rule. These comments have been considered by the FAA and are discussed in this section. The regulatory evaluation of the final rule follows this discussion of comments. The FAA has revised its evaluation in many respects to reflect issues raised by the commenters.

A. Comments on Costs

A.1. Part 121 Proposals

Numerous comments criticize FAA's estimates of the cost to retrofit existing pre-1969 type-certificated airplanes operated under Part 121 with digital flight recorders and to upgrade these airplanes to record 11 parameters of information. In its regulatory evaluation of the notice, FAA considered the costs of various digital flight recorder and flight data acquisition unit equipment combinations that would meet the proposed requirements and estimated that the maximum cost for any of the various options, including labor and signal sources, would be approximately $22,000 per airplane. Comments have been received arguing the FAA's costs were significantly underestimated and that compliance costs could exceed $50,000 per airplane, more than twice FAA's highest estimate. Further, commenters also state that additional costs would result because airplanes would need to be removed from service to accomplish the retrofit; that the two-phase approach (initial digital recorder retrofit within 2 years followed by the upgrade to 11 parameters within 7 years) would result in higher compliance costs than a one-phase approach because airplanes would need to be taken out of service twice; that design certification costs had been omitted; and that many spherical foil recorders were still in service that would create special installation problems when replaced with digital recorders in standard one-half ATR boxes.

The FAA was unable to find evidence that the very high compliance cost estimates of approximately $50,000 would be incurred by cost-conscious operators. These high costs could be realized if the equipment were purchased through third parties and if the installation work was not scheduled to coincide with regular maintenance intervals. However, because most prudent operators would negotiate with recorder equipment manufacturers to obtain the best fleet purchase price, reflecting quantity discounts, and because cost-conscious operators can be expected to use scheduled maintenance cycles as efficiently as possible, FAA expects that actual compliance costs will in most cases be similar to those estimated by the FAA. The FAA has raised its equipment cost estimates by 10 percent to reflect inflation in the prices of recorders since the notice was prepared 2 years ago.

To allow for the additional cost which may be incurred by some operators who find it necessary to rely on a modification shop to perform the retrofit as a complete package, including the provision of all necessary equipment, the FAA has added 40 percent to its estimated cost values for recorders, flight data acquisition units (FDAU's), and signal sources. This modification shop markup factor has been applied to 15 percent of the airplanes affected by the retrofit provisions of this final rule.

The FAA also found that air carriers, when performing contract maintenance work for other carriers, and modification shops charge labor rates of approximately $35 to $40 per hour. Further, the contractor's overhead expenses are already included in the labor rates charged to customers. The FAA has used a $40 labor rate in its evaluation of the final rule, slightly higher than the $35 value used for the notice.

Other factors may affect the compliance costs of the rule, not all of which may necessarily have been identified by the FAA or the commenters. Installation labor may in some instances exceed FAA estimates; or, as one commenter argued, recorder manufacturers may increase their prices following implementation of the rule (which the FAA does not expect to be much of a problem because of competition among manufacturers). However, to allow for these contingencies, the FAA has performed a sensitivity analysis on its cost estimates. This enables comparisons to be made of the potential effects variations in the cost estimates may have on the overall desirability of the new Part 121 recorder standards.

The FAA maintains its expectation that both the digital retrofit and parameter upgrade work can be completed without requiring airplanes to be removed from service specifically for this purpose. Although it will require careful planning on the part of operators, both the digital recorder retrofit and parameter upgrade work can be completed in steps and integrated into regularly scheduled maintenance intervals over the 2-year digital conversion compliance period and the 7-year parameter upgrade compliance period. Similarly, installation labor costs can be partially reduced by anticipating maintenance procedures involving aircraft disassembly that would also provide an opportunity to install the additional information parameter signal sources and wiring.

Engineering design and certification costs are expected to be relatively minor for each airplane type/recorder equipment combination that operators elect to install. These costs usually have already been incurred by recorder equipment manufacturers and are reflected in the prices they charge their customers. Further, many of the airplane types affected by the amendments are operated by foreign carriers with similar or more stringent recorder requirements; therefore, the engineering work has, to a large extent, previously been completed. Finally, when prorated over the total number of airplanes converted using a particular equipment combination, the per-airplane cost attributable to design and certification is expected to be an extremely small portion of the overall equipment and installation costs.

Nevertheless, a cost sensitivity analysis has been added to the regulatory evaluation, and this should adequately provide for the occasional situation where design and certification costs present a special problem.

The FAA agrees that for those aircraft equipped with the Lockheed spherical foil recorder, a new mounting rack will be required which will add about $500 to the installation costs. However, because of a previous rule change, any spherical recorders that had originally been installed in the wheel wells should have already been relocated to the rear of the airplane. Therefore, no additional installation costs should result from the need to relocate the recorder.

Commenters also question the FAA's estimate of the annual recorder maintenance savings that could be realized as a result of replacing foil recorders with digitial recorders. One commenter states that converting to digital equipment would result in carriers experiencing a range of from $2,400 additional annual maintenance expense per airplane to $1,800 annual maintenance savings per airplane. This compares to the $2,500 annual maintenance savings estimate used by the FAA in the notice, which the FAA considered a conservative reduction of flight recorder manufacturer savings estimates that ranged from $3,000 to $5,00 annually per airplane.

The FAA maintains its expectation that because of the higher reliability of digital recorders in comparison to aging foil recorders, and the continuously increasing cost of the foil medium, digital recorders should result in net maintenance savings for operators. However, because of the concerns raised by commenters, the FAA has reduced its estimate of annual maintenance savings from $2,500 per airplane to only $1,500 per airplane in its analysis of the final rule. Further, the FAA also maintains its original expectation that the additional signal sources will require maintenance only infrequently and that any maintenance costs which may result from the signal sources will be negligible in comparison to savings resulting from the conversion to much more reliable digital equipment.

Similarly, the FAA expects that the relatively higher mean time between failures of digital equipment in comparison to foil recorders should actually reduce the potential for flight delays because of minimum equipment list requirements, rather than increase this possibility, as some commenters state.

Another commenter states that the short remaining life of older airplanes would reduce the maintenance savings attributable to digital recorders well below FAA estimates. However, in its regulatory evaluation of the notice, the FAA allowed for forecast fleet attrition in estimating the total maintenance savings that would result from the rule. Further, the FAA did not take credit for maintenance savings realized by digitally equipped airplanes that had voluntarily converted or were expected to voluntarily convert in the absence of the rule. Finally, in later years of the 15-year analysis period, the FAA reduced the percentage of active airplanes forecast in those years that would realize maintenance savings as a result of the new rule. This was because newly manufactured airplanes just entering service are currently delivered with digital recorders and because airplanes that operators have voluntarily converted generally would be the airplanes with the longest remaining service life.

One commenter expresses concern that airplanes exempt from the noise standards of Part 36 until January 1, 1988, would be retired shortly after the effective date of the flight recorder final rule. As stated in the notice, the FAA expects that the availability of hush kits will enable many of these airplanes to remain active after their noise exemption expires. Similarly, Boeing 707 and McDonnell Douglas DC–8 airplanes, other than DC–8–70's retrofitted with noise compliant engines, were excluded from the fleet expected to be affected by the proposed rule because of other Part 36 noise standards that became effective in 1985. However, since the notice was written, hush kits have become available for both DC–8's and Boeing 707's, and a limited number of these airplanes are now expected to remain in service. Therefore, based upon preliminary information prepared by the FAA's Office of Environment and Energy, these types of airplanes have been added to the forecast of the pre-1969 type certificated airplane fleet expected to be affected by the rule.

Other comments state that any additional weight attributable to the digital retrofit and parameter upgrade would result in slightly higher fuel consumption. The FAA agrees and has added a weight penalty cost factor to its analysis.

Comments were received stating that in its cost estimates the FAA did not allow for the lost residual value of foil recorders when the new rule makes them instantaneously obsolete. The FAA recognizes that this is a valid consideration; however, this factor has already been reflected in the analysis. It is the remaining utility or useful life of the foil recorders that will be lost as a result of this rule change, or in other words, the foregone *benefits* that would have been derived from their continued use. (The equipment costs of the old foil recorders are sunken costs that will not affect, or be affected by, any decisions made concerning the new requirements. Therefore, these costs are not relevant for the present analysis and have been excluded.) However, the regulatory evaluations of both the notice and the final rule have assessed the *improvements* in accident investigations and consequently safety which will result from the new requirements, i.e., the *additional* or *incremental* benefits which will be realized over and above the current rule. Therefore, to offset the incremental benefits by the lost benefit of the old recorders (i.e., the lost residual value) would represent double-counting. Further, because the incremental cost of the new requirements is on average only about one or two cents per enplanement over the analysis period (based on *FAA Aviation Forecasts Fiscal Years 1986–1997*), operators should not find it difficult to recover their additional costs in the fares collected from passengers who are the ultimate beneficiaries of the safety improvements.

The NTSB expresses concern in its comments that the longitudinal acceleration parameter had not been included among the additional information parameters proposed in the NPRM. The FAA has reconsidered this question and decided that longitudinal acceleration should be included. Although this change from the original proposal may at first glance appear potentially expensive because it will affect airplanes type certificated after September 30, 1969, as well as those type certificated before that date, it will have a relatively minor cost impact. First, the FAA has determined that virtually all post-1969 type certificated airplanes are equipped with tri-axis accelerometers, capable of sensing longitudinal, vertical, and laferal acceleration; and in most cases the longitudinal axis sensor is wired to the recorder. Second, for airplanes type certificated before 1969, the FAA will allow operators to substitute longitudinal acceleration for the pitch trim parameter originally proposed for existing airplanes that will be required to upgrade to 11 parameters and to substitute longitudinal for lateral acceleration on newly manufactured airplanes subject to the new 17-parameter requirement. A slight additional signal source expense will be incurred over that estimated in the notice for airplanes upgrading from 6 to

11 parameters, and the regulatory evaluation of the final rule has been revised accordingly.

One commenter states that the 1983 Trans Systems Corporation report entitled "Cockpit Voice and Flight Data Recorder Evaluation" indicated that expanding the retrofit requirement for pre-1969 airplanes from the 6-parameter digital conversion to the 11-parameter upgrade requirement would more than double the total compliance costs of the rule change. The Trans Systems Corporation study did state this. However, the Trans Systems Corporation study presented an overview of numerous cockpit voice recorder and flight recorder options for airplanes operating under various operating regulations of the FAR. The FAA's regulatory evaluations of NPRM No. 85–1 and of the final rule are much more focused and have analyzed the specific option that has been proposed and adopted in much greater detail than was possible in the Trans System Corporation study. The FAA's cost estimates of the final rule indicate that the 11-parameter upgrade requirement will increase total compliance costs by only about one-third over the total costs of a rule that would require just the 6-parameter digital retrofit for existing pre-1969 airplanes.

One commenter expresses concern that the new flight recorder requirements would create problems for the international exchange of aircraft for either sale or lease. The FAA does not agree. Many foreign countries currently have flight recorder requirements that exceed those of the United States. The new requirements being adopted by this final rule will reduce the differences between the airplanes of U.S. operators and those of many foreign operators. This may in fact facilitate, rather than hamper, the internatonal exchange of aircraft.

Other comments state that the development of new recorder technology and the expense of maintaining old foil recorders would result in the gradual attrition of foil recorders. Therefore, they concluded, this rulemaking action was unnecessary. The FAA disagrees. Voluntary replacement of foil recorders with digital equipment has already occurred in about one-third of the pre-1969 fleet affected by this rulemaking, and in its analysis of the notice the FAA estimated that, in the absence of a new rule, this trend would have continued until about one-half of the pre-1969 fleet had been voluntarily converted at the time the new rule would mandate the conversion. Although attrition could have been expected to continue beyond this deadline in the absence of the rule change (and this has been considered in estimating the compliance costs of the final rule), it alone would not have resulted in a timely replacement of the remaining foil recorders still active in the fleet. Further, attrition would not have resulted in the voluntary upgrade of the safety information parameters that will be required by this final rule.

One commenter states that because this operation intends to purchase new airplances in the near future, there would not be enough time to fully depreciate the investment in the new flight recorders that would be required by this rule. Although this is true, the resale value of the operator's current fleet should be enhanced because the airplanes have already been equipped with the digital recorders that many potential customers will also require for their operations. The value of these assets should not be lost when the airplanes are placed on the market.

A.2. Part 135 Proposals

Some commenters disagrees with the FAA's estimates of the cost of equip newly manufactured airplanes operated under Part 135 with cockpit voice recorders. In NPRM No. 85–1, FAA estimated that the cost would be $7,275 per airplane based upon the least expensive unit available at the time. This estimate was the CVR cost to the airframe manufacturer but did not include any markup by the airframe manufacturer, only installation labor. One commenter obtained a quote from an airframe manufacturer of about $30,000 per airplane. This higher cost could be incurred only if a more expensive model CVR were to be installed in the airplane and if the airframe manufacturer significantly marked up the recorder price over its own acquisition cost. However, the FAA's cost estimates in the final rule are based on the expectation that CVR equipment will be furnished by the airplane customer to the airframe manufacturer for installation. This is the common practice in the industry for avionics equipment because it enables prudent operators to negotiate with equipment manufacturers to obtain the best fleet purchase price and quantity discount.

Another commenter states that the FAA did not consider the reduced complexity and associated costs of recorders meeting the Society of Automotive Engineers Aerospace Standard (AS) 8039, "Minimum Performance Standard—General Aviation Flight Recorder," issued in January 1985. Although this standard was not available in 1983, the original Trans System Corporation study used order of magnitude recorder cost estimates reflective of simpler recorder designs in its evaluation of various Part 135 recorder options. Further, the FAA has contacted various recorder manufacturers and determined that none currently plan to produce a separate CVR unit meeting the AS 8039 standard, although some are considering a combined cockpit voice/flight data recorder unit. Therefore, the FAA has again based its CVR equipment cost estimates for the Part 135 amendment on a relatively inexpensive CVR model that is currently available. The FAA has adjusted its cost estimates in the evaluation of the final rule to reflect 1986 equipment prices.

Another comment states that the additional weight of the cockpit voice recorder would result in a slight increase in fuel consumption for those airplanes that will be required to install them. The FAA agrees and has added a weight penalty cost factor to its analysis.

One commenter expresses concern that the additional weight of the CVR would sometimes result in payload restrictions. FAA does not expect that this will be a problem for the types of airplanes affected by the rule. The turbine-powered airplanes typically used by Part 135 operators have sufficient performance capability to accommodate the slight additional weight of the CVR without affecting most operations. In high-altitude, hot-temperature conditions where the airplane will be operating closer to its performance limits, the weight of the CVR is light enough that careful planning of fuel load should prevent impacting payload any further than it might already have been impacted by those conditions. Situations where the CVR weight would be critical to conducting an operating with the desired payload are expected to be extremely rare.

A related comment also argues that the added weight of the recorder would result in higher engine operating temperatures and consequently higher engine maintenance costs. The FAA does not agree. The additional weight of the CVR installation will only be about 30 pounds, and this represents only a very small fraction of a percent of the overall weight for those airplane types that will be effected by the rule. Any possible effect on engine operating temperatures, and consequently engine maintenance costs, will be so slight as to be unmeasurable.

B. Comments on Benefits Analysis

B.1 Part 121 Proposals

Some of the comments addressing the analysis of benefits focus on the particular examples of accident investigations that were cited in the evaluation and on the discussion of advances in understanding wind shear that the FAA attributed to expanded parameter recorders.

One commenter states that the FAA provided no evidence to support its contention that the expanded parameter flight recorder requirements "are necessary to ensure that all of the underlying casual factors of an accident are identified" and that the FAA only referenced two accidents in the notice in discussing the benefits of recorders. The benefits analysis in the complete regulatory evaluation, available in the docket, discussed six accidents or incidents supporting the value of expanded parameter recorders, although only three were referred to in the summary of the regulatory evaluation published in NPRM No. 85-1. The availability in the docket of the complete regulatory evaluation was stated in the notice.

Another commenter states that no benefits would be realized by replacing foil recorders with digital recorders during the first phase of implementation. Airplanes retrofitted with digital recorders would be allowed to operate for at least 5 years before being required to upgrade to 11 parameters. The FAA does not agree with this argument. The FAA reviewed NTSB data from 1983 to early 1986 and found that in about 49 percent of the accident or incident investigations in which foil recorder tracings were read, a recorder malfunction or maintenance deficiency resulted in the partial or complete loss of recorded information. Further, the two-phase approach is intended to allow operators to perform all retrofit work during regularly scheduled maintenance cycles.

One commenter questions specific details of one of the examples. In the notice, the FAA stated that following the May 1979 crash of a DC-10 at Chicago, the expanded 17-parameter digital flight recorder provided evidence that the loss of control was a direct result of the unwanted retraction of the airplane's left leading edge slats, not the separation of the No. 1 engine and pylon assembly itself. The commenter asserts that this statement is erroneous because the recorder did not record slat retraction since power to the recorder was lost when the engine and pylon separated. Identification of the unwanted slat retraction was not based on recorded information of the left inboard and outboard slat positions. These parameters were lost when the No. 1 engine and pylon separated, together with certain other parameters that received electrical power from the No. 1 a.c. generator bus. However, the flight recorder continued to record all remaining parameters for approximately one-half of a minute until the recording ended upon impact. It was the *correlation* of the remaining recorded aircraft and flightcrew information, together with simulator tests, knowledge of the DC-10's performance characteristics, and other investigation findings, that resulted in the conclusion that the left leading edge slats had retracted.

Other comments question the validity of the FAA's claim that recorders contributed significantly to a better understanding of wind shear. The comments state that almost all wind shear accidents involved airplanes equipped with 6-parameter foil recorders and that sufficient information was available to determine probable cause. The FAA does not disagree that the presence of wind shear could be determined from the limited parameter recorders and other sources of accident information. However, only a limited amount of information concerning airplane performance or flightcrew response in these situations could be obtained. Although very few wind shear accidents or incidents involving expanded parameter recorders have occurred, they have provided significant amounts of information about wind shear. Further, preliminary analysis of information recorded by the expanded parameter recorder installed aboard the Lockheed L-1011 that crashed in Dallas in August 1985 has provided strong evidence confirming theories about especially hazardous microburst characteristics that previously had only been simulated in laboratory tests.

Comments also state that, because the wind shear problem was well on the way to being solved, the FAA was relying on the detection of other "random unknown safety hazards." The commenter states that the FAA's estimate of a range of between zero and four accidents, distributed around a mean of 2, that might be prevented during the 15-year analysis period as a result of information learned from the expanded parameter recorders was speculation. FAA expects that the information learned from the expanded parameter recorder, especially in the area of human factors, could result in the prevention of a number of accidents in the future. However, because the relationship between accident investigations, increased understanding of potential hazards, improvements in equipment and crew training, and the actual prevention of future accidents is somewhat indirect and cannot be easily measured, the FAA will not attempt to assign a specific probability distribution to the potential number of future accidents that might be prevented, as it did in the evaluation of the notice. Rather, the FAA will show that if just one accident is prevented as a result of this rule, the compliance costs, in terms of costs per fatality avoided, fall well within the range of values generally considered acceptable by various regulatory agencies when implementing safety regulations. It is very reasonable to expect that at least one accident will be prevented as a result of information learned from the expanded parameter recorders required by this final rule.

One commenter states that the Trans Systems Corporation study concluded that because of the well-known and *proven characteristics of the pre-1969* airplanes, "the probability of not being able to determine a cause of an accident for these aircraft is considered to be low." The FAA agrees that the basic cause of an accident usually can be detected from limited parameter recorders and other sources of accident information. However, as stated previously, only a limited amount of information concerning airplane performance and flightcrew response during these accident situations can be obtained, and the opportunity to improve flightcrew reactions in potentially survivable situations is lost.

One major point needs to be made concerning those comments that address the analysis of benefits. Comments tend to focus on details of specific examples but miss the more general principles that these examples were attempting to demonstrate. The detailed information that expanded parameter flight recorders make available allows a much more objective accident analysis to be completed. Investigators can compare and correlate the actual performance of the airplane with that intended by the flightcrew, and, most importantly, the numerous assumptions that investigators often must make in determining probable cause can be reduced significantly. Thus, more specific and focused corrective actions can take place, especially in the area of human factors and crew training, than would otherwise be possible in the absence of this additional information. Further, the graphic depiction of an

accident scenario that can be reconstructed in great detail will leave a much more lasting impression on the part of flightcrews. This concept is very similar to the old maxim "A picture is worth a thousand words." The opportunity that a detailed, specific accident report provides for flightcrews to more thoroughly think through their own possible reactions if they were to find themselves in a similar situation is a learning experience that cannot be obtained from an accident report characterized by more general conclusions based upon numerous assumptions.

B.2 Part 135 Proposals

Comments that address the benefits of the proposal to require that CVR's be installed on newly manufactured turbine-powered airplanes operated under Part 135 generally question the value of such recorders. Commenters state that the safety benefits that the FAA attributed to the CVR's were overstated.

The FAA considers this rule to be a long-term corrective action reflecting recent changes in the structure of the airline industry. Part 135 operations have grown significantly since airline deregulation in 1978 opened up the commuter industry, yet only turbojet airplanes equipped with 10 or more passenger seats are currently required to have CVR's (Section 135.151). Implementation of this final rule will eventually result in all turbine-powered airplanes operated by the commuter industry being equipped with a recorder of some type—a CVR for those smaller airplanes with 30 seats or less operated under Part 135, and both a CVR and flight recorder for those larger airplanes with between 31 and 60 seats operated under Part 121. The FAA recognizes that these benefits will not be realized immediately, but expects that this long-term approach will provide the public with the safety benefit of more thorough investigations of accidents involving those airplane types that now carry a much larger share of passenger traffic than in previous years, yet not unduly burden the operators of these airplanes.

II. Evaluation of Costs and Benefits

The 15-year period of the regulatory evaluation includes the years from 1987 through 2001. Values are expressed in 1986 dollars, and present values have been calculated using the 10 percent discount rate prescribed by the Office of Management and Budget.

A. Costs.

1. Amendment of the flight recorder requirements for aircraft operating under Part 121.

The major cost components of complying with the amendments to the Part 121 flight recorder requirements include the digital flight recorder, an FDAU necessary to convert input signals into a digital format, signal sources (such as transducers, potentiometers, etc.) when none are presently available for the additional parameters to be recorded, labor costs for installation, and ground support equipment to maintain the digital recorders. Offsetting these retrofit and upgrade costs are the present value of the retrofit costs that would have eventually been incurred to replace many foil recorders reaching the end of their economic lives subsequent to the digital conversion deadline established by this final rule, and the reduction in the cost of maintenance for a digital flight recorder in comparison to the older, electromechanical foil recorders.

In response to comments, a cost factor has been added reflecting the fuel penalty resulting from any increases in airplane weight that are attributable to the new rule. Cost estimates have also been modified to reflect substitution of the longitudinal acceleration parameter for other parameters originally proposed in the notice and special retrofit installation requirements for airplanes equipped with older, spherical foil recorders.

Further, the FAA expects that the majority of operators will find it most economical to purchase recorder and FDAU equipment directly from the manufacturers of that equipment, even though the actual installation work may be contracted out. However, in some instances an operator may have a modification shop provide the equipment as well as the labor. This would increase the retrofit costs to the operator because the modification shop marks up the parts it supplies. This additional unit cost in converting some airplanes has been considered in estimating the cost of the final rule.

Other cost factors may potentially affect the compliance costs of this rule. These factors include the possibility that recorder manufacturers might attempt to increase the prices of their equipment following implementation of the rule (which is not expected to be a very significant problem because of competition between manufacturers), that in some special cases design engineering and certification costs may not be fully included in equipment costs, or that installation labor may exceed FAA's estimates, even when the work is carefully planned ahead of time. To allow for these contingencies, the FAA has performed a sensitivity analysis on its cost estimates.

For airplanes operated under Part 121, the present value total cost of the various digital flight recorder requirements in this final rule, after deducting maintenance savings and the present value of costs which would result from the expected future attrition of many foil recorders in the absence of this rule, has been estimated to be approximately $27.6 million. These costs are summarized in Table 1 below:

TABLE 1.—SUMMARY OF PART 121 FLIGHT RECORDER COSTS, PRESENT VALUE—1986 DOLLARS (THOUSANDS)

Initial Retrofit with Digital Recorder	$24,870
Upgrade from 6 to 11 Parameters	6,612
Newly Manufactured Aircraft	1,385
Ground Support Equipment	2,504
Fuel Penalty	1,824
Subtotal	$39,195
Less Anticipated Foil Attrition/Digital Replacement	(3,689)
Less Maintenance Savings	(7,928)
Total Cost	$27,578

Should the contingencies allowed for in the cost sensitivity analysis result in actual costs that are 25 percent higher than estimated, and actual deductions that are 25 percent lower, the total cost could increase to approximately $40.3 million. These costs represent discounted values of incremental costs incurred as a result of the final rule for the 15-year period between 1987 and 2001.

The revised unit costs and additional cost factors used in evaluating the final rule are summarized in Table 2.

1. Initial retrofit from foil to digital flight recorder:

TABLE 2.—SUMMARY OF REVISED ASSUMPTIONS USED IN ESTIMATING COSTS OF AMENDMENTS TO PART 121 FLIGHT RECORDER REQUIREMENTS

Equipment	Installation
Direct replacement, single unit digital flight recorder:	
$15,420 combined FDAU/flight recorder unit.	$0
Separate flight recorder and FDAU:	
	(including 6-to-11 parameter upgrade):
$11,000 flight recorder	$1,400 labor (35 hrs @ $40 per hour, FDAU in avionics bay)
$11,000 mini-FDAU	$1,900 signal sources.
$22,000 Total	$3,300 Total.

2. Upgrade from 6-parameter digital to 11-parameter digital flight recorder:

Equipment	Installation
Direct replacement flight recorder capable of recording 11-parameters as single-unit	
$2,200 Modification kit (when required).	$2,000 labor (50 hrs. @ $40 per hour, FDAU/recorder in rear of aircraft). $1,900 signal sources.
	$3,900 Total.
Direct replacement flight recorder requiring external mini-FDAU to record 11-parameters	
$11,000 mini-FDAU	$3,300 (same as separate FDAU and flight recorder installation above).

3. Installation of 17-parameter vs. 6-parameter digital flight recorder during assembly of newly manufactured aircraft:

$4,800 average FDAU/flight recorder cost differential over 6-parameter options.
1,400 labor (35 hrs. @ $40 per hour).
2,175 signal sources.

$8,375 Total.

4. Miscellaneous Costs: a. Recorder, FDAU, and signal source equipment costs increased 40 percent when purchased through modification shop rather than directly from manufacturer.

b. Retrofit of spherical foil recorders—$500 additional cost to install rack for standard ½ ATR long container.

c. Lost asset value of obsolete foil recorders—$4,500 per unit.

d. Fuel penalty 15 gallons annually for each additional pound of weight added to transport category airplane. Current fuel price $0.85 per gallon. Average additional weight estimated at 10 pounds for airplanes subject to retrofit and 25 pounds for newly manufactured airplanes requiring 17 parameters.

e. Digital recorder ground support equipment (maintenance and testing)—$55,000 per set.

5. Maintenance Savings—Foil to Digital Conversion: $1,500 annually per airplane.

Source: Equipment price quotations from flight recorder and FDAU manufacturers, labor and signal source estimates from FAA aircraft engineering and maintenance staff, air carrier maintenance personnel, and modification shop personnel.

2. Amendment requiring cockpit voice recorders on certain newly-manufactured, turbine-powered aircraft operated under Part 135

The equipment that will be required to comply with this proposal includes the cockpit voice recorder, the control unit with area microphone, and the vibration mounts, connectors, and other hardware required for installation. The manufacturer of a relatively inexpensive unit currently available indicates that this equipment could be purchased for approximately $9,500 per set. Adding 15 hours of labor at $40 per hour for installation, the total cost of equipping a newly manufactured airplane with a CVR has been estimated to be $10,100.

The maintenance cost of a CVR is approximately $150 per 1,000 hours of operation. The FAA estimates that the Part 135 aircraft affected by this proposal are utilized a maximum of 1,600 hours per year. Annual maintenance costs are therefore estimated to be $240.

The additional airplane weight resulting from the CVR is approximately 30 pounds. Based upon the 14 gallons of fuel estimated to be consumed annually for each pound of weight carried aboard typical commuter airplanes affected by this rule, and current jet fuel prices in the $.80 to $.85 per gallon range, the FAA estimates that the cost of additional fuel attributable to the weight of the CVR will be approximately $350 per year for each airplane.

Estimating the number of multiengine, turbine-powered airplanes certificated to carry six or more passengers and requiring two pilots, which will be manufactured during the 15-year period of this analysis and operated under Part 135, is extremely difficult because the commuter market is undergoing a major transition. A new generation of aircraft developed specifically for the expanding commuter industry has recently begun to enter service. These new aircraft, most of which are large enough to operate under Part 121, are expected to dominate the commuter market in the years to come, but the exact impact that they will have on the future market share of the older generation commuter aircraft which operate under Part 135 is difficult to predict.

Because of the uncertainty characterizing this transitional period, the FAA estimated a range of costs based upon a low delivery rate of 120 aircraft per year and a high delivery rate of 240 aircraft per year in the regulatory evaluation of the notice. However, the FAA has reviewed current trends in the delivery of new turbine-powered airplanes with airframe manufacturers or their representatives and found that its original estimates for Part 135 were somewhat high. Therefore, the FAA has revised its forecast downward for the evaluation of the final rule and estimates that only between 75 and 125 new turbine-powered airplanes for Part 135 operators will be delivered annually during the period of this analysis.

Applying the unit cost values discussed above to these delivery rates and discounting yields present value total costs which range from $8.3 to $13.8 million.

B. Benefits

1. Overview of Benefits Analysis

Estimating the benefits of flight recorders and cockpit voice recorders is difficult because a recorder is an investigative tool, and unlike other airborne safety devices, the absence of a flight recorder or cockpit voice recorder cannot be considered the cause of or a contributing factor to an accident involving that airplane.

Therefore, the benefits of flight recorders and cockpit voice recorders can only be measured in abstract terms; that is, how the recorder's contribution to determining the cause of one accident can lead to corrective measures to prevent other similar accidents, or, in other words, preventing the opportunity cost of lost information. It is not possible to accurately predict the number of accidents that would have occurred had these corrective actions not been taken. Nor is it possible to look at accidents wherein the probable cause remained elusive and state with assurance that the cause would have been positively determined and corrective action taken if the accident airplane had recorded more information. To demonstrate the utility of flight data and cockpit voice recorders, the benefits analysis of the regulatory evaluation examines the types of accidents in which recorders have been or could have been the key element in determining the cause of an accident.

2. Proposal to amend the flight recorder requirements for aircraft operating under Part 121

The accident investigations cited in the regulatory evaluation demonstrate how expanded parameter flight recorders have been effective in the determination of an aircraft structural, mechnical, or systems failure. This information has led directly to corrective actions such as aircraft modifications or changes in operating procedures that can prevent future accidents. Further, the determination that an accident was *not* caused by an airplane mechanical, structural, or systems problem can also be quite beneficial because costly but unnecessary design analyses or modifications to an airplane prompted by hypotheses rather than conclusive evidence can be prevented. Similarly, use of expanded parameter flight recorders could prevent an unnecessary suspension of an airworthiness certificate and avert economic losses to

passengers and carriers alike. Although such costs are difficult to quantify, the benefits of avoiding these costs must be recognized.

Another benefit resulting from the determination of accident cause through expanded parameter flight recorders is the ability to define more precisely those operational problems that need to be addressed by research and development programs. The most prominent example of this is wind shear. Expanded parameter flight recorders have made, and continue to make, significant contributions towards understanding this hazardous phenomenon and improving pilot training programs so that flightcrews are better able to handle wind shear encounters. At least one averted accident has been attributed directly to the improved techniques that have resulted from the wind shear program.

In the regulatory evaluation of the notice, the FAA developed a probability distribution of possible future accidents that could be prevented as a result of the expanded parameter recorder requirements. However, the relationship between accident investigations and the actual prevention of future accidents is somewhat abstract and cannot be directly observed. Further, the prevention of accidents is the cumultative result of numerous related learning experiences, only one of which is the feedback made possible through recorded accident information. In most cases it is not possible to link a prevented accident with a specific source of learning, if in fact it is even possible to identify most situations where an accident has been averted. The accident that does not occur often goes unnoticed. For these reasons, the FAA has reconsidered its original approach, and has determined that a meaningful probability distribution of the future accidents that may be prevented as a result of this final rule cannot realistically be assigned. Any effort to do so would be an attempt to give the analysis a greater degree of precision than the nature of the problem and the availability of information can support. However, because the various arguments presented in the regulatory evaluation demonstrate how expanded parameter recorders enable the detailed correlation of accident investigation information and contribute to much more specific corrective actions, it is highly probable that at least one accident, if not more, will be prevented as a result of information learned because of the amended flight recorder requirements which are being adopted in this final rule. The benefits of flight recorders are realized particularly in the area of human factors analysis providing information on how flightcrews respond to hazardous situations, and this information is valuable for preventing future accidents regardless of whether it is learned from an accident involving an older or newer airplane model.

The FAA estimates that the benefits that will be realized from a typical catastrophic accident that is avoided in the future will be the prevention of approximately 110 passenger and crew fatalities, the loss of the airplane, and the associated accident investigation costs. The standard average air carrier hull value of $8.9 million for destroyed airplane and the standard NTSB major accident investigation cost of $953,000 have been used to estimate the quantifiable benefits for each accident prevented.[1]

Discounting these values as a uniform series of payments over the 15-year period of the analysis (to allow for the random nature of acidents that may be prevented anywhere within that period) at the 10 percent discount rate prescribed by OMB yields an average quantifiable benefit of $5.2 million for each accident prevented. From this information and the previous cost analysis, the cost per fatality avoided has been determined. This is discussed subsequently in subsection C, "Comparison of Costs and Benefits."

3. Amendment requiring cockpit voice recorders on certain newly-manufactured, turbine-powered airplanes operated under Part 135.

The benefits that will result from the Part 135 amendment requiring cockpit voice recorders on all newly manufactured multiengine, turbine-powered airplanes certificated to carry six or more passengers and requiring two pilots are very similar to those achieved from flight recorders on Part 121 aircraft. Implementation of this rule will eventually result in all turbine-powered airplanes operated by the commuter industry being equipped with a recorder of some type—a CVR for those smaller airplanes with 30 seats or less operated under Part 135, and both a CVR and flight recorder for those larger airplanes with between 31 and 60 seats operated under Part 121. Therefore, the traveling public would benefit from the learning opportunities that more thorough investigations would allow.

The CVR's are particularly useful for human factors analysis. Although frequently the aircraft system malfunction, weather situation, or other causal factor can be identified, without the recorder it is difficult to ascertain whether or not the flightcrew responded to the emergency situation appropriately. The lack of this information makes it difficult to develop techniques that could benefit future travelers caught in similar situations. CVR's also can pick up other information useful to investigators, such as engine sounds, audio alarms and signals, and the sounds of some switches and control activation.

There have been a number of recent accidents involving turbine-powered airplanes operated under Part 135 in which a CVR would have greatly assisted in the accident investigations. This is especially true of the December 1984 Embraer Bandeirante accident in Jacksonville, Florida. The airplane crashed shortly after takeoff, but the exact cause of this accident has been extremely difficult for investigators to pinpoint. The other fatal accidents include three landing accidents and one training accident. Investigations of all of these accidents would have been enhanced if recorded information were available. Adoption of this final rule will prevent future occurrences of this problem in many newly manufactured airplanes operated under Part 135 and will contribute to the prevention of future accidents.

The FAA estimates that the benefits that will be realized from a typical catastrophic commuter accident that is avoided in the future will be the prevention of approximately 12 passenger and crew fatalities, the loss of the airplane, and the associated accident investigation costs. An average hull value of $1.0 million for a typical used turbine-powered airplane and the previously cited major accident investigation cost of $953,000 have been used to estimate the quantifiable benefits for each accident prevented.

Discounting these values as a uniform series of payments over the 15-year period of the analysis (to allow for the random nature of accidents that may be prevented anywhere within that period) at the 10 percent discount rate prescribed by OMB yields an average quantifiable benefit of $1.0 million for each accident prevented. From this information and the previous cost analysis, the cost per fatality avoided has been determined. This is discussed

[1] See *Economic Values for Evaluation of Federal Aviation Administration Investment and Regulatory Programs* (Report # FAA-APO-81-3), and *Economic Analysis of Investment and Regulatory Decisions—A Guide* (Report # FAA-APO-82-1), FAA Office of Aviation Policy and Plans. Values have been adjusted for inflation as prescribed in these guides.

subsequently in subsection D, "Comparison of Costs and Benefits."

C. Comparison of Costs and Benefits

1. Amendment of the flight recorder requirements for airplanes operating under Part 121.

The FAA has estimated that the total compliance costs of meeting the new Part 121 flight recorder standards will be approximately $27.6 million. The cost sensitivity analysis indicated that this figure could increase to approximately $40.3 million. If one or more catastrophic accidents are prevented, which is a highly probable consequence of this rule change, then the loss of at least one transport category airplane and 110 fatalities will be avoided.

This will prevent aircraft hull value and accident investigation costs of $5.2 million (discounted present value). Deducting the prevented hull loss and accident investigation costs from the total compliance costs yields that portion of costs that will go entirely toward saving lives. Based upon the average of 110 fatalities avoided for each accident prevented, the maximum cost per fatality avoided will fall between $203,000 and $319,000, depending on whether the higher costs allowed for in the cost sensitivity analysis are in fact incurred. These are maximum values for the cost per fatality avoided and will be less if more than one accident is prevented as a result of this rule.[2]

2. Amendment requiring cockpit voice recorders on certain newly-manufactured, turbine-powered airplanes operated under Part 135.

The FAA has estimated that the total compliance costs of meeting the new Part 135 CVR requirement will range from $8.3 to $13.8 million, depending on the number of new airplanes delivered during the 15-year period of this analysis. If one or more catastophic accidents are prevented as a result of information learned from these CVR's, then the loss of at least one commuter airplane and 12 fatalities will be avoided. This will prevent aircraft hull value and accident investigation costs of $1.0 million (discounted present value). Deducting the prevented hull loss and accident investigation costs from the total compliance costs yields that portion of costs that will go entirely towards saving lives. Based upon the average of 12 fatalities avoided for each accident prevented, the maximum cost per fatality avoided will be between $602,000 and $1.1 million. However, there is a greater likelihood of realizing the potential benefits as the cost per fatality avoided increases because there will also be more airplanes equipped with CVR's in active service. Further, the cost per fatality avoided will be less if more than one accident is prevented as a result of this rule.

III. International Trade Impact Analysis

The amendment will have little or no impact on trade for either U.S. firms doing business in foreign countries or foreign firms doing business in the United States. The amendments will affect only U.S. air carriers because foreign air carriers are not subject to Part 121 or 135. Foreign air carriers are prohibited from operating between points within the United States; therefore, they will not gain any competitive advantage over the domestic operations of U.S. carriers. In international operations, foreign air carriers are not expected to realize any cost advantages over U.S. air carriers because many foreign countries have even more stringent recorder requirements than those adopted in this final rule. Therefore, there will essentially be no trade impact.

IV. Regulatory Flexibility Determination

The Regulatory Flexibility Act of 1980 (RFA) was enacted by Congress to ensure that small entities are not unnecessarily and disproportionately burdened by government regulations. The RFA requires agencies to review rules that may have "a significant economic impact on a substantial number of small entities."

All of the rule changes will directly affect those air carriers operating under Parts 121 and 135 that are classified as small entities. However, with one exception, they are not expected to result in "a significant economic impact on a substantial number" of small entity air carriers.

The following evaluation analysis explains the reasons for this determination. In developing estimates of annualized net compliance costs, uniform annualized costs for capital investments have been determined by multiplying the amount of the investment by a capital recovery factor appropriate for the discount rate and period of the analysis. A capital recovery factor of .125, based upon a 10 percent discount rate over a 15-year period, has been used in this analysis. Threshold cost values and small entity size standards are those stated in FAA Order 2100.14, *Regulatory Flexibility Criteria and Guidance.* Values have been adjusted to 1986 dollars.

The Part 121 amendment requires aircraft to initially equip with 6-parameter digital flight recorders and later increase the number of parameters to 11. The unit investment cost for the most expensive configuration (separate FDAU and separate flight recorder) has been estimated to be $28,000, including a prorated share of the test equipment cost, and assuming that the foil recorder on this airplane would not have been replaced at any time during the analysis period in the absence of this rule. The uniform annualized cost for this investment is $3,508. Adding the annual fuel penalty cost of $128 and deducting the annual maintenance savings of $1,500 from this amount yields an annual net cost of $2,136 per aircraft.

The threshold values defining a significant economic impact for schedued carriers are $94,094 if the entire fleet has a seating capacity of over 60 seats and $52,546 for other scheduled carriers. A carrier would have to convert 45 or 25 airplanes, respectively, to exceed either of these thresholds. A small entity is defined as one which owns nine or fewer airplanes. Consequently, any scheduled operator exceeding either of the minimum cost thresholds for scheduled operators as a result of this amendment would not be considered a small entity.

However, the threshold value defining a significant economic impact for an unscheduled operator is only $3,666. A carrier would only have to convert two airplanes to exceed this threshold. Data collected by the FAA on Part 121 fleet size distribution indicated that there are 64 unscheduled carriers operating under Part 121 and that 26 of these carriers, or 40 percent, operate 2 or more airplanes. This is more than one-third of the small unscheduled operators subject to the rule. Consequently, the FAA has determined that this amendment may have a significant economic impact on a substantial number of small unscheduled operators, and a regulatory flexibility analysis is required under the terms of the RFA. The regulatory flexibility analysis for these

[2] The prevented accidents that may result from this rule could occur at any time during the period of this analysis. Generally, there is a social preference to realize benefits at an earlier rather than later time, and when a specific monetary value has been assigned to a particular benefit, discounting is used to reflect this time preference. Benefits realized earlier will have a higher present value than those realized later. However, when it is difficult to assign a specific monetary value to a benefit and it is therefore expressed in other units for comparison to costs (in this case the benefit unit is the number of fatalities avoided), discounting of the benefit units would only serve to introduce an element of specious accuracy into the analysis and is therefore inappropriate. Realistically, the actual benefit units can only be compared to the present value of costs, with the understanding that if it could be measured more precisely, the time preference would be to realize the benefits as early as possible.

unscheduled operators follows in Section V.

Those air carriers that have already retrofitted their fleet voluntarily would only incur costs as a result of the requirement to upgrade from 6 to 11 parameters. However, none of the carriers that the NTSB identified as having converted voluntarily are small carriers. Therefore, no small entities would be impacted by this requirement.

The Part 135 amendment requiring CVR's on certain turbine-powered aircraft would not have a significant economic impact on small entity commuter air carriers. The uniform annualized cost of the $10,100 investment to install a CVR on a newly-manufactured aircraft is $1,266. Adding the annual maintenance and fuel penalty costs of $590 yields a net annual compliance cost of $1,856. Commuter carriers are scheduled operators and therefore the threshold value of $52,546 applies. An operator would have to buy 29 new aircraft to exceed this threshold, far greater than the 9 aircraft defining a small entity. Therefore, no small entity commuter carriers will be affected by this amendment.

With respect to on-demand air taxis operating under Part 135, the FAA's Aviation Standards National Field Office in Oklahoma City lists approximately 4,000 operators registered as on-demand air taxis. The majority of these are small entities. However, data examined in the *FAA Statistical Handbook of Aviation* indicate that less than 20 percent of all air taxis operate turbine-powered aircraft. Therefore, the criteria for a "substantial number," one-third of the small entities affected, has not been exceeded.

For these reasons, the amendments adopted in this final rule are not expected to have a significant economic impact on a substantial number of small entities for all affected categories other than the small unscheduled Part 121 operators. However, a regulatory flexibility analysis is required under the terms of the RFA for the small unscheduled Part 121 operators.

V. Final Regulatory Flexibility Analysis

As required by section 604 of the RFA, the following analysis deals with the amended Part 121 flight recorder requirements as they relate to small unscheduled operators.

A. Why Agency Action is Taken

The reasons for agency action are detailed in the final rule and the regulatory evaluation.

Briefly, the amendment upgrades flight recorder standards for airplanes receiving original type certificates before September 30, 1969, and operated under Part 121. The expected service life of a pre-1969 type certificated airplane has been prolonged far longer than anticipated at the time higher flight recorder standards were adopted for post-1969 airplanes. The advantages of the additional parameters of recorded information have been demonstrated by those airplanes so equipped, and it is desirable that more specific information be obtained following an accident than is possible under current regulations.

B. Objectives and Legal Basis for the Rule

The objective of the amendment is simply to make commercial air transportation safer. This objective has been thoroughly discussed in the final rule and the regulatory evaluation.

The legal bases of the proposal are sections 313(a), 314(a), 601 through 610, and 1102 of the Federal Aviation Act of 1958, as amended (49 U.S.C. 1354(a), 1421 through 1430 and 1502); 49 U.S.C. 106(g) (Revised, Pub. L. 97–449, January 12, 1983).

C. Description of Small Entities Affected by the Rule

The entities are unscheduled air carriers subject to Part 121 of the FAR with nine or fewer airplanes. This is covered in detail in Section IV above.

D. Compliance Requirements of the Rule

The amendment requires that pre-1969 type certificated airplanes operated under Part 121 be equipped with digital flight recorders within 2 years of the effective date of the rule and that these recorders be upgraded to record 11-parameters of information within 7 years of the effective date of the rule.

E. Overlap of the Rule with Other Federal Rules

There are no other Federal rules that duplicate, overlap, or conflict with the amended rule.

F. Comments in Response to the Initial Regulatory Flexibility Analysis

In NPRM No. 85–1, the FAA certified that the proposed rule was not expected to have a significant economic impact on a substantial number of small entities for all categories of operators which would be affected by the rule. Consequently, an Initial Regulatory Flexibility Analysis was not required and none was prepared. The revisions to the cost estimates in the final rule resulted in the determination that the amendment could result in a significant economic impact on a substantial number of small entities for only one category of operator, the small unscheduled Part 121 air carriers. However, as discussed below, this is the result of the relatively low threshold value for determining a significant economic impact applicable to unscheduled operators in comparison to scheduled operators of similar equipment, and therefore the small unscheduled Part 121 air carriers are not expected to be any more adversely affected than their scheduled counterparts.

The FAA's original regulatory flexibility determination remains the same for all other categories of small entities.

G. Alternatives to the Proposal

The small entity nonscheduled Part 121 operators should be included in the rule, rather than excluded, because they operate the same types of airplanes as those operated by scheduled Part 121 operators. Further, Part 121 operators engage in common, rather than private, carriage of persons and property. The standards should be the same for all operators of similar equipment that hold out to the public as a common air carrier, regardless of whether their operations are scheduled or not. Finally, because unscheduled carriers operate the same types of airplanes as scheduled carriers, their operating costs are very similar for the same scale of operations. The $3,666 threshold value defining a significant economic impact for unscheduled operators is substantially lower than the $52,546 and $94,094 thresholds applicable to scheduled carriers. However, this is because the vast majority of unscheduled operators are air taxis that operate under Part 135 with much smaller and less costly piston-powered airplanes. Although small entity unscheduled Part 121 operators will exceed their low threshold value if they convert two or more airplanes, they should be no more adversely affected than the scheduled small entity Part 121 operators because their costs are much more comparable to those of scheduled Part 121 operators than to those of unscheduled Part 135 operators.

Conclusion

For the reasons discussed in the preamble and based upon the findings in the Regulatory Evaluation, Regulatory Flexibility Determination, and Trade Impact Assessment located in the docket, the FAA has determined that this document: (1) Involves an amended regulation that is not major under Executive Order 12291; and (2) is a significant rule pursuant to the Department of Transportation

Regulatory Policies and Procedures (44 FR 11064; February 26, 1979). In addition, it is certified under the criteria of the Regulatory Flexibility Act that this rule will not have a significant economic impact on a substantial number of small entities for all the affected categories of small entities other than the small, unscheduled Part 121 operators. A final Regulatory Flexibility Analysis has been prepared in accordance with Sections 604 (a) and (b) of the Regulatory Flexibility Act for this category. A copy of the evaluation may be obtained by contacting the person identified in the "FOR FURTHER INFORMATION CONTACT" paragraph.

List of Subjects

14 CFR Part 91

Air carriers, Aviation safety, Safety, Aircraft, Air transportation.

14 CFR Part 121

Aviation safety, Safety, Air carriers, Air transportation, Aircraft, Airplanes, Transportation, Common carriers.

14 CFR Part 125

Aircraft, Airplanes, Airworthiness.

14 CFR Part 135

Air carriers, Aviation safety, Safety, Air transportation, Air taxi, Aircraft, Transportation, Airplanes.

Adoption of The Amendment

Accordingly, Parts 91, 121, 125, and 135 (14 CFR Parts 91, 121, 125, and 135) are amended as follows:

PART 91—GENERAL OPERATING AND FLIGHT RULES

1. The authority citation for Part 91 is revised to read as set forth below, and the authority citations following all sections in Part 91 are removed:

Authority: 49 U.S.C. 1301(7), 1303, 1344, 1348, 1352 through 1355, 1401, 1421 through 1431, 1471, 1472, 1502, 1510, 1522, and 2121 through 2125; Articles 12, 29, 31, and 32(a) of the Convention on International Civil Aviation (61 Stat 1180); 42 U.S.C 4321 et seq.; E.O. 11514; 49 U.S.C. 106(g) (Revised Pub. L. 97-449, January 12, 1983).

2. By amending § 91.35 by designating the introductory text as paragraph (a); by redesignating paragraphs (a), (b), (c), and (d) as (a)(1), (2), (3), and (4); and by adding a new paragraph (b) to read as follows:

§ 91.35 Flight recorders and cockpit voice recorders.

* * * * *

(b) In the event of an accident or occurrence requiring immediate notification to the National Transportation Safety Board under Part 830 of its regulations that results in the termination of the flight, any operator who has installed approved flight recorders and approved cockpit voice recorders shall keep the recorded information for at least 60 days or, if requested by the Administrator or the Board, for a longer period. Information obtained from the record is used to assist in determining the cause of accidents or occurrences in connection with investigation under Part 830. The Administrator does not use the cockpit voice recorder record in any civil penalty or certificate action.

PART 121—CERTIFICATION AND OPERATIONS: DOMESTIC FLAG AND SUPPLEMENTAL AIR CARRIERS AND COMMERCIAL OPERATORS OF LARGE AIRCRAFT

3. The authority citation for Part 121 is revised to read as set forth below, and the authority citations following all sections in Part 121 are removed:

Authority: 49 U.S.C. 1354(a), 1355, 1356, 1357, 1401, 1421–1430, 1472, 1485, and 1502; 49 U.S.C. 106(g) (Revised, Pub. L. 97-449, January 12, 1983).

4. By revising § 121.343 to read as follows:

§ 121.343 Flight recorders.

(a) Except as provided in paragraph (b), (c), or (d) of this section, no person may operate a large airplane that is certificated for operations above 25,000 feet altitude or is turbine-engine powered unless it is equipped with one or more approved flight recorders that record data from which the following may be determined within the ranges, accuracies, and recording intervals specified in Appendix B of this part:
(1) Time;
(2) Altitude;
(3) Airspeed;
(4) Vertical acceleration;
(5) Heading; and
(6) Time of each radio transmission either to or from air traffic control.

(b) No person may operate a large airplane type certificated up to and including September 30, 1969, for operations above 25,000 feet altitude, or a turbine-engine powered airplane certificated before the same date, unless it is equipped before May 26, 1989 with one or more approved flight recorders that utilize a digital method of recording and storing data and a method of readily retrieving that data from the storage medium. The following information must be able to be determined within the ranges, accuracies, and recording intervals specified in Appendix B of this part:
(1) Time;
(2) Altitude;
(3) Airspeed;
(4) Vertical acceleration;
(5) Heading; and
(6) Time of each radio transmission either to or from air traffic control.

(c) No person may operate an airplane specified in paragraph (b) of this section unless it is equipped, before May 26, 1994 with one or more approved flight recorders that utilize a digital method of recording and storing data and a method of readily retrieving that data from the storage medium. The following information must be able to be determined within the ranges, accuracies and recording intervals specified in Appendix B of this part:
(1) Time;
(2) Altitude;
(3) Airspeed;
(4) Vertical acceleration;
(5) Heading;
(6) Time of each radio transmission either to or from air traffic control;
(7) Pitch attitude;
(8) Roll attitude;
(9) Longitudinal acceleration;
(10) Control column or pitch control surface position; and;
(11) Thrust of each engine.

(d) No person may operate an airplane specified in paragraph (b) of this section that is manufactured after May 26, 1989, as well as airplanes specified in paragraph (a) of this section that have been type certificated after September 30, 1969, unless it is equipped with one or more approved flight recorders that utilize a digital method of recording and storing data and a method of readily retrieving that data from the storage medium. The following information must be able to be determined within the ranges, accuracies, and recording intervals specified in Apendix B of this part:
(1) Time;
(2) Altitude;
(3) Airspeed;
(4) Vertical acceleration;
(5) Heading;
(6) Time of each radio transmission either to or from air traffic control;
(7) Pitch attitude;
(8) Roll attitude;
(9) Longitudinal acceleration;
(10) Pitch trim position;
(11) Control column or pitch control surface position;
(12) Control wheel or lateral control surface position;
(13) Rudder pedal or yaw control surface position;
(14) Thrust of each engine;
(15) Position of each thrust reverser;

(16) Trailing edge flap or cockpit flap control position; and

(17) Leading edge flap or cockpit flap control position.

For the purpose of this section, "manufactured" means the point in time at which the airplane inspection acceptance records reflect that the airplane is complete and meets the FAA-approved type design data.

(e) Whenever a flight recorder required by this section is installed, it must be operated continuously from the instant the airplane begins the takeoff roll until it has completed the landing roll at an airport.

(f) Except as provided in paragraph (g) of this section, and except for recorded data erased as authorized in this paragraph, each certificate holder shall keep the recorded data prescribed in paragraph (a), (b), (c), or (d) of this section, as appropriate, until the airplane has been operated for at least 25 hours of the operating time specified in § 121.359(a). A total of 1 hour of recorded data may be erased for the purpose of testing the flight recorder or the flight recorder system. Any erasure made in accordance with this paragraph must be of the oldest recorded data accumulated at the time of testing. Except as provided in paragraph (g) of this section, no record need be kept more than 60 days.

(g) In the event of an accident or occurrence that requires immediate notification of the National Transportation Safety Board under Part 830 of its regulations and that results in termination of the flight, the certificate holder shall remove the recording media from the airplane and keep the recorded data required by paragraph (a), (b), (c), or (d) of this section, as appropriate, for at least 60 days or for a longer period upon the request of the Board or the Administrator.

(h) Each flight recorder required by this section must be installed in accordance with the requirements of § 25.1459 of this chapter in effect on August 31, 1977. The correlation required by § 25.1459(c) of this chapter need be established only on one airplane of any group of airplanes—

(1) That are of the same type;

(2) On which the model flight recorder and its installation are the same; and

(3) On which there is no difference in the type design with respect to the installation of those first pilot's instruments associated with the flight recorder. The most recent instrument calibration, including the recording medium from which this calibration is derived, and the recorder correlation must be retained by the certificate holder.

(i) Each flight recorder required by this section that records the data specified in paragraph (a), (b), (c), or (d) of this section, as appropriate, must have an approved device to assist in locating that recorder under water.

Appendix B—[Amended]

5. By amending Appendix B by removing the phrase "Lateral acceleration" in the "Information" column and inserting the phrase "Longitudinal acceleration" in its place and by removing "Sideslip angle" in its entirety.

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

6. The authority citation for Part 125 is revised to read as set forth below, and the authority citations following all sections in Part 125 are removed:

Authority: 49 U.S.C. 1354, 1421 through 1430, and 1502; 49 U.S.C. 106(g) (Revised, Pub. L. 97-449, January 12, 1983).

7. By adding a new § 125.202 to read as follows:

§ 125.202 Flight recorders and cockpit voice recorders.

In the event of an accident or occurrence requiring immediate notification of the National Transportation Safety Board under Part 830 of its regulations which that in the termination of the flight, any operator who has installed approved flight recorders and approved cockpit voice recorders shall keep the recorded information for at least 60 days or if requested by the Board, for a longer period. Information obtained from the record is used to assist in determining the cause of accidents or occurrences in connection with investigations under Part 830. The Administrator does not use the cockpit voice recorder record in any civil penalty or certificate action.

PART 135—AIR TAXI OPERATORS AND COMMERCIAL OPERATORS

8. The authority citation for Part 135 is revised to read as set forth below, and the authority citations following all sections in Part 135 are removed:

Authority: 49 U.S.C. 1354(a), 1355(a), 1421 through 1431, and 1502; 49 U.S.C. 106(g) (Revised Pub. L. 97-449, January 12, 1983).

9. By amending § 135.151 by revising the introductory text of paragraph (a); by redesignating paragraph (b) as (c); and by adding a new paragraph (b) to read as follows:

§ 135.151 Cockpit voice recorders.

(a) No person may operate: A turbojet airplane having a passenger seating configuration, excluding any pilot seat, of 10 seats or more, or a multiengine, turbine-powered airplane that has been manufactured after May 26, 1989, certificated to carry six or more passengers and requiring two pilots by certification or operating rules, unless it is equipped with an approved cockpit voice recorder that—

* * * * *

(b) For the purpose of this section, "manufactured" means the point in time at which the airplane inspection acceptance records reflect that the airplane is complete and meets the FAA-approved type design data.

* * * * *

Issued in Washington, DC, on March 18, 1987.

Donald D. Engen,

Administrator.

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