U.S. Department of Transportation

FEDERAL AVIATION ADMINISTRATION

REGULATORY EVALUATION

QUALIFICATION, SERVICE AND USE OF CREWMEMBERS AND AIRCRAFT DISPATCHERS

FINAL RULEMAKING
(14 CFR PART 121)

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TABLE OF CONTENTS

I. INTRODUCTION……3

II. BACKGROUND…….……5

III. GENERAL BENEFIT-COST ANALYSIS ASSUMPTIONS……..…10

IV. BENEFIT ANALYSIS……11

V. COST ANALYSIS……35

VI. BENEFIT COST SUMMARY…….....66

VII. APPENDICES……..…….…….....69

I. INTRODUCTION

In January 2009, the FAA published a notice of proposed rulemaking (NPRM) for "Qualification, Service, and Use of Crewmembers and Aircraft Dispatchers". Based on a public meeting and comments, along with an increase in the NPRM scope, the FAA updated the NPRM and the regulatory evaluation. We then published a supplemental notice of proposed rulemaking (SNPRM) in May 2011. After reviewing the changes proposed in the NPRM and the SNPRM, the agency has decided to move forward with a final rule that increases safety benefit by including certain provisions that enhance pilot training for rare, but high risk scenarios. This focus reduces the overall requirements as proposed in the NPRM and SNPRM.

The final rule adds safety-critical tasks to pilot training such as recovery from stall and upset with an emphasis on manual handling skills. In addition, the final rule requires enhanced runway safety training, training on pilot monitoring duties for the pilot not flying to be incorporated into existing requirements for scenario-based flight training, and requires air carriers to implement remedial training programs for pilots. The FAA expects these changes to contribute to a reduction in aviation accidents. Additionally, the final rule revises recordkeeping requirements for communications between the flightcrew and dispatch; ensures that personnel identified as flight attendants have completed flight attendant training and qualification requirements; provides civil enforcement authority against those making fraudulent statements; and, provides a number of conforming and technical changes to existing air carrier crewmember training and qualification requirements. The final rule also includes provisions that codify current processes that provide training efficiencies for certificate holders who operate multiple aircraft types with similar design and flight handling characteristics.

In developing the training and evaluation requirements, the FAA reviewed the current requirements in subparts A, M, N, O, P, T, V and Y as well as the flight training tasks listed in Appendix E (flight training requirements), Appendix F (proficiency check requirements), and Appendix H (advanced simulation) of part 121.

Table 1 shows the FAA's estimate for the base case costs, including the low and high cost range, in 2012 dollars. Table 1 also shows our estimated potential quantified safety benefits using a 22-year historical accident analysis period.

Table 1

Total Benefits and Costs (2012 $ Millions) From 2019 to 2028

			Present Value	
Range		**2012 $**	**7%**	**3%**
Low	Cost	$274.1	$130.8	$197.5
High	Cost	$353.7	$168.8	$254.8
Base Case	**Cost**	**$313.9**	**$149.8**	**$226.1**
	Benefit	**$689.2**	**$317.1**	**$488.7**

II. BACKGROUND

The regulations governing training and qualification requirements for crewmembers engaged in operations under part 121 are found in 14 CFR part 121 subparts N and O[1]. Subpart N prescribes the requirements for establishing and maintaining a training program for crewmembers, aircraft dispatchers, and other operations personnel and requirements for the use of training devices in conducting the program. Subpart O prescribes crewmember qualifications related to the final rule. Appendix E to part 121 establishes the training tasks required for initial, transition, and upgrade pilot flight training. Appendix F to part 121 establishes the tasks for pilot proficiency checks. Appendix H to part 121 provides guidelines and a means for using advanced airplane simulators for flightcrew training and checking.

This rule is necessary to address several National Transportation Safety Board (NTSB) recommendations and addresses the requirements in the Airline Safety and Federal Aviation Administration Extension Act of 2010 (the 2010 Act).[2] Under the 2010 Act, Congress directed the FAA to conduct rulemaking to ensure that all flightcrew members receive ground training and flight training in recognizing and avoiding stalls, recovering from stalls, and recognizing and avoiding upset of an aircraft, as well as the proper techniques to recover from upset. The 2010 Act also directed the FAA to ensure air carriers develop remedial training programs for flight crew members who have demonstrated performance deficiencies or experienced failures in the training environment.

The FAA reviewed the crewmember and aircraft dispatcher training regulations to identify improvements in training program content and application. Although the agency's review is ongoing, we have identified the following areas where changes were necessary to the current rules:

- Fraud and falsification,
- Personnel identified as flight attendants,

[1] Further references to part 121 operators include both part 121 and part 121/135 operators listed in the FAA National Vital Information Subsystem (NVIS) database.
[2] Public Law 111-216.

- Proficiency checks for pilots in command (PIC),
- Related aircraft differences training,
- Training equipment other than Flight Simulation Training Device (FSTD) approved under part 60,
- Approval of FSTDs,
- Pilot monitoring,
- Remedial training,
- Communication record for domestic and flag operations,
- Training for instructors and check airmen who serve in FSTDs,
- Extended envelope flight training maneuvers and procedures,
- Extended envelope ground training subjects,
- Runway safety maneuvers and procedures, and
- Crosswinds maneuvers with gusts.

On May 20, 2011, the FAA published the Supplemental Notice of Proposed Rulemaking (SNPRM). Following a four month comment period ending on September 19, 2011, the FAA received 134 comments on the SNPRM and regulatory evaluation.[3] These comments came from air carriers, trade associations, labor unions, the National Transportation Safety Board (NTSB), the Families of Continental Flight 3407, and many individual commenters. The FAA fully considered these comments in developing the final rule and regulatory evaluation.

One of the commenters' major concerns was the proposal would cause additional training, and therefore costs, to operators who train their pilots under the Advanced Qualification Program (AQP). Based upon further review of the final rule requirements and AQP curriculums, the FAA has concluded that the final rule contains training tasks that are not currently included in existing pilot AQPs. Therefore, the final rule will increase the training costs for all pilots who operate in part 121 service, including those who train under an AQP.

[3] http://www.regulations.gov/#!docketDetail;dct=PS+O+SR+FR;rpp=10;so=ASC;sb=postedDate;po=280;D=FAA-2008-0677 . Accessed March 22, 2013.

Based on public comments and further agency review of the proposal, the FAA made the following changes to the regulatory evaluation for the final rule:

- Re-estimated costs and benefits to correspond directly to the provisions of this final rule. The final rule focuses on safety-critical enhancements to pilot training for rare, but high-risk scenarios.
- Assumed that the final rule will affect all AQP and non-AQP trained pilots in command, second in command pilots, check pilots, and flight instructors by adding simulator and ground school time to their current training curriculum.
- Accounted for paperwork costs documenting the required revisions to part 121 operators pilot training programs.
- Updated the value of averted fatalities, injuries, accident investigation and medical costs based on current U.S. Department of Transportation (DOT) guidance.[4]
- Updated the hourly wages and benefits for aircraft crew members with current hourly wages from the Bureau of Labor Statistics (BLS).
- Removed airfare, hotel, and per diem travel costs from the cost estimates because the FAA believes operators will be able to complete the new final rule training requirements within their current initial, upgrade, transition, or recurrent simulator and ground school training days. The FAA conducted a sensitivity analysis on the costs of the final rule adding an additional day of travel. The results of the sensitivity analysis are shown in Appendix 10. Even with the cost of an extra day of travel, the benefits of the final rule still exceed the costs.
- Conducted a new accident analysis that took into account the mitigations of other final rulemakings for the same accidents in determining the probability of effectiveness for this final rule.
- Assumes that the "Flight Simulation Training Devices Qualification Standards For Extended Envelope and Adverse Weather Event Training Tasks" rulemaking (RIN 2120-AK08) rulemaking is in place by the time compliance is required with the new pilot training requirements because amendments to FSTD qualification and evaluation

[4] "Revised Departmental Guidance 2013: Treatment of the Value of Preventing Fatalities and Injuries in Preparing Economic Analysis." available at http://www.dot.gov/regulations/economic-values-used-in-analysis

standards in part 60 are needed to support the new full flight simulator training requirements in this final rule. In addition, the agency recognizes that the final rule on Pilot Certification and Qualification Requirements for Air Carrier Operations will be in place at the time that compliance is required with the pilot training requirements in this final rule.

- Included a table in Appendix 13 comparing the probability of effectiveness ratings of the overlapping accidents from the Flightcrew Member Duty and Rest Requirements final rule, the Pilot Certification and Qualification Requirements final rule and this final rule.
- Updated employment growth rates for pilots based on current FAA forecasts and actual February 2013 employment statistics for part 121 operators.
- Updated the hourly simulator costs from the $550 estimate used in the SNPRM to $500 for the final rule based on updated FAA Flight Standards Service (AFS) data. This revised cost maintains consistency with analysis from the "Pilot Certification and Qualification Requirements for Air Carrier Operations" final rule published on July 15, 2013 (78 FR 42324).
- Conducted a sensitivity analysis on the hourly simulator rental rate using the $550 rate from the SNPRM. We estimated $323.1 million for the total costs using the $550 hourly rate. The total benefits, as shown in Table 22, exceed the costs for the $550 hourly simulator rental rate.
- Initiated the "Flight Simulation Training Device Qualification Standards for Extended Envelope and Adverse Weather Event Training Tasks" rulemaking to amend 14 CFR Part 60 to require the additional programming and upgrades to simulators, which will be needed to comply with extended envelope training required by the final rule. The FAA estimates that the $500 hourly simulator rental rate assumed in this analysis includes all upgrades expected to be required by the Flight Simulation Training Device rulemaking. As an alternative, we also conducted a sensitivity analysis using $600 for an hourly simulator rental rate. We estimated $332.4 million for the total costs with the $600 hourly rate. The total benefits as shown in Table 22 also exceed the costs for $600 hourly simulator rental rate.
- Conducted a sensitivity analysis to explore the effect of reducing the historical analysis period from the 22 year period to 10 years in response to comments disputing the use of a

22-year time frame for accidents. Appendix 14 shows that using the 10-year period, the estimated benefits of this final rule increase by approximately 17 percent.

- Changed the pilot ground school distance learning[5] percentage from the 80 percent estimate used in the SNPRM to 100 percent, because the FAA allows 100 percent of non-hands on pilot ground training to be accomplished via distance learning.[6] Therefore, the FAA assumes that 100% of the non-hands on pilot ground training required by the final rule can be done via distance learning.

[5] Distance learning allows pilots to train out of the classroom (such as at home).

[6] FAA Order 8900.1, Vol.3, Ch. 19, Sec. 5, Para. 3-1209 (July 15, 2013). The FAA notes pilot ground school training requirements include hands-on emergency equipment training (current §121.417(c) requires that every 24 months, pilots must perform hands-on drills on aircraft emergency equipment) that may not be accomplished via distance learning. The costs for those hands-on drills are not included in this cost analysis because they are currently required.

III. GENERAL BENEFIT-COST ANALYSIS ASSUMPTIONS

This section details the derivation of the FAA's estimation of the benefits and costs. First, we discuss general assumptions used in our estimation of the benefits and costs. Then we explain the estimation of the quantified benefits and discuss the qualitative benefits. Next, we discuss the estimation of the quantified costs. Lastly, we summarize the estimated benefits and costs for the final rule.

The benefit and cost analysis for the regulatory evaluation is based on the following factors/assumptions:

- The analysis is conducted in constant dollars with 2012 as the base year.
- The estimates of costs and benefits reported in this evaluation include both 2012 dollar values and present values. Benefits and costs are calculated in present values using both 3 percent and 7 percent discount rates as prescribed by OMB in Circular A-4.
- This final rule will be published in late 2013.
- This final rule will become effective in 2014, 120 days after its publication. Compliance is required on the effective date (120 days) for a few of the provisions, including for example all technical amendments, §§ 121.9 (falsification), 121.392 (identification of personnel as flight attendants), and 121.711 (communication records). Compliance with the provisions related to training is required within 5 years after the effective date. We note, however, that individual air carriers may submit proposed training program revisions for approval at any point after the effective date. The agency will work with each air carrier to meet their implementation needs.
- Although some incidental costs are expected to occur prior to 2019, the primary analysis period for costs and benefits extends for 10 years, from 2019 through 2028. This period was selected because annual costs and benefits will have reached a steady state by 2019.

IV. BENEFIT ANALYSIS

The FAA contracted Volpe National Transportation System Center to assist the FAA with the estimation of the final rule's benefits and the forecast of future accidents, fatalities and injuries. The FAA estimates of the phased-in benefits of this final rule over the analysis interval are shown in Table 1. These benefits are anticipated to result from the additional operational and training requirements of the final rule. The FAA estimates that these requirements will reduce the probability of aviation accidents. Reducing the probability of their recurrence generates benefits in the form of reductions in the expected fatalities, injuries, and other costs resulting from such accidents. The regulations will enhance traditional pilot training programs by requiring training in areas that NTSB and FAA have identified as critical to preventing the recurrence of certain types of accidents.

Benefit Assumptions

In addition to the general assumptions identified at the beginning of this section, the FAA made the following specific assumptions to facilitate the benefit analysis for this regulatory evaluation:

- Safety benefits will be realized beginning in 2019, when compliance is required with the new training provisions in the final rule.
- Past accident history from 1988 to 2009 (22 years) is an appropriate basis on which to forecast the likely future occurrence of the types of accidents that the training and other provisions of this rule will help to prevent. The Accident Population and Scoring section provides the reasons for a 22-year benefit period.

Accident Population and Scoring

The FAA expects that the major benefit of the final rule will be to prevent or reduce the probability of certain types of aircraft accidents in the future. For the benefits analysis, the FAA analyzed the causal factors, as determined by the NTSB, for past accidents that occurred in part 121 operations. The objective of the analysis was to determine if an accident could have been prevented or mitigated by the training provisions in the final rule. In 1988, Delta flight 1141 crashed shortly after lifting off from the runway at the Dallas-Fort Worth International Airport

(DCA88MA072). In its final report, the NTSB determined that one causal factor for the accident was "The captain and first officer's inadequate cockpit discipline which resulted in the flightcrew's attempt to take off without wing flaps and slats properly configured."

As a result of the accident investigation, the NTSB made recommendations to the FAA that emphasized the importance of training and manual procedures regarding "the roles of each flight crewmember in visually confirming the accomplishment of all operating checklist items," as well as the "verification of flap position during stall recognition and recovery procedures."

The FAA determined that the pilot monitoring training and operational provisions may have prevented or mitigated this accident. The pilot monitoring training will provide pilots an opportunity to practice monitoring skills in an environment that closely simulates real line operations. The operational requirements will require flightcrew members to follow air carrier procedures regarding pilot monitoring. Together, these provisions establish an active requirement for the pilot not flying the aircraft to remain engaged throughout the flight by monitoring the pilot flying, as well as the position of the aircraft, the flight instruments, the configuration of the aircraft, etc. The provisions will ensure that the pilot monitoring is prepared to notify the pilot flying of any anomalies or to assume the flying responsibilities if necessary. If these requirements had been in place at the time of this accident, the pilot monitoring may have identified the incorrect configuration and notified the pilot flying prior to takeoff.

Therefore, the FAA initiated the historical accident interval for the benefits analysis with this accident in 1988. The FAA concluded the accident interval in 2009 with the Colgan accident because, at this time, the NTSB still has not finalized its reports on the major accidents (that may be pertinent to this training rule) that occurred in 2010 and 2011. This is why the FAA uses the same 22 year accident interval (1988-2009) for the benefits analysis in the final rule as in the SNPRM.

The FAA identified 10 additional major accidents with casual factors identified by the NTSB that are addressed by the provisions in the final rule that occurred during this 22 year accident interval. The FAA cited these accidents in the benefits analysis based on pertinent accident

causal factors, regardless of whether or not there were open NTSB recommendations associated with those accidents.

In response to comments questioning the use of a 22-year period, however, the FAA conducted a sensitivity analysis to explore the effect of reducing the historical analysis period from 22 years to 10 years. As indicated in Appendix 14, using the 10-year historical accident analysis period increases the estimated benefits of the final rule by approximately 17 percent.

The analysis conducted for the Regulatory Evaluation accompanying the SNPRM identified 149 pilot-related accidents during the 22 year historical analysis period covering 1988 to 2009 for which the proposed rule would reduce the probability of their recurrence. The FAA Accident Investigation and Prevention Group (AVP) and FAA's Flight Standards Service (AFS) subsequently determined that the more limited set of regulatory changes in this final rule address the causal factors (as determined by the NTSB) involved in nine of those 149 historical pilot-related accidents. For further explanation regarding the limited set of regulatory changes, please see Section I of the final rule preamble, "Overview of Final Rule."

For example, on February 12, 2009, a Colgan Air, Inc. Bombardier DHC-8-400, operating as Continental Connection flight 3407, was on an instrument approach to Buffalo-Niagara International Airport, Buffalo, New York, when it crashed into a residence in Clarence Center, New York, about five nautical miles northeast of the airport resulting in the death of everyone aboard and one person on the ground. The NTSB determined that the probable cause of this accident was the pilot in command's (PIC) inappropriate response to the activation of the stick shaker, which led to an aerodynamic stall from which the airplane did not recover. The PIC's response was inappropriate because he pulled back on the control column rather than pushing it forward to reduce the angle of attack. As a result, the airplane's pitch increased and its airspeed decreased, resulting in the stall. A contributing factor was both pilots' failure to monitor airspeed via their primary flight display and thus their failure to recognize the impending stick shaker onset as airspeed fell and pitch increased. The NTSB noted that the "failure of both pilots to detect this situation was the result of a significant breakdown in their monitoring responsibilities and workload management." The PIC's poor response suggests he was surprised

by activation of the stick shaker. Another contributing factor was the crew's lack of professionalism in failing to follow FAA sterile cockpit rules below 10,000 feet. The PIC had 3,379 hours total flying time and the second in command (SIC) 2,244 hours. Had the flightcrew been required to complete the extended envelope training provisions required by this final rule, this accident would likely have been mitigated.

Also, on September 8, 1994 a USAir (now US Airways) Boeing 737-300, flight 427, crashed while maneuvering to land at Pittsburgh International Airport, Pittsburgh, Pennsylvania. Flight 427 was operating as a scheduled domestic passenger flight from Chicago-O'Hare International Airport, Chicago, Illinois, to Pittsburgh. The flight crew did not report any problems with the airplane and radar data indicates that the closest other traffic was about 4.5 miles and 1,500 feet vertically separated from flight 427 at the time of the accident. About 6 miles northwest of the destination airport, the airplane entered an uncontrolled descent and crashed near Aliquippa, Pennsylvania. All 132 people on board were killed, and the airplane was destroyed by impact forces and fire. The NTSB determined that the probable cause of the accident was a loss of control of the airplane resulting from the movement of the rudder surface to its limit. The rudder surface most likely deflected to its limit in a direction opposite to that commanded by the pilots as a result of a failed main rudder power control unit (PCU). The FAA has determined that the provisions regarding upset prevention and recovery training in this final rule may have prevented or mitigated this accident.

In addition, given the changes adopted in the final rule and the impact the training provisions will have on air carriers who provide training under an Advanced Qualification Program, the FAA has determined that two additional accidents, American 587 and Continental 1404, involved contributing factors that are addressed by the final rule.

On November 12, 2001 an American Airlines A300-600, flight 587, crashed in a residential area of Belle Harbor, New York. The airplane accident occurred shortly after takeoff from John F. Kennedy International Airport, Jamaica, New York. All 260 people aboard the airplane and 5 people on the ground were killed, and the airplane was destroyed by impact forces and a post-crash fire. The NTSB found the probable cause of this accident to be the in-flight separation of

the vertical stabilizer as a result of the loads beyond ultimate design caused by the SIC's unnecessary and excessive rudder pedal inputs. The rudder input was a reaction to wake turbulence. Characteristics of the Airbus A300-600 rudder system design and elements of the American Airlines Advanced Aircraft Maneuvering Program also contributed to the incorrect rudder pedal inputs. The NTSB found that the American Airlines Advanced Aircraft Maneuvering Program excessive bank angle simulator exercise could have caused the SIC to have an unrealistic and exaggerated view of the effects of wake turbulence; erroneously associate wake turbulence encounters with the need for aggressive roll upset recovery techniques; and develop control strategies that would produce a much different, and potentially surprising and confusing, response if performed during flight. The provisions adding upset prevention and recovery training in this final rule may have mitigated this accident because the training delivers recovery strategies which focus on primary control inputs and early intervention strategies.[7] Further, the provisions that require pilots to complete upset prevention and recovery training in a full flight simulator (FFS) with an instructor who has been trained on the specific motion and data limitations of the FFS, would mitigate the possibility of delivering negative training in simulation.[8]

On December 20, 2008, a Continental Airlines Boeing 737-500, flight 1404, departed the left side of runway 34R during takeoff from Denver International Airport, Denver, Colorado. At the time of the accident, visual meteorological conditions prevailed, with strong and gusty winds out of the west. The NTSB reported that, as the airplane crossed the uneven terrain before coming to a stop; the airplane became airborne, resulting in a jarring impact when it regained contact with the ground. A post-crash fire ensued and the airplane was substantially damaged. The PIC and 5 of the 110 passengers were seriously injured; the SIC, 2 cabin crewmembers, and 38 passengers sustained minor injuries. The NTSB accident report revealed that before starting the takeoff roll the PIC verbally repeated the wind speed and direction; however, during the takeoff roll the PIC inconsistently applied cross wind correction. The NTSB found that the probable cause of the

[7] All pilots have received training on wake turbulence from the early stages of flight training. Since wake turbulence can lead to an upset condition, the enhanced training required in this rule will reinforce earlier training by teaching pilots appropriate upset prevention and recovery techniques.

[8] Appendix 15 provides a sensitivity analysis to determine the impact of removing the catastrophic American 587 accident from the benefits analysis for the 10 and 22 year historical accident analysis intervals.

accident was the PIC's ceased rudder input, which was needed to maintain directional control of the airplane, about 4 seconds before the excursion, when the airplane encountered a strong and gusty crosswind that exceeded the PIC's training and experience. The FAA has determined that the expansion of existing requirements for training on crosswind maneuvers to include wind gusts in this final rule may have prevented or mitigated this accident.

American 587 and Continental 1404 were excluded from the benefits estimates reported in the SNPRM because the SNPRM analysis assumed that the proposed rule would have no impact on the safety of flights operated by pilots trained using an Advanced Qualification Program (AQP).

Following further review of existing AQP curriculums and the pilot training requirements retained for the final rule, the agency has determined that the majority of the rule's new pilot training maneuvers and procedures are *not* incorporated into existing AQPs used to train pilots; therefore, it is appropriate to include those two additional accidents in this analysis. For these 11 accidents, the NTSB investigations identified several specific areas of inadequate training that were either the probable cause or a contributing factor for many of these accidents. Of the 11 pilot-related accidents, nine accidents involved one or more fatalities and two had no fatalities.

To determine the likely probability of effectiveness of the final rule in preventing the recurrence of accidents similar to the 11 accidents identified in the historic period, AVP undertook a multiple-step process. The FAA recognizes that there are multiple rulemakings occurring in parallel with this final rule and there is some degree of overlap among them regarding the historical accidents used to estimate benefits.[9] Therefore, to account for the relationship of these new rules, AVP first rated the effectiveness of the entire suite of these rules in reducing the probability of the future recurrence of these accidents, using the scoring process of the Commercial Aviation Safety Team (CAST).[10] AVP used the NTSB recommendations along

[9] Specifically, these parallel rulemakings are: Flightcrew Member Duty and Rest Rule (FDR); Pilot Certification and Qualification Requirements for Air Carrier Operations Rule (FOQ); Flight Simulation Training Device Qualification Standards for Extended Envelope and Adverse Weather Event Training (part 60) and Safety Management Systems for part 121 Certificate Holders (SMS).

[10] The FAA evaluated these historical accidents in the context of the other rulemakings such that the sum of the probabilities for each accident across all these rules will not exceed one. Appendix 13 details the overlap of the probability for each accident in the parallel rules that are published as a final rule.

with its narrative descriptions, probable cause findings, identification of contributing factors, and other pertinent data to assign scores reflecting the likelihood that the *collection* of these rules could have prevented each accident in the final rule analysis interval.

AVP developed these scores using a Joint Implementation Monitoring Data Analysis Team (JIMDAT)-like method because many of the issues surrounding these accidents are not clearly defined in the probable cause or contributing factors statements of the NTSB reports. The JIMDAT-like score, as applied to a specific historical accident, is based upon the likelihood that the training, operational, and other changes these rules collectively require would have prevented the occurrence of that accident if they had been in place at the time it occurred. AVP used a sliding percentage scale of zero to 0.9 to describe the score assigned to each accident.

The second step of the process was to allocate the overall probability of effectiveness for the suite of new rules to each individual rule, so that the safety-related benefits of each individual rule – which arise from the projected effectiveness *of that specific rule* in reducing the probability of future accidents – could be estimated. AVP used the same zero to 0.9 sliding scale noted above to arrive at the final effectiveness ratings. In some cases, this effort to allocate the composite probability of effectiveness among individual rules is complicated by their interrelatedness. For instance, this final rule requires additional simulator training for pilots, while the upcoming part 60 rulemaking would establish the requirements that simulators be capable of providing the enhanced training capabilities required under this final rule. In that case, the combined probability of effectiveness of these two rules was allocated roughly evenly between this final rule and the part 60 rulemaking.

Table 2 shows probability of effectiveness for this final rule for the 11 historical accidents that were used as the basis for estimating its benefits, and also reports important summary information regarding these accidents. Appendix 1 and Appendix 2 provide additional details of the historical accidents.

Table 2

Selected Characteristics of 11 Historic Accidents (1988-2009)

Carrier	Flt#	Date	State of Accident	Aircraft	Fatalities	Serious Injury	Minor Injury	People on Board	Probability of Effectiveness
Colgan	3407	2/12/2009	NY	DHC-8	50	0	0	49	0.20
American	587	11/12/2001	NY	A300	265	0	0	260	0.25
American Eagle	4184	10/31/1994	IN	ATR-72	68	0	0	68	0.20
USAir	427	9/8/1994	PA	B737	132	0	0	132	0.20
COMAIR	5191	8/27/2006	KY	CRJ-100ER	49	1	0	50	0.15
Northwest	1482	12/3/1990	MI	DC-9	8	10	26	44	0.50
Continental	1404	12/20/2008	CO	B737	0	6	41	115	0.25
FedEx	647	12/18/2003	TN	MD-10	0	0	2	7	0.35
Delta	1141	8/31/1988	TX	B727	14	26	50	108	0.35
Corporate	5966	10/19/2004	MO	Jetstream 32	13	2	0	15	0.05
USAir	5050	9/20/1989	NY	B737	2	3	18	63	0.50
Total					601	48	137	911	

Quantification of Safety Benefits

This section describes the methodology the FAA used to quantify the safety benefits for the final rule. Appendix 3 identifies the specific provisions of this final rule that respond to the probable causes and contributing factors that the NTSB identified for each historic accident. Because many accidents were the result of multiple contributing factors, and the provisions of this final rule were developed to respond to these contributing factors, there are several cases where the rule's probability of effectiveness for an historical accident is the result of the expected impacts of multiple provisions of the rule. For that reason, the FAA has not attempted to develop separate benefit estimates for each individual provision of this rule, and our quantitative estimates of the rule's benefits will be derived only for all of its provisions taken together. In addition, there are other provisions of the rule for which anticipated benefits can be described only in qualitative terms; these provisions will be discussed separately in a later section of this document.

The following provisions of the final rule are expected to have quantifiable safety benefits:

- Pilot monitoring (§§ 121.544, 121.409, Appendix H),
- Remedial training (§§ 121.415(h) and § 121.415(i)),
- Extended envelope flight training maneuvers and procedures (§§ 121.423, 121.407(e), 121.424, 121.427(d)(1)(i), 121.433(e), Appendix E),
- Extended envelope ground training subjects (§§ 121.419(a)(2) and 121.427),
- Runway safety maneuvers and procedures (Appendices E and F), and

- Crosswind maneuvers including wind gusts (Appendices E and F).

The benefits of avoiding the recurrence of an accident potentially include avoided fatalities, injuries, aircraft replacement or repair, loss of cargo for cargo plane accidents, property damage on the ground, and accident investigation costs.[11]

In estimating the value of an averted future accident, we take the characteristics of the historic accidents as a starting point. No future accident is expected to have exactly the same causes or consequences as the historical accidents included in this analysis. Rather, this analysis uses these historical accidents to indicate the prevalence of accidents due to insufficient training in the past, and uses this information as an indication of how frequently these same types of accidents might occur in the future in the absence of this final rule.

The accident history is also used to inform our estimates of the likely severity of these types of potential future accidents, which is measured by the percent of passengers aboard the aircraft that were injured (fatal, serious, minor), the extent of physical damage to the aircraft involved, and the extent of any physical damage on the ground. This analysis then applies forward-looking estimates of the value of preventing the recurrence of accidents of that same severity. For instance, the projected value of avoiding a hull loss during the future analysis period is not the actual economic value of the aircraft hull that was lost in an historical accident, but is instead the estimated value of an aircraft that would be likely to be in use in the future.

In estimating benefit values for avoided fatalities and injuries, the FAA follows the Department of Transportation's (DOT) recently-issued document "Revised Departmental Guidance 2013: Treatment of the Value of Preventing Fatalities and Injuries in Preparing Economic Analysis."[12] That document estimates the value for preventing a fatality at $9.1 million (in 2012 dollars), while preventing a serious injury is valued at $1,264,900 (assumed to be the average of economic costs for severe, serious, and moderate injuries), and preventing a minor injury is

[11] Avoided emergency response and environmental clean-up costs might be included as other categories of benefits but at this time FAA does not have access to estimates of these cost categories. The FAA believes the magnitude of the benefit categories to be relatively small in comparison to the other categories of benefits analyzed here.
[12] Available at http://www.dot.gov/regulations/economic-values-used-in-analysis

estimated to have an economic value of $27,300. As recommended in the recent DOT guidance document identified above, these values are then escalated at 1.07 percent per year to reflect the effect of growth in real income levels on the value that society collectively places on avoiding accidental fatalities and injuries. See Appendix 4 for more details.

In estimating the number of fatalities and injuries avoided by preventing the occurrence of future accidents, we calculate the number of fatalities and serious and minor injuries as percentages of the number of people on board the aircraft involved in each historic accident. Table 3 shows this information for each historical accident. We then apply those percentages to the expected passenger count on a typical future flight. The average number of passengers per flight for part 121 passenger operations during 2012 was 84 persons, and the average seating capacity of the aircraft they operated was 106 seats.[13] After allowing for three flight attendants (one for every 50 seats) and two flightcrew members, this procedure assumes there would have been 89 people aboard a typical flight during 2012. For the single cargo plane accident (FedEx Flight 647), this analysis includes the benefits of avoiding the two minor injuries that occurred in the actual historical accident. Any additional fatalities or injuries on the ground that occurred in a historical accident are also included in the estimates, without adjustment.

[13] Bureau of Transportation Statistics, Air Carrier Statistics, T-100 Segment Data (U.S. Carriers) for Jan – Oct 2012. The listing of part 121 carriers can be found in Appendix 8.

Table 3

Fatalities and Injuries as Percentages of People Onboard

Carrier	Flt#	Onboard			
		Fatalities	Serious Injuries	Minor Injuries	Total People Onboard
Colgan	3407	100%	0%	0%	49
American	587	100%	0%	0%	260
American Eagle	4184	100%	0%	0%	68
USAir	427	100%	0%	0%	132
COMAIR	5191	98%	2%	0%	50
Northwest	1482	18%	23%	59%	44
Continental	1404	0%	5%	36%	115
FedEx	647	0%	0%	29%	7
Delta	1141	13%	24%	46%	108
Corporate	5966	87%	13%	0%	15
USAir	5050	3%	5%	29%	63
Total		65%	5%	15%	911

* Details may not add to row or column totals due to rounding.

Table 4 shows the forecasted number of fatalities and injuries that would be expected to result if an accident of the same severity as the historical accident recurred in 2012, and involved the typical airplane carrying 89 people. The 11 historical accidents resulted in a total of 601 fatalities, 48 serious injuries, and 137 minor injuries. In contrast, the method described above results in estimates of 44 fewer fatalities, 16 additional serious injuries, and 16 additional minor injuries from an identical number of similarly severe potential future accidents. This discrepancy results because although the average number of people on board the aircraft involved in the historical accidents (90) is in line with the average future passenger load projected for this analysis (89), two of the historical accidents (American 587 and USAir 427) occurred on larger than average aircraft and were catastrophic. This means that the actual accident history shows higher fatalities than we assume would occur in the future without the final rule. The decision to use expected future values for aircraft size and passenger counts is made because the FAA believes that the risk of a catastrophic accident is not specific to a certain size of aircraft. All FAA regulations require the same level of pilot training and qualifications for all part 121 operations, regardless of the size of aircraft they typically operate, so that improving pilot training is expected to uniformly reduce the probability that aircraft of all sizes will be involved in future accidents.

Our estimate of future benefits incorporates information related to the rule's expected impacts on the aviation system looking forward in order to appropriately value the reduction in future risks. However, as a test of the sensitivity of our benefits estimates using this approach, we also include an analysis assuming that the exact number of fatalities and injuries as actually occurred in each historical accident would occur in a potential future accident. The details and results of those calculations are in Appendix 5.

Table 4

Forecasted Fatalities and Injuries for Accidents

		Onboard				On Ground
Carrier	Flt#	Fatalities	Serious Injuries	Minor Injuries	Total People Onboard	Fatalities
Colgan	3407	89	0	0	89	1
American	587	89	0	0	89	5
American Eagle	4184	89	0	0	89	0
USAir	427	89	0	0	89	0
COMAIR	5191	87	2	0	89	0
Northwest	1482	16	20	53	89	0
Continental	1404	0	5	32	89	0
FedEx	647	0	0	2	7	0
Delta	1141	12	21	41	89	0
Corporate	5966	77	12	0	89	0
USAir	5050	3	4	25	89	0
Total		551	64	153	897	6

Table 5 below shows the estimated benefits from preventing the forecasted fatalities and injuries associated with the potential future recurrence of each of the 11 historical accidents. These estimated benefits have not yet been adjusted for the projected probability of effectiveness of the rule in preventing the recurrence of similar accidents in the future. Those adjustments are made in a later section. In addition, the benefits are projected to grow throughout the future analysis period, in order to account for projected growth in the airline industry.

Table 5

Valuation of Forecasted Fatalities and Injuries for Accidents (2012 $)

Carrier	Flt	Onboard and Ground			Total
		Fatalities	Serious Injuries	Minor Injuries	
Colgan	3407	$819,000,000	$0	$0	$819,000,000
American	587	$855,400,000	$0	$0	$855,400,000
American Eagle	4184	$809,900,000	$0	$0	$809,900,000
USAir	427	$809,900,000	$0	$0	$809,900,000
COMAIR	5191	$791,700,000	$2,535,800	$0	$794,235,800
Northwest	1482	$145,600,000	$25,358,000	$1,446,900	$172,404,900
Continental	1404	$0	$6,339,500	$873,600	$7,213,100
FedEx	647	$0	$0	$54,600	$54,600
Delta	1141	$109,200,000	$26,625,900	$1,119,300	$136,945,200
Corporate	5966	$700,700,000	$15,214,800	$0	$715,914,800
USAir	5050	$27,300,000	$5,071,600	$682,500	$33,054,100
Total		$5,068,700,000	$81,145,600	$4,176,900	$5,154,022,500

An additional benefit from preventing future accidents is avoiding damage to the aircraft itself. Again, we take the approach of estimating benefits based on the replacement value of a "typical" aircraft expected to be in the future fleet. As indicated previously, the average seating capacity per passenger flight operating under part 121 in 2012 was 106 seats.[14] The FAA forecasts that seats per flight will grow by approximately 0.5 percent annually over the analysis period, which implies that the average seating capacity of part 121 passenger aircraft is expected to average 112 by 2023, the midpoint of the benefits analysis period.[15] With a capacity of 117 seats, the Boeing B717-200 is the aircraft model in the current US fleet which is the closest in size to average forecast size of 112 seats.[16] We therefore estimate the value of a passenger aircraft of average size, and of average age to be $10.5 million based on the current market value of a nine year old Boeing B717-200. We estimate the value of a "typical" cargo aircraft to be $27.7 million, based on the market values of average-aged Boeing B757-200, Airbus A300-600, and McDonnell Douglas MD-11, the most frequently used cargo airplanes used in part 121 operations.[17] Appendix 6 reports the details of these estimates.

In all eleven historical accidents used as the basis for this benefit analysis, the primary aircraft was destroyed. In one case (Northwest 1482 on December 3, 1990), a second aircraft was

[14] Bureau of Transportation Statistics, Air Carrier Statistics, T-100 Segment Data (U.S. Carriers) for Jan – Oct 2012.
[15] See Appendix 6, Table 1 for sources and methods.
[16] Bureau of Transportation Statistics, Form 41, Schedule B-43, 2011.
[17] Bureau of Transportation Statistics, Air Carrier Statistics, T-100 Segment Data (U.S. Carriers) for Jan – Oct 2012.

involved and also sustained substantial damage, but was later repaired and placed back in service. For that accident, the damage to the second aircraft was valued at 13 percent of the average replacement value.[18]

In the case of the single cargo plane accident used in the benefits analysis (FedEx Flight 647), preventing the destruction of the cargo and the resulting loss of its value is an additional benefit category. While the FAA is unaware of published estimates for the value of air cargo, we derived the average value per ton of air cargo by assessing the commodity flow value and commodity flow weight of goods transported by air using the U.S. Department of Transportation's 2007 Freight Analysis Framework (FAF) Survey.[19] Because both weight and value of commodities typically shipped by air vary by shipment origin and destination, the average value of all shipments by air was used. An average cargo value per ton of $89 thousand (in 2012 dollars) was calculated by dividing the average value of commodities shipped by air over all origins and destinations by the corresponding average weight of an air freight shipment, and then adjusted to 2012 dollars using the change in the Gross Domestic Product deflator. The average amount of freight on a part 121 cargo-only aircraft operation is approximately 25 tons.[20] Thus the value of the complete loss of the aircraft's cargo on a typical flight is estimated to be $2.225 million in 2012 dollars.

In nine of the historical accidents, property damage on the ground was minimal because the aircraft accident occurred on or near the airport runway, in an undeveloped area such as a field, or in the water.[21] However, the Colgan 3407 accident (February 12, 2009) destroyed one home on the ground, while the American 587 accident (November 12, 2001) destroyed four homes, severely or substantially damaged four other homes and one boat (parked in a driveway), and also resulted in minor damage to a retail gasoline station and three additional homes. To estimate

[18] "Economic Values for FAA Investment and Regulatory Decisions, A Guide," Oct. 3, 2007 by GRA, Incorporated, Table 5-4.
[19] Freight Analysis Framework 2007, a joint survey conducted by the Census Bureau and BTS and updated every 5 years. (http://www.bts.gov/publications/commodity_flow_survey/2007/state_summaries/)
[20] Bureau of Transportation Statistics, Air Carrier Statistics, T-100 Segment Data (U.S. Carriers) for Jan - Oct 2012.
[21] It is worth noting that where the accident actually occurs and subsequently how much damage occurs on the ground for any future possible accident that this final rule prevents cannot be known with any level of certainty. In the absence of data or forecasts on where these types of crashes are likely to occur, we use the information on the actual ground damage experienced in the historical accidents.

the value of avoiding similar damage to ground property by preventing the recurrence of such an accident, the FAA used the 2012 median home value of $175,400.[22] Roughly 25 percent of a typical home's value is associated with the land and would not be destroyed by an accident, so the value for a destroyed house structure used in this analysis is $131,600 (75 percent of $175,400).[23] The economic benefit from preventing severe or substantial damage to homes is in turn valued at 75 percent of this average structure value ($98,700); preventing minor damage (of homes and gas station) is estimated to result in benefits equal to 25 percent of structure value ($32,900). For completeness, we have also included an estimate of the value of a pre-owned recreational boat to be $14,600.[24]

FAA estimates a value of $10.7 million for the accident investigation costs associated with a catastrophic accident, and $0.6 million for the accident investigation costs associated with a non-catastrophic accident.[25] These values are derived from estimates of costs to NTSB, FAA, and private parties associated with historical accident investigations, adjusted to 2012 dollars using the GDP deflator.

Table 6 below shows these benefit calculations for preventing damage or destruction of aircraft hull values (primary and secondary aircraft), cargo value, property damage, and accident investigation costs applied to the 11 historic accidents. Again, note that these benefits estimates are not yet adjusted to reflect the rule's probability of effectiveness in preventing similar future accidents.

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[22] Average of monthly U.S. Existing Home Median Sales Price from National Association of Realtors accessed at http://ycharts.com/indicators/sales_price_of_existing_homes on April 4, 2013.

[23] Davis, Morris A. and Jonathan Heathcote, 2007, "The Price and Quantity of Residential Land in the United States," Journal of Monetary Economics, vol. 54 (8), p. 2595-2620; data located at Land and Property Values in the U.S., Lincoln Institute of Land Policy http://www.lincolninst.edu/resources/ accessed on April 4, 2013. Estimate is based on average aggregate U.S. quarterly values for Q4 2011 through Q3 2012 for both CWS and FHFA sources.

[24] Average price of a pre-owned powerboat (with engine) in 2010 was $14,039 according to "Recreation Boating Stakeholders Growth Summit Industry Overview 2011" accessed at http://consensus.fsu.edu/Boat-Summit/pdfs/Recreational%20Boating%20Growth%20Summit%20Industry%20Overview.pdf on April 4, 2013. This value has been adjusted to 2012 value using the GDP deflator.

[25] The estimated accident investigation costs are the estimated costs of "Major" and "Air Carrier Weighted Average" investigations from "Economic Values for FAA Investment and Regulatory Decisions, A Guide," Oct. 3, 2007 by GRA for the FAA, Table 8-2.

Table 6

Additional Categories of Benefits from Preventing Historic Accident (2012 $)

Carrier	Flt#	Hull Damage		Property Damage on Ground	Cargo Value	Accident Investigation Costs	Total
		Primary	Secondary				
Colgan	3407	$10,500,000		$131,600		$10,700,000	$21,331,600
American	587	$10,500,000		$1,067,400		$10,700,000	$22,267,400
American Eagle	4184	$10,500,000				$10,700,000	$21,200,000
USAir	427	$10,500,000				$10,700,000	$21,200,000
COMAIR	5191	$10,500,000				$10,700,000	$21,200,000
Northwest	1482	$10,500,000	$1,365,000			$600,000	$12,465,000
Continental	1404	$10,500,000				$600,000	$11,100,000
FedEx	647	$27,700,000			$2,225,000	$600,000	$30,525,000
Delta	1141	$10,500,000				$600,000	$11,100,000
Corporate	5966	$10,500,000				$10,700,000	$21,200,000
USAir	5050	$10,500,000				$600,000	$11,100,000
Total		$132,700,000	$1,365,000	$1,199,000	$2,225,000	$67,200,000	$204,689,000

The next steps in estimating the benefits of the final rule are to adjust the estimated benefits from preventing each accident by the probability of effectiveness of this rule in preventing the recurrence of that specific accident, and then to project those annualized benefit values forward through the future analysis period. Table 7 displays the probability of effectiveness for each accident, along with the adjusted fatality and injury-related benefits estimates, and other categories of benefits derived using the forecasting methods discussed above. Each of the entries in the two columns containing these adjusted benefits estimates is equal to the entry in Table 5 (fatalities and injuries) or Table 6 (other benefit categories) corresponding to a specific historical accident, multiplied by the estimated probability of effectiveness of the rule in preventing that accident shown in Table 7. The bottom two rows of Table 7 show the total estimated benefits of the rule if it had been in place during the full 22 years of the accident history, and the estimated average annual benefit of the rule.

Table 7

Single Year Benefits of Final Rule (2012 $)

Carrier	Flt#	Effectiveness Rating	Benefits from Avoided Fatalities and Injuries	Other Benefits
Colgan	3407	20%	$163,800,000	$4,266,320
American	587	25%	$213,850,000	$5,566,850
American Eagle	4184	20%	$161,980,000	$4,240,000
USAir	427	20%	$161,980,000	$4,240,000
COMAIR	5191	15%	$119,135,370	$3,180,000
Northwest	1482	50%	$86,202,450	$6,232,500
Continental	1404	25%	$1,803,275	$2,775,000
FedEx	647	35%	$19,110	$10,683,750
Delta	1141	35%	$47,930,820	$3,885,000
Corporate	5966	5%	$35,795,740	$1,060,000
USAir	5050	50%	$16,527,050	$5,550,000
Total benefit over 22 year history			$1,009,023,815	$51,679,420
Per year benefit			$45,864,719	$2,349,065

The US airline industry has grown over time, and the FAA forecasts that the airline industry will continue to grow throughout the forecast period. This projected increase in traffic is accompanied by an increase in the risk of future accidents under the baseline scenario, where this rule would not be adopted. To incorporate the effect of forecasted growth on the number of future accidents prevented by the rule and the resulting economic benefits, we apply the FAA forecast of 2.1 percent annual growth in passenger enplanements to the estimates of benefits from avoided fatalities and injuries.[26] This accounts for the effects of projected increases in both overall flight activity and the typical number of passengers aboard each flight on the reduction in future fatalities expected to result from adopting this rule. Table 8 below shows the resulting growth in the estimated number of annual fatalities and injuries avoided due to the final rule.[27] We apply the 1.6 percent anticipated annual growth in commercial aircraft operations to the estimates of the other categories of benefits (avoided property damage and accident investigation costs), as these categories of benefits are more closely related to the number of flights rather than

[26] FAA Aerospace Forecasts 2013 - 2033, Table 10, U.S. Mainline Air Carriers Schedules Passenger Traffic, Average Annual Growth Rate (2013-2033) for Revenue Passenger Enplanements (System).

[27] Due to rounding, using the information in Table 8 to calculate the benefits from avoided fatalities and injuries will result in a slightly different total than is presented below.

the number of people on a flight.[28] The projected future growth rates in passenger enplanements and the number of flights differ because the industry is moving toward larger aircraft with higher load factors; therefore an increase in passenger demand can be met with a less than proportionate increase in the number of flights.

Table 8

Forecasted Growth in Fatalities and Injuries Avoided Due to Final Rule (2012 $)

Year	Calendar Year	Passenger Growth Factor	Fatalities	Serious Injuries	Minor Injuries
0	2012	1.0000			
1	2013	1.0210			
2	2014	1.0424			
3	2015	1.0643			
4	2016	1.0867			
5	2017	1.1095			
6	2018	1.1328			
7	2019	1.1566	5.66734	1.13347	3.26161
8	2020	1.1809	5.78641	1.15728	3.33014
9	2021	1.2057	5.90793	1.18159	3.40007
10	2022	1.2310	6.03190	1.20638	3.47142
11	2023	1.2568	6.15832	1.23166	3.54418
12	2024	1.2832	6.28768	1.25754	3.61862
13	2025	1.3102	6.41998	1.28400	3.69476
14	2026	1.3377	6.55473	1.31095	3.77231
15	2027	1.3658	6.69242	1.33848	3.85156
16	2028	1.3945	6.83305	1.36661	3.93249

As indicated previously, the unit values for fatalities and injuries avoided are escalated at 1.07 percent per year to account for growth in real incomes, in accordance with DOT guidance.[29] In the absence of information on how unit values for the other categories of benefits (aircraft hull damage, property damage on the ground, etc.) are likely to change in real terms over the future, the 2012 estimates of unit values for each other category of benefits are used throughout the future analysis period. Table 9 shows the results of these forecasting assumptions for each year of the 10-year benefit period for this rule, which extends from 2019 through 2028. To summarize, the annual benefits from avoided fatalities and injuries from the last row of Table 9 are escalated by two factors: 1.07 percent per year to account for real income growth, and 2.1

[28] FAA Aerospace Forecasts 2013 - 2033, p. 62.
[29] "Revised Departmental Guidance 2013: Treatment of the Value of Preventing Fatalities and Injuries in Preparing Economic Analysis" available at http://www.dot.gov/regulations/economic-values-used-in-analysis

percent per year to reflect growth in passenger enplanements. The other categories of benefits from the last row of Table 9 are escalated at 1.6 percent per year, to account for future growth in the number of flights and the associated increase in accident risk exposure. In addition, Table 9 displays the present value of the benefits over the future analysis period when discounted at both the seven percent and three percent rates recommended in OMB Circular A-4.

Appendix 5 presents calculations that parallel this analysis, but instead use the actual fatalities and injuries resulting from each historical accident as the basis for an alternative estimate of the rule's benefits. The calculations in Appendix 5 use the same 2012 estimates of property damage and accident investigation estimates as the central analysis, but do not incorporate any forecasted growth in industry-wide flight activity.

Table 9

Total Benefits of Final Rule (2012 $)

Year	Calendar Year	Benefits from Avoided Fatalities and Injuries	Other Benefits	Total Benefits		
				Total	Present Value at 7%	Present Value at 3%
0	2012					
1	2013					
2	2014					
3	2015					
4	2016					
5	2017					
6	2018					
7	2019	$57,147,677	$2,625,080	$59,772,757	$37,220,496	$48,601,229
8	2020	$58,976,617	$2,667,128	$61,643,745	$35,876,660	$48,661,572
9	2021	$60,856,650	$2,709,881	$63,566,531	$34,573,836	$48,717,389
10	2022	$62,799,867	$2,753,104	$65,552,971	$33,320,575	$48,777,966
11	2023	$64,802,012	$2,797,267	$67,599,279	$32,116,417	$48,833,719
12	2024	$66,869,469	$2,841,899	$69,711,368	$30,951,847	$48,895,554
13	2025	$69,009,601	$2,887,471	$71,897,072	$29,837,285	$48,961,906
14	2026	$71,212,699	$2,933,747	$74,146,446	$28,753,992	$49,018,215
15	2027	$73,485,369	$2,980,494	$76,465,863	$27,711,229	$49,083,437
16	2028	$75,829,021	$3,028,180	$78,857,201	$26,708,934	$49,143,808
Total		$660,988,982	$28,224,251	$689,213,233	$317,071,271	$488,694,795

* Details may not add to row or column totals due to rounding.

The total estimated benefit of the final rule over the analysis period is $689.2 million in 2012 dollars. This stream of benefits has a present value of $317.1 million when discounted at seven percent and $488.7 million when discounted at three percent.

These benefits estimates differ from those presented as part of the SNPRM for several reasons. On one hand, certain changes in the benefits estimation methodology acted to lower the estimated benefits of the final rule. The final rule has fewer training requirements and other provisions than the previously-proposed version of the rule analyzed in the SNPRM; this results in lower benefits, because fewer accidents are judged to be prevented by the final rule. Further, the effectiveness ratings used in the SNPRM represented the impact of this rule when considered in isolation, while the probability of effectiveness used here take into account the reductions in accident risk expected to result from other contemporaneous rulemakings that FAA is undertaking. Thus for the most part, the probability of effectiveness ratings assigned to the accidents that could have been mitigated by this final rule are lower than those used in the SNPRM.

The probability of effectiveness for USAir 427, which had an effectiveness rating of zero in the SNPRM, is the exception. USAir 427 crashed while maneuvering to land at Pittsburgh International Airport, Pittsburgh, Pennsylvania.[30] As part of the analysis for the final rule, AVP re-evaluated the accidents to be included as the basis for the benefits estimates for the final rule. In doing so, AVP determined that the upset recovery and prevention training provisions in the final rule, together with the enhancements to simulators from the new part 60 rulemaking, may have prevented or mitigated the accident in such a way that the revised 20 percent probability of effectiveness was appropriate. Further, two additional accidents, American 587 and Continental 1404, were added to the list of accidents used to develop the benefits estimates for the final rule when it was determined that the final rule would indeed improve the safety of flights operated by pilots trained using AQP. Finally, there have also been modifications to the unit values used to estimate the various benefit categories. The most significant change is that DOT guidance now specifies that benefit cost analyses use an estimate of $9.1 million for the value of preventing a fatality, whereas at the time of the SNPRM, the DOT guidance specified $6.0 million as the Value of Statistical Life (VSL) to use in benefit cost analyses.

[30] Appendix 1 and Appendix 2 provide additional details of the historical accidents.

On net, the methodology changes that acted to increase the estimated benefits outweighed the methodology changes that acted to reduce estimated benefits. As a result, the projected benefits for this final rule are higher than those estimated and reported in the SNPRM.

Qualitative Benefit Discussion

This section discusses the benefits of the remaining provisions of the final rule in qualitative terms:

- Fraud and falsification(§ 121.9),
- Personnel identified as flight attendants (§ 121.392),
- Proficiency checks for PICs (§ 121.441(a)(1)(ii)),
- Related aircraft differences training (§§ 121.400, 121.418, 121.434, 121.439, 121.441),
- Training equipment other than FSTDs approved under part 60 (§§ 121.408, 121.403(b)(2)),
- Approval of FSTDs (§ 121.407),
- Communication records for domestic and flag operations (§ 121.711), and
- Training for instructors and check airmen who serve in FSTDs (§§ 121.413 and 121.414).

Fraud and falsification (§ 121.9)

Although fraud is currently prohibited by criminal statute, the FAA has added language prohibiting fraud and falsification to part 121 to emphasize the importance of truthful statements. This provision prohibits fraudulent or intentionally false statements in, or a known omission from, any record or report that is kept, made, or used to show compliance with this part, or to exercise any privileges under this chapter. This provision enhances FAA enforcement options by allowing the agency to take certificate action or assess a civil penalty against a person for making a fraudulent or intentional false statement. This provision may contribute to safety of the aviation system although it is not possible to quantify or value that improvement.

Personnel identified as flight attendants (§ 121.392)

This provision prohibits operators from identifying any person as a flight attendant if that person has not completed all flight attendant training and qualification. Individuals who have not completed all flight attendant training and qualification requirements must be clearly identified (e.g. via an announcement, by wearing civilian clothes, or not wearing a uniform). This provision may reduce confusion of passengers during an emergency situation on a flight who might otherwise presume that these individuals are fully qualified flight attendants. However FAA does not have access to any information that would allow for quantifying the safety benefit of this provision.

Proficiency checks for PICs (§ 121.441(a)(1)(ii))

Currently, in accordance with §§ 121.433(d) and 121.441(a)(1), a PIC who serves on more than one aircraft type must complete either recurrent flight training or a proficiency check on each aircraft type every 12 months. The final rule amends § 121.441(a)(1) to require PICs who fly more than one aircraft type to receive a proficiency check in each aircraft type flown every 12 months. This amendment ensures PICs operating multiple aircraft types maintain proficiency on each aircraft type flown. However, the FAA does not have access to any information that would allow for quantifying the safety benefits of this provision.

Related aircraft differences training (§§ 121.400, 121.418, 121.434, 121.439, 121.441)

This provision formalizes the current practice of allowing carriers and their pilots to take credit for training or qualification events on one type of aircraft, and apply that same credit to other aircraft types that have similar flight handling characteristics. This type of training credit is currently allowed in practice for some aircraft types, most notably the Boeing 757 and Boeing 767. New advances in fly-by-wire technology allow aircraft manufacturers to design aircraft with different models and aerodynamic airframes that are operated in the same way. The ability to transfer credit for previous training and qualification on existing aircraft types to different but related aircraft types that have similar flight handling characteristics could offer a significant cost savings to carriers when they add new aircraft types to their fleets. In this scenario, they will not need to develop completely new training programs or completely retrain the pilots flying the new

aircraft types. In addition, there are long term training and qualification efficiencies for pilots who are qualified on more than one related aircraft type, in the form of recurrent simulator training and qualification, as well as recency of experience requirements, operating experience requirements, and consolidation. Lowering the training costs for air carriers to adopt new aircraft types will speed up the entry of newer aircraft types into the fleet, which will also bring about social benefits from the reduced noise, emissions, and fuel usage that the newer aircraft types provide.

Training equipment other than FSTDs approved under part 60 (§§ 121.408, 121.403(b)(2))

Current regulations do not provide specific requirements for training equipment other than FSTDs, but the regulations generally require training equipment to be adequate. Section 121.408 states that the FAA must approve training equipment (e.g. cockpit procedures trainers, door/exit trainers, water survival equipment, etc.) used to functionally replicate aircraft equipment required to be used as part of the approved training program. As such, this provision enables the safety benefits from the regulations governing training on equipment other than FSTDs. It is not feasible to separately estimate the benefits of this specific provision.

Approval of FSTDs (§ 121.407)

This provision conforms the requirements for evaluation, qualification, and maintenance of FSTDs used in part 121 to existing part 60 requirements, by providing a reference to part 60 in part 121 and adding a new paragraph consistent with the § 121.423 requirement to use an FSTD for extended envelope training. This provision therefore provides clarification regarding part 60 requirements that currently apply to part 121 training. Compliance with new paragraph (e) of this provision is required 5 years and 120 days after the date of publication of the final rule in the Federal Register because the new extended envelope training required by § 121.423 is not required until such time.

Communication records for domestic and flag operations (§ 121.711)

This provision clarifies the information that must be included in the record of communications between the pilot and aircraft dispatcher based on a legal interpretation of the current requirement in § 121.711. This provision also clarifies the recordkeeping requirement by defining “en route” for purposes of this section and applies the requirement to all flightcrew/dispatch communications made using a two-way communication system required in accordance with § 121.99.

Training for instructors and check airmen who serve in FSTDs (§§ 121.413, 121.414)

These final rule provisions will add some additional check airman (simulator) and flight instructor (simulator) initial, transition and recurrent training curriculum items to current requirements in existing §§ 121.413 and 121.414 to ensure comprehensive check airman and flight instructor understanding of new training tasks in the final rule and the limitations of simulation. When the FAA introduced the extended envelope requirements, we felt it was important to train simulator instructors how to train pilots for these events. Instructors need to understand the simulator control and possess the knowledge to be able to handle these new training requirements. This provision enables the safety benefits from the FSTD training program by ensuring that the check airmen and flight instructors can adequately operate the FSTDs to achieve positive training outcomes. It is not possible to separately quantify the benefits of this individual provision.

V. COST ANALYSIS

The final rule costs will accrue from additional training requirements, a low and high range for the use of simulator time, ground school training facilities, and paperwork. Those individuals affected by the new requirements include crew members (pilots and flight attendants) and aircraft dispatchers. The constant 2012 dollars and discounted 3 and 7 percent present value costs are summarized in the Cost Summary section below.

General Cost Assumptions and Data Sources

The assumptions and identification of key data sources to estimate costs are:

- The number of part 121 and 121/135 operators, and their pilots were obtained through the FAA National Vital Information Subsystem (NVIS) database in February 2013. [31]
- NVIS only provides a total number for pilots and does not break out total pilots into pilots, check pilots and flight instructors. We use the same assumptions as in the SNPRM that 4.0 percent of the total number of pilots are check pilots, and 2.0 percent of the total number of pilots are instructors.
- Using the FAA Aerospace Forecasts, for fiscal years 2013-2033, the FAA estimated that the affected population of pilots would grow at approximately 0.4 percent per year. [32]
- In estimating simulator costs, we assume a full simulator; therefore, two pilots and one instructor will occupy a simulator during training. We assume operators will assign pilots for training in the simulator based on availability and current training schedules.
- Flight crewmembers undergoing initial, transition, upgrade, or recurrent training will train on one airplane group per training cycle.
- As in the SNRPM, the turnover rate of 5 percent covers pilot retirements and other pilot attrition.[33]

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[31] The National Vital Information Subsystem (NVIS) is a comprehensive Flight Standards Services (AFS) information system containing up-to-date information about operators including the number of pilots.
[32] FAA Aerospace Forecasts 2013-2033. Table 30: Active Pilots by Type of Certificate, Airline Transport, 2012-2033.
http://www.faa.gov/about/office_org/headquarters_offices/apl/aviation_forecasts/aerospace_forecasts/2013-2033/
Accessed March 2013.

- The FAA conducted a survey of eight part 121 operators and estimated that annually 2.6 percent of the affected pilots will require upgrade training and annually 5.7 percent will require transition training.
- For part 121 operators, there is an average of two major groupings of aircraft types (equipment groups) per operator.[34]
- As in the SNPRM, we assume that check pilots and flight instructors earn 10 percent more than line pilots.

Cost Estimate

The FAA analyzed the expected costs of the final rule over the 2013 through 2028 analysis interval. The major factor driving the expected costs is the additional training tasks in sophisticated simulators. The final rule adds training tasks, and therefore costs, to initial, transition, upgrade, and recurrent pilot training programs. Other cost driving factors include the high value of pilot's time, ground school training, and additional paperwork.

Some paperwork costs will begin on the effective date in 2014 while other paperwork costs will begin one year before the 2019 compliance date. The rest of the new paperwork costs start on the compliance date in 2019, and will continue to 2028, the end of the analysis interval. These start dates are listed in the Estimated Paperwork Costs section.

This cost analysis estimates the final rule costs by the objective group.[35] The cost model was computed annually as follows:

> (the number of pilots * fully burdened pilot wage * training hours) + (the number of pilots * (simulator costs[36] +ground school costs)) + paperwork cost.

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[33] http://www.faa.gov/news/conferences_events/aviation_forecast_2010/agenda/media/GAF%20Jim%20Higgins%20and%20Kent%20Love.pdf The University of North Dakota estimates that 2.12% of pilots have retired annually along with forecasting 2.94% pilot attrition (loss of medical, loss of certificate, career transfer) from 2009 to 2024. We rounded to three digits.

[34] As of March 2013, the OAG Fleet Database reports an average of 1.85 equipment groups per operator which we rounded up to two. The OAG Fleet Database defines an equipment group as major groupings of aircraft types. For example, B737 would include all of the B-737 variants.

[35] An objective group is a grouping of related final rule sections.

[36] Includes flight instructor's fully burdened wages.

Table 10 details the final rule provisions by objective grouping and provides the basis for the cost analysis.

Table 10
Summary of Final Rule Requirements and When FAA Expects Costs to Accrue

SUMMARY OF FINAL RULE REQUIREMENTS		
Final Rule Requirement	**Description**	**Date When Costs Start to Accrue**
Fraud and falsification (§ 121.9)	Although currently prohibited by criminal statute, this section authorizes the FAA to take certificate action or assess a civil penalty against a person for making a fraudulent or intentionally false statement.	120 days
Personnel identified as flight attendants (§ 121.392)	Prohibits part 121 operators from identifying persons as flight attendants if those persons have not completed flight attendant training and qualification.	120 days
Proficiency checks for PICs (§ 121.441(a)(1)(ii))	Amends current provision to require PICs who fly more than one aircraft type to receive a proficiency check in each aircraft type flown.	5 years and 120 days
Related aircraft differences training (§§ 121.400, 121.418, 121.434, 121.439, 121.441)	Allows air carriers to modify training program requirements for flightcrew members when the air carrier operates aircraft with similar flight handling characteristics.	120 days
Training equipment other than flight simulator training devices approved under part 60 (§§ 121.408, 121.403(b)(2))	Ensures that all equipment used in approved training programs adequately replicate the equipment that would be used on an aircraft.	5 years and 120 days
Approval of flight simulator training devices (§ 121.407)	Conforms the requirements for the evaluation, qualification, and maintenance of flight simulation training devices used in part 121 to existing part 60 requirements.	5 years and 120 days
Pilot monitoring (§§ 121.409, 121.544, Appendix H)	Requires training on pilot monitoring to be incorporated into existing requirements for scenario-based training and establishes an operational requirement that flightcrew members follow air carrier procedures regarding pilot monitoring. The pilot not flying must monitor the aircraft operation.	5 years and 120 days
Remedial training (§§ 121.415(h) and 121.415(i))	Implements Congressional direction to require part 121 operators to identify and correct pilot training deficiencies through remedial training.	5 years and 120 days
Communication records for domestic and flag operations (§ 121.711)	Codifies details of content for records of communication between aircraft dispatchers and flight crew previously described in a legal interpretation.	120 days
Training for instructors and check airmen who serve in flight simulator training devices (§§ 121.411, 121.412, 121.413, 121.414)	Requires check airmen and flight instructors who conduct training or checking in FSTDs to complete initial, transition and recurrent training on the operation of the FSTD and the device's limitations.	4 years
Extended envelope flight training maneuvers and procedures (§§ 121.423, 121.407(e), 121.424, 121.427(d)(1)(i), 121.433(e), Appendix E)	Requires pilot flight training on the following safety-critical maneuvers and procedures: Upset recovery maneuvers; Manually controlled slow flight; Manually controlled loss of reliable airspeed; Manually controlled instrument arrivals and departures; Recovery from stall and stick pusher activation, if aircraft equipped; Recovery from bounced landing. This training is required in a full flight simulator (FFS) during all qualification and recurrent training and will require additional time to complete.	5 years and 120 days
Extended envelope ground training subjects (§§ 121.419(a)(2), 121.427)	Requires pilots to complete ground training during qualification and recurrent training on stall prevention and recovery and upset prevention and recovery. This training adds 2 hours to qualification ground training and 30 minutes to recurrent ground training.	5 years and 120 days
Runway safety maneuvers and procedures (Appendices E and F)	Expands on existing taxi and pre-takeoff requirements.	5 years and 120 days
Crosswind maneuvers including wind gusts (Appendices E and F)	Expands existing requirement for training on crosswind maneuvers to include gusts.	5 years and 120 days

The final rule will add paperwork costs to most of the objective groups listed in the Table 10. Additionally, the final rule will add simulator and ground school costs to both extended envelope training objective groups. However, the FAA has determined that the training and evaluation time required to complete the taxi and pre-takeoff procedures would not take any longer than the time currently required to complete those maneuvers because, the procedures are incorporated into the existing taxi and pre-takeoff maneuver requirements. Moreover, since crosswind takeoff and landing are already required training tasks, and gusty winds are merely one variable of these current requirements, the agency does not believe any additional time is necessary to train and evaluate crosswind takeoffs and landings with gusts. Finally, the amended proficiency check requirement for PICs does not add simulator time during recurrent training because under existing regulations PICs who fly multiple aircraft types must complete either a recurrent training or checking event on each aircraft type flown. Therefore, the recurrent training

framework in place today contemplates that a PIC could fulfill the recurrent training program requirements by completing a proficiency check on each aircraft type in which the PIC is qualified to serve.

The following sections will discuss the development of parameters that form the basis for the final rule cost estimate. First, we will discuss our forecast of the annual number of pilots who will go through the additional initial, transition, upgrade and recurrent training required by the final rule. Next, we present the pilot's hourly wages and the derivation of hourly employee benefits. Then we list the part 121 operators affected by the final rule. Next, we discuss the increase in time and cost the final rule adds to simulator and ground school training programs for the extended envelope objective groupings. We then estimate the paperwork costs of revising pilot manuals, air carrier training courseware, and air carrier training programs for each of the objective groupings.[37] Lastly, we present a summary of the total costs.

There are other changes in the final rule that are either editorial or procedural. Some changes expand or clarify the intent of the final rule through reorganization, updating terminology, and clarifying procedures. These editorial or procedural changes will not impose any new requirements or costs.

Number of Pilots and Operators Affected by the Final Rule

In this section, we first estimate the number of pilots affected by the final rule. Then we discuss the source and number of part 121 operators affected.

To estimate the number of flightcrew members in the analysis interval we begin with a 2013 base of 76,039 pilots who are employed by part 121 operators. As stated in the General Cost Assumptions and Data Sources section, we obtain the number of pilots from National Vital Information Subsystem (NVIS). Appendix 9 lists the part 121 operators, their pilots employed, and if the operator trains their pilots under AQP.

[37] The Training Program is the document that is submitted to the FAA for approval. It contains all the training requirements for that air carrier's crewmembers. Training courseware is the document that instructors teach from—or the speaker's notes. This document is not FAA approved, although the FAA can review the document at any time and require changes to be made.

We apply the same estimate of check pilots and flight instructor, used in the SNPRM, to calculate the adjusted pilot base. First, we estimate the number of check pilots by multiplying the 2013 base of 76,039 pilots by 4.0 percent to arrive at 3,042 check pilots in 2013. Next we estimate the number of flight instructors by multiplying the 76,039 pilots by 2.0 percent to arrive at 1,521 flight instructors in 2013. We then subtracted the number of check pilots and instructor pilots from the 76,039 pilots to arrive at 71,476 pilots.

We then estimate the number of pilots, check pilots and flight instructors who will undergo initial, upgrade, transition, and recurrent training in 2013. Next, we estimated the number of pilots who will have to go through initial training.

Pilots who undergo initial training consist of newly hired pilots who replace pilots lost to attrition (loss of medical certificate, loss of airman certificate, career transfer, or retirement). We estimate five percent of the total number of pilots would leave an operator through attrition. Pilots who undergo initial training are also newly hired pilots due to operator growth (fleet and route expansion and traffic growth). Based on the FAA forecast, we expect the total number of part 121 pilots to increase by 0.4 percent annually.

We then estimated the number of newly hired pilots by multiplying the 2013 base of pilots, check pilots, and flight instructors by 0.4 percent for growth and five percent for attrition. These calculations are displayed in the Table 11 below.

In addition, we expect that annually 2.6 percent of the total pilots will go through upgrade training and annually 5.7 percent through transition training.[38] Pilots who go through upgrade training do so because they are upgrading from a flight engineer to a first officer (second in command) or a first officer to a captain (pilot in command). Pilots who go through transition training do so because they are transitioning to another aircraft in an operator's fleet. We estimated the number of pilots who would complete upgrade and transition training by

[38] This expectation is based on a survey of 8 part 121 operators, and the FAA believes this data is representative of all part 121 operators.

multiplying the 2013 base of pilots, check pilots, and flight instructors by 2.6 percent for upgrade training and 5.7 percent for transition training. These two calculations are displayed in the Table 11 below in the column labeled “Upgrade” and “Transition”.

Next, we calculated the remaining number of pilots by subtracting the pilots who left due to attrition, who completed upgrade training, and who completed transition training from the 2013 base of pilots, check pilots, and flight instructors. The remaining pilots take recurrent training. Lastly, we estimated the number of pilots in 2014 by adding the 2013 base of pilots, check pilots, and flight instructors to the number of pilots that would be added by growth.

We repeated this process to estimate the number of pilots in the rest of the analysis interval (2014-2028) for pilots, check pilots, and flight instructors. The FAA notes that the final rule requires pilots to go through extended envelope simulator training every 24 months and extended envelope ground school training every 12 months and therefore must forecast pilots annually throughout the analysis interval. Table 11 shows these results:

Table 11
Pilot, Check Pilot and Flight Instructor Forecast

Pilot Population								
		Total	Intial Training			Upgrade	Transition	Remaining = Total -
Year	Calendar Year	Number Of Pilots	Attrition 5.0%	Growth 0.4%	Sum of Attrition and Growth	Training 2.6%	Training 5.7%	Attrition - Upgrade - Transition
1	2013	71,476	3,574	286	3,860	1,858	4,074	61,969
2	2014	71,762	3,588	287	3,875	1,866	4,090	62,218
3	2015	72,049	3,602	288	3,890	1,873	4,107	62,467
4	2016	72,337	3,617	289	3,906	1,881	4,123	62,716
5	2017	72,626	3,631	291	3,922	1,888	4,140	62,967
6	2018	72,917	3,646	292	3,938	1,896	4,156	63,219
7	2019	73,209	3,660	293	3,953	1,903	4,173	63,473
8	2020	73,502	3,675	294	3,969	1,911	4,190	63,726
9	2021	73,796	3,690	295	3,985	1,919	4,206	63,981
10	2022	74,091	3,705	296	4,001	1,926	4,223	64,236
11	2023	74,387	3,719	298	4,017	1,934	4,240	64,494
12	2024	74,685	3,734	299	4,033	1,942	4,257	64,752
13	2025	74,984	3,749	300	4,049	1,950	4,274	65,011
14	2026	75,284	3,764	301	4,065	1,957	4,291	65,271
15	2027	75,585	3,779	302	4,081	1,965	4,308	65,532
16	2028	75,887	3,794	304	4,098	1,973	4,326	65,794

Check Pilot Population								
		Total	Intial Training			Upgrade	Transition	Remaining = Total -
Year	Calendar Year	Number Of Pilots	Attrition 5.0%	Growth 0.4%	Sum of Attrition and Growth	Training 2.6%	Training 5.7%	Attrition - Upgrade - Transition
1	2013	3,042	152	12	164	79	173	2,638
2	2014	3,054	153	12	165	79	174	2,648
3	2015	3,066	153	12	165	80	175	2,659
4	2016	3,078	154	12	166	80	175	2,669
5	2017	3,090	155	12	167	80	176	2,679
6	2018	3,102	155	12	167	81	177	2,690
7	2019	3,114	156	12	168	81	177	2,700
8	2020	3,126	156	13	169	81	178	2,711
9	2021	3,139	157	13	170	82	179	2,721
10	2022	3,152	158	13	171	82	180	2,732
11	2023	3,165	158	13	171	82	180	2,744
12	2024	3,178	159	13	172	83	181	2,755
13	2025	3,191	160	13	173	83	182	2,766
14	2026	3,204	160	13	173	83	183	2,778
15	2027	3,217	161	13	174	84	183	2,789
16	2028	3,230	162	13	175	84	184	2,800

Instructor Pilot Population								
		Total	Intial Training			Upgrade	Transition	Remaining = Total -
Year	Calendar Year	Number Of Pilots	Attrition 5.0%	Growth 0.4%	Sum of Attrition and Growth	Training 2.6%	Training 5.7%	Attrition - Upgrade - Transition
1	2013	1,521	76	6	82	40	87	1,319
2	2014	1,527	76	6	82	40	87	1,324
3	2015	1,533	77	6	83	40	87	1,329
4	2016	1,539	77	6	83	40	88	1,334
5	2017	1,545	77	6	83	40	88	1,340
6	2018	1,551	78	6	84	40	88	1,344
7	2019	1,557	78	6	84	40	89	1,350
8	2020	1,563	78	6	84	41	89	1,355
9	2021	1,569	78	6	84	41	89	1,361
10	2022	1,575	79	6	85	41	90	1,365
11	2023	1,581	79	6	85	41	90	1,371
12	2024	1,587	79	6	85	41	90	1,376
13	2025	1,593	80	6	86	41	91	1,381
14	2026	1,599	80	6	86	42	91	1,386
15	2027	1,605	80	6	86	42	91	1,392
16	2028	1,611	81	6	87	42	92	1,396

* Details may not add to row or column totals due to rounding.

In order to estimate the paperwork costs for each part 121 operator affected by the final rule, the number of operators are necessary. We also needed to determine which operators train their pilots under AQP and which ones train their pilots under the traditional training rules. This estimate is necessary because operators who train under AQP are required under § 121.909, to complete an evaluation of their existing training program against the new requirements set forth in this final rule to ensure these requirements are being met. Thus, operators training under AQP will have an additional paperwork burden that operators who train under traditional training rules will not have.

The numbers of part 121 operators were obtained through the FAA National Vital Information Subsystem (NVIS) database and are current as of February 2013. The determination of the

operators who train their pilots under AQP versus non-AQP was provided the AFS-230, the Voluntary Safety Programs Branch of the FAA.[39]

Appendix 9 shows that there are 83 operators currently affected by the final rule; 22 of the 83 operators train their pilots under AQP, while the remaining 61 operators train their pilots under subparts N and O.

Annual and Hourly Wages and Benefits

In this section, we discuss the pilot wages the FAA used in the SNPRM, the reason for using those wages, and their source. We then discuss the wages the FAA uses in the final rule, the reason for using these wages, and their source.

The proposed requirements of the SNPRM contained provisions, with different requirements, for pilots in command (captains), second in command pilots (first officers), check pilots, flight engineers, and flight instructors. In addition, the SNPRM resulted in different training time increases for pilots who operate turbojet airplanes and pilots who operate turboprop airplanes. Therefore the SNPRM costs analysis required hourly wages for each of these pilot categories. For the SNPRM, the Flight Standards Services (AFS) of the FAA provided the average hourly wages for each of these pilot categories. As stated in the General Cost Assumptions and Data Sources section, for the SNPRM check pilots and flight instructors earn 10 percent more than pilots. For the SNPRM, the FAA multiplied the hourly pilot wages, for each category of pilots, by a total 2009 benefit as a percentage of payroll from the Bureau of Labor Statistics (BLS) survey of employee benefits to arrive at a fully burdened hourly wage. Table 12 shows the pilot hourly wages, the estimated hourly benefits, and total hourly costs, by pilot category, used in the SNPRM.

[39] The FAA makes the determination that an operators can start training their pilots under AQP when the operator receives an FAA-approved Phase IV Qualification letter.

Table 12
SNPRM Pilot, Flight Engineer Hourly Wage & Benefit (2009 $)

	Hourly Wage	Hourly Benefit	Total
Pilot - PIC	$91.35	$27.59	$118.94
Check Pilot - PIC	$100.49	$30.35	$130.84
Instructor Pilot - PIC	$100.49	$30.35	$130.84
Pilot - SIC	$62.96	$19.01	$81.97
Flight Engineer	$62.96	$19.01	$81.97
Check Flight Engineer	$100.49	$30.35	$130.84
Instructor	$100.49	$30.35	$130.84

Source: U.S. Department of Transportation, Federal Aviation Administration

The final rule does not contain different requirements for each of the pilot categories or turbojet or turboprop equipment types. The final rule requirements add the same amount of simulator and ground school training time to captains and first officers regardless of the aircraft they operate.

In May 2012, BLS published the National Industry-Specific Occupational Employment and Wage Estimates for Scheduled Air Transportation. The North American Industry Classification System (NAICS) code for Scheduled Air Transportation pilots is 481100.[40] The major group for pilots under the 481100 NAICS code is 53-2011. The FAA believes that the 53-2011 pilot survey is the appropriate wage to estimate the salary of the part 121 pilots, check pilots, and flight instructors affected by the final rule.[41] The BLS survey lists $128,760 as the annual mean salary for a pilot. The cost analysis will use the annual mean salary of $128,760 for a pilot to estimate the additional costs the final rule adds for simulator and ground school training tasks. The FAA notes that the survey lists the annual mean salary range for pilots, by area in the continental United States, from $72,580 to $184,320.

BLS website for Scheduled Air Transportation pilots states "Wages for some occupations that do not generally work year-round, full time, are reported either as hourly wages or annual salaries

[40] The NAICS code is the standard used by Federal statistical agencies in classifying business establishments for the purpose of collecting, analyzing, and publishing statistical data related to the U.S. business economy.
[41] BLS describes this survey as "Pilot and navigate the flight of fixed-wing, multi-engine aircraft, usually on scheduled air carrier routes, for the transport of passengers and cargo. Requires Federal Air Transport certificate and rating for specific aircraft type used. Includes regional, National, and international airline pilots and flight instructors of airline pilots." http://www.bls.gov/oes/current/oes532011.htm Accessed April 2013.

depending on how they are typically paid";[42] BLS reports pilot wages as annual salaries because pilots do not work a 40 hour work week. Therefore, the FAA used the Pro Pilot Compensation Salary Study – 2012 compiled by ABCO Data Systems in Vienna, VA and estimated that pilots, who work for part 121 airlines, typically have their annual pay based on 80 hours per month.[43] The FAA divided the BLS annual mean salary by 80 hours per month to estimate the average hourly wage for a pilot operating in part 121 service.

In addition, pilot benefits (such as health benefits, vacation, sick time, etc.) must be added to estimate the costs for this analysis. In March 2013, BLS published their "Employer Costs for Employee Compensation" study of employee benefits. In Table A of the BLS study, they estimated the total 2012 benefits, as a percentage of total compensation, at 29.7 percent for private industry.[44] The FAA accepts the BLS 29.7 percentage of total compensation to estimate the value of benefits for pilots, check pilots, and flight instructors as an additional cost of this final rule.

Technical writers and flight instructors are also necessary to complete the paperwork requirements of the final rule. In May 2012, BLS published the National Industry-Specific Occupational Employment and Wage Estimates for Scheduled Air Transportation. The NAICS code for Scheduled Air Transportation technical writers is 27-3042. The FAA believes that the 27-3042 technical writer survey is the appropriate wage to estimate the salary of the part 121 technical writers affected by the final rule.[45] The BLS survey lists the mean hourly wage for a technical writer is $32.65. The cost analysis will use the annual mean hourly wage of $32.65 for a technical writer to estimate the additional costs along with the total 2012 benefits of 29.7 percent discussed above. The survey lists the annual mean salary range, by area in the continental United States, for technical writers from $33,570 to $97,050.

Table 13 shows these results for pilots, check pilots, flight instructors and technical writers.

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[42] http://www.bls.gov/oes/current/oes532011.htm#(4)
[43] http://www.safetystanddown.com/wp-content/uploads/2012/06/Salary-study-6-12-lyt_June.pdf Accessed April 2013.
[44] http://www.bls.gov/news.release/pdf/ecec.pdf Accessed April 2013.
[45] http://www.bls.gov/oes/current/oes273042.htm Accessed April 2013.

Table 13
Mean Hourly Wages Plus Benefits (2012 $)

	Hourly Wage	Hourly Benefit	Total
Pilot	$134.13	$56.66	$190.79
Check Pilot	$147.54	$62.33	$209.87
Instructor Pilot	$147.54	$62.33	$209.87
Technical Writer	$32.65	$13.79	$46.44
			Source: BLS and ABCO, Inc.

* Details may not add to row or column totals due to rounding.

Final Rule Simulator and Ground School Additional Time for Pilots

Pilots must undergo two basic methods of training. This training includes flight training and ground school. In this section, we first discuss the method the FAA used to estimate the simulator training time this final rule adds to current pilot flight training requirements. We then discuss the additional ground school training time the final rule adds.

This regulatory evaluation will not attempt to estimate the existing practice relative to the new requirements. We base our estimate on the incremental time this final rule adds to the current regulatory requirements for captains and first officers who operate in part 121 service. To the extent industry current practices exceed the regulatory requirements, we believe that the cost estimate will result in an over estimate of the actual compliance costs.

Under the assumption that existing facilities are optimized,[46] the final rule could result in additional capital and operating expenses to either build or expand training and simulator facilities for flight crewmembers. Rather than estimate the capital recovery costs over the life cycle of simulators and expansion of facilities, we estimated the rent of simulator services with a usage fee per pilot. As mentioned in the Background section, the FAA estimates the average cost of simulator session to be $500 an hour plus the cost of an instructor with two pilots in the simulator.

[46] Responders to the NPRM and SNPRM confirmed that their existing training facilities, simulators, and ground school classes are optimized.

Typically, simulator sessions are scheduled in four hour blocks. In the NRPM, the FAA estimated the costs based on four-hour simulator sessions. After analyzing the tasks prescribed in the technical report accompanying the SNPRM,[47] we believe many of the simulator sessions will last less than four hours. Therefore, in the SNPRM and final rule cost analysis, we estimate the cost of the additional tasks the final rule requires for pilots in the simulator rather than the number of four hour simulator sessions.

When a pilot enters a simulator for training, the pilot must complete a prescribed number of tasks. On October 26, 2009 the FAA conducted a simulator trial to determine the time necessary to perform the proposed recurrent proficiency check requirements. The agency collected data on the time it took to complete the recurrent proficiency check tasks proposed in the NPRM and then used this data to estimate the time required to complete the proficiency check requirements proposed in the SNPRM.

For the final rule, the FAA conducted a second simulator trial to determine the time required to complete the additional final rule maneuvers and procedures in each curriculum. During the second simulator trial, two FAA pilots performed the extended envelope flight training requirements. The FAA pilots serving as the pilot in command (PIC) and second in command pilot (SIC) both held ATP certificates and were current and qualified to operate the Airbus 330. The PIC was type rated. The SIC was not type rated. The Instructor Operating Station (IOS) operator had experience operating the Airbus 330 Level D simulator. All required checklists and procedures were completed in their entirety for each maneuver/procedure. All required Air Traffic Control (ATC) instructions and clearances were provided. The FAA expects task times to be comparable throughout the various aircraft fleets used in part 121 operations because we do not expect the differences in aircraft design to have an impact on task times.

The training time listed below represent the data collected during the second simulator trial and provides the estimated simulator time required to meet the extended envelope flight training

[47] The Flightcrew Member Training and Qualification Review and Analysis Technical Report can be found in the docket for this rulemaking. The URL for the docket is http://www.regulations.gov/search/Regs/home.html#docketDetail?R=FAA-2008-0677.

requirements in the final rule. The FAA has reviewed both simulator trials and revised the cost estimates for the training tasks required by the final rule. The full discussion of the additional tasks the final rule adds to pilot training, along with an estimate of the time necessary to complete them, are listed in the preamble and technical report in the federal docket.[48]

The final rule adds simulator time for pilots to complete extended envelope training maneuvers and procedures. As noted previously, we determined the training and evaluation time required to complete the taxi and pre-takeoff procedures, as well as crosswind maneuver with gusts, will not take any longer than the time required under existing regulations for completion. Also, the final rule requirement to include pilot monitoring during Line Oriented Flight Training (LOFT) does not place any additional burden on operators who use advanced simulation training programs to train their pilots or substitute LOFT for recurrent proficiency check requirements because the requirement can be met during the ordinary course of any LOFT that is currently part of a part 121 operator's training program.

The final rule requires extended envelope training maneuvers and procedures for all pilots during initial, transition, and upgrade flight training and at least once every 24 months during recurrent flight training. At a minimum, all extended envelope training must take place in a Level C full flight simulator.[49] To account for these variables, the agency estimates the following ranges of simulator time are required to meet the extended envelope training requirements. For the base case cost estimate, we compute the average simulator time, for initial, upgrade, transition, and recurrent training, with the range of minutes listed in Table 14.

[48] These reports may be found in the docket for this rulemaking. The URL for the docket is http://www.regulations.gov/search/Regs/home.html#docketDetail?R=FAA-2008-0677.
[49] The FAA notes that the final rule provides deviation authority in those instances in which a Level C or higher full flight simulator is unavailable.

Table 14
Additional Simulator Time from Final Rule (Minutes)

	Initial	Upgrade	Transition	Recurrent
Captain	90-135	45-60	60-90	30-45 every 24 months
First Officer	90-135	45-60	60-90	30-45 every 24 months

As stated in the Background section, the FAA did not include travel expenses in the final rule cost analysis for the additional simulator training time because the FAA believes operators can complete the new training requirements within the same amount of days as their current initial, upgrade, transition, or recurrent simulator and ground school training sessions. With regard to simulator training, we are assuming an additional 90-135 minutes for the initial extended envelope simulator training. If an operator uses 4 hour simulator sessions (which is not required), it would take 6 days of training to get 24 hours. The operator could add 15-25 minutes to each simulator session and still finish in the same number of days. For transition, upgrade, and recurrent simulator training we are assuming even less time for the extended envelope training, so again the same rationale applies. It is not efficient for the operator to use an extra day of training just for the additional simulator training time the final rule requires.[50]

In addition, the final rule extended envelope ground training will be required for all pilots during initial, transition, and upgrade training and at least once every 12 months during recurrent ground school training. To account for these variables, the agency estimates the following amount of ground school time is required to meet the extended envelope training requirements.

[50] Although industry informed us that simulators are typically rented in four-hour blocks, simulator rental varies depending on the contract that the carrier has with the simulator owner. We assume that air carriers will be able to rent only the time needed to complete the training required by the rule. In addition, many large operators have their own simulators and do not need to rent.

Table 15
Additional Ground School Time from Final Rule

	Initial	Upgrade	Transition	Recurrent
Captain	2 hours	1 hour	2 hours	30 minutes every 12 months
First Officer	2 hours	1 hour	2 hours	30 minutes every 12 months

From the General Cost Assumptions and Data Sources section, 100 percent of the pilots will undergo distance learning for their ground school training. The costs for a pilot to undergo distance learning will be the same for the hours spent in a ground school class room but will not include transportation costs such as airfare, automobile mileage, hotel, facility usage fees, and per diems because of distance learning.

The FAA believes that the additional simulator and ground school time this final rule requires can be conducted in an operator's current training schedule without adding any additional travel time. In the interest of performing a robust cost benefit analysis, the FAA conducted a sensitivity analysis on the cost of pilots having to spend an extra day in simulator for the additional training tasks added by the final rule and determined that the benefits still exceed the costs. The results of this sensitivity analysis can be found in Appendix 10.

Costs and Methodology for Final Rule Estimated Simulator Training Costs

We now discuss the methodology used to estimate the final rule costs for the additional simulator training tasks required by the final rule. Additional simulator training costs are estimated by summing the cost of the additional time the final rule requires pilots to spend in the simulator plus the cost of the additional time simulators are used. The additional final rule cost for pilots in the simulator is estimated using fully burdened pilot wages from BLS. The cost for the additional time simulators are being used is estimated using hourly simulator costs based on FAA data.

The FAA estimates the additional time pilots spend in the simulator by multiplying the number of pilots by the additional time the final rule will require. We then multiply the additional simulator time by the fully burdened pilot's hourly wage. An instructor will be needed for each additional simulator session with two pilots. The additional instructor time is multiplied by the flight instructors' fully burdened wage. As mentioned in the General Cost Assumptions and Data Sources section, there are two pilots being trained for each simulator session. This calculation is repeated for pilots who go through initial, upgrade, transition or recurrent training while taking into consideration that there is one instructor for every two pilots in the simulator. The FAA notes that pilots who go through initial, upgrade, or transition training would go through recurrent training in the following years of the analysis interval.

The FAA estimates the cost of the simulator usage fees by multiplying the additional hours the final rule requires for pilots to be in the simulator, with the $500 average hourly simulator cost.[51] We perform these calculations for the additional time the final rule adds for pilots training in the simulator and the additional time the simulator is being operated for both the low and high range of simulator times the FAA estimated for initial, upgrade, transition, or recurrent simulator training.

For the check pilots and flight instructors we calculate the incremental costs the final rule adds in a similar manner as we did for the pilots.

We then sum the initial (attrition or growth) training costs for pilots, check pilots, and flight instructors with the transition, upgrade, and recurrent training costs to arrive at the total cost the final rule adds to part 121 operators for simulator training. We perform this calculation for the both low and high range of simulator times. Lastly, we multiply the total costs, by year, by the three and seven percent present value series.

[51] Hourly simulator costs provided by the FAA Flight Standards Service (AFS).

Table 16 shows these results for the low and high range of time the FAA estimates the final rule adds to the time pilots are in the simulator.[52] Appendix 11 shows the details by pilot, check pilot, and flight instructors in 2012 dollars.

Table 16
Simulator Training Costs – Pilot Wages Plus Simulator Usage Time (2012 $)

	Calendar	Low			High		
Year	Year	2012 $	7% P.V.	3% P.V.	2012 $	7% P.V.	3% P.V.
1	2013	$0	$0	$0	$0	$0	$0
2	2014	$0	$0	$0	$0	$0	$0
3	2015	$0	$0	$0	$0	$0	$0
4	2016	$0	$0	$0	$0	$0	$0
5	2017	$0	$0	$0	$0	$0	$0
6	2018	$0	$0	$0	$0	$0	$0
7	2019	$25,170,300	$15,673,546	$20,465,971	$37,617,032	$23,424,126	$30,586,408
8	2020	$6,734,459	$3,919,455	$5,316,182	$9,962,719	$5,798,302	$7,864,570
9	2021	$25,372,283	$13,799,984	$19,445,317	$37,918,897	$20,624,088	$29,061,043
10	2022	$6,789,427	$3,451,066	$5,052,013	$10,044,056	$5,105,394	$7,473,782
11	2023	$25,575,726	$12,151,027	$18,475,904	$38,222,944	$18,159,721	$27,612,255
12	2024	$6,842,909	$3,038,252	$4,799,616	$10,123,156	$4,494,681	$7,100,381
13	2025	$25,781,213	$10,699,203	$17,557,006	$38,530,046	$15,989,969	$26,238,962
14	2026	$6,897,447	$2,674,830	$4,559,902	$10,203,830	$3,957,045	$6,745,752
15	2027	$25,986,739	$9,417,594	$16,680,887	$38,837,199	$14,074,601	$24,929,598
16	2028	$6,953,818	$2,355,499	$4,333,389	$10,287,247	$3,484,647	$6,410,672
Total		**$162,104,321**	**$77,180,457**	**$116,686,189**	**$241,747,126**	**$115,112,574**	**$174,023,424**

* Details may not add to row or column totals due to rounding.

Estimated Costs and Methodology for Final Rule Ground School Training Tasks

We now discuss the FAA's estimate of the final rule's additional ground school training costs to pilots, check pilots, and flight instructors.

For the final rule, the FAA re-estimated the ground school cost analysis based on updated data and analysis that reflect the final rule requirements.

The ground school costs consists of the sum of the additional time the final rule requires for pilots, check pilots, and flight instructors to be in initial, transition, upgrade, and recurrent ground school training. The initial, transition, and upgrade training occurs only once while the recurrent training occurs annually.

For ground school training, the FAA continues to allow training to be conducted in an environment other than a classroom by distance learning. An approved distance learning

[52] See Table 14, Additional Simulator Time from Final Rule (Minutes).

program ensures the training will provide the students with the knowledge and cognitive skills to perform their required duties. As mentioned in the Background section, the agency assumes 100 percent of pilots will take advantage of distance learning and will not incur travel costs for the final rule ground school training.

We calculate the additional time pilots are in ground school training by multiplying the number of pilots, with the additional ground school time, and then their hourly wage. We note that although operators do not incur travel costs from distance learning, we still need to include the cost of the additional time the final rule adds to pilots' ground school training regardless of whether the pilots are distance learning or learning in a classroom.

We then sum the initial, transition, upgrade, and recurrent ground school training costs to arrive at a total cost. Next, we sum the pilot, check pilot, and flight instructor final rule ground school training costs. We calculate the final rule ground school training costs for check pilots and flight instructors in a similar manner as for pilots.

Table 17 shows the results of our calculations for the estimate of total ground school training costs. Appendix 11 shows the details by pilot, check pilot, and flight instructors in 2012 dollars.

Table 17

Ground School Costs (2012 $)

Year	Calendar Year	2012 $	Present Value 7%	Present Value 3%
1	2013	$0	$0	$0
2	2014	$0	$0	$0
3	2015	$0	$0	$0
4	2016	$0	$0	$0
5	2017	$0	$0	$0
6	2018	$0	$0	$0
7	2019	$10,186,715	$6,343,268	$8,282,818
8	2020	$10,227,527	$5,952,421	$8,073,610
9	2021	$10,268,474	$5,585,023	$7,869,759
10	2022	$10,309,850	$5,240,497	$7,671,559
11	2023	$10,350,806	$4,917,668	$7,477,422
12	2024	$10,392,209	$4,614,141	$7,289,096
13	2025	$10,434,042	$4,330,127	$7,105,582
14	2026	$10,475,359	$4,062,344	$6,925,260
15	2027	$10,517,105	$3,811,399	$6,750,930
16	2028	$10,559,662	$3,576,923	$6,580,432
Total		**$103,721,749**	**$48,433,810**	**$74,026,468**

* Details may not add to row or column totals due to rounding.

Estimated Paperwork Costs

The final rule adds paperwork in the curriculums for part 121 operator training programs, training courseware, and operating manuals. This section discusses the estimated costs, by objective groups of provisions, for the additional hours it takes to create the paperwork, along with the number of pages the final rule adds. The FAA notes that there is only a one-time paperwork cost to respondents for each of the groups of provisions.

The FAA estimates no paperwork costs for the following groups of provisions:

- Fraud and falsification (§ 121.9),
- Related aircraft differences training (§§ 121.400, 121.418, 121.434, 121.439, 121.441),
- Proficiency checks for PICs (§ 121.441(a)(1)(ii)), and
- Approval of FSTDs (§ 121.407).

The FAA assumed that air carriers will incur costs related to the paperwork burden for the following groups of provisions on the effective date of the final rule, which is 120 days after the publication of the rule:

- Personnel identified as flight attendants (§ 121.392),
- Communication records for domestic and flag operations (§ 121.711), and
- Approval of Advanced Qualification Program (§ 121.909).

Although compliance with the provisions on qualification and training for instructors and check airmen who serve in FSTDs (§§ 121.411, 121.412, 121.413, 121.414) is required 5 years after the effective date, the FAA believes that air carriers will start to accrue paperwork costs 4 years after the effective date.

Air carriers will incur paperwork costs for the following groups of provisions five years and 120 days after the publication of the rule:

- Training equipment other than FSTDs approved under part 60 (§§ 121.403(b)(2), 121.408),
- Pilot monitoring (§§121.409,121.544, Appendix H),

- Remedial training (§§ 121.415(h) and § 121.415(i)), and
- Extended envelope flight training maneuvers and procedures (§§121.407(e),121.423, 121.424, 121.427(d)(1)(i), 121.433(e)), Extended envelope ground training subjects (§§ 121.419(a)(2), 121.427), Runway safety maneuvers and procedures (Appendices E and F) and Crosswind maneuvers including wind gusts (Appendices E and F).

The FAA estimated the paperwork costs for these provisions by multiplying the number of hours the FAA estimates to update the training program, training courseware, or operating manual by the hourly rate of the person responsible for the update, by the number of part 121 operators affected by the provision. The Flight Standards Service (AFS) of the FAA provided average hourly times and the number of additional pages of paperwork the final rule will add. Table 18 summarizes the FAA's cost estimate of the total paperwork requirement for each of the following groups of provisions.

The FAA estimates the total paperwork costs for the final rule will be about $8.2 million. The following sections discuss each objective group of provisions, when the provisions will become effective, and their paperwork costs.

Fraud and falsification (§ 121.9)

Although fraud is currently prohibited by criminal statute, the FAA has added language prohibiting fraud and falsification to part 121 to emphasize the importance of truthful statements. This provision prohibits fraudulent or intentionally false statements in, or a known omission from, any record or report that is kept, made, or used to show compliance with this part, or to exercise any privileges under this chapter.[53] This provision enhances FAA enforcement options by allowing the agency to take certificate action or assess a civil penalty against a person for making a fraudulent or intentional false statement. Compliance with this provision is required

[53] 18 USC 1001is a criminal statute prohibiting fraud and intentional falsification in matters within the jurisdiction of the executive branch. This regulation will allow the agency to pursue civil enforcement in instances in which a person has committed fraud or falsification.

120 days after the date of publication of the final rule in the Federal Register. The FAA estimates that there are no costs for this provision.

Personnel identified as flight attendants (§ 121.392)

This provision prohibits operators from identifying any person as a flight attendant if that person has not completed all flight attendant training and qualification. Individuals who have not completed all flight attendant training and qualification requirements must be clearly identified (e.g. via an announcement, by wearing civilian clothes, or not wearing a uniform). This provision may reduce confusion of passengers during an emergency situation on a flight who might otherwise presume that these individuals are fully qualified flight attendants.

Operators must revise flight attendant manuals to reflect the new procedures. Compliance with this provision is required on the effective date of the final rule, 120 days after the date of publication in the Federal Register. The FAA estimates that, for a certificate holder operating under part 121, one page of the content of the flight attendant operating manual will require revision for each affected operator.

Proficiency checks for PICs (§ 121.441(a)(1)(ii))

Currently, in accordance with §§ 121.433(d) and 121.441(a)(1), a PIC who serves on more than one aircraft type must complete either recurrent flight training or a proficiency check on each aircraft type every 12 months. To ensure PICs operating multiple aircraft types maintain proficiency on each aircraft type, the final rule amends § 121.441(a)(1) by requiring PICs who fly more than one aircraft type to receive a proficiency check in each aircraft type flown at the existing 12-month recurrent training interval. The FAA expects that any recurrent training program updates needed to reflect this change are minimal and are subsumed in the paperwork costs for the collective amendments made to the recurrent training provisions in this final rule. Compliance with new paragraph (a)(1)(ii) of this provision is required 5 years and 120 days after the date of publication of the final rule in the Federal Register, consistent with the SNPRM. The FAA estimates that there are no costs for this provision.

Related aircraft differences training (§§ 121.400, 121.418, 121.434, 121.439, 121.441)

Section 121.400 discusses the applicability and terms used in the final rule and adds no costs.

The remaining cost relieving provisions allow pilots, who train in aircraft types that do not have a common type certificate, to take credit for common tasks that pilots are already trained in. An example of this would be the Airbus airplanes that have cockpit commonality, and through related aircraft difference training, these provisions could provide cost savings to operators.

Although air carriers are not required to seek a related aircraft designation as permitted by § 121.418(b), if they seek the designation and receive it, it may provide relief from the training, checking, and experience requirements in §§ 121.419, 121.424, 121.425, 121.427, 121.434, 121.439 and 121.441. Lowering the cost for air carriers to adopt new aircraft types could speed up the entry of the newer aircraft types into the fleet. However, the magnitude of any cost savings would be based on operator's future actions and therefore we do not attempt to quantify the savings.

These provisions are effective 120 days after the date of publication of the final rule in the Federal Register. The FAA estimates that there are no costs for these provisions.

Training equipment other than FSTDs approved under part 60 (§§ 121.403(b)(2),121.408)

Current regulations do not provide specific requirements for training equipment other than FSTDs, but the regulations generally require training equipment to be adequate. Section 121.408 states that the FAA must approve training equipment (e.g. cockpit procedures trainers, door/exit trainers, water survival equipment, etc.) used to functionally replicate aircraft equipment required to be used as part of the approved training program. Compliance with this provision is required 5 years and 120 days after date of publication of the final rule in the Federal Register. This provision will require an additional 5 pages in each air carrier's General Operating manual. Section 121.403(b)(2) requires that operators provide the FAA with a list of all training devices or training aids that the certificate holder will use. Compliance with this provision is required 5

years and 120 days after date of publication of the final rule in the Federal Register. The FAA estimates that, for a certificate holder operating under part 121, one page of the content of the air carrier's approved training program will require revision for each affected operator.

Approval of FSTDs (§ 121.407)

This provision conforms the requirements for evaluation, qualification, and maintenance of FSTDs used in part 121 to existing part 60 requirements, by providing a reference to part 60 in part 121 and adding a new paragraph consistent with the requirement in § 121.423 to use an FSTD for extended envelope training. This provision therefore provides clarification regarding part 60 requirements that currently apply to part 121 training. Compliance with new paragraph (e) of this provision is required 5 years and 120 days after date of publication of the final rule in the Federal Register, because the new extended envelope training required by § 121.423 is not required until such time. The FAA estimates that there are no compliance or paperwork costs for this provision.

Pilot monitoring (§§121.409,121.544, Appendix H)

Section 121.409 and Appendix H require training on pilot monitoring to be incorporated into existing requirement for scenario based training. Section 121.544 also establishes an operational requirement for pilots to follow air carrier procedures regarding pilot monitoring.

These provisions reinforce active monitoring skills to the pilot not flying by requiring the inclusion of active pilot monitoring skills during line oriented flight training (LOFT). Appendix H currently requires all part 121 pilots in training to complete a four hour LOFT in a simulator. The FAA believes that the active monitoring skills of this provision can be accomplished in the current four hour LOFT requirements.[54]

[54] Appendix H requires all pilots trained using advanced simulation to complete a qualification LOFT upon completion of initial, transition, or upgrade training. Under existing regulations, LOFT may be substituted for recurrent flight training on an alternating basis, but it is not required.

Compliance with pilot monitoring is required 5 years and 120 days after date of publication of the final rule in the Federal Register. The FAA estimates that §§ 121.544 and 121.409 will add 20 pages to each air carrier's training courseware and one page to each air carrier's approved training program.

Remedial training (§§ 121.415(h) and § 121.415(i))

These provisions require certificate holders to incorporate methods for remedial training and tracking for pilots who have experienced multiple failures or demonstrated performance deficiencies in the training or checking environment into approved training programs. Although the FAA expects that industry already addresses deficiencies in pilot performance in accordance with existing agency guidance, these final rule provisions create a requirement for compliance. Examples of tracking include extra line checks, extra procedures, etc. to make sure the pilot trains to his deficiencies.

In August 2010, Congress directed the FAA to ensure air carriers develop remedial training programs for flight crew members who have demonstrated performance deficiencies or experienced failures in the training environment. The final rule remedial training requirements are intended to reflect the congressional direction and existing agency guidance.[55] We assume air carriers training under subparts N and O are already implementing the recommendations in the agency's guidance material based on information received during FAA inspections in 2009 as part of the Call to Action to Enhance Airline Safety. Also, since subpart Y already requires an AQP to include such a system, we assume no additional cost to carriers training under AQP. Therefore, we only estimate the paperwork costs for documenting this guidance.

Compliance with these provisions is required 5 years and 120 days after the final rule is published. The FAA estimates that, for a certificate holder operating under part 121, 20 pages will be added to each air carrier's courseware and one page to each air carrier's training program.

Communication records for domestic and flag operations (§ 121.711)

[55] SAFO 06015, Remedial Training for part 121 Pilots.

This provision clarifies the information that must be included in the record of communications between the pilot and aircraft dispatcher based on a legal interpretation of the current requirement in § 121.711. This provision also clarifies the recordkeeping requirement by defining "en route" for purposes of this section and applies the requirement to all flight crew/dispatch communications made using a two-way communication system required in accordance with § 121.99. It is current industry practice to record all en route communications as defined by the final rule. Compliance with this provision is required 120 days after date of publication of the final rule in the Federal Register.

The FAA estimates that, for a certificate holder operating under part 121, one page will be added to each air carrier's pilot operating manual and one page to each air carrier's aircraft dispatcher operating manual.

Qualifications and Training for instructors and check airmen who serve in FSTDs (§§ 121.411, 121.412, 121.413, 121.414)

Sections 121.411 and 121.412 add simple technical changes, such as the deletion of obsolete dates, deletion of obsolete duty positions (such as flight navigator), and correction of terminology. These modifications do not affect costs.

Appendix H currently includes robust requirements for simulator training for check airmen and instructors. These final rule provisions will add some additional check airman (simulator) and flight instructor (simulator) initial, transition and recurrent training curriculum items to current requirements in existing §§ 121.413 and 121.414 training to ensure comprehensive check airman and flight instructor understanding of new training tasks in the final rule and the limitations of simulation. When the FAA introduced the extended envelope requirements, we felt it was important to train simulator instructors on how to train pilots for these events. Although this requirement adds recurrent training subjects to instructor training, the FAA believes the additional time can be incorporated into the time currently required to train check pilots and instructors. The addition of these minimal curriculum requirements will not require additional program hour requirements and therefore have minimal to no costs.

Although compliance with this provision is required at 5 years and 120 days, the FAA believes that operators will start accruing paperwork costs 4 years after date of publication of the final rule in the Federal Register. The FAA estimates for a certificate holder operating under part 121, §§ 121.413 and 121.414, these provisions will each add 40 pages to each air carrier's training courseware and two pages to each air carrier's approved training program.

Extended envelope flight training maneuvers and procedures (§§121.407(e),121.423, 121.424, 121.427(d)(1)(i), 121.433(e)), Extended envelope ground training subjects (§§ 121.419(a)(2), 121.427), Runway safety maneuvers and procedures (Appendices E and F) and Crosswind maneuvers including wind gusts (Appendices E and F).

Amendments to §121.407 provide a reference in part 121 to part 60 and the new extended envelope training requirement in § 121.423, but does not add requirements; therefore there is no paperwork cost.

Sections 121.419 and 121.427 revise current initial, transition, upgrade or recurrent ground training to include training for extended envelope flight training maneuvers and procedures, as well as additional training regarding runway safety and crosswind takeoffs and landings with gusts. The FAA estimates that, for a certificate holder operating under part 121, §§ 121.419 and 121.427 will add 20 pages to each air carrier's training courseware and one page, for each provision (two pages total) to each air carrier's approved training program.

Section 121.423 details new extended envelope flight training and provides the interval for recurrent training. The FAA estimates that, for a certificate holder operating under part 121, 20 pages will be added to each air carrier's training courseware, one page to each air carrier's approved training program, and 20 pages to each air carrier's flightcrew operating manual.

Section 121.424 revises revise current initial, transition and upgrade flight training curriculum/courseware to include flight training and evaluation, as appropriate. The FAA estimates that, for a certificate holder operating under part 121, 20 pages will be added to each

air carrier's training courseware, one page to each air carrier's approved training program, and 20 pages to each air carrier's pilots operating manual.

Section 121.433 has paperwork included in the § 121.423 cost estimate.

Compliance with the extended envelope training maneuvers and procedures as well as the crosswind maneuvers with gusts and runway safety procedures, is required 5 years and 120 days after date of publication of the final rule in the Federal Register.

Approval of Qualification Standards Document for Operators with AQP (§ 121.909)

Although the final rule does not make any changes to § 121.909, when the new N and O training requirements are published, operators that use AQP will have to review their training programs to make sure they address the new N and O requirements (recovery from stall, upset recovery, etc.) and possibly revise their Qualifications Standards Document during this process.

This is a cost that only applies to operators that use AQP for pilot training because they are the only ones who must meet the § 121.909 requirements. This provision does not apply to operators who train their pilots under a traditional N and O training program.

The FAA estimates that, for a certificate using AQP to conduct training, this provision will add 5 pages to each air carrier's Qualification Standards Document. For each of the 22 operators, it will take an instructor 9.6 hours and a tech writer 40.0 hours to complete the 5 pages required for this provision.

Summary of Estimated Paperwork Costs by Objective Grouping

The FAA estimates the total paperwork costs for the final rule will be about $8.2 million in 2012 dollars. Table 18 shows the details of the number of pages required for each objective grouping of final rule provisions, the estimated date that the FAA believes paperwork costs will start to

accrue, the number hours required for each provision, the person conducting the paperwork review, their salary, and the total costs for each provision.[56] For some of these provisions, technical writers and instructors will both be needed to complete the paperwork requirements. We have reflected the labor costs of the technical writers and instructors for these provisions in separate rows for the objective groupings in Table 18.

[56] In most cases, because the actual implementation will vary by operator, the FAA used the date on which compliance is required to estimate paperwork costs.

Table 18

Summary of Paperwork Requirements and Costs (2012 $)

Final Rule Requirement	FAA Assumed Costs Start To Accrue	Number of Pages			Number Of Hours	Paper Work Person	Number Of Operators	Wage (2012 $)	Total Number Of Pages	Total Cost (2012 $)
		Training Program	Training Courseware	Operating Manual						
Fraud and falsification (§ 121.9)	120 days	0	0	0	0.0	n/a	83	$0.00	0	$0
Personnel identified as flight attendants (§ 121.392)	120 days	0	0	1	2.0	Tech Writer	83	$46.44	83	$7,710
Proficiency checks for PICs (§ 121.441(a)(1)(ii))	5 years and 120 days	0	0	0	0.0	n/a	83	$0.00	0	$0
Related aircraft differences training (§§ 121.400, 121.418, 121.434, 121.439, 121.441)	120 Days	0	0	0	0.0	n/a	83	$0.00	0	$0
Training equipment other than FSTDs approved under part 60 (§§ 121.403(b)(2), 121.408)	5 years and 120 days	1	0	5	40.0	Tech Writer	83	$46.44	498	$154,193
Approval of FSTDs (§ 121.407)	5 years and 120 days	0	0	0	0.0	n/a	83	$0.00	0	$0
Pilot monitoring (§§121.409,121.544, Appendix H)	5 years and 120 days	0	20	0	40.0	Instructor	83	$209.87	1,660	$696,763
		1	0	0	20.0	Tech Writer	83	$46.44	83	$77,097
Remedial training (§§ 121.415(h) and § 121.415(i))	5 years and 120 days	0	20	0	48.0	Instructor	83	$209.87	1,660	$836,116
		1	0	0	20.0	Tech Writer	83	$46.44	83	$77,097
Communication records for domestic and flag operations (§ 121.711)	120 days	0	0	2	2.0	Tech Writer	83	$46.44	166	$7,710
Qualifications and Training for instructors and check airmen who serve in FSTDs (§§ 121.411, 121.412, 121.413, 121.414)	4 years	0	40	0	60.0	Instructor	83	$209.87	3320	$1,045,145
		2	0	0	40.0	Tech Writer	83	$46.44	166	$154,193
Extended envelope flight training maneuvers and procedures (§§121.407(e),121.423, 121.424, 121.427(d)(1)(i), 121.433(e)), Extended envelope ground training subjects (§§ 121.419(a)(2), 121.427), Runway safety maneuvers and procedures (Appendices E and F) and Crosswind maneuvers including wind gusts (Appendices E and F).	5 years and 120 days	0	60	0	240.0	Instructor	83	$209.87	4980	$4,180,579
		4	0	40	240.0	Tech Writer	83	$46.44	3652	$925,161
Approval of Advanced Qualification Program (§ 121.909)	120 Days	0	0	0	9.6	Instructor	22	$209.87	0	$44,324
		5	0	0	40.0	Tech Writer	22	$46.44	110	$40,871
Total					**801.6**				**16,461**	**$8,246,958**

* Details may not add to row or column totals due to rounding.

Cost Summary

From 2013 to 2028, the FAA estimates the base case costs to air carriers for complying with the provisions of this final rule are $313.9 million in constant 2012 dollars. The present value of the base case is $149.8 million when discounted at a 7 percent annual rate and $226.1 million when discounted at 3 percent. As mentioned earlier, we estimate the base case costs using the average of the range of simulator training times required by the final rule.

Table 19 summarizes the FAA estimate of the final rule low range costs.

Table 19

Total Costs – Low (2012 $)

Final Rule Additional Total Costs - Low							
		Low					
						Present Value	
Year	Calendar Year	Pilot & Simulator	Ground School	Paperwork	Total	7%	3%
1	2013	$0	$0	$0	$0	$0	$0
2	2014	$0	$0	$100,614	$100,614	$87,876	$94,839
3	2015	$0	$0	$0	$0	$0	$0
4	2016	$0	$0	$0	$0	$0	$0
5	2017	$0	$0	$0	$0	$0	$0
6	2018	$0	$0	$1,199,338	$1,199,338	$799,119	$1,004,446
7	2019	$25,170,300	$10,186,715	$6,947,006	$42,304,021	$26,342,714	$34,397,399
8	2020	$6,734,459	$10,227,527	$0	$16,961,987	$9,871,876	$13,389,792
9	2021	$25,372,283	$10,268,474	$0	$35,640,757	$19,385,008	$27,315,076
10	2022	$6,789,427	$10,309,850	$0	$17,099,277	$8,691,563	$12,723,572
11	2023	$25,575,726	$10,350,806	$0	$35,926,532	$17,068,695	$25,953,326
12	2024	$6,842,909	$10,392,209	$0	$17,235,118	$7,652,393	$12,088,712
13	2025	$25,781,213	$10,434,042	$0	$36,215,255	$15,029,331	$24,662,589
14	2026	$6,897,447	$10,475,359	$0	$17,372,806	$6,737,174	$11,485,162
15	2027	$25,986,739	$10,517,105	$0	$36,503,843	$13,228,993	$23,431,817
16	2028	$6,953,818	$10,559,662	$0	$17,513,480	$5,932,421	$10,913,821
Total		**$162,104,321**	**$103,721,749**	**$8,246,958**	**$274,073,027**	**$130,827,162**	**$197,460,552**

* Details may not add to row or column totals due to rounding.

Table 20 summarizes the FAA estimate of the final rule base case costs.

Table 20

Total Costs – Base Case (2012 $)

Final Rule Additional Total Costs - Base Case							
		Base Case					
	Calendar					Present Value	
Year	Year	Pilot & Simulator	Ground School	Paperwork	Total	7%	3%
1	2013	$0	$0	$0	$0	$0	$0
2	2014	$0	$0	$100,614	$100,614	$87,876	$94,839
3	2015	$0	$0	$0	$0	$0	$0
4	2016	$0	$0	$0	$0	$0	$0
5	2017	$0	$0	$0	$0	$0	$0
6	2018	$0	$0	$1,199,338	$1,199,338	$799,119	$1,004,446
7	2019	$31,393,666	$10,186,715	$6,947,006	$48,527,387	$30,218,004	$39,457,618
8	2020	$8,348,589	$10,227,527	$0	$18,576,116	$10,811,300	$14,663,986
9	2021	$31,645,590	$10,268,474	$0	$41,914,064	$22,797,059	$32,122,939
10	2022	$8,416,741	$10,309,850	$0	$18,726,591	$9,518,726	$13,934,457
11	2023	$31,899,335	$10,350,806	$0	$42,250,141	$20,073,042	$30,521,502
12	2024	$8,483,032	$10,392,209	$0	$18,875,242	$8,380,607	$13,239,094
13	2025	$32,155,630	$10,434,042	$0	$42,589,671	$17,674,714	$29,003,566
14	2026	$8,550,639	$10,475,359	$0	$19,025,998	$7,378,282	$12,578,087
15	2027	$32,411,969	$10,517,105	$0	$42,929,074	$15,557,496	$27,556,172
16	2028	$8,620,533	$10,559,662	$0	$19,180,194	$6,496,995	$11,952,463
Total		**$201,925,723**	**$103,721,749**	**$8,246,958**	**$313,894,430**	**$149,793,221**	**$226,129,169**

Table 21 summarizes the FAA estimate of the final rule high range costs.

Table 21

Total Costs – High (2012 $)

Final Rule Additional Total Costs - High							
		High					
	Calendar					Present Value	
Year	Year	Pilot & Simulator	Ground School	Paperwork	Total	7%	3%
1	2013	$0	$0	$0	$0	$0	$0
2	2014	$0	$0	$100,614	$100,614	$87,876	$94,839
3	2015	$0	$0	$0	$0	$0	$0
4	2016	$0	$0	$0	$0	$0	$0
5	2017	$0	$0	$0	$0	$0	$0
6	2018	$0	$0	$1,199,338	$1,199,338	$799,119	$1,004,446
7	2019	$37,617,032	$10,186,715	$6,947,006	$54,750,753	$34,093,294	$44,517,837
8	2020	$9,962,719	$10,227,527	$0	$20,190,246	$11,750,723	$15,938,180
9	2021	$37,918,897	$10,268,474	$0	$48,187,371	$26,209,111	$36,930,801
10	2022	$10,044,056	$10,309,850	$0	$20,353,906	$10,345,890	$15,145,341
11	2023	$38,222,944	$10,350,806	$0	$48,573,750	$23,077,389	$35,089,677
12	2024	$10,123,156	$10,392,209	$0	$20,515,365	$9,108,822	$14,389,477
13	2025	$38,530,046	$10,434,042	$0	$48,964,088	$20,320,097	$33,344,544
14	2026	$10,203,830	$10,475,359	$0	$20,679,189	$8,019,390	$13,671,012
15	2027	$38,837,199	$10,517,105	$0	$49,354,304	$17,886,000	$31,680,528
16	2028	$10,287,247	$10,559,662	$0	$20,846,909	$7,061,569	$12,991,104
Total		**$241,747,126**	**$103,721,749**	**$8,246,958**	**$353,715,833**	**$168,759,279**	**$254,797,786**

* Details may not add to row or column totals due to rounding.

VI. BENEFIT COST SUMMARY

This final rule will increase safety and contribute significantly to reducing the frequency of future aviation accidents. Phased-in potential quantified benefits will accrue from the additional training initiatives and shown in Table 23 below.

The final rule will also generate qualitative benefits, by addressing NTSB safety recommendations related to crewmember training, and requirements in the Airline Safety and Federal Aviation Administration Extension Act of 2010 (the 2010 Act).[57]

Under the 2010 Act, Congress directed the FAA to conduct rulemaking to ensure that all flightcrew members receive ground training and flight training in recognizing and avoiding stalls, recovering from stalls, recognizing and avoiding upset of an aircraft, and the proper techniques to recover from upset. The 2010 Act also directed the FAA to ensure air carriers develop remedial training programs for flight crew members who have demonstrated performance deficiencies or experienced failures in the training environment.

The changes in this final rule address the following NTSB recommendations:

- A-96-120. Require 14 CFR part 121 and 135 operators to provide training to flightcrews in the recognition of and recovery from unusual attitudes and upset maneuvers, including upsets that occur while the aircraft is being controlled by automatic flight control systems, and unusual attitudes that result from flight control malfunctions and uncommanded flight control surface movements.
- A-05-14. Require all 14 Code of Federal Regulations part 121 air carrier operators to establish programs for flight crewmembers who have demonstrated performance deficiencies or experienced failures in the training environment that would require a review of their whole performance history at the company and administer additional oversight and training to ensure that performance deficiencies are addressed and corrected
- A-05-30. Require all 14 Code of Federal Regulations part 121 and 135 air carriers to incorporate bounced landing recovery techniques in their flight manuals and to teach these techniques during initial and recurrent training

[57] Public Law 111-216.

- A-07-44. Require that all 14 *Code of Federal Regulations* parts 91K, 121, and 135 operators establish procedures requiring all crewmembers on the flight deck to positively confirm and cross-check the airplane's location at the assigned departure runway before crossing the hold short line for takeoff. This required guidance should be consistent with the guidance in Advisory Circular 120-74A and Safety Alert for Operators 06013 and 07003.
- A-10-22. Require 14 *Code of Federal Regulations* (CFR) part 121,135, and 91K operators and 14 CFR Part 142 training centers to develop and conduct training that incorporates stalls that are fully developed; are unexpected; involve autopilot disengagement; and include airplane-specific features, such as a reference speeds switch.
- A-10-23. Require all 14 *Code of Federal Regulations* part 121, 135, and 91K operators of stick pusher-equipped aircraft to provide their pilots with pusher familiarization Simulator training.
- A-10-111. Require 14 *Code of Federal Regulations* parts 121, 135, and 91 K operators to incorporate the realistic, gusty crosswind profiles developed as a result of Safety Recommendation A-10-110 into their pilot simulator training programs.

Table 22 shows a summary of the costs in 2012 dollars, 7 and 3 percent present value. The total costs include increased training for pilots, check pilots and flight instructors along with additional costs of more simulator time and paperwork for updating curriculums and operating manuals.

Table 22

Range of Total Costs (2012 $ Millions) From 2019 to 2028

		Present Value	
	2012 $	7%	3%
Low	$274.1	$130.8	$197.5
High	$353.7	$168.8	$254.8
Base Case	**$313.9**	**$149.8**	**$226.1**

Table 23 shows the final rule's present value (using a 7% discount rate) quantitative benefit estimate of $317.1 million exceeds the present value quantitative base case cost estimate of $149.8 million to operators training their pilots under part 121.

Table 23

Summary of Benefits and Costs (2012 $ Millions) From 2019 to 2028

Range		2012 $	Present Value 7%	Present Value 3%
Low	Cost	$274.1	$130.8	$197.5
High	Cost	$353.7	$168.8	$254.8
Base Case	**Cost**	**$313.9**	**$149.8**	**$226.1**
	Benefit	**$689.2**	**$317.1**	**$488.7**

Thus, the FAA concludes that the benefits of the final rule justify the costs.

VII. APPENDICES

Appendix 1 –Accident Descriptions

Colgan 3407
(1) Accident Information- 2-12-2009 NTSB Report Number: DCA09MA027 COLGAN 3407 Part 121 Scheduled Domestic Flight Bombardier DHC-8-402 Fatalites-50
(2) Summary of NTSB accident narrative related to rulemaking. On February 12, 2009, about 2217 eastern standard time, a Colgan Air, Inc., Bombardier DHC-8-400, N200WQ, operating as Continental Connection flight 3407, was on an instrument approach to Buffalo-Niagara International Airport, Buffalo, New York, when it crashed into a residence in Clarence Center, New York, about 5 nautical miles northeast of the airport. The 2 pilots, 2 flight attendants, and 45 passengers aboard the airplane were killed, one person on the ground was killed, and the airplane was destroyed by impact forces and a post-crash fire. The flight was operating under the provisions of 14 *Code of Federal Regulations* Part 121. Night visual meteorological conditions prevailed at the time of the accident.
(3) NTSB causal factors. The NTSB determined that the probable cause of the accident was the captain's inappropriate response to the activation of the stick shaker, which led to an aerodynamic stall from which the airplane did not recover. Other contributing factors are: 1. The flight crew's failure to monitor airspeed in relation to the rising position of the low speed cue. 2. The flight crew's failure to adhere to sterile cockpit procedures. 3. The captain's failure to effectively manage the flight. 4. Colgan Air's inadequate procedures for airspeed selection and management during approaches in icing conditions.

American Airlines 587

(1) Accident Information-
11/12/2001
NTSB Report Number: DCA02MA001
American Airlines 587
Part 121 Scheduled International Flight
Airbus A-300
Fatalites-265

(2) Summary of NTSB accident narrative related to rulemaking.
On November 12, 2001, about 0916:15 eastern standard time, American Airlines flight 587, an Airbus Industrie A300-605R, N14053, crashed into a residential area of Belle Harbor, New York, shortly after takeoff from John F. Kennedy International Airport, Jamaica, New York. Flight 587 was a regularly scheduled passenger flight to Las Americas International Airport, Santo Domingo, Dominican Republic, with 2 flight crewmembers, 7 flight attendants, and 251 passengers aboard the airplane. The airplane's vertical stabilizer and rudder separated in flight and were found in Jamaica Bay, about 1 mile north of the main wreckage site. The airplane's engines subsequently separated in flight and were found several blocks north and east of the main wreckage site. All 260 people aboard the airplane and 5 people on the ground were killed, and the airplane was destroyed by impact forces and a post-crash fire. In the immediate vicinity of the impact area, four homes were destroyed, three homes received substantial damage, and three homes received minor damage. In addition, the in-flight separation of the engines resulted in property damage where the engines came to rest. A gas station received minor damage as a result of the impact of the left engine, and a home and a boat (parked in the driveway) received severe damage as a result of the impact of the right engine.
Flight 587 was operating under the provisions of 14 Code of Federal Regulations Part 121 on an instrument flight rules flight plan. Visual meteorological conditions prevailed at the time of the accident.

(3) NTSB causal factors. The National Transportation Safety Board determines that the probable cause of this accident was the in-flight separation of the vertical stabilizer as a result of the loads beyond ultimate design that were created by the first officer’s unnecessary and excessive rudder pedal inputs. Contributing to these rudder pedal inputs were characteristics of the Airbus A300-600 rudder system design and elements of the American Airlines Advanced Aircraft Maneuvering Program.

American Eagle 4184

(1) Accident Information-
10/31/1994
NTSB Report Number: DCA95MA001
American Eagle Airlines 4184
Part 121 Scheduled Domestic Flight
ATR 72
68-Fatalities

(2) Summary of NTSB accident narrative related to rulemaking.
On October 31, 1994, American Eagle flight 4184 Chicago's O'Hare International Airport (ORD) to Indianapolis, Indiana (IND) at 1559 crashed at 41° 5' 40" north latitude and 87° 19' 20" west longitude (near Roselawn, IN) during a rapid descent after an uncommanded roll excursion. The airplane was in a holding pattern and was descending to a newly assigned altitude of 8,000 feet when the initial roll excursion occurred. The airplane was destroyed by impact forces; and the captain, first officer, 2 flight attendants and 64 passengers received fatal injuries. Flight 4184 was a regularly scheduled passenger flight being conducted under 14 Code of Federal Regulations, Part 121; and an instrument flight rules flight plan had been filed.

(3) NTSB causal factors.
The NTSB determined that the probable cause was the loss of control, attributed to a sudden and unexpected aileron hinge moment reversal that occurred after a ridge of ice accreted beyond the deice boots while the airplane was in a holding pattern during which it intermittently encountered supercooled cloud and drizzle/rain drops, the size and water content of which exceeded those described in the icing certification envelope. The airplane was susceptible to this loss of control, and the crew was unable to recover.
Other contributing factors are:

1. The French Directorate General for Civil Aviation's (DGAC's) inadequate oversight of the ATR 42 and 72, and its failure to take the necessary corrective action to ensure continued airworthiness in icing conditions.
2. The DGAC's failure to provide the FAA with timely airworthiness information developed from previous ATR incidents and accidents in icing conditions.
3. the Federal Aviation Administration's (FAA's) failure to ensure that aircraft icing certification requirements, operational requirements for flight into icing conditions, and FAA published aircraft icing information adequately accounted for the hazards that can result from flight in freezing rain.
4. The FAA's inadequate oversight of the ATR 42 and 72 to ensure continued airworthiness in icing conditions.
5. ATR's inadequate response to the continued occurrence of ATR 42 icing/roll upsets which, in conjunction with information learned about aileron control difficulties during the certification and development of the ATR 42 and 72, should have prompted additional research, and the creation of updated airplane flight manuals, flightcrew operating manuals and training programs related to operation of the ATR 42 and 72 in such icing conditions.

USAir 427
(1) Accident Information- 09/08/1994 NTSB Report Number: DCA94MA076 USAir 427 Part 121 Scheduled Domestic Flight Boeing B-737-300 Fatalites-132
(2) Summary of NTSB accident narrative related to rulemaking. On September 8, 1994, about 1903:23 eastern daylight time, USAir (now US Airways) flight 427, a Boeing 737-3B7 (737-300), N513AU, crashed while maneuvering to land at Pittsburgh International Airport, Pittsburgh, Pennsylvania. Flight 427 was operating under the provisions of 14 Code of Federal Regulations Part 121 as a scheduled domestic passenger flight from Chicago-O'Hare International Airport, Chicago, Illinois, to Pittsburgh. The flight departed about 1810, with 2 pilots, 3 flight attendants, and 127 passengers on board. The airplane entered an uncontrolled descent and impacted terrain near Aliquippa, Pennsylvania, about 6 miles northwest of the destination airport. All 132 people on board were killed, and the airplane was destroyed by impact forces and fire. Visual meteorological conditions prevailed for the flight, which operated on an instrument flight rules flight plan.
(3) NTSB causal factors. The National Transportation Safety Board determines that the probable cause of the USAir flight 427 accident was a loss of control of the airplane resulting from the movement of the rudder surface to its blow-down limit. The rudder surface most likely deflected in a direction opposite to that commanded by the pilots as a result of a jam of the main rudder power control unit servo valve secondary slide to the servo valve housing offset from its neutral position and over-travel of the primary slide.

Comair 5191

(1) Accident Information-
08/27/2006
NTSB Report Number: DCA06MA064
COMAIR 5191
Part 121 Scheduled Domestic Flight
Bombardier CL-600-2B19
Fatalites-49

(2) Summary of NTSB accident narrative related to rulemaking.
On August 27, 2006, about 0606:35 eastern daylight time, Comair flight 5191, a Bombardier CL-600-2B19, N431CA, crashed during takeoff from Blue Grass Airport, Lexington, Kentucky. The flight crew was instructed to take off from runway 22 but instead lined up the airplane on runway 26 and began the takeoff roll. The airplane ran off the end of the runway and impacted the airport perimeter fence, trees, and terrain.
The captain, flight attendant, and 47 passengers were killed, and the first officer received serious injuries. The airplane was destroyed by impact forces and postcrash fire. The flight was operating under the provisions of 14 Code of Federal Regulations Part 121 and was en route to Hartsfield-Jackson Atlanta International Airport, Atlanta, Georgia. Night visual meteorological conditions prevailed at the time of the accident.

(3) NTSB causal factors.
The National Transportation Safety Board determines that the probable cause of this accident was the flight crewmembers' failure to use available cues and aids to identify the airplane's location on the airport surface during taxi and their failure to cross-check and verify that the airplane was on the correct runway before takeoff. Contributing to the accident were the flight crew's non-pertinent conversation during taxi, which resulted in a loss of positional awareness, and the Federal Aviation Administration's (FAA) failure to require that all runway crossings be authorized only by specific air traffic control (ATC) clearances.

Northwest 1482

(1) Accident Information-
12/03/1990
NTSB Report Number: DCA91MA010A
NORTHWEST AIRLINES 1482
Part 121 Scheduled Domestic Flight
DC-9
Fatalites-8

(2) Summary of NTSB accident narrative related to rulemaking.
On December 3, 1990, at 1345 EST, Northwest Flight1482, a DC-9 (N3313L) a regular schedule flight to Pittsburg Pa, and Northwest Flight 299, a Boeing 727 (N278US) a regular schedule flight to Memphis, collided near the intersection of runway 09/27 and 03C/21C in dense fog at Detroit Metropolitan/Wayne County Airport, Romulus, MI. At the time of the collision, theB-727 was on its takeoff roll, and the DC-9 had just taxied onto the active runway. The B-727 was substantially damaged, and DC-9 was destroyed. Seven of the 40 passengers and 1 crewmember aboard the DC-9 received fatal injuries.

(3) NTSB causal factors.
The NTSB found the probable cause of the accident was the lack of proper crew coordination, including virtual reversal of roles by the DC-9 pilots, which led to their failure to stop taxiing & alert ground controller of their positional uncertainty in a timely manner before & after intruding onto the active runway.
Other contributing factors include:

1. Deficiencies in ATC services provided by Detroit tower, including failure of ground controller to take timely action to alert local controller to possible runway incursion, inadequate visual observation, failure to use progressive taxi instructions in low-vis conditions, & issuance of inappropriate & confusing taxi instructions compounded by inadequate backup supervision for level of experience of staff on duty.
2. Deficiencies in surface markings, signage & lighting at airport & failure of FAA surveillance to detect or correct any of these deficiencies;
3. Failure of northwest airlines to provide adequate cockpit resource management training to line aircrews.
4. Contributing to fatalities was inoperability of DC-9 internal tailcone release mechanism.
5. Contributing to number & severity of injuries was failure of crew of DC-9 to properly execute the passenger evacuation.

Continental 1404
(1) Accident Information- 12-20-2008 NTSB Report Number: DCA09MA021 Continental 1404 Part 121 Scheduled Domestic Flight Boeing B-737-500 Fatalites-0
(2) Summary of NTSB accident narrative related to rulemaking. On December 20, 2008, about 1818 mountain standard time, Continental Airlines flight 1404, a Boeing 737-500, N18611, departed the left side of runway 34R during takeoff from Denver International Airport (DEN), Denver, Colorado. A postcrash fire ensued. The captain and 5 of the 110 passengers were seriously injured; the first officer, 2 cabin crewmembers, and 38 passengers received minor injuries; and 1 cabin crewmember and 67 passengers (3 of whom were lap-held children) were uninjured. The airplane was substantially damaged. The scheduled, domestic passenger flight, operated under the provisions of 14 Code of Federal Regulations Part 121, was departing DEN and was destined for George Bush Intercontinental Airport, Houston, Texas. At the time of the accident, visual meteorological conditions prevailed, with strong and gusty winds out of the west. The flight operated on an instrument flight rules flight plan.
(3) NTSB causal factors. The NTSB found that the probable cause of the accident was the captain's ceased rudder input, which was needed to maintain directional control of the airplane, about 4 seconds before the excursion, when the airplane encountered a strong and gusty crosswind that exceeded the captain's training and experience. Other contributing factors include: 1. An air traffic control system that did not require or facilitate the dissemination of key, available wind information to the air traffic controllers and pilots 2. 'Inadequate crosswind training in the airline industry due to deficient simulator wind gust modeling

FedEx 647
(1) Accident Information- 12-18-2003 NTSB Report Number: DCA04MA011 FEDEX 647 Part 121 Scheduled Domestic Flight Boeing MD-10-10F Fatalites-0
(2) Summary of NTSB accident narrative related to rulemaking. On December 18, 2003, about 1226 central standard time, Federal Express Corporation (FedEx) flight 647, a Boeing MD-10-10F (MD-10), N364FE, crashed while landing at Memphis International Airport (MEM), Memphis, Tennessee. The right main landing gear collapsed after touchdown on runway 36R, and the airplane veered off the right side of the runway. After the gear collapsed, a fire developed on the right side of the airplane. Of the two flight crewmembers and five nonrevenue FedEx pilots on board the airplane, the first officer and one nonrevenue pilot received minor injuries during the evacuation. The post-crash fire destroyed the airplane's right wing and portions of the right side of the fuselage. Flight 647 departed from Metropolitan Oakland International Airport (OAK), Oakland, California, about 0832 (0632 Pacific standard time) and was operating under the provisions of 14 Code of Federal Regulations (CFR) Part 121 on an instrument flight rules flight plan.
(3) NTSB causal factors. The NTSB probable cause findings: 1) The first officer failed to properly apply crosswind landing techniques to align the airplane with the runway centerline and to properly arrest the airplane's descent rate (flare) before the airplane touched down; and 2) the captain failed to adequately monitor the first officer's performance and command or initiate corrective action during the final approach and landing.

Delta 1141

(1) Accident Information-
08-31-1988
NTSB Report Number: DCA88MA072
DELTA 1141
Part 121 Scheduled Domestic Flight
Boeing B-727-232
Fatalites-14

(2) Summary of NTSB accident narrative related to rulemaking.
About 0901 central daylight time on August 31, 1988, Delta Air Lines, Inc., flight 1141, crashed shortly after lifting off from runway 18L at the Dallas-Fort Worth International Airport, Texas. The airplane, a Boeing 727-232, U.S. Registry N473DA, was a regularly scheduled passenger flight and was en route to Salt Lake City, Utah, with 101 passengers and 7 crewmembers. The flightcrew reported that the takeoff roll appeared to be normal in all respects, with no warning lights, audible warnings, or unusual engine instrument conditions. The captain stated that the rotation was initially normal, but as the main gear wheels left the ground he heard "two explosions." He said it felt as though the airplane was experiencing "reverse thrust." The captain stated that the airplane began to "roll violently." The airplane struck the instrument landing system (ILS) localizer antenna array approximately 1,000 feet beyond the end of runway 18L, and came to rest about 3,200 feet beyond the departure end of the runway. The flight was airborne approximately 22 seconds from liftoff to the first ground impact near the ILS localizer antenna. The airplane was destroyed by impact forces and the post-crash fire.

(3) NTSB causal factors.
The NTSB probable cause findings: (1) The Captain and First Officer's inadequate cockpit discipline which resulted in the flightcrew's attempt to takeoff without the wing flaps and slats properly configured; and (2) the failure of the takeoff configuration warning system to alert the crew that the airplane was not properly configured for the takeoff.
Other contributing factors include:

1. Delta's slow implementation of necessary modifications to its operating procedures, manual's, checklists, training, and crew checking programs which were necessitated by significant changes in the airline following rapid growth and merger.
2. 'The lack of sufficiently aggressive action by the FAA to have known deficiencies corrected by Delta and the lack of sufficient accountability within the FAA's air carrier inspection process.

Corporate 5966
(1) Accident Information- 10/19/2004 NTSB Report Number: DCA05MA004 CORPORATE 5966 Part 121 Scheduled Domestic Flight British Aerospace BAE-J3201 Fatalites-13
(2) Summary of NTSB accident narrative related to rulemaking. On October 19, 2004, about 1937 central daylight time, Corporate Airlines (doing business as American Connection) flight 5966, a BAE Systems BAE-J3201, N875JX, struck trees on final approach and crashed short of runway 36 at Kirksville Regional Airport (IRK), Kirksville, Missouri. The flight was operating under the provisions of 14 Code of Federal Regulations (CFR) Part 121 as a scheduled passenger flight from Lambert-St. Louis International Airport (STL), in St. Louis, Missouri, to IRK. The captain, first officer, and 11 of the 13 passengers were fatally injured, and 2 passengers received serious injuries. The airplane was destroyed by impact and a post-impact fire. Night instrument meteorological conditions (IMC) prevailed for the flight, which operated on an instrument flight rules (IFR) flight plan.
(3) NTSB causal factors. The pilots' failure to follow established procedures and properly conduct a non-precision instrument approach at night in IMC, including their descent below the minimum descent altitude (MDA) before required visual cues were available (which continued un-moderated until the airplane struck the trees) and their failure to adhere to the established division of duties between the flying and nonflying (monitoring) pilot. Contributing to the accident was (1) the pilots' failure to make standard callouts and the current Federal Aviation Regulations that allow pilots to descend below the MDA into a region in which safe obstacle clearance is not assured based upon seeing only the airport approach lights, (2) the pilots' failure to establish and maintain a professional demeanor during the flight, and (3) the pilots’ fatigue likely contributed to their degraded performance.

USAir 5050
(1) Accident Information- 09-20-1989 NTSB Report Number: DCA89MA074 USAir 5050 Part 121 Scheduled Domestic Flight BOEING B-737-400 Fatalites-2
(2) Summary of NTSB accident narrative related to rulemaking. On September 20, 1989, USAir, Inc. flight 5050 was departing New York City's LaGuardia Airport, Flushing, New York, for Charlotte Douglas International Airport, Charlotte, North Carolina. As the first officer began the takeoff on runway 31, he felt the airplane drift left. The captain noticed the left drift also and used the nosewheel tiller to help steer. As the takeoff run progressed, the aircrew heard a "bang" and a continual rumbling noise. The captain then took over and rejected the takeoff but did not stop the airplane before running off the end of the runway into Bowery Bay. Instrument flight conditions prevailed at the time and the runway was wet.
(3) NTSB causal factors. The captain's failure to exercise his command authority in a timely manner to reject the takeoff or take sufficient control to continue the takeoff, which was initiated with a mistrimmed rudder. Also causal was the captain's failure to detect the mistrimmed rudder before the takeoff was attempted.

Appendix 2 – Historical Accidents

					Onboard Injuries				Persons Onboard				Injuries on Ground	Total Injuries				
Carrier	Flt	Date	Site of Accident	Aircraft	Fatalities	Serious	Minor	No Injury	Passengers	Crew	Total	Pax seats	Fatalities	Fatalities	Serious	Minor	Hull Damage	Other Damage at Accident Site
Colgan	3407	2/12/2009	Clarence Center, NY	DHC-8-402	49				45	4	49	70	1	50	0	0	Destroyed	One house destroyed
American	587	11/12/2001	Queens, NY	A300B4-605R	260				251	9	260	266	5	265	0	0	Destroyed	Destroyed four homes, severely or substantially damaged four homes and boat (parked in a driveway) and resulted in minor damage to a gas station and three homes
American Eagle	4184	10/31/1994	Roselawn, IN	ATR-72-212	68				64	4	68	64		68	0	0	Destroyed	
USAir	427	9/8/1994	Hopewell Township, PA	B737-300	132				127	5	132	140		132	0	0	Destroyed	
COMAIR	5191	8/27/2006	Lexington, KY	CRJ-100ER	49	1			47	3	50	50		49	1	0	Destroyed	
Northwest	1482	12/3/1990	Detroit, MI	DC-9-14	8	10	26		40	4	44	80		8	10	26	Destroyed	Secondary aircraft (B727) substantially damaged and eventually repaired
Continental	1404	12/20/2008	Denver, CO	B737-500		6	41	68	110	5	115	108		0	6	41	Destroyed	
FedEx	647	12/18/2003	Memphis, TN	MD-10-10F			2	5	5	2	7	N/A		0	0	2	Destroyed	
Delta	1141	8/31/1988	Dallas-Fort Worth, TX	B727-232	14	26	50	18	101	7	108	145		14	26	50	Destroyed	
Corporate	5966	10/19/2004	Kirksville, MO	Jetstream 32	13	2			13	2	15	19		13	2	0	Destroyed	
USAir	5050	9/20/1989	New York, NY	B737-400	2	3	18	40	57	6	63	146		2	3	18	Destroyed	
Total					595	48	137	131	860	51	911		6	601	48	137		

Appendix 3

Historical Accidents Probable Cause(s), Contributing Factors, and Relevant Provisions of Final Rule

		Provision of Final Rule					
		Extended Envelope Training		Runway Safety	Gusty Crosswinds	Remedial Training	Pilot Monitoring
		Full Stall Recovery	Upset Prevention and Recovery				
Colgan 3408 .20	**Probable Cause**						
	The captain's inappropriate response to the activation of the stick shaker, which led to an aerodynamic stall from which the airplane did not recover.	X				X	X
	Contributing Factors						
	The flight crew's failure to monitor airpeed in relation to the rising position of the low-speed cue.						X
	The flight crew failure to adhere to sterile cockpit procedures.						
	The captain's failure to effectively manage the flight,					X	
	Colgan Air's inadequate procedures for airspeed selection and management during approaches in icing conditions.						X
American 587 .25	**Probable Cause**						
	The in-flight separation of the vertical stabilizer as a result of the loads beyond ultimate design that were created by the first officer's unnecessary and excessive rudder pedal inputs		X			X	X
	Contributing Factors						
	Characteristics of the Airbus A300-600 rudder system design.						
	Elements of the American Airlines Advanced Aircraft Maneuvering Program		X				X
American Eagle 4184 .20	**Probable Cause**						
	The loss of control, attributed to a sudden and unexpected aileron hinge moment reversal that occurred after a ridge of ice accreted beyond the deice boots while the airplane was in a holding pattern during which it intermittently encountered supercooled cloud and drizzle/rain drops, the size and water content of which exceeded those described in the icing certification envelope. The airplane was susceptible to this loss of control, and the crew was unable to recover.	X	X				X
	Contributing Factors						
	The French Directorate General for Civil Aviation's (DGAC's) inadequate oversight of the ATR 42 and 72, and its failure to take the necessary corrective action to ensure continued airworthiness in icing conditions.						
	The DGAC's failure to provide the FAA with timely airworthiness information developed from previous ATR incidents and accidents in icing conditions.						
	the Federal Aviation Administration's (FAA's) failure to ensure that aircraft icing certification requirements, operational requirements for flight into icing conditions, and FAA published aircraft icing information adequately accounted for the hazards that can result from flight in freezing rain.						
	The FAA's inadequate oversight of the ATR 42 and 72 to ensure continued airworthiness in icing conditions.						
	ATR's inadequate response to the continued occurrence of ATR 42 icing/roll upsets which, in conjunction with information learned about aileron control difficulties during the certification and development of the ATR 42 and 72, should have prompted additional research, and the creation of updated airplane flight manuals, flightcrew operating manuals and training programs related to operation of the ATR 42 and 72 in such icing conditions.	X	X				

		Provision of Final Rule					
		Extended Envelope Training		Runway Safety	Gusty Crosswinds	Remedial Training	Pilot Monitoring
		Full Stall Recovery	Upset Prevention and Recovery				
US Airways 427 .20	**Probable Cause**						
	A loss of control of the airplane resulting from the movement of the rudder surface to its blowdown limit. The rudder surface most likely deflected in a direction opposite to that commanded by the pilots as a result of a jam of the main rudder power control unit servo valve secondary slide to the servo valve housing offset from its neutral position and overtravel of the primary slide.		X				
	Contributing Factors						
	None						
Comair 5191 .15	**Probable Cause**						
	The flight crewmembers's failure to use available cues and aids to identify the airplane's location on the airport surface during taxi and their failure to cross-check and verify that the airplane was on the correct runway before takeoff			X			
	Contributing Factors						
	The flight crew's nonpertinent conversation during taxi, which resulted in a loss of positional awareness						X
	The Federal Aviation Administration's failure to require that all runway crossings be authorized only by specific air traffic control clearances						
Northwest 1482 .50	**Probable Cause**						
	Lack of proper crew coordination, including virtual reversal of roles by the DC-9 pilots, which led to their failure to stop taxiing & alert ground controller of their positional uncertainty in a timely manner before & after intruding onto the active rwy.			X			X
	Contributing Factors						
	Deficiencies in ATC services provided by Detroit tower, including failure of ground controller to take timely action to alert local controller to possible runway incursion, inadeaute visusal observation, failure to use progressive taxi instructions in low-vis conditions, & issuance of inappropriate & confusing taxi instructions compounded by inadequate backup supervision for level of experience of staff on duty.						
	Deficiencies in surface markings, signage & lighting at arpt & failure of FAA surveillance to detect or correct any of these deficiencies;						
	Failure of northwest airlines to provide adequate cockpit resource management training to line aircrews.						
	Contributing to fatalities was inoperability of DC-9 internal tailcone release mechanism. Contributing to number & severity of injuries was failure of crew of DC-9 to properly execute the passenger evacuation.						
Continental 1404 .25	**Probable Cause**						
	The captain's cessation of rudder input, which was needed to maintain directional control of the airplane, about 4 seconds before the excursion, when the airplane encountered a strong and gusty crosswind that exceeded the captain's training and experience.				X		
	Contributing Factors						
	An air traffic control system that did not require or facilitate the dissemination of key, available wind information to the air traffic controllers and pilots						
	Inadequate crosswind training in the airline industry due to deficient simulator wind gust modeling						
Fedex 647 .35	**Probable Cause**						
	The first officer's failure to properly apply crosswind landing techniques to align the airplane with the runway centerline and to properly arrest the airplane's descent rate (flare) before the airplane touched down; and 2) The captain's failure to adequately monitor the first officer's performance and command or initiate corrective action during the final approach and landing.				X	X	
	Contributing Factors						
	None						

		Provision of Final Rule					
		Extended Envelope Training		Runway Safety	Gusty Crosswinds	Remedial Training	Pilot Monitoring
		Full Stall Recovery	Upset Prevention and Recovery				
Delta 1141 .35	**Probable Cause**						
	The captain and first officer's inadequate cockpit discipline which resulted in the flightcrew's attempt to takeoff without the wing flaps and slats properly configured.						X
	The failure of the takeoff configuration warning system to alert the crew that the airplane was not properly configured for the takeoff.						
	Contributing Factors						
	Delta's slow implementation of necessary modifications to its operating procedures, manual's, checklists, training, and crew checking programs which were necessitated by significant changes in the airline following rapid growth and merger.						
	The lack of sufficiently aggressive action by the FAA to have known deficiencies corrected by Delta and the lack of sufficient accountability within the FAA's air carrier inspection process.						
Corporate 5966 .05	**Probable Cause**						
	The pilots' failure to follow established procedures and properly conduct a nonprecision instrument approach at night in instrument meteorological conditions, including their descent below the minimum descent altitude (MDA) before required visual cues were available (which continued unmoderated until the airplane struck the trees).					X	X
	The pilots' failure to adhere to the established division of duties between the flying and nonflying (monitoring) pilot.						X
	Contributing Factors						
	The pilots' failure to make standard callouts.					X	X
	Current regulations which allow pilots to descent below the MDA into a region in which safe obstacle clearance is not assured based upon seeing only the airport approach lights.						
	The pilots' failure to establish and maintain a professional demeanor during the flight.					X	
	Their fatigue likely contributed to their degraded performance.						
US Airways 5050 .50	**Probable Cause**						
	The captain's failure to exercise his command authority in a timely manner to reject the takeoff or take sufficient control to continue the takeoff, which was initiated with a mistrimmed rudder.						X
	Also causal was the captain's failure to detect the mistrimmed rudder before the takeoff was attempted.						
	Contributing Factors						
	None						

Appendix 4 – Value of Statistical Life (VSL)

Appendix 4, Table 1

Estimated Value of Preventing Fatalities and Injuries (2012 $)

AIS Level	Severity	Fraction of VSL	Estimated Value	Average of Moderate, Serious, Severe
AIS 1	Minor	0.003	$27,300	
AIS 2	Moderate	0.047	$427,700	
AIS 3	Serious	0.105	$955,500	$1,267,900
AIS 4	Severe	0.266	$2,420,600	
AIS 5	Critical	0.593	$5,396,300	
AIS 6	Unsurvivable	1.000	$9,100,000	

Appendix 4, Table 2

Estimated Value of Preventing Fatalities and Injuries

(2012 $)

Analysis Year	Calendar Year	Growth Factor	VSL	Serious	Minor
0	2012	1.0000	$9,100,000	$1,267,900	$27,300
1	2013	1.0107	$9,197,370	$1,281,467	$27,592
2	2014	1.0215	$9,295,782	$1,295,178	$27,887
3	2015	1.0324	$9,395,247	$1,309,037	$28,186
4	2016	1.0435	$9,495,776	$1,323,043	$28,487
5	2017	1.0547	$9,597,381	$1,337,200	$28,792
6	2018	1.0659	$9,700,073	$1,351,508	$29,100
7	2019	1.0773	$9,803,863	$1,365,969	$29,412
8	2020	1.0889	$9,908,765	$1,380,585	$29,726
9	2021	1.1005	$10,014,789	$1,395,357	$30,044
10	2022	1.1123	$10,121,947	$1,410,288	$30,366
11	2023	1.1242	$10,230,252	$1,425,378	$30,691
12	2024	1.1362	$10,339,715	$1,440,629	$31,019
13	2025	1.1484	$10,450,350	$1,456,044	$31,351
14	2026	1.1607	$10,562,169	$1,471,624	$31,687
15	2027	1.1731	$10,675,184	$1,487,370	$32,026
16	2028	1.1856	$10,789,409	$1,503,285	$32,368

Appendix 5 – Fatalities, Injuries, and Quantified Benefit - Sensitivity Analysis

Our estimate of future benefits incorporates information related to the rule's expected impacts on the aviation system looking forward in order to appropriately value the reduction in future risks. However, as a test of the sensitivity of our benefits estimates using this approach, we also include an analysis assuming that the exact number of fatalities and injuries as actually occurred in each historical accident would occur in a potential future accident. The details and results of the calculations for the sensitivity follow.

Appendix 5, Table 1

Actual Fatalities and Injuries from Historical Accidents - Sensitivity Analysis

		Onboard				On Ground
Carrier	Flt#	Fatalities	Serious Injuries	Minor Injuries	Total People Onboard	Fatalities
Colgan	3407	49	0	0	49	1
American	587	260	0	0	260	5
American Eagle	4184	68	0	0	68	0
USAir	427	132	0	0	132	0
COMAIR	5191	49	1	0	50	0
Northwest	1482	8	10	26	44	0
Continental	1404	0	6	41	115	0
FedEx	647	0	0	2	7	0
Delta	1141	14	26	50	108	0
Corporate	5966	13	2	0	15	0
USAir	5050	2	3	18	63	0
Total		595	48	137	911	6

Appendix 5, Table 2

Valuation of Actual Fatalities and Injuries for Historical Accidents (2012 $)

Sensitivity Analysis

Carrier	Flt#	Onboard and Ground			Total
		Fatalities	Serious Injuries	Minor Injuries	
Colgan	3407	$455,000,000	$0	$0	$455,000,000
American	587	$2,411,500,000	$0	$0	$2,411,500,000
American Eagle	4184	$618,800,000	$0	$0	$618,800,000
USAir	427	$1,201,200,000	$0	$0	$1,201,200,000
COMAIR	5191	$445,900,000	$1,267,900	$0	$447,167,900
Northwest	1482	$72,800,000	$12,679,000	$709,800	$86,188,800
Continental	1404	$0	$7,607,400	$1,119,300	$8,726,700
FedEx	647	$0	$0	$54,600	$54,600
Delta	1141	$127,400,000	$32,965,400	$1,365,000	$161,730,400
Corporate	5966	$118,300,000	$2,535,800	$0	$120,835,800
USAir	5050	$18,200,000	$3,803,700	$491,400	$22,495,100
Total		$5,469,100,000	$60,859,200	$3,740,100	$5,533,699,300

* Details may not add to row or column totals due to rounding.

Appendix 5, Table 3

Single Year Benefits of Final Rule (Actual Fatalities and Injuries) (2012 $)

Sensitivity Analysis

Carrier	Flt	Effectiveness Rating	Benefits from Avoided Fatalities and Injuries	Other Benefits
Colgan	3407	20%	$91,000,000	$4,266,320
American	587	25%	$602,875,000	$5,566,850
American Eagle	4184	20%	$123,760,000	$4,240,000
USAir	427	20%	$240,240,000	$4,240,000
COMAIR	5191	15%	$67,075,185	$3,180,000
Northwest	1482	50%	$43,094,400	$6,232,500
Continental	1404	25%	$2,181,675	$2,775,000
FedEx	647	35%	$19,110	$10,683,750
Delta	1141	35%	$56,605,640	$3,885,000
Corporate	5966	5%	$6,041,790	$1,060,000
USAir	5050	50%	$11,247,550	$5,550,000
Single year benefits over 22 year history			$1,244,140,350	$51,679,420
Per year benefit			$56,551,834	$2,349,065

* Details may not add to row or column totals due to rounding.

Appendix 5, Table 4

Total Benefits of Final Rule (Actual Fatalities and Injuries) (2012 $) - Sensitivity Analysis

Year	Calendar Year	Benefits from Avoided Fatalities and Injuries	Other Benefits	Total Benefits		
				Total Benefits	Total Discounted at 7%	Total Discounted at 3%
0	2012					
1	2013					
2	2014					
3	2015					
4	2016					
5	2017					
6	2018					
7	2019	$60,923,291	$2,349,065	$63,272,356	$39,399,696	$51,446,753
8	2020	$61,579,292	$2,349,065	$63,928,357	$37,206,304	$50,465,045
9	2021	$62,235,293	$2,349,065	$64,584,358	$35,127,432	$49,497,452
10	2022	$62,902,605	$2,349,065	$65,251,670	$33,167,424	$48,553,768
11	2023	$63,575,572	$2,349,065	$65,924,637	$31,320,795	$47,623,958
12	2024	$64,254,194	$2,349,065	$66,603,259	$29,571,847	$46,715,526
13	2025	$64,944,126	$2,349,065	$67,293,191	$27,926,674	$45,826,663
14	2026	$65,639,714	$2,349,065	$67,988,779	$26,366,048	$44,947,382
15	2027	$66,340,956	$2,349,065	$68,690,021	$24,893,264	$44,092,124
16	2028	$67,047,854	$2,349,065	$69,396,919	$23,504,736	$43,248,160
Total		$639,442,897	$23,490,650	$662,933,547	$308,484,220	$472,416,831

* Details may not add to row or column totals due to rounding.

Appendix 6

Table 1: Expected Value of a Typical Part 121 Passenger Aircraft During Benefits Period

Item	Value	Source
Average Seating Capacity of Aircraft in 2012	106	T-100 US Carrier Segment Data (Jan 2012 - Oct 2012), Part 121 Passenger Operations (average weighted by departures)
Forecasted Growth in Passenger Enplanements	2.10%	FAA Aerospace Forecasts 2013 - 2033, Table 10, U.S. Mainline Air Carriers Schedules Passenger Traffic, Avg Annual Growth Rate (2013-2033) for Revenue Passenger Enplanements (System)
Forecasted Growth in US Commercial Operations	1.60%	FAA Aerospace Forecasts 2013 - 2033, page 62
Inferred Growth in Seats per Flight	0.5%	=(1.021/1.016)-1
Expected Average Seating Capacity after 11 years (midpoint of benefits period)	112	=106*(1+0.005)^11
Average Age of Passenger Aircraft	10	Form 41, Schedule B-43 (2011)
2012 Market Value of Boeing 717-200 (Seating Capacity 117)		Airliner Price Guide (Winter 2012)

Year of Manufacture	Used Wholesale Price ($M)	Used Retail Price ($ M)
1998	6.7	7.43
2003	9.52	10.58
2006	12.03	13.37

2012 Value of an Aircraft of Typical Size and Age During Forecast Period	$ 10,500,000	2012 Market Value of a 9 yro Boeing 717-200

Appendix 6

Table 2: Average Value of Most Frequently Used Cargo Aircraft

(Jan-Oct 2012 T-100 Segment Data for Part 121 Cargo Only Operations)

Appendix 6, Table 2. Average Value of Most Frequently Used Cargo Aircraft (Jan-Oct 2012 T-100 Segment Data for Part 121 Cargo Only Operations)

Model	Departures	Year of Manufacture	Used Wholesale Price ($M)	Used Retail Price ($ M)	Midpoint ($M)	Weighted Average Value ($M)
	[a]	[b]	[c]	[c]	[d]	[e]
A300-600	63,744	1992	$32.97	$37.90	$35.44	
B757-200	44,823	1992	$19.90	$22.11	$21.01	$27.7
MD-11	41,587	1992	$24.03	$22.11	$23.07	
Sources:						
[a]	T-100 Segment Data, (Jan - Oct 2012, Part 121 Cargo Only Operations)					
[b]	2012 minus 20 (average age of cargo fleet from 2011 Form 41, Schedule B-43)					
[c]	Airliner Price Guide (Winter 2012 edition).					
[d]	Average of Used Wholesale Price and Used Retail Price					
[e]	Average Value Weighted by Departures (column [a])					

Appendix 7
Unit Values for Benefit Analysis

Item	Values	Unit	Source
Fatalities and Injuries			
VSL	$9,100,000	2012 dollars	Revised Departmental Guidance 2013: Treatement of the Value of Preventing Fatalities and Injuries in Preparing Economic Analyses
Serious Injury	$1,267,900	2012 dollars	Revised Departmental Guidance 2013: Treatement of the Value of Preventing Fatalities and Injuries in Preparing Economic Analyses, average of severe, serious, and moderate injury)
Minor Injury	$27,300	2012 dollars	Revised Departmental Guidance 2013: Treatement of the Value of Preventing Fatalities and Injuries in Preparing Economic Analyses
VSL annual growth rate	1.07%	Percentage	
VSL High	$5,200,000	2012 dollars	
VLS Low	$12,900,000	2012 dollars	
People on Flights			
Average Seating Capacity (Part 121 Pax operations)	106	Seats	T-100 segment data (Jan - Oct 2012), average weighted by departures
Average # of Pax (Part 121 Pax operations)	84	People	T-100 segment data (Jan - Oct 2012), average weighted by departures
average load factor	79%	Percentage	Calculated
Cabin crew	3	People	one FA per each 50 seats
Flight crew	2	People	
Estimated people on typical flight	89.0	People	Calculated
Aircraft Hull Values			
Passenger	$10,500,000	2012 dollars	See Appendix 6
Cargo	$27,700,000	2012 dollars	See Appendix 6
Cargo Value			
Average pounds of freight per flight (Part 121 Cargo Only Operations)	49,468	lbs	T-100 segment data (Jan - Oct 2012), average weighted by departures
	25	tons	Calculated
Value per Ton	$ 89.00	$1000 per ton (2012 dollars)	2007 FAF
Value of Cargo (100% load factor)	$ 2,225,000	2012 dollars	Calculated
Accident Investigations			
Catastrophic accident investigation	$ 10,700,000	2012 dollars	"Economic Values for FAA Investment and Regulatory Decisions, A Guide", Oct. 3, 2007 by GRA for the FAA, Table 8-2: Aviation Accident Investigation Costs
Regular accident investigation	$ 600,000	2012 dollars	"Economic Values for FAA Investment and Regulatory Decisions, A Guide", Oct. 3, 2007 by GRA for the FAA, Table 8-2: Aviation Accident Investigation Costs
Damage to Structures			
Median House Value	$175,400	2012 dollars	Average of Monthly US Existing Home Median Sales Price for 2012, Source: National Association of Realtors accessed at http://ycharts.com/indicators/sales_price_of_existing_homes
% of home value that is land			
2011Q4	0.201727908	Percentage	CWS, Source: Davis, Morris A. and Jonathan Heathcote, 2007, "The Price and Quantity of Residential Land in the United States," Journal of Monetary Economics, vol. 54 (8), p. 2595-2620; data located at Land and Property Values in the U.S., Lincoln Institute of Land Policy http://www.lincolninst.edu/resources/
2012Q1	0.218424863	Percentage	
2012Q2	0.233690069	Percentage	
2012Q3	0.237298105	Percentage	
2011Q4	0.255719234	Percentage	FHFA, Source: Davis, Morris A. and Jonathan Heathcote, 2007, "The Price and Quantity of Residential Land in the United States," Journal of Monetary Economics, vol. 54 (8), p. 2595-2620; data located at Land and Property Values in the U.S., Lincoln Institute of Land Policy http://www.lincolninst.edu/resources/
2012Q1	0.266111287	Percentage	
2012Q2	0.277798746	Percentage	
2012Q3	0.280930886	Percentage	
Average % of Home Value that Is Land	0.250	Percentage	Average of last four quarters of CWS and FHFA
Value of destroyed home structure	$131,600.0	2012 dollars	(1-Percent of Home Value that is Land)*Median House Value
% Value lost for substantially/severely amaged home structure	0.75	Percentage	
% Value lost for minor damage to house structure	0.25	Percentage	
Value lost for substantially/severealy damaged home structure	$98,700	2012 dollars	
Value lost for minor damage to house structure	$32,900	2012 dollars	
Boat			
Average price of preowned powerboat (with engine) in 2010	$ 14,039	2010 dollars	Source: "Recreation Boating Stakeholdrs Growth Summit Industry Overview 2011" accessed at http://consensus.fsu.edu/Boat-Summit/pdfs/Recreational%20Boating%20Growth%20Summit%20Industry%20Overview.pdf
GDP deflator	1.03954		
Average price of preowned powerboat (with engine) in 2010	$ 14,600	2012 dollars	
Growth Rates			
Passenger Growth Forecast (2012-33)	2.10%	Percentage	FAA Aerospace Forecasts 2013 - 2033, Table 10, U.S. Mainline Air Carriers Schedules Passenger Traffic, Avg Annual Growth Rate (2013-2033) for Revenue Passenger Enplanements (System)
Commercial Aircraft Activity Growth	1.60%	Percentage	FAA Aerospace Forecasts 2013 - 2033, page 62

Appendix 8
Part 121 Carriers in T-100 Segment Data (US Carriers) (Jan 2012 - Oct 2012)

Carrier Name as Listed in T-100 Segment Data
ABX Air, Inc.
Air Transport International
Air Wisconsin Airlines Corp
AirTran Airways Corporation
Alaska Airlines Inc.
Allegiant Air
Aloha Air Cargo
American Airlines Inc.
American Eagle Airlines Inc.
Amerijet International
Ameristar Air Cargo
Atlas Air Inc.
Cape Air
Capital Cargo International
Caribbean Sun Airlines, Inc. d/b/a World Atlantic Airlines
Centurion Cargo Inc.
Chautauqua Airlines Inc.
Colgan Air
Comair Inc.
Compass Airlines
Delta Air Lines Inc.
Dynamic Airways, LLC
Ellis Air Taxi Inc.
Empire Airlines Inc.
Era Aviation
Evergreen International Inc.
Executive Airlines
ExpressJet Airlines Inc.
Falcon Air Express
Federal Express Corporation
Florida West Airlines Inc.
Frontier Airlines Inc.
GoJet Airlines, LLC d/b/a United Express
Great Lakes Airlines
Gulf And Caribbean Cargo
Hawaiian Airlines Inc.
Horizon Air
Island Air Hawaii
JetBlue Airways
KaiserAir, Inc.
Kalitta Air LLC
Kalitta Charters II
Lynden Air Cargo Airlines
Mesa Airlines Inc.
Miami Air International
National Air Cargo Group, Inc. d/b/a Murray Air
North American Airlines
Northern Air Cargo Inc.
Omni Air Express
Peninsula Airways Inc.
Piedmont Airlines
Pinnacle Airlines Inc.
Polar Air Cargo Airways
Prescott Support Company, Inc.
PSA Airlines Inc.
Republic Airlines
Seaborne Aviation
Shuttle America Corp.
Sierra Pacific Airlines
Silver Airways
Sky King Inc.
SkyWest Airlines Inc.
Southern Air Inc.
Southwest Airlines Co.
Spirit Air Lines
Sun Country Airlines d/b/a MN Airlines
Swift Air, LLC
Tatonduk Outfitters Limited d/b/a Everts Air Alaska and Everts Air Cargo
Trans States Airlines
United Air Lines Inc.
United Parcel Service
US Airways Inc.
USA Jet Airlines Inc.
Virgin America
Vision Airlines
World Airways Inc.

Appendix 9

Part 121 and 121/135 Pilot Employment
February 2013

Air Operator Name	Operator FAR	PIC Captains	Other Pilots	Total	Pilots AQP Trained?
ABX AIR INC	121	107	109	216	No
AEKO KULA INC (ALOHA)	121	15	11	26	Yes
AERO MICRONESIA INC	121	7	5	12	No
AERODYNAMICS INC	121/135	0	0	0	No
AIR TRANSPORT INTERNATIONAL INC	121	69	18	87	No
AIR WISCONSIN AIRLINES CORPORATION	121	356	321	677	Yes
ALASKA AIRLINES INC	121	694	660	1354	Yes
ALLEGIANT AIR LLC	121	173	157	330	No
AMERICAN AIRLINES INC	121	3559	4201	7760	Yes
AMERICAN EAGLE AIRLINES INC	121	1271	1254	2525	No
AMERIJET INTERNATIONAL INC	121	33	23	56	No
AMERISTAR AIR CARGO INC	121	19	3	22	No
ATLAS AIR INC	121	375	700	1075	No
AVIATION SERVICES LTD	121/135	4	3	7	No
CAPITAL CARGO INTERNATIONAL AIRLINES INC	121	29	27	56	No
CARIBBEAN SUN AIRLINES INC	121	12	11	23	No
CENTURION AIR CARGO INC	121	25	35	60	No
CHAMPLAIN ENTERPRISES INC	121	109	78	187	No
CHAUTAUQUA AIRLINES INC	121	292	279	571	No
COMPASS AIRLINES LLC	121	213	230	443	Yes
DELTA AIR LINES INC	121	4871	5784	10655	Yes
DYNAMIC AIRWAYS LLC	121	2	0	2	No
ELITE AIRWAYS LLC	121	5	2	7	No
EMPIRE AIRLINES INC	121/135	88	23	111	No
ERA AVIATION INC	121	30	27	57	No
EVERGREEN INTERNATIONAL AIRLINES INC	121	48	69	117	No
EXECUTIVE AIRLINES INC	121	100	94	194	No
EXPRESSJET AIRLINES INC	121	2350	2200	4550	Yes
FALCON AIR EXPRESS INC	121	17	13	30	No
FEDERAL EXPRESS CORP	121	1738	1620	3358	Yes
FLORIDA WEST INTERNATIONAL AIRWAYS INC	121	18	25	43	No
FRONTIER AIRLINES INC	121	333	348	681	No
GOJET AIRLINES LLC	121	214	239	453	No
GREAT LAKES AVIATION LTD	121	162	130	292	No
GULF AND CARIBBEAN CARGO INC	121	25	23	48	No
HAWAII ISLAND AIR INC	121	20	21	41	No
HAWAIIAN AIRLINES INC	121	300	272	572	Yes
HORIZON AIR INDUSTRIES INC	121	320	301	621	Yes
HYANNIS AIR SERVICE INC	121/135	183	36	219	No
JETBLUE AIRWAYS CORPORATION	121	979	1000	1979	Yes
KAISERAIR INC	121/135	20	18	38	No
KALITTA AIR LLC	121	129	197	326	Yes
KALITTA CHARTERS II LLC	121	18	15	33	No
KEY LIME AIR CORPORATION	121/135	38	5	43	No
LYNDEN AIR CARGO L L C	121	31	29	60	No
MESA AIRLINES INC	121	370	370	740	Yes
MIAMI AIR INTERNATIONAL INC	121	41	49	90	No
MN AIRLINES LLC	121	73	72	145	No
MOUNTAIN AIR CARGO INC	121/135	98	28	126	No
NATIONAL AIR CARGO GROUP INC	121	37	43	80	No
NORTH AMERICAN AIRLINES	121	57	69	126	No
NORTHERN AIR CARGO INC	121	24	24	48	No
OMNI AIR INTERNATIONAL INC	121	105	128	233	No
PENINSULA AIRWAYS INC	121/135	70	49	119	No
PIEDMONT AIRLINES INC	121	230	275	505	Yes
PINNACLE AIRLINES INC	121	803	681	1484	Yes
POLAR AIR CARGO WORLDWIDE INC	121	2	0	2	No
PRESCOTT SUPPORT CO	121/135	5	8	13	No
PSA AIRLINES INC	121	251	232	483	No
REPUBLIC AIRLINES INC	121	380	369	749	Yes
RHOADES AVIATION INC	121/135	3	2	5	No
RYAN INTERNATIONAL AIRLINES INC	121	50	50	100	No
SEABORNE VIRGIN ISLAND INC	121	12	9	21	No
SHUTTLE AMERICA CORPORATION	121	333	324	657	Yes
SIERRA PACIFIC AIRLINES INC	121	5	3	8	No
SILVER AIRWAYS CORPORATION	121	92	90	182	No
SKY KING INC	121	31	14	45	No
SKY LEASE I INC	121	27	59	86	No
SKYWEST AIRLINES INC	121	1399	1347	2746	Yes
SOUTHERN AIR INC	121	83	181	264	No
SOUTHWEST AIRLINES CO	121	3866	4021	7887	No
SPIRIT AIRLINES INC	121	336	343	679	No
SWIFT AIR L L C	121/135	18	7	25	No
TATONDUK OUTFITTERS LTD	121/135	25	22	47	No
TEM ENTERPRISES	121	22	18	40	No
TRANS STATES AIRLINES LLC	121	120	150	270	Yes
UNITED AIR LINES INC CONTINENTAL AIRLINES INC	121	4185	5332	9517	Yes
UNITED PARCEL SERVICE CO	121	1350	1340	2690	Yes
US AIRWAYS INC	121	2285	2657	4942	Yes
USA JET AIRLINES INC	121/135	38	30	68	No
VIRGIN AMERICA INC	121	260	244	504	No
VISION AIRLINES INC	121/135	27	24	51	No
WORLD AIRWAYS INC	121	125	120	245	No
Total		36,639	39,400	76,039	

Appendix 10

Sensitivity Analysis on Pilots Spending an Extra Day in Training

As a sensitivity analysis, the FAA estimated the travel costs of pilots spending an extra day in simulator training for the additional tasks added by the final rule. Since travel costs include hotel, airfare or automobile mileage, and per diems (meals, etc.), the airfare or automobile mileage has already occurred. Therefore, the only remaining travels costs are for the final rule are for hotel and per diem costs. The FAA notes that the pilots' salary has already been estimated and included in the costs above.

We used the same hotel and per diem costs we used in the SNPRM regulatory evaluation. The FAA notes that no comments were received on our SNPRM estimates for hotel and per diem costs.

Based on the locations of the flight simulators and training centers, and the corresponding per diem rates for those locations, the FAA assumes that the weighted averages for lodging and meals are $92 and $44, respectively. [58] Per Diem cost (i.e., lodging and meals) rates are based on rates established annually by the General Services Administration (GSA) for travelers on official Government business to use for their lodging, meals, and incidental expenses.

We estimated the additional day of travel costs by taking the product of the number of pilots in simulator training with the sum of hotel and per diem. We perform this calculation for pilots in initial, upgrade, transition, and recurrent training and then sum the results.

The following table shows our cost estimate for an additional day in simulator training.

[58] Includes incidental expenses.

Appendix 10

Table 1: Cost of an Additional Day in Pilot Simulator Training

Year	Calendar Year	Total Travel Cost for an Extra Day						
		Initial	Upgrade	Transition	Recurrent	2012 $	7% Present Value	3% Present Value
1	2013	$0	$0	$0	$0	$0	$0	$0
2	2014	$0	$0	$0	$0	$0	$0	$0
3	2015	$0	$0	$0	$0	$0	$0	$0
4	2016	$0	$0	$0	$0	$0	$0	$0
5	2017	$0	$0	$0	$0	$0	$0	$0
6	2018	$0	$0	$0	$0	$0	$0	$0
7	2019	$571,880	$275,384	$603,726	$9,182,987	$10,633,976	$6,621,777	$8,646,486
8	2020	$574,192	$276,483	$606,137	$0	$1,456,812	$847,865	$1,150,007
9	2021	$576,504	$277,590	$608,563	$9,256,591	$10,719,248	$5,830,199	$8,215,232
10	2022	$578,952	$278,700	$610,997	$0	$1,468,650	$746,515	$1,092,822
11	2023	$581,128	$279,814	$613,439	$9,330,819	$10,805,200	$5,133,551	$7,805,676
12	2024	$583,440	$280,935	$615,896	$0	$1,480,272	$657,241	$1,038,263
13	2025	$585,888	$282,060	$618,362	$9,405,523	$10,891,832	$4,520,110	$7,417,338
14	2026	$588,064	$283,188	$620,834	$0	$1,492,086	$578,631	$986,418
15	2027	$590,376	$284,319	$623,315	$9,480,998	$10,979,008	$3,978,792	$7,047,425
16	2028	$592,960	$285,454	$625,803	$0	$1,504,218	$509,531	$937,379
Total		$5,823,384	$2,803,928	$6,147,072	$46,656,917	$61,431,301	$29,424,210	$44,337,046

The FAA estimates the total travel cost for an extra day would be about $61.4 million in 2012 dollars ($29.4 million at a seven percent present value and $44.3 million at a three percent present value).

Even if pilots would have to travel an extra day for in order to complete the additional simulator training tasks the final rule adds, the final rule would be cost beneficial.

Appendix 11

Low and High Estimated Simulator Costs by Pilot, Check Pilot, and Flight Instructor (2012 $)

		Pilot									
	Calendar	Total Pilot + Simulator Costs - Low					Total Pilot + Simulator Costs - High				
Year	Year	Initial	Upgrade	Transition	Recurrent	Total	Initial	Upgrade	Transition	Recurrent	Total
1	2013	$0	$0	$0	$0	$0	$0.00	$0.00	$0.00	$0	$0
2	2014	$0	$0	$0	$0	$0	$0.00	$0.00	$0.00	$0	$0
3	2015	$0	$0	$0	$0	$0	$0.00	$0.00	$0.00	$0	$0
4	2016	$0	$0	$0	$0	$0	$0.00	$0.00	$0.00	$0	$0
5	2017	$0	$0	$0	$0	$0	$0.00	$0.00	$0.00	$0	$0
6	2018	$0	$0	$0	$0	$0	$0.00	$0.00	$0.00	$0	$0
7	2019	$3,235,869	$779,062	$2,277,257	$17,319,265	$23,611,453	$4,853,802.88	$1,038,749.02	$3,415,886.18	$25,978,898	$35,287,336
8	2020	$3,248,966	$782,180	$2,286,372	$0	$6,317,517	$4,873,448.93	$1,042,906.34	$3,429,557.38	$0	$9,345,913
9	2021	$3,262,063	$785,308	$2,295,517	$17,457,955	$23,800,844	$4,893,094.98	$1,047,077.85	$3,443,275.24	$26,186,932	$35,570,381
10	2022	$3,275,161	$788,448	$2,304,693	$0	$6,368,302	$4,912,741.04	$1,051,263.55	$3,457,039.75	$0	$9,421,044
11	2023	$3,288,258	$791,598	$2,313,901	$17,597,919	$23,991,675	$4,932,387.09	$1,055,463.44	$3,470,850.93	$26,396,878	$35,855,579
12	2024	$3,301,355	$794,769	$2,323,170	$0	$6,419,294	$4,952,033.14	$1,059,691.71	$3,484,755.42	$0	$9,496,480
13	2025	$3,314,453	$797,951	$2,332,471	$17,739,111	$24,183,985	$4,971,679.19	$1,063,934.16	$3,498,706.58	$26,608,666	$36,142,986
14	2026	$3,327,550	$801,143	$2,341,803	$0	$6,470,496	$4,991,325.25	$1,068,190.81	$3,512,704.39	$0	$9,572,220
15	2027	$3,340,648	$804,346	$2,351,166	$17,881,304	$24,377,463	$5,010,971.30	$1,072,461.64	$3,526,748.86	$26,821,955	$36,432,137
16	2028	$3,354,563	$807,560	$2,360,560	$0	$6,522,683	$5,031,845.23	$1,076,746.66	$3,540,839.99	$0	$9,649,432

		Check Pilot									
	Calendar	Total Pilot + Simulator Costs - Low					Total Pilot + Simulator Costs - High				
Year	Year	Initial	Upgrade	Transition	Recurrent	Total	Initial	Upgrade	Transition	Recurrent	Total
1	2013	$0	$0	$0	$0	$0	$0.00	$0.00	$0.00	$0	$0
2	2014	$0	$0	$0	$0	$0	$0.00	$0.00	$0.00	$0	$0
3	2015	$0	$0	$0	$0	$0	$0.00	$0.00	$0.00	$0	$0
4	2016	$0	$0	$0	$0	$0	$0.00	$0.00	$0.00	$0	$0
5	2017	$0	$0	$0	$0	$0	$0.00	$0.00	$0.00	$0	$0
6	2018	$0	$0	$0	$0	$0	$0.00	$0.00	$0.00	$0	$0
7	2019	$142,330	$34,297	$100,251	$762,353	$1,039,231	$213,495.39	$45,728.68	$150,377.01	$1,143,530	$1,553,131
8	2020	$143,177	$34,429	$100,638	$0	$278,244	$214,766.20	$45,904.90	$150,956.49	$0	$411,628
9	2021	$144,025	$34,572	$101,056	$768,545	$1,048,197	$216,037.01	$46,095.80	$151,584.27	$1,152,817	$1,566,534
10	2022	$144,872	$34,715	$101,475	$0	$281,062	$217,307.81	$46,286.71	$152,212.05	$0	$415,807
11	2023	$144,872	$34,858	$101,893	$774,995	$1,056,619	$217,307.81	$46,477.61	$152,839.83	$1,162,493	$1,579,118
12	2024	$145,719	$35,001	$102,312	$0	$283,032	$218,578.62	$46,668.51	$153,467.61	$0	$418,715
13	2025	$146,566	$35,145	$102,730	$781,164	$1,065,605	$219,849.42	$46,859.42	$154,095.38	$1,171,745	$1,592,550
14	2026	$146,566	$35,288	$103,149	$0	$285,003	$219,849.42	$47,050.32	$154,723.16	$0	$421,623
15	2027	$147,413	$35,431	$103,567	$787,614	$1,074,026	$221,120.23	$47,241.22	$155,350.94	$1,181,421	$1,605,134
16	2028	$148,261	$35,574	$103,986	$0	$287,821	$222,391.04	$47,432.13	$155,978.72	$0	$425,802

		Flight Instructor									
	Calendar	Total Pilot + Simulator Costs - Low					Total Pilot + Simulator Costs - High				
Year	Year	Initial	Upgrade	Transition	Recurrent	Total	Initial	Upgrade	Transition	Recurrent	Total
1	2013	$0	$0	$0	$0	$0	$0.00	$0.00	$0.00	$0	$0
2	2014	$0	$0	$0	$0	$0	$0.00	$0.00	$0.00	$0	$0
3	2015	$0	$0	$0	$0	$0	$0.00	$0.00	$0.00	$0	$0
4	2016	$0	$0	$0	$0	$0	$0.00	$0.00	$0.00	$0	$0
5	2017	$0	$0	$0	$0	$0	$0.00	$0.00	$0.00	$0	$0
6	2018	$0	$0	$0	$0	$0	$0.00	$0.00	$0.00	$0	$0
7	2019	$71,165	$17,148	$50,126	$381,177	$519,616	$106,747.70	$22,864.34	$75,188.50	$571,765	$776,565
8	2020	$71,165	$17,214	$50,319	$0	$138,698	$106,747.70	$22,952.45	$75,478.25	$0	$205,178
9	2021	$71,165	$17,280	$50,512	$384,284	$523,242	$106,747.70	$23,040.56	$75,767.99	$576,426	$781,982
10	2022	$72,012	$17,347	$50,705	$0	$140,064	$108,018.50	$23,128.67	$76,057.73	$0	$207,205
11	2023	$72,012	$17,413	$50,898	$387,109	$527,432	$108,018.50	$23,216.78	$76,347.48	$580,664	$788,247
12	2024	$72,012	$17,479	$51,091	$0	$140,582	$108,018.50	$23,304.89	$76,637.22	$0	$207,961
13	2025	$72,860	$17,545	$51,285	$389,934	$531,623	$109,289.31	$23,393.00	$76,926.97	$584,902	$794,511
14	2026	$72,860	$17,611	$51,478	$0	$141,948	$109,289.31	$23,481.10	$77,216.71	$0	$209,987
15	2027	$72,860	$17,677	$51,671	$393,042	$535,249	$109,289.31	$23,569.21	$77,506.45	$589,563	$799,928
16	2028	$73,707	$17,743	$51,864	$0	$143,314	$110,560.12	$23,657.32	$77,796.20	$0	$212,014

* Details may not add to row or column totals due to rounding.

Appendix 12

Estimated Ground School Costs by Pilot, Check Pilot, and Flight Instructor (2012 $)

Year	Calendar Year	Pilot Costs				
		Additional Cost of Ground School				
		Initial	Upgrade	Transition	Recurrent	Total
1	2013	$0.00	$0.00	$0.00	$0.00	$0.00
2	2014	$0.00	$0.00	$0.00	$0.00	$0.00
3	2015	$0.00	$0.00	$0.00	$0.00	$0.00
4	2016	$0.00	$0.00	$0.00	$0.00	$0.00
5	2017	$0.00	$0.00	$0.00	$0.00	$0.00
6	2018	$0.00	$0.00	$0.00	$0.00	$0.00
7	2019	$1,508,382	$363,155	$1,592,296	$6,054,957	$9,518,789.53
8	2020	$1,514,487	$364,609	$1,598,669	$6,079,157	$9,556,920.81
9	2021	$1,520,592	$366,067	$1,605,063	$6,103,444	$9,595,166.28
10	2022	$1,526,697	$367,530	$1,611,479	$6,127,819	$9,633,525.93
11	2023	$1,532,803	$368,999	$1,617,917	$6,152,377	$9,672,095.17
12	2024	$1,538,908	$370,477	$1,624,399	$6,177,014	$9,710,797.38
13	2025	$1,545,013	$371,960	$1,630,902	$6,201,739	$9,749,613.79
14	2026	$1,551,118	$373,448	$1,637,427	$6,226,551	$9,788,544.38
15	2027	$1,557,224	$374,941	$1,643,974	$6,251,450	$9,827,589.16
16	2028	$1,563,711	$376,439	$1,650,542	$6,276,437	$9,867,129.71

Year	Calendar Year	Check Pilot				
		Additional Cost of Ground School				
		Initial	Upgrade	Transition	Recurrent	Total
1	2013	$0.00	$0.00	$0.00	$0.00	$0.00
2	2014	$0.00	$0.00	$0.00	$0.00	$0.00
3	2015	$0.00	$0.00	$0.00	$0.00	$0.00
4	2016	$0.00	$0.00	$0.00	$0.00	$0.00
5	2017	$0.00	$0.00	$0.00	$0.00	$0.00
6	2018	$0.00	$0.00	$0.00	$0.00	$0.00
7	2019	$70,516	$16,992	$74,502	$283,274	$445,283.92
8	2020	$70,936	$17,057	$74,790	$284,429	$447,210.93
9	2021	$71,355	$17,128	$75,101	$285,575	$449,158.61
10	2022	$71,775	$17,199	$75,412	$286,721	$451,106.29
11	2023	$71,775	$17,270	$75,723	$287,971	$452,739.18
12	2024	$72,195	$17,341	$76,034	$289,117	$454,686.86
13	2025	$72,614	$17,412	$76,345	$290,263	$456,634.54
14	2026	$72,614	$17,483	$76,656	$291,514	$458,267.43
15	2027	$73,034	$17,554	$76,967	$292,660	$460,215.11
16	2028	$73,454	$17,625	$77,278	$293,806	$462,162.79

Year	Calendar Year	Flight Instructor				
		Addtitional Cost of Ground School				
		Initial	Upgrade	Transition	Recurrent	Total
1	2013	$0.00	$0.00	$0.00	$0.00	$0.00
2	2014	$0.00	$0.00	$0.00	$0.00	$0.00
3	2015	$0.00	$0.00	$0.00	$0.00	$0.00
4	2016	$0.00	$0.00	$0.00	$0.00	$0.00
5	2017	$0.00	$0.00	$0.00	$0.00	$0.00
6	2018	$0.00	$0.00	$0.00	$0.00	$0.00
7	2019	$35,258	$8,496	$37,251	$141,637	$222,641.96
8	2020	$35,258	$8,529	$37,395	$142,214	$223,395.60
9	2021	$35,258	$8,561	$37,538	$142,792	$224,149.23
10	2022	$35,678	$8,594	$37,682	$143,264	$225,217.67
11	2023	$35,678	$8,627	$37,825	$143,841	$225,971.31
12	2024	$35,678	$8,660	$37,969	$144,419	$226,724.95
13	2025	$36,097	$8,692	$38,113	$144,891	$227,793.39
14	2026	$36,097	$8,725	$38,256	$145,469	$228,547.03
15	2027	$36,097	$8,758	$38,400	$146,046	$229,300.66
16	2028	$36,517	$8,791	$38,543	$146,518	$230,369.10

* Details may not add to row or column totals due to rounding.

Appendix 13

The Probability of Effectiveness Ratings of Overlapping Accidents For the Following Final Rules: Flightcrew Member Duty and Rest Requirements, The Pilot Certification and Qualification Requirements, and Qualification, Service, and Use of Crewmembers and Aircraft Dispatchers

Carrier	Aircraft	Site of Accident	Flt	Date	Fatalities	Serious Injury	Minor Injury	People on Board	Probability of Effectiveness			Total
									N&O	FOQ	FD&R	
Corporate	Jetstream 32	Kirksville, MO	5966	10/19/2004	13	2	0	15	5%	15%	75%	95%
COMAIR	CRJ-100ER	Lexington, KY	5191	8/27/2006	49	1	0	50	15%	n/a	35%	50%
Colgan	DHC-8-402	Clarence Center, NY	3407	2/12/2009	50	0	0	49	20%	20%	50%	90%

The FAA notes that for future related final rules, the total probability of effectiveness will not exceed 100% for any accident.

Appendix 14

Sensitivity Analysis on 10 Year Historical Accident Analysis Period for Benefits Estimation

The FAA reviewed accident data for U.S. certificate holders required to train under part 121 over the 22-year interval from 1988 through 2009. The objective of the analysis was to determine if an accident could have been prevented or mitigated by the training provisions in the final rule. In 1988, Delta flight 1141, crashed shortly after lifting off from the runway at the Dallas-Fort Worth International Airport (DCA88MA072). In their final report, the NTSB determined that one causal factor for the accident was "The captain and first officer's inadequate cockpit discipline which resulted in the flightcrew's attempt to takeoff without wing flaps and slats properly configured." The FAA determined that the pilot monitoring training provisions in the final rule may have prevented or mitigated this accident. The FAA initiated the historical accident interval for the benefits analysis with this accident.

Over the next 22 year historical accident interval, the FAA identified accidents with casual factors identified by the NTSB that are addressed by the provisions in the final rule. The FAA cited these accidents based on pertinent accident causal factors, regardless of whether there were open NTSB recommendations associated with those accidents.

We have explored the effect of reducing the historical analysis period from 22 years to 10 years here in response to comments disputing the use of a 22-year time frame for accidents. These comments state the accident rate has declined over time so using older accidents is not appropriate. As a result of reducing the historical analysis period to 10 years from 2000 to 2009, the number of relevant accidents is reduced from eleven to six. The 22-year historical period had an accident rate of 0.5 accidents per year, while the 10 year historical period had a slightly higher rate of 0.6 accidents per year.

Table 1

Accidents During 10 Year Period (2000-2009)

Carrier	Flt#	Date	State of Accident	Aircraft	Fatalities	Serious Injury	Minor Injury	People on Board	Effectiveness Rating for Final Rule
American	587	11/12/2001	NY	A300B4-605R	265	0	0	260	0.25
FedEx	647	12/18/2003	TN	MD-10-10F	0	0	2	7	0.35
Corporate	5966	10/19/2004	MO	Jetstream 32	13	2	0	15	0.05
COMAIR	5191	8/27/2006	KY	CRJ-100ER	49	1	0	50	0.15
Continental	1404	12/20/2008	CO	B737-500	0	6	41	115	0.25
Colgan	3407	2/12/2009	NY	DHC-8-402	50	0	0	49	0.20
10 Year Total					377	9	43	496	

Table 2, below, is adapted from Table 7 of this regulatory evaluation to cover just those accidents that occurred during the 10 year historical period. Table 3 is similar to Table 9 of this regulatory evaluation and shows those single year benefits grown to account for industry growth and also displays the present value of the benefits over the future analysis period when discounted at both the seven percent and three percent rates as recommended in OMB Circular A-4. Using a 10-year historical analysis period rather than the 22-year period increases the estimated benefits by approximately 17 percent. The total estimated benefit of the final rule using the 10-year historical analysis period is $803 million in 2012 dollars, compared to $689 million when using the 22-year historical analysis period. The stream of benefits estimated using the 10-year historical analysis period has a present value of $370 million when discounted at seven percent and $570 million when discounted at three percent, compared to $317 million and $489 million respectively when estimated using the 22-year historical analysis period.

Table 2

Single Year Benefits of Final Rule for 10 Year Period (2012 $)

Carrier	Flt#	Effectiveness Rating	Benefits from Avoided Fatalities and Injuries	Other Benefits
American	587	25%	$213,850,000	$5,566,850
FedEx	647	35%	$19,110	$10,683,750
Corporate	5966	5%	$35,795,740	$1,060,000
COMAIR	5191	15%	$119,135,370	$3,180,000
Continental	1404	25%	$1,803,275	$2,775,000
Colgan	3407	20%	$163,800,000	$4,266,320
Total benefit over 10 year history			$534,403,495	$27,531,920
Per year benefit			$53,440,350	$2,753,192

Table 3

Total Benefits of Final Rule for 10 Year Period (2012 $)

Year	Calendar Year	Benefits from Avoided Fatalities and Injuries	Other Benefits	Total Benefits		
				Total Benefits	Total Discounted at 7%	Total Discounted at 3%
0	2012					
1	2013					
2	2014					
3	2015					
4	2016					
5	2017					
6	2018					
7	2019	$66,586,953	$3,076,692	$69,663,645	$43,379,552	$56,643,510
8	2020	$68,717,985	$3,125,974	$71,843,959	$41,813,184	$56,713,621
9	2021	$70,908,550	$3,176,082	$74,084,632	$40,294,631	$56,778,462
10	2022	$73,172,734	$3,226,741	$76,399,475	$38,833,853	$56,848,849
11	2023	$75,505,580	$3,278,501	$78,784,081	$37,430,317	$56,913,620
12	2024	$77,914,525	$3,330,812	$81,245,337	$36,072,930	$56,985,479
13	2025	$80,408,150	$3,384,224	$83,792,374	$34,773,835	$57,062,607
14	2026	$82,975,142	$3,438,461	$86,413,603	$33,511,195	$57,128,033
15	2027	$85,623,197	$3,493,250	$89,116,447	$32,295,800	$57,203,847
16	2028	$88,353,957	$3,549,140	$91,903,097	$31,127,579	$57,274,010
Total		$770,166,773	$33,079,877	$803,246,650	$369,532,876	$569,552,038

Appendix 15

Sensitivity Analysis on Inclusion of AA 587 Accident in Historical Accident Analysis for Benefits Estimation

As explained in the "Accident Population and Scoring" section of the RIA benefits and the "Background" section of the Preamble, the accident involving American Airlines 587 was added to analysis of historical accidents subsequent to the NPRM. The AA 587 accident resulted in the deaths of all 260 people on board and an additional 5 people on the ground. The FAA Accident Investigation and Prevention Group (AVP) assigned an effectiveness rating of 0.25 to this accident.

Because this catastrophic accident was added to the benefits analysis for the final rule, the FAA feels it is worthwhile to present a sensitivity analysis exploring the impact on the benefits estimates of not including that accident.

Table 1, below, is adapted from Table 7 of this regulatory evaluation but removes AA 587 from the calculations. Table 2 is similar to Table 9 of this regulatory evaluation and shows those single year benefits grown to account for industry growth and also displays the present value of the benefits over the future analysis period when discounted at both the seven percent and three percent rates as recommended in OMB Circular A-4.

Removing AA 587 from the benefits analysis decreases the estimated benefits by approximately 26 percent. However, the benefits estimate without AA 587 still exceeds the costs of the final rule by a significant margin.

Table 1

Single Year Benefits of Final Rule, Omitting AA 587 (2012 $)

Carrier	Flt#	Effectiveness Rating	Benefits from Avoided Fatalities and Injuries	Other Benefits
Colgan	3407	20%	$163,800,000	$4,266,320
American Eagle	4184	20%	$161,980,000	$4,240,000
USAir	427	20%	$161,980,000	$4,240,000
COMAIR	5191	15%	$119,135,370	$3,180,000
Northwest	1482	50%	$86,202,450	$6,232,500
Continental	1404	25%	$1,803,275	$2,775,000
FedEx	647	35%	$19,110	$10,683,750
Delta	1141	35%	$47,930,820	$3,885,000
Corporate	5966	5%	$35,795,740	$1,060,000
USAir	5050	50%	$16,527,050	$5,550,000
Total benefit over 22 year history			$795,173,815	$46,112,570
Per year benefit			$36,144,264	$2,096,026

Table 2

Total Benefits of Final Rule, Omitting AA 587 (2012 $)

Year	Calendar Year	Benefits from Avoided Fatalities and Injuries	Other Benefits	Total Benefits		
				Total	Present Value at 7%	Present Value at 3%
0	2012					
1	2013					
2	2014					
3	2015					
4	2016					
5	2017					
6	2018					
7	2019	$45,035,940	$2,342,309	$47,378,249	$29,502,436	$38,523,254
8	2020	$46,477,259	$2,379,828	$48,857,087	$28,434,825	$38,567,784
9	2021	$47,958,843	$2,417,976	$50,376,819	$27,399,952	$38,608,794
10	2022	$49,490,219	$2,456,542	$51,946,761	$26,404,539	$38,653,585
11	2023	$51,068,034	$2,495,948	$53,563,982	$25,448,248	$38,694,621
12	2024	$52,697,319	$2,535,772	$55,233,091	$24,523,492	$38,740,490
13	2025	$54,383,877	$2,576,435	$56,960,312	$23,638,529	$38,789,972
14	2026	$56,120,056	$2,617,727	$58,737,783	$22,778,512	$38,831,548
15	2027	$57,911,062	$2,659,438	$60,570,500	$21,950,749	$38,880,204
16	2028	$59,758,006	$2,701,987	$62,459,993	$21,155,200	$38,925,068
Total		$520,900,615	$25,183,962	$546,084,577	$251,236,482	$387,215,320

As shown in Table 3 and 4 below, omitting AA 587 from the 10 year benefits history explored in Appendix 14 also does not impact the central conclusion that the estimated benefits of the final rule exceed the costs by a wide margin.

Table 3

Single Year Benefits of Final Rule for 10 Year Period, Omitting AA 587 (2012 $)

Carrier	Flt#	Effectiveness Rating	Benefits from Avoided Fatalities and Injuries	Other Benefits
FedEx	647	35%	$19,110	$10,683,750
Corporate	5966	5%	$35,795,740	$1,060,000
COMAIR	5191	15%	$119,135,370	$3,180,000
Continental	1404	25%	$1,803,275	$2,775,000
Colgan	3407	20%	$163,800,000	$4,266,320
Total benefit over 10 year history			$320,553,495	$21,965,070
Per year benefit			$32,055,350	$2,196,507

Table 4

Total Benefits of Final Rule for 10 Year Period, Omitting AA 587 (2012 $)

Year	Calendar Year	Benefits from Avoided Fatalities and Injuries	Other Benefits	Total Benefits		
				Total Benefits	Total Discounted at 7%	Total Discounted at 3%
0	2012					
1	2013					
2	2014					
3	2015					
4	2016					
5	2017					
6	2018					
7	2019	$39,941,132	$2,454,597	$42,395,729	$26,399,820	$34,471,967
8	2020	$41,219,398	$2,493,914	$43,713,312	$25,441,148	$34,507,288
9	2021	$42,533,374	$2,533,890	$45,067,264	$24,512,085	$34,539,551
10	2022	$43,891,509	$2,574,306	$46,465,815	$23,618,574	$34,575,213
11	2023	$45,290,830	$2,615,601	$47,906,431	$22,760,345	$34,607,606
12	2024	$46,735,798	$2,657,334	$49,393,132	$21,930,551	$34,644,343
13	2025	$48,231,559	$2,699,946	$50,931,505	$21,136,575	$34,684,355
14	2026	$49,771,329	$2,743,218	$52,514,547	$20,365,141	$34,717,367
15	2027	$51,359,722	$2,786,928	$54,146,650	$19,622,746	$34,756,735
16	2028	$52,997,726	$2,831,517	$55,829,243	$18,909,365	$34,792,784
Total		$461,972,377	$26,391,251	$488,363,628	$224,696,350	$346,297,209