CASE NOT YET SCHEDULED FOR ORAL ARGUMENT

CASE NO. 11-1483
Consolidated with Case No. 15-1027

UNITED STATES COURT OF APPEALS
FOR THE DISTRICT OF COLUMBIA CIRCUIT

INDEPENDENT PILOTS ASSOCIATION,
Petitioner,

v.

FEDERAL AVIATION ADMINISTRATION,
Respondent.

JOINT APPENDIX TO REPLY BRIEF OF PETITIONER INDEPENDENT PILOTS ASSOCIATION

VOLUME IV of V
PAGES 2173-2889

Review of the FAA Rule, Flightcrew Member Duty and Rest Requirements,
Docket No. the FAA-2009-1093; Amdt. Nos. 117-1, 119-16, 121-357
issued on December 21, 2011.

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TAB 21

FEDERAL AVIATION ADMINISTRATION
COMPLIANCE WITH E.O. 12866

Section 6(a)(3)(E) of E.O. 12866 requires agencies to identify for the public, in a complete, clear, and simple manner, those changes in a regulatory action made at the suggestion or recommendation of the Office of Information and Regulatory Affairs (OIRA), Office of Management and Budget.

Title of Rulemaking: Flightcrew Member Duty and Rest Requirements

Regulatory Identification Number: 2120-AJ58

__________ OIRA did not review the rulemaking document.

__________ OIRA reviewed the rulemaking document, but did not suggest or recommend any changes.

X OIRA reviewed the rulemaking document, and we have documented the changes we made at OIRA's suggestion or recommendation in an attachment to this sheet.

[signature] 1/23/12

Signature of Analyst *Date*

Attachment

DEPARTMENT OF TRANSPORTATION

Federal Aviation Administration

14 CFR Parts 117, 119, and 121

Docket No.: FAA-2009-1093; Amdt. Nos.

RIN 2120–AJ58

Flightcrew Member Duty and Rest Requirements

AGENCY: Federal Aviation Administration (FAA), DOT.

ACTION: Final rule.

SUMMARY: This rule amends the FAA's existing flight, duty and rest regulations applicable to certificate holders and their flightcrew members operating under 14 CFR Part 121. The rule recognizes the universality of factors that lead to fatigue in most individuals and regulates these factors to ensure that flightcrew members in passenger operations do not accumulate dangerous amounts of fatigue. Fatigue threatens aviation safety because it increases the risk of pilot error that could lead to an accident. This risk is heightened in passenger operations because of the additional number of potentially impacted individuals. The new requirements eliminate the current distinctions between domestic, flag and supplemental passenger operations. The rule provides different requirements based on the time of day, whether an individual is acclimated to a new time zone, and the likelihood of being able to sleep under different circumstances.

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Deleted: Because this rule regulates fatigue factors that apply universally,

DATES: Effective [INSERT DATE 2 YEARS AFTER DATE OF PUBLICATION IN THE FEDERAL REGISTER].

ADDRESSES: For information on where to obtain copies of rulemaking documents and other information related to this final rule, see "How To Obtain Additional Information" in the SUPPLEMENTARY INFORMATION section of this document.

FOR FURTHER INFORMATION CONTACT: For technical issues: Dale E. Roberts, Air Transportation Division (AFS-200), Flight Standards Service, Federal Aviation Administration, 800 Independence Avenue, SW., Washington, DC 20591; telephone (202) 267-5749; e-mail: dale.e.roberts@faa.gov. For legal issues: Rebecca MacPherson, Office of the Chief Counsel, Regulations Division (AGC-200), 800 Independence Avenue, SW., Washington, DC 20591; telephone (202) 267-3073; e-mail: rebecca.macpherson@faa.gov.

SUPPLEMENTARY INFORMATION:

Authority for this Rulemaking

The FAA's authority to issue rules on aviation safety is found in Title 49 of the United States Code. This rulemaking is promulgated under the authority described in 49 U.S.C. § 44701(a)(5), which requires the Administrator to promulgate regulations and minimum safety standards for other practices, methods, and procedures necessary for safety in air commerce and national security. This rulemaking is also promulgated under the authority described in 49 U.S.C. § 44701(a)(4), which requires the Administrator to promulgate regulations in the interest of safety for the maximum hours or periods of service of airmen and other employees of air carriers.

Table of Contents

I. Overview of Final Rule

The FAA is issuing this final rule to address the risk that fatigue poses to passenger operations conducted under 14 CFR part 121. Part 121 applies to the majority of flights flown by the American public. As such, changes to the existing flight, duty and rest rules in part 121 will directly affect the flying public. This rule applies to all part 121 passenger operations, including traditional scheduled service and large charter operations. The FAA has removed the existing distinctions between domestic, supplemental and flag passenger operations because the factors leading to fatigue are universal and addressing the risk to the flying public should be consistent across the different types of operations.

This final rule addresses fatigue risk in several ways. The underlying philosophy of the rule is that no single element of the rule mitigates the risk of fatigue to an acceptable level; rather, the FAA has adopted a system approach, whereby both the carrier and the pilot accept responsibility for mitigating fatigue. The carrier provides an environment that permits sufficient sleep and recovery periods, and the crewmembers take advantage of that environment. Both parties must meet their respective responsibilities in order to adequately protect the flying public.

The final rule recognizes the natural circadian rhythms experienced by most people that causes them to be naturally more tired at night than during the day. Under the final rule, flightcrew members will be able to work longer hours during the day than during the night. Significant changes in time zones, a situation unique to aviation, are accounted for to reduce the risk to the flying public posed by "jetlag".

The FAA has decided against adopting various provisions proposed in the NPRM. The final rule does not apply to all-cargo operations, although those carriers have the ability to fly under the new rules if they so choose. The proposal that carriers meet certain schedule reliability requirements has been dropped, as has the proposed requirement that carriers evaluate flightcrew members for fatigue. The FAA has determined that these provisions were either overly costly or impractical to implement.

1. *Fitness for Duty.*

This rule places a joint responsibility on the certificate holder and each flightcrew member. In order for the flightcrew member to report for an FDP properly rested, the certificate holder must provide the flightcrew member with a meaningful rest opportunity that will allow the flightcrew member to get the proper amount of sleep. Likewise, the flightcrew member bears the responsibility of actually sleeping during the rest opportunity provided by the certificate holder instead of using that time to do other things. The consequence of a flightcrew member reporting for duty without being properly rested is that he or she is prohibited from beginning or continuing an FDP until he or she is properly rested.

2. *Fatigue Education and Training.*

Part 121 air carriers are currently statutorily-required to annually provide, as part of their Fatigue Risk Management Plan, fatigue-related education and training to increase the trainees' awareness of: (1) fatigue; (2) "the effects of fatigue on pilots;" and (3) "fatigue countermeasures." Today's rule adopts the same standard of training as required by the statute. In addition, today's rule adopts a mandatory update of the carriers' education and training program every two years, as part of the update to their FRMP. Both of these regulatory provisions merely place the existing statutory requirements in the new flight and duty regulations for the ease and convenience of the regulated parties and the FAA.

3. *Fatigue Risk Management System.*

The FAA proposed a Fatigue Risk Management System (FRMS) as an alternative regulatory approach to provide a means of monitoring and mitigating fatigue. Under an FRMS, a certificate holder develops processes that manage and mitigate fatigue and meet an equivalent level of safety. The FAA is adopting that proposal largely as proposed. The FAA has also decided to extend the voluntary FRMS program to all-cargo operations, which are not required to operate under part 117. Under the FRMS provisions that this rule adds to subparts Q, R, and S of part 121, an all-cargo operator that does not wish to operate under part 117 can nevertheless utilize an FRMS as long as it has the pertinent FAA approval.

4. *Unaugmented Operations.*

One of the regulatory concepts that this rule introduces is the restriction on flightcrew members' maximum Flight Duty Period (FDP). In creating a maximum FDP limit, the FAA attempted to address three concerns. First, flightcrew members' circadian rhythms needed to be addressed because studies have shown that flightcrew members who fly during their window of circadian low (WOCL) can experience severe performance degradation. Second, the amount of time spent at work needed to be taken into consideration because longer shifts increase fatigue. Third, the number of flight segments in a duty period needed to be taken into account because flying more segments requires more takeoffs and landings, which are both the most task-intensive and the most safety-critical stages of flight. To address these concerns, the FAA is adopting as part of the regulatory text a table limiting maximum FDP based on the time of day and the number of segments flown during the FDP period. Under today's rule an FDP begins when a flightcrew member is required to report for duty that includes a flight and ends when the aircraft is parked after the last flight and there is no plan for further aircraft movement by the same flightcrew member. The maximum FDP limit is reduced during nighttime hours to account for being awake during the WOCL; when an FDP period consists of multiple flight segments in order to account for the additional time on task; and if a flightcrew member is unacclimated to account for the fact that the unacclimated flightcrew member's circadian rhythm is not in sync with the theater in which he or she is operating. Actual time at the controls (flight time) is limited to 8 or 9 hours, depending on the time of day that the FDP commences.

5. *Augmented Operations.*

In order to accommodate common operational practices, the final rule allows longer duty periods in instances where the carrier provides additional crew and adequate on-board rest facilities. The extended FDPs are laid out in a table and provide maximum credit when an operator employs a 4-man crew and provides the highest quality on-board rest facility.

6. *Extensions of Flight Duty Periods.*

This rule sets forth the limits on the number of FDPs that may be extended; implements reporting requirements for affected FDPs; and distinguishes extended FDPs due to unforeseen operational circumstances that occur prior to takeoff from those unforeseen operational circumstances that arise after takeoff. The FAA agrees that an extension must be based on exceeding the maximum FDP permitted in the regulatory tables rather than on the times that the air carrier had originally intended for an FDP, which may be considerably less than the tables allow. It is unreasonable to limit extensions on FDPs that are less than what the certificate holder can legally schedule. In addition, there is a 30-minute buffer attached to each FDP to provide certificate holders with the flexibility to deal with delays that are minimal.

7. *Split Duty.*

Split duty rest breaks provide carriers with nighttime operations with additional flexibility. Typically split duty rest would benefit carriers who conduct late night and early morning operations where the flightcrew members would typically be afforded some opportunity to sleep, but would not receive a legal rest period. Under today's rule split duty rest must be at least 3 hours long and must be scheduled in advance. The actual split duty rest breaks may not be shorter than the scheduled split duty rest breaks. The rationale for this is that flightcrew members must, at the beginning of their FDP, evaluate their ability to safely complete their entire assigned FDP. In order to do so, they must not only know the length of the FDP, but any scheduled split duty rest breaks that they will receive during the FDP.

8. *Consecutive Night Operations.*

In formulating this rule, the FAA was particularly concerned about cumulative fatigue caused by repeatedly flying at night. Modeling shows substantially deteriorating performance after the third consecutive nighttime FDP for flightcrew members who worked nightshifts during their WOCL and obtained sleep during the day. However, if a sleep opportunity is provided during each nighttime FDP, that sleep opportunity may sustain flightcrew member performance for five consecutive nights. Based on modeling results, the FAA has determined that a 2-hour nighttime sleep opportunity each night improves pilot performance sufficient to allow up to 5 nights of consecutive nighttime operations.

9. *Reserve.*

The FAA has decided to rely on the expertise represented in the ARC to address the issue of reserve duty. The adopted regulatory provisions addressing reserve and unaugmented operations provide that the total number of hours a flightcrew member may spend in a flight duty period and reserve availability period may not exceed 16 hours or the maximum applicable flight duty period table plus four hours, whichever is less. This will allow most FDPs to be accommodated by a flightcrew member on short-call reserve. This rule adopts the proposal that limits the short-call reserve availability period, in which the flightcrew member is not called to report to work, to 14 hours.

10. *Cumulative Limits.*

The FAA is adopting cumulative limits for FDP and flight-time limits. The FAA has decided to retain both of these cumulative limits because (1) the FDP limits restrict the amount of cumulative fatigue that a flightcrew member accumulates before and during flights; and (2) the flight-time limits allow the FAA to provide air carriers with more scheduling flexibility by setting higher cumulative FDP limits in this rule. This additional scheduling flexibility justifies the added restrictions on cumulative flight time, which can easily be tracked by scheduling programs currently in use throughout the industry. The FAA has decided to eliminate the cumulative duty-period limits, which should greatly simplify compliance with this section.

11. *Rest.*

Carriers will be required to provide their crew with a 10-hour rest opportunity prior to commencing a duty period that includes flying. While the 10-rest period may include the amount of time it takes to get to or from a flightcrew member's house or hotel room, the actual amount of time required for a sleep opportunity may not be reduced below 8 hours. In addition, the length of continuous time off during a 7-day period has been extended from 24 hours under the existing rules to 30 hours. Additional time off is required for individuals whose internal clock may be off because of flipping back and forth between different time zones.

12. *Emergency and Government Sponsored Operations.*

This rulemaking also addresses operations that require flying into or out of hostile areas, and politically sensitive, remote areas that do not have rest facilities. These operations range from an emergency situation to moving armed troops for the U.S. military, conducting humanitarian relief, repatriation, Air Mobility Command (AMC), and State Department missions. The applicability provision of this section now specifically articulates the two categories of operations that are affected. This section applies to operations conducted pursuant to contracts with the U.S. Government department and agencies. This section also applies to operations conducted pursuant to a deviation issued by the Administrator under § 119.57 that authorizes an air carrier to deviate from the requirements of parts 121 and 135 to perform emergency operations. This authority is issued on a case-by-case basis during an emergency situation as determined by the Administrator. The FAA concludes that these two categories are the only types of operations that warrant separate consideration because of the unique operating circumstances that otherwise limit a certificate holder's flexibility to deal with unusual circumstances.

Costs and Benefits

We have analyzed the benefits and the costs associated with the requirements contained in this final rule. We provide a range of estimates for our quantitative benefits. Our base case estimate is $376 million ($247 million present value at 7% and $311 million at 3%) and our high case estimate is $716 million ($470 million present value at 7% and $593 million at 3%). The FAA believes there are also not-quantified benefits to the rule that, when added to the base case estimate, make the rule cost beneficial. The total estimated cost of the final rule is $390 million ($297 million present value at 7% and $338 million at 3%).

Summary Over a 10 Year Period

Total Quantified Benefits

Estimate	Nominal (millions)	PV at 7% (millions)	PV at 3% (millions)
Base	**$ 376**	**$ 247**	**$ 311**
High	$ 716	$ 470	$ 593

Total Quantified Costs

Component	Nominal (millions)	PV at 7% (millions)	PV at 3% (millions)
Flight Operations	$236	$157	$191
Rest Facilities	$138	$129	$134
Training	$16	$11	$13
Total	**$390**	**$297**	**$338**

The FAA has made significant changes to the final rule since the NPRM. The training requirement has been substantially reduced because the FAA has determined that pilots are already receiving the requisite training as part of the statutorily required Fatigue Risk Management Plans. The FAA also has removed all-cargo operations from the applicability section of the new part 117 because their compliance costs significantly exceed the quantified societal benefits.[1] All-cargo carriers may choose to comply with the new part 117 but are not required to do so. Since the carrier would decide voluntarily to comply with the new requirements, those costs are not attributed to the costs of this

[1] The projected cost for all-cargo operations is $306 million ($214 million present value at 7% and $252 million at 3%). The projected benefit of avoiding one fatal all-cargo accident ranges between $20.35 million and $32.55 million, depending on the number of crewmembers on board the aircraft.

rule. The costs associated with the rest facilities occur in the two years after the rule is published. The other costs of the rule and the benefits are then estimated over the next ten years.

II. Background

On September 14, 2010, the FAA published a Flightcrew Member Duty and Rest Requirements notice of proposed rulemaking (NPRM) setting out proposed flight, duty, and rest regulations intended to limit flightcrew member fatigue in part 121 operations. These proposed regulations applied to all operations conducted pursuant to part 121, and the regulations would have imposed, among other things, the following limits/requirements: (1) a requirement that a flightcrew member must notify the certificate holder (air carrier) when he or she is not fit for duty and that a certificate holder must also independently evaluate its flightcrew members for fitness for duty; (2) a limit on daily flight duty period (FDP) and flight-time hours that varies depending on the time of day that the FDP begins; (3) cumulative limits on FDPs, flight times, and duty periods; (4) a schedule reliability requirement, which stated that a certificate holder's scheduled FDPs must be at least 95% consistent with actual FDPs; (5) a requirement that a flightcrew member be provided with at least 9 consecutive hours of rest between FDPs, as measured from the time the flightcrew member reaches a suitable accommodation; and (6) credit for employing fatigue-mitigating measures such as split-duty rest and augmentation.

The FAA received over 8,000 comments in response to the NPRM. In response to the comments, the FAA has made a number of changes to the regulatory provisions proposed in the NPRM. These changes include the following:

- The mandatory provisions of the NPRM do not apply to all-cargo operations. Instead, this rule permits all-cargo operations to voluntarily opt into the new flight, duty, and rest limitations imposed by this rule.
- Certificate holders are no longer required to independently verify whether flightcrew members are fit for duty.
- Most of the daily FDP limits have been increased to provide certificate holders with more scheduling flexibility. One of the daily flight-time limits has been decreased to address safety considerations.
- The cumulative duty-period limit has been removed from this rule.
- The schedule-reliability requirement has been largely removed from the final rule. The remaining parts of the schedule-reliability process have been changed to only apply to instances in which a flightcrew member exceeds the FDP and/or flight-time limits imposed by this rule.
- The flightcrew member must now be provided with 10 hours of rest between FDP periods, but that rest is measured from the time that the flightcrew member is released from duty. The rest must provide for an 8-hour sleep opportunity.
- The amount of credit provided for split-duty rest and augmentation has been increased, and changes to the final rule make these credits easier to obtain.

The changes listed above are just some of the amendments that were made to the NPRM in response to the comments. The Discussion of Public Comments and Final Rule section of this preamble contains a discussion of the changes that were made to the NPRM in response to issues raised by the commenters.

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A. Statement of the Problem

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We have analyzed the benefits and the costs associated with the requirements contained in this final rule and our estimates are summarized below. We provide a range of estimates for our quantitative benefits. Our base estimate is $726 million ($477 million present value at 7% and $601 million at 3%) and our high estimate is $1.33 billion ($873 million present value at 7% and $1.1 billion at 3%) The static historical benefit estimate is $380 million ($249 million present value at 7% and $315 million at 3%). The total estimated cost of the final rule is $862 million ($606 million present value at 7% and $729 million at 3%). ¶
Summary ... [1]

Fatigue is characterized by a general lack of alertness and degradation in mental and physical performance. Fatigue manifests in the aviation context not only when pilots fall asleep in the cockpit in flight, but perhaps more importantly, when they are insufficiently alert during take-off and landing. Reported fatigue-related events have included procedural errors, unstable approaches, lining up with the wrong runway, and landing without clearances.

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There are three types of fatigue: transient, cumulative, and circadian. Transient fatigue is acute fatigue brought on by extreme sleep restriction or extended hours awake within 1 or 2 days. Cumulative fatigue is fatigue brought on by repeated mild sleep restriction or extended hours awake across a series of days. Circadian fatigue refers to the reduced performance during nighttime hours, particularly during an individual's WOCL (typically between 2:00 a.m. and 6:00 a.m.).

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Common symptoms of fatigue include:

- Measurable reduction in speed and accuracy of performance,
- Lapses of attention and vigilance,
- Delayed reactions,

- Impaired logical reasoning and decision-making, including a reduced ability to assess risk or appreciate consequences of actions,
- Reduced situational awareness, and
- Low motivation to perform optional activities.

A variety of factors contribute to whether an individual experiences fatigue as well as the severity of that fatigue. The major factors affecting fatigue include:

- *Time of day*. Fatigue is, in part, a function of circadian rhythms. All other factors being equal, fatigue is most likely, and, when present, most severe, between the hours of 2:00 a.m. and 6:00 a.m.
- *Amount of recent sleep.* If a person has had significantly less than 8 hours of sleep in the past 24 hours, he or she is more likely to be fatigued.
- *Time awake.* A person who has been continually awake for a long period of time since his or her last major sleep period is more likely to be fatigued.
- *Cumulative sleep debt.* For the average person, cumulative sleep debt is the difference between the amount of sleep a person has received over the past several days, and the amount of sleep he or she would have received with 8 hours of sleep a night.
- *Time on task.* The longer a person has continuously been doing a job without a break, the more likely he or she is to be fatigued.
- *Individual variation*. Individuals respond to fatigue factors differently and may become fatigued at different times, and to different degrees of severity, under the same circumstances.

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Scientific research and experimentation have consistently demonstrated that adequate sleep sustains performance. For most people, 8 hours of sleep in each 24-hour period sustains performance indefinitely. Sleep opportunities during the WOCL are preferable because sleep that occurs during the WOCL provides the most recuperative value. Within limits, shortened periods of nighttime sleep may be nearly as beneficial as a consolidated sleep period when augmented by additional sleep periods, such as naps before evening departures, during flights with augmented flightcrews, and during layovers. Sleep should not be fragmented with interruptions. In addition, environmental conditions, such as temperature, noise, and turbulence, impact how beneficial sleep is and how performance is restored.

When a person has accumulated a sleep debt, recovery sleep is necessary to fully restore the person's "sleep reservoir." Recovery sleep should include at least one physiological night, that is, one sleep period during nighttime hours in the time zone in which the individual is acclimated. The average person requires in excess of 9 hours of sleep a night to recover from a sleep debt. [2]

Several aviation-specific work schedule factors[3] can affect sleep and subsequent alertness. These include early start times, extended work periods, insufficient time off between work periods, insufficient recovery time off between consecutive work periods, amount of work time within a shift or duty period, number of consecutive work periods,

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[2] Recovery sleep does not require additional sleep equal to the cumulative sleep debt; that is, an 8-hour sleep debt does not require 8 additional hours of sleep.
[3] Rosekind MR. *Managing work schedules: an alertness and safety perspective.* In: Kryger MH, Roth T, Dement WC, editors. Principles and Practice of Sleep Medicine; 2005:682.

night work through one's window of circadian low, daytime sleep periods, and day-to-night or night-to-day transitions.

The FAA believes that its current regulations do not adequately address the risk of fatigue. The impact of this risk is greater in passenger operations due to the number of persons placed at risk. Presently, flightcrew members are effectively allowed to work up to 16 hours a day (regardless of the time of day), with all of that time spent on tasks directly related to aircraft operations. The regulatory requirement for 9 hours of rest is regularly reduced, with flightcrew members spending rest time traveling to or from hotels and being provided with little to no time to decompress. Additionally, certificate holders regularly exceed the allowable duty periods by conducting flights under part 91 instead of part 121, where the applicable flight, duty and rest requirements are housed. As the National Transportation Safety Board repeatedly notes, the FAA's regulations do not account for the impact of circadian rhythms on alertness. The entire set of regulations is overly complicated, with a different set of regulations for domestic operations, flag operations, and supplemental operations. In addition, these regulations do not consider other factors that can lead to varying degrees of fatigue. Instead, each set of operational rules (i.e. those applicable to domestic, flag, or supplemental operations) sets forth a singular approach toward addressing fatigue, regardless of the operational circumstances that may be more or less fatiguing.[4]

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B. National Transportation Safety Board (NTSB) Recommendations

[4] While several of the commenters have claimed that the NPRM proposed a "one-size-fits-all" regulatory structure, the FAA believes this suggestion is misleading. In the NPRM, and in the final rule with regard to passenger-carrying operations, the FAA has eliminated distinctions between domestic, flag, and

The NTSB has long been concerned about the effects of fatigue in the aviation industry. The first aviation safety recommendations, issued in 1972, involved human fatigue, and aviation safety investigations continue to identify serious concerns about the effects of fatigue, sleep, and circadian rhythm disruption. Currently, the NTSB's list of Most Wanted Transportation Safety Improvements includes safety recommendations regarding pilot fatigue. These recommendations are based on two accident investigations and an NTSB safety study on commuter airline safety.[5]

In February 2006 the NTSB issued safety recommendations after a BAE–J3201 operated under part 121 by Corporate Airlines struck trees on final approach and crashed short of the runway at Kirksville Regional Airport, Kirksville, Missouri. The captain, first officer, and 11 of the 13 passengers died. The NTSB determined the probable cause of the October 19, 2004 accident was the pilots' failure to follow established procedures and properly conduct a non-precision instrument approach at night in instrument meteorological conditions. The NTSB concluded that fatigue likely contributed to the pilots' performance and decision-making ability. This conclusion was based on the less than optimal overnight rest time available to the pilots, the early report time for duty, the number of flight legs, and the demanding conditions encountered during the long duty day.

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supplemental operations, but in all of these operations, the rule imposes differing requirements based on the operating environment.

[5] On February 2, 2010, the NTSB released a press release summarizing the results of its investigation into the Colgan Air crash of February 12, 2009, which resulted in the death of 50 people. The NTSB did not state that fatigue was causal factor to the crash; however, it did recommend that the FAA take steps to address pilot fatigue.

As a result of the accident, the NTSB issued the following safety recommendations related to flight and duty time limitations: (1) modify and simplify the flightcrew hours-of-service regulations to consider factors such as length of duty day, starting time, workload, and other factors shown by recent research, scientific evidence, and current industry experience to affect crew alertness (recommendation No. A–06–10); and (2) require all part 121 and part 135 certificate holders to incorporate fatigue-related information similar to the information being developed by the DOT Operator Fatigue Management Program into initial and recurrent pilot training programs. The recommendation notes that this training should address the detrimental effects of fatigue and include strategies for avoiding fatigue and countering its effects (recommendation No. A–06–10).

The NTSB's list of Most Wanted Transportation Safety Improvements also includes a safety recommendation on pilot fatigue and ferry flights conducted under 14 CFR part 91. Three flightcrew members died after a Douglas DC–8–63 operated by Air Transport International was destroyed by ground impact and fire during an attempted three-engine takeoff at Kansas City International Airport in Kansas City, Missouri. The NTSB noted that the flightcrew conducted the flight as a maintenance ferry flight under part 91 after a shortened rest break following a demanding round trip flight to Europe that crossed multiple time zones. The NTSB further noted that the international flight, conducted under part 121, involved multiple legs flown at night following daytime rest periods that caused the flightcrew to experience circadian rhythm disruption. In addition, the NTSB found the captain's last rest period before the accident was repeatedly interrupted by the certificate holder.

In issuing its 1995 recommendations, the NTSB stated that the flight time limits and rest requirements under part 121 that applied to the flightcrew before the ferry flight did not apply to the ferry flight operated under part 91. As a result, the regulations permitted a substantially reduced flightcrew rest period for the nonrevenue ferry flight. As a result of the investigation, the NTSB reiterated earlier recommendations to (1) finalize the review of current flight and duty time limitations to ensure the limitations consider research findings in fatigue and sleep issues and (2) prohibit certificate holders from assigning a flightcrew to flights conducted under part 91 unless the flightcrew met the flight and duty time limits under part 121 or other applicable regulations (recommendation No. A–95–113).

In addition to recommending a comprehensive approach to fatigue with flight duty limits based on fatigue research, circadian rhythms, and sleep and rest requirements, the NTSB has also stated that a Fatigue Risk Management System (FRMS) may hold promise as an approach to dealing with fatigue in the aviation environment. However, the NTSB noted that it considers fatigue management plans to be a complement to, not a substitute for, regulations to address fatigue.

C. Flight and Duty Time Limitations and Rest Requirements Aviation Rulemaking Committee

As part of this rulemaking action, the FAA chartered an aviation rulemaking committee (ARC) on June 24, 2009. The FAA brought together pilots, airlines, and scientific experts to collaborate and develop options for an FAA-proposed rulemaking to help mitigate pilot fatigue. The ARC provided a forum for the U.S. aviation community to discuss current approaches to mitigate fatigue found in international standards (e.g., the International Civil Aviation Organization (ICAO) standard, the United Kingdom Civil Aviation Publication (CAP) 371, and the European Aviation Safety Agency Notice of Proposed Amendment). The ARC provided its report, a copy of which is in this rulemaking docket, to the agency on September 9, 2009.

D. Congressional Mandate

On August 1, 2010, the President signed the Airline Safety and Federal Aviation Administration Extension Act of 2010 (Public Law 111-216). Section 212 of Public Law 111-216 required "the FAA Administrator to issue regulations to limit the number of flight and duty time hours allowed for pilots to address pilot fatigue." This section, in subsection 212(a)(3), set a deadline of 180 days for the FAA to publish an NPRM and 1 year for the FAA to issue a final rule.

E. Notice of Proposed Rulemaking

On September 14, 2010, the FAA published in the Federal Register the Flightcrew Member Duty and Rest Requirements NPRM.[6] The NPRM proposed to amend the FAA's existing flight, duty, and rest regulations applicable to certificate holders and their flightcrew members. The proposal recognized the factors that lead to fatigue in most individuals, and it proposed to regulate these factors to ensure that flightcrew members do not accumulate dangerous amounts

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[6] 75 Fed. Reg. 55852; September 14, 2010

of fatigue. Because the proposed rule addressed fatigue factors that apply universally, the proposed requirements eliminated the existing distinctions between domestic, flag and supplemental operations. The proposal also provided different requirements based on the time of day, whether an individual is acclimated to a new time zone, and the likelihood of being able to sleep under different circumstances.

The NPRM provided for a 60-day comment period, which ended on November 15, 2010. Following publication of the NPRM, the FAA received a number of requests to extend the comment period and to clarify various sections of the preamble, regulatory text, and the Regulatory Impact Analysis (RIA). In response, the agency published two actions in the Federal Register.

The first action was a "Notice of procedures for submission of clarifying questions."[7] Persons asking for clarifications were advised to file their questions to the rulemaking docket by October 15, 2010. The FAA said it would respond by October 22, 2010. On October 22, 2010, the agency filed two response documents to the rulemaking docket: "Response to Clarifying Questions to the RIA" and "Response to Clarifying Questions to the NPRM."

The second action was a "Response to requests for a comment period extension."[8] The FAA provided notice that the comment period would not be extended. The agency's rationale for this decision is outlined in the October 15, 2010 action.

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[7] 75 Fed. Reg. 62486; October 12, 2010

The FAA received more than 8,000 comment submissions, containing multiple comments on various sections of the preamble and the rule. Many comment submissions also included specific recommendations for changes and clarifications.

III. Discussion of Public Comments and Final Rule

A. Applicability

In the NPRM, the FAA stated that fatigue factors are "universal."[9] The FAA noted that sleep science, while still evolving, was clear in several important respects:

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> most people need eight hours of sleep to function effectively, most people find it more difficult to sleep during the day than during the night, resulting in greater fatigue if working at night; the longer one has been awake and the longer one spends on task, the greater the likelihood of fatigue; and fatigue leads to an increased risk of making a mistake.

Id. In light of its determination concerning the universal applicability of factors underlying fatigue, the FAA proposed a single set of flight, duty, and rest regulations that would regulate these factors. The proposed regulations would have been applicable to all part 121 domestic, flag, and supplemental operations. The proposed regulations would also have applied to all part 91 flights conducted by part 121 certificate holders, including flights, such as ferry flights, that have historically been conducted under part 91. The NPRM also stated that "the part 135 community should expect to see an NPRM addressing its operations that looks very similar to, if not exactly like, the final rule the

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[8] 75 Fed. Reg. 63424; October 15, 2010

agency anticipates issuing as part of its rulemaking initiative." Id. The comments received in response to the proposed applicability of this rule and the corresponding FAA responses are included below.

The National Air Carrier Association (NACA) and a number of air carriers operating non-scheduled flights objected to the proposed rule applying to supplemental operations. These industry commenters stated that non-scheduled operations require additional scheduling flexibility because they are fundamentally different from scheduled operations. The industry commenters stated that, unlike scheduled operations, non-scheduled operations provide on-demand operations on behalf of private and government consumers on a timetable that is determined by the consumer. According to the industry commenters, non-scheduled carriers do not have regularly-set schedules that they know months in advance, but are instead called to fly with little advance notice, making it more difficult to plan flightcrew member flight times and rest periods. The industry commenters emphasized that this difficulty is exacerbated by the fact that non-scheduled operations' flight times (especially departure times) are controlled largely by the consumer and not the air carrier.

The non-scheduled industry commenters also asserted that non-scheduled carriers serve remote, sometimes hostile locations, with no established crew bases. Thus, they do not have the same extensive infrastructure that scheduled operations have access to and must deadhead flightcrew members into remote locations in order to be able to swap out flightcrew members during an operation. These commenters emphasized that the

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[9] 75 Fed. Reg. 55852, 55857 (Sep. 14, 2010).

certificate holders running non-scheduled operations are largely small businesses that will have difficulty adjusting to the burdens imposed by this rule.

Based on the differences between non-scheduled and scheduled operations, the industry commenters stated that a "one-size-fits-all" approach does not work for non-scheduled operations. The industry commenters stated that the existing regulations governing supplemental operations have existed for over 60 years, and that changing these regulations will adversely affect air security and national defense missions conducted through the use of non-scheduled operations. The commenters emphasized that the existing supplemental flight, duty, and rest regulations ensure aviation safety by containing additional rest requirements that are not a part of this rule. In conclusion, the industry commenters suggested that the FAA either: (1) retain the existing flight, duty, and rest regulations governing supplemental operations, and/or (2) adopt the alternative proposal put forward by the industry commenters.

In addition to the concerns expressed by non-scheduled air carriers, the Cargo Airline Association (CAA) and a number of air carriers operating all-cargo flights have also objected to the proposed rule applying to supplemental operations. These industry commenters asserted that, while a passenger-operation accident can result in numerous fatalities, an all-cargo accident would consist primarily of property damage.

The commenters also stated that the cargo industry is composed of both scheduled and on-demand operators, and that it specializes in express delivery services. To effectuate these express delivery services, some all-cargo carriers do not maintain U.S. domicile bases and regularly operate long-haul flights and point-to-point operations

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outside the United States, traveling across multiple time zones at all hours of the day and night. The industry commenters also stated that all-cargo carriers regularly operate around the world in all directions with extended overseas routings, not with quick overnight turns at foreign destinations. This results in a lower aircraft utilization rate than domestic passenger operations. According to the industry commenters, these types of nighttime and around-the-world operations are the norm for all-cargo carriers.

The all-cargo industry commenters added that, similar to non-scheduled operations, some all-cargo operations also fly to remote, undeveloped, and sometimes hostile locations. According to the industry commenters, these types of operations are driven by the same considerations as similar non-scheduled operations: (1) the schedule is determined primarily by the customer, and (2) there is a lack of infrastructure, which necessitates deadheading in flightcrew members. The industry commenters emphasized that many all-cargo carriers currently provide their flightcrew members with split duty rest while cargo is being sorted at sorting facilities, and that the carriers have invested millions of dollars in high-quality rest facilities. The industry commenters also stated that flightcrew members working in all-cargo operations fly fewer total hours than their passenger-transporting counterparts. The industry commenters concluded by asking the FAA to either: (1) retain the existing flight, duty, and rest regulations that govern supplemental operations, or (2) adopt the alternative proposal that they have included in their comments.

Conversely, a number of labor groups submitted comments approving of a single flight, duty, and rest standard. These groups stated that they were "pleased that the FAA has acknowledged the current science and recognizes that pilot fatigue does not differ whether the pilot is operating domestically, internationally or in supplemental operations." The NTSB also expressed support for a single flight, duty, and rest standard, commending the proposed rule for recognizing that "human fatigue factors are the same across [domestic, flag, and supplemental] operations and science cannot support the notion of allowing longer duty hours for certain subgroups." Numerous individual commenters have also stated that the existing 16-hour duty periods utilized by supplemental operations result in an unsafe amount of fatigue.

In addition to the concerns expressed by the preceding comments, United Air Lines (United) objected to the applicability of this rule to flightcrew members who conduct only part 91 operations on behalf of part 121 certificate holders. United stated that the original reason for the applicability of this rule to part 91 operations on behalf of part 121 certificate holders was to ensure that flightcrew members operating under part 121 did not use part 91 to avoid their flight, duty, and rest requirements under part 121. Because flightcrew members who only conduct part 91 operations cannot conduct part 121 flights, United argued that these flightcrew members should not be subject to this rule.

The FAA also received a number of other questions and concerns about the applicability of this rule. The NetJets Association of Shared Aircraft Pilots (NJASAP) asked how this rule would apply to certificate holders who operate under several different parts of the regulation (e.g., Part 121, Part 135, Subpart 91K). The Regional Airline Association (RAA) asked the FAA to amend this section in order to clarify that this rule applies to "operations directed by the certificate holder under part 91 of this chapter." In addition, a number of part 135 certificate holders objected to having their operations included in the proposed flight, duty, and rest requirements. These commenters asserted that part 135 operations are fundamentally different from part 121 operations, and thus, these operations should not be subject to the same requirements.

In response to concerns expressed by part 135 certificate holders, the FAA emphasizes that this rule does not apply to part 135 operations. If, in the future, the FAA initiates a rulemaking to change the existing part 135 flight, duty, and rest regulations, the FAA will solicit comments from the affected stakeholders and respond to part-135-specific concerns at that time.

Turning to concerns expressed by United, this rule applies to some part 91 operations because many flightcrew members involved in part 121 operations have routinely used part 91 as a way of exceeding the limits imposed by the part 121 flight, duty, and rest requirements. However, the FAA agrees with United that there is no reason to require flightcrew members who do not fly any part 121 operations to comply with part 121 flight, duty, and rest requirements. Accordingly, the FAA has amended this rule so that it applies to flightcrew members operating under part 91 only if at least one their flight segments is operated under part 117. Flightcrew members operating under part 91 and who do not have any flight segments subject to part 117 (e.g. pilots flying only part 91 operations) are not subject to the provisions of this rule.

Turning to concerns expressed by air carriers conducting all-cargo operations, as discussed in the regulatory evaluation, the FAA has determined that this rule would

Deleted: NJASAP's question, the FAA notes that this rule applies to part 121 certificate holders and all part 121 and part 91 operations conducted on behalf of these certificate holders. Thus, if a certificate holder operates under parts 121, 135, and 91K, the operations conducted under part 121 and part 91 operations other than those conducted under 91K will be subject to the provisions of this rule. Parts 135 and 91K have their own set of flight, duty, and rest requirements that will continue to apply to these operations.¶
In response to

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create far smaller benefits for all-cargo operations than it does for passenger operations. Consequently, the FAA is unable to justify imposing the cost of this rule on all-cargo operations. The FAA notes that in the past it has excluded all-cargo operations from certain mandatory requirements due to the different cost-benefit comparison that applies to all-cargo operations. For example, in 2007, the FAA excluded all-cargo operations of airplanes with more than two engines from many of the requirements of the extended range operations (ETOPS) rule because the cost of these provisions for all-cargo operations relative to the potential societal benefit was simply too high.[10]

Based on the cost-benefit analysis of this rule and its past precedent, the FAA has amended this rule to make compliance with part 117 voluntary for all-cargo operations and to allow those operations to continue operating under the existing part 121 flight, duty, and rest regulations if they choose to do so. As such, this rule now allows all-cargo operations to voluntarily determine, as part of their collective bargaining and business decisions, whether they wish to operate under part 117.

In order to prevent manipulation of this voluntary provision, certificate holders who wish to operate their all-cargo operations under part 117 cannot pick and choose specific flights to operate under this rule. Instead, the certificate holders can only elect to operate under part 117: (1) all of their all-cargo operations conducted under contract to a US government agency; and (2) all of their all-cargo operations not conducted under contract to a US Government agency.

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[10] 72 Fed. Reg. 1808, 1816 (2007).

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Turning to the objections expressed by non-scheduled passenger operations, the FAA notes that existing regulations set out different flight, duty, and rest standards for part 121 domestic, flag, and supplemental operations. Under these regulations, supplemental operations consist of non-scheduled, all-cargo, and public-charter flights. The existing regulations provide supplemental operations with significant scheduling flexibility because they allow air carriers conducting supplemental operations to schedule unaugmented flightcrew members for 16-hour FDPs[11] and augmented flightcrew members for 30-hour FDPs[12] regardless of the time of day.[13]

The FAA acknowledges that this rule will significantly impact supplemental passenger operations because it reduces the existing 16 and 30-hour across-the-board limits. This section discusses these reductions and why they are justified in light of the flexibility concerns of non-scheduled passenger operations. The other changes made by this rule that affect supplemental operations are discussed in the other parts of this preamble.

The FAA has decided to impose the same FDP limits on supplemental passenger operations as other part 121 operations because it has determined that the 16-hour unaugmented FDP and the 30-hour augmented FDP permitted by existing supplemental

[11] 14 CFR 121.505(b). The existing regulations do not regulate FDPs, but instead, regulate the length of duty time. The FAA believes that duty time, as used in the existing regulations, is roughly equivalent to the concept of an FDP because flightcrew members typically begin and end their duty periods at about the same times as an FDP, as defined by this rule, would begin and end.

[12] 14 CFR 121.523(c).

[13] An unaugmented flight contains the minimum number of flightcrew members necessary to safely pilot an aircraft. An augmented flight contains additional flightcrew members and at least one onboard rest facility, which allows flightcrew members to work in shifts and sleep during the flight.

flight, duty, and rest regulations are almost always unsafe for passenger operations.[14] As discussed in other parts of this preamble, a series of studies analyzing the national accident rate as a function of the amount of hours worked have shown that after a person works for about eight or nine hours, the risk of an accident increases exponentially for each additional hour worked.[15] According to these studies, the risk of an accident in the 12th hour of a work shift is "more than double" the risk of an accident in the 8th hour of a work shift.[16] Based on this exponential increase in the accident rate, the FAA has determined that the risk of an accident in the 16th hour of an unaugmented FDP rises to unacceptable levels for passenger operations, especially for shifts that take place during the WOCL. The FAA has also determined, based on the above data, that a 30-hour FDP likewise poses an unacceptably high risk of an accident for passenger operations even with the fatigue-mitigation benefits provided by augmentation.

In determining that a 16-hour unaugmented and a 30-hour augmented FDP is unsafe for passenger operations, the FAA has also taken into account the fact that aviation-specific data shows that FDPs of this length significantly increase the risk of an

[14] The FAA notes that this rule technically allows an unaugmented flightcrew member to work on a 16-hour FDP if a 14-hour FDP is extended through the use of a 2-hour FDP extension. However, a 14-hour unaugmented FDP is only permitted during periods of peak circadian alertness, and the 2-hour FDP extension is subject to additional safeguards. A 30-hour FDP is never permitted, although a carrier could potentially develop an FRMS that allowed a 30-hour FDP in augmented operations.

[15] See Simon Folkard & Philip Tucker, Shift work, safety and productivity, Occupational Medicine, Feb. 1, 2003, at 98 (analyzing three studies that reported a trend in risk over successive hours on duty).

[16] Id. The FAA notes that the Federal Motor Carrier Safety Administration, another DOT agency, has examined studies comparing crash risk to hours worked in certain truck operations. Similar to the Folkard & Tucker study, these studies found a steady rise in crash risk with additional work hours; however, they did not show an increase as rapid as the results reported by Folkard and Tucker. (See, for example, Blanco, M., Hanowski, R., Olson, R., Morgan, J., Soccolich, S., Wu, S.C., and Guo, F., "The Impact of Driving, Non-Driving Work, and Rest Breaks on Driving Performance in Commercial Motor vehicle Operations," FMCSA, April 2011).

accident. A study published in 2003 analyzed the accident rate of pilots as a function of the amount of time that the pilots spent on duty.[17] The study found that:

> [T]he proportion of accidents associated with pilots having longer duty periods is higher than the proportion of longer duty periods for all pilots. For 10-12 hours of duty time, the proportion of accident pilots with this length of duty period is 1.7 times as large as for all pilots. For pilots with 13 or more hours of duty, the proportion of accident pilot duty periods is over five and a half times as high.[18]

Because studies examining the national accident rate and aviation-specific accidents have both shown that working over 13 hours significantly increases the risk of an accident, the FAA has decided to disallow the 16-hour unaugmented and 30-hour augmented FDPs currently permitted in supplemental passenger operations by subjecting supplemental passenger operations to the same FDP limits as other part 121 passenger operations. The effect that other provisions of this rule will have on supplemental passenger operations and the reasons why the FAA has chosen to adopt these provisions are discussed in the corresponding portions of this preamble.

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The FAA understands that including supplemental passenger operations in this rule will take away a portion of the scheduling flexibility currently enjoyed by non-scheduled passenger operations. However, this rule contains a number of provisions that ease the burden of current rules on non-scheduled operations in a way that does not decrease safety.

[17] Jeffrey H. Goode, Are pilots at risk of accidents due to fatigue?, Journal of Safety Research 34 (2003)

The most significant way in which this rule eases the burden of existing rules on supplemental passenger operations is the elimination of compensatory rest requirements. Under the existing rules, a pilot who flies an aircraft for over 8 hours in a supplemental operation must receive a compensatory rest period that is 16 hours or longer (depending on whether the flight was augmented) at the conclusion of his or her duty day. This compensatory rest requirement imposed a significant burden on supplemental passenger operations because pilots had to be provided with at least 16 hours of rest simply for flying for 9 hours. In addition, the FAA found that by focusing on flight time and not on FDP, the existing supplemental flight, duty, and rest regulations led to counterintuitive results in which long 16 and 30-hour FDPs were permitted with only a 9-hour required rest period, but a 9-hour flight time with a relatively-short FDP resulted in a 16 to 18-hour required rest period.

In order to address the concerns discussed in the preceding paragraph and because there was an absence of scientific data showing that rest periods providing for more than 8 hours of sleep were always necessary to combat transient fatigue, this rule eliminates the existing compensatory rest requirements for supplemental passenger operations The removal of this additional rest requirement will allow certificate holders conducting non-scheduled passenger operations to fly augmented international operations, including those that are under contract with the United States Government, without having to provide flightcrew members with an additional 6 hours of rest at the end of the operation. In addition, to ensure that certificate holders conducting supplemental operations are able

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to provide critical services in support of government operations, this rule also contains an Emergency and Government Sponsored Operations section that allows operations performed in accordance with a government contract to exceed this rule's flight, duty, and rest limits in certain situations.

Another example of a provision in this rule that benefits supplemental passenger operations is the increase of the flight-time limits for augmented and unaugmented flights. This increase will allow certificate holders conducting supplemental operations to schedule unaugmented flightcrew members for 9 hours of flight time during peak circadian times after providing them with only 10 hours of rest. The existing regulations would require certificate holders conducting supplemental operations to provide their flightcrew members with 18 hours of rest after an operation involving 9 hours of unaugmented flight time.

In addition to including provisions that ease the burden of the maximum-FDP-limit reduction on supplemental operations, the FAA has also made adjustments to this rulemaking in response to concerns raised by air carriers (certificate holders) conducting non-scheduled passenger operations. Thus, the FAA has: (1) increased the unaugmented and augmented FDP limits in Tables B and C, (2) increased the amount of the split-duty credit and made that credit easier to obtain, and (3) largely eliminated the scheduling reliability requirements that were proposed in the NPRM. All of these adjustments were made, at least in part, in response to the concerns raised by certificate holders conducting non-scheduled operations, and they should significantly ease the burden of this rule on

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[18] Id. at 311.

these types of operations. In making these adjustments, the FAA has, where possible, incorporated into this rule portions of the alternative proposal put forward by the industry commenters who conduct non-scheduled passenger operations.

While air-carrier business models for passenger operations may differ, the factors that give rise to unsafe levels of fatigue are the same for each flightcrew member involved in these operations. A flightcrew member working a 16 or 30-hour FDP as part of a supplemental passenger operation will not be less tired simply because he or she is working in a supplemental type of operation instead of a domestic type operation. To account for this fact and ensure that fatigue is limited to safe levels, the FAA has decided to set a single flight, duty, and rest standard for all part 121 certificate holders conducting passenger operations. The FAA is sympathetic to the fact that supplemental passenger operations require additional flexibility that is not required by other business models and as a result, may bear a disproportionate cost of this rule. To ameliorate the cost of this rulemaking on supplemental operations, this rule contains supplemental-friendly provisions and adjustments that do not have an adverse effect on safety. However, the flexibility and cost-savings required by supplemental passenger operations can no longer be used to justify 16 and 30-hour FDPs for these operations because scientific studies have shown that FDPs of this length significantly increase the risk of an aviation accident that could injure passengers onboard an aircraft.

In response to NJASAP's question, the FAA notes that this rule applies to all part 121 certificate holder passenger operations and all part 121 and part 91 operations where

Deleted: Turning to concerns expressed by air carriers conducting all-cargo operations, the FAA notes that the scheduling flexibility permitted by the existing 16 and 30-hour across-the-board FDP limits is particularly important for all-cargo operations because a large portion of these operations are conducted at night. However, the risk from these types of long FDPs is even higher for nighttime unaugmented operations because studies have shown that working during the WOCL causes a substantial degradation in human performance.[19] Because of the substantial safety risks caused by long FDPs and working during the WOCL, the FAA has concluded certificate holders conducting all-cargo operations can no longer be permitted to schedule 16-hour unaugmented nighttime FDPs and 30-hour augmented FDPs. In addition, as discussed in other parts of this preamble, because nighttime operations raise additional safety concerns, the FAA has decided to subject certificate holders who conduct all-cargo operations to the flight, duty, and rest limits imposed by this rule.¶
. The FAA is sensitive to the fact that air carriers conducting all-cargo operations may have some flexibility-based concerns as a result of their business model. That is why this rule contains a number of provisions, such as the split-duty credit and an increase in the peak flight-time limits, which should benefit the all-cargo industry. The split-duty credit in particular should make this rule much less burdensome to all-cargo carriers because it will allow these carriers to obtain credit for their existing split-duty schedules (with some modifications). ¶

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an FDP includes at least one flight segment conducted under part 117. Thus, if a flightcrew member flies one or more segments of an FDP in passenger-carrying operations, but also flies a part 91 positioning flight as part of that FDP, the part 91 flight would have to be conducted under part 117. Parts 135 and 91K have their own set of flight, duty, and rest requirements that will continue to apply to those operations.

B. Definitions

The NPRM included definitions specific to this part. The definitions adopted in this rule are in addition to those in §§ 1.1 and 110.2. In the event that terms conflict, the definitions in part 117 control for purposes of the flight and duty regulations adopted in this rule. The section below provides a discussion of the specific definitions used in the final rule.

1. Acclimated

The FAA proposed to define "acclimated" as a condition in which a flightcrew member has been in a theater for 72 hours or has been given at least 36 consecutive hours free from duty.

The Airline Pilots Association (ALPA), the Allied Pilots Association (APA), the Coalition of Airline Pilots Associations (CAPA), and the Independent Pilots Association (IPA) stated that acclimated should mean a condition in which a flightcrew member has been in a new theater for the first 72 hours since arriving and has been given at least 36 consecutive hours free from duty during the 72 hour period. Also, the Flight Time Aviation Regulation Committee and Flightcrew Representatives (representing labor) (Flight Time ARC) supported the suggested, revised definition. These commenters noted that according to established science, three consecutive local nights rest is required to become acclimated. They also noted that Cap 371 provides for three consecutive local nights rest to become acclimated.

NACA, North American Airlines (NAA), World Airways, and Atlas Air Worldwide Holdings, Inc. (Atlas) contended that the proposed definition should be revised to allow 30 consecutive hours free from duty instead of 36 hours.

NACA and NAA said that it is important in regulations controlling both schedules and operations that the extended rest periods be consistent across domestic and international operations. NACA, NAA, and World Airways said that the FAA's proposed acclimation time should be changed to reflect the agency's proposed 168-hour look-back rest period of 30 hours. (See § 117.25(b)). These commenters believed that 30 hours is appropriate because any further time to acclimate may preclude flightcrew members from returning to their home base as flightcrew members, which becomes important in commercial operations where flight hours are guaranteed.

World Airways said that its recommendation of 30 hours free from duty is within the range the ARC discussed as sufficient for acclimation to occur. Atlas said that there is no scientific justification for selecting 36 as the minimum number of consecutive hours. Atlas further commented that subsequent to publication of the NPRM, the FAA clarified its definition of acclimated, stating that the computation is based on actual, not scheduled, operations. Atlas believed that this clarification needs to be incorporated into the definition as follows: "Time in theater begins upon block in at an airport more than four time zones from the previous acclimated location."

In response to the above comments, the FAA is not persuaded by the argument that acclimation only can occur when the flightcrew member is in a new theater for 72 hours and has been given 36 consecutive hours free from duty during that period. The Flight Time ARC did receive information from the sleep specialists that an individual attempting to acclimate to a new time zone will adjust his or her clock approximately one hour per day for each hour of time zone difference. 75 Fed. Reg. 55852, 55861 (Sep. 14, 2010). The ARC, however, concluded that, based on its collective experience, acclimation can occur more quickly if the flightcrew member manages the sleep opportunity appropriately. The ARC also concluded that a flightcrew member can become acclimated by either receiving three consecutive physiological nights rest or a layover rest period of 30 to 36 consecutive hours. The ARC universally rejected the premise that, because the United Kingdom is 5 time zones away from the eastern coast of the United States, it would take between five and nine days to acclimate to a European time zone. The commenters did not present new information that was not considered during the ARC. There is no compelling information or argument that refutes the body of experience represented in the ARC and the FAA declines to amend this definition as suggested.

The FAA also declines to accept the suggestion that a 30 hour rest period is adequate to acclimate compared to the 36 hour period proposed in the NPRM. The ARC recommended a 30 to 36 hour layover rest period. The FAA decided to propose the 36-hour rest period because it provides for one physiological night's rest and then opportunity for a shorter rest period. The agency finds that the more conservative approach is appropriate to provide the more meaningful opportunity for rest.

United Parcel Service Co. (UPS) commented that administrative duties should be exempted or removed from the scope of flight duty when determining flightcrew member acclimation. UPS further commented that if flightcrew members revised company manuals or navigation charts during a duty free period (layover) or prior to report time, it is possible that the flightcrew members would not satisfy the definition of being acclimated or could drive different FDP limits based on when they claim their duties started.

In response to UPS' concern, to acclimate a flightcrew member under this rule, the certificate holder must provide the required rest and cannot assign any duties during the rest period. Similarly, it is the flightcrew member's responsibility to take advantage of the period and rest accordingly. If a flightcrew member independently decides to perform administrative type duties during this time period, as described by the commenter, the flightcrew member is considered acclimated regardless of whether he or she actually rested during this time period.

2. Acclimated Local Time

While the FAA did not propose this term, ALPA, CAPA, Flight Time ARC, and the Southwest Airlines Pilots Association (SWAPA) suggested including this term. They suggested that acclimated local time means the local time at the location where the pilot last had greater than 36 hours free from duty in the first 72 hours in theater. IPA recommended the same definition, except it replaced the term "pilot" with "flightcrew member." In support of their recommendation, ALPA, CAPA, and Flight Time ARC said this new definition would provide an unambiguous time for applying the definition of "nighttime duty period" and for entering the FDP and flight time limit tables. They further said that the wording in the NPRM concerning acclimated or home base time left many questions of interpretation. For example, a USA-based pilot who acclimates in Europe and then subsequently flies to Japan would, under the current NPRM wording, enter the tables at home-base time instead of Europe time. The commenters also stated that the exact location of acclimation must be known to determine future loss of acclimation. Under their proposal, the commenters contended that both the tables and the definition of nighttime flight duty period would use the new term, "acclimated local time."

The FAA has accommodated these concerns by changing the heading of Tables A, B, and C to reflect acclimated time. In addition, the FAA clarifies that a flightcrew member is considered acclimated based on which rest he or she was given first. If the flightcrew member completes 36 consecutive hours of rest prior to being in theater for 72 hours, then the flightcrew member is acclimated at the time that the 36-hour period ends and he or she is acclimated at the location that the rest occurred.

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3. Airport/standby reserve

According to the proposed definition, "Airport/standby reserve" means a defined duty period during which a flightcrew member is required by a certificate holder to be at, or in close proximity to, an airport for a possible assignment.

UPS said that the FAA's definition of airport/standby reserve is too vague and is open to interpretation. It recommended revising the definition to mean an assignment that requires a flightcrew member to be in a position to begin preflight activities following notification of an assignment without requiring additional travel time to arrive for the operation.

NACA and NAA did not believe that the definition is necessary because airport/standby reserve is an assignment within an FDP. If the term is adopted, NACA and NAA recommended that the term be defined as a duty period during which a flightcrew member is required by a certificate holder to be at, or in close proximity to, an airport for a possible assignment, and to show at the departure gate or aircraft within one hour.

Atlas contended that the FAA did not clarify the relationship of airport/standby reserve and short-call reserve in its clarification document published after the NPRM. This commenter noted that according to the FAA's clarification, airport/standby reserve and short-call reserve are mutually exclusive. Atlas said that the distinction was explained as whether or not the flightcrew member is "at the airport or in close proximity to the airport." If at or in close proximity to the airport, a flightcrew member is deemed to be on airport/standby reserve, this suggests that a flightcrew member on short-call reserve in a hotel room near an airport could be deemed to be on airport/standby reserve. Atlas believed the distinction is important because it determines if the reserve is counted as part of the FDP. Atlas argued that airport/standby reserve means a defined duty period at an on-airport facility to which a flightcrew member has been required to report by a certificate holder immediately following assignment (usually within one hour) and at which no rest facilities are available or no rest is scheduled.

The FAA agrees that the proposed terminology could be confusing and has modified the term to mean a duty period during which a flightcrew member is required by a certificate holder to be at an airport for possible assignment.

4. Augmented Flightcrew

The NPRM defined "augmented flightcrew" as a flightcrew that has more than the minimum number of flightcrew members required by the airplane type certificate to operate the aircraft to allow a flightcrew member to be replaced by another qualified flightcrew member for in-flight rest.

A number of industry commenters objected to the fact that the proposed augmented flightcrew definition did not allow a flight engineer to augment a pilot. These commenters stated that adding a flight engineer to a flightcrew has a number of safety benefits. The commenters added that their inability to augment with a flight engineer would result in three-seat aircraft being retired prematurely, which would raise the costs of this rule.

This rule does not allow augmentation with a flight engineer for safety reasons. As discussed more fully in other parts of this preamble, an augmented flight provides fatigue-mitigation benefits because it contains more than the minimum number of pilots, and the additional pilots allow the flightcrew to obtain in-flight rest by working in shifts and replacing each other at the aircraft controls. However, a flight engineer is not qualified to manipulate the flight controls and pilot an aircraft and is generally prohibited from occupying a pilot duty station. Because a flight engineer who is not qualified as a pilot cannot occupy a pilot duty station, an engineer cannot replace a pilot at the aircraft controls. As such, this rule does not allow a pilot to be augmented with a flight engineer.

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With regard to three-seat aircraft, even though this rule does not give augmentation credit for a flight engineer to augment a pilot, it does not prohibit flight engineers from working on three-seat aircraft. All this rule states is that, without additional pilots, a flightcrew that has a flight engineer would not be considered augmented. Because a flight engineer could still work on a three-seat aircraft under the terms of this rule, the FAA does not believe that the above limitation on augmentation would lead to the premature retirement of three-seat aircraft.

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5. Calendar Day

The NPRM proposed that a "calendar day" means a 24-hour period from 0000 through 2359.

Alaska Airlines said that while the FAA contends in its clarifying document that the calendar day for the flightcrew member's home base should be sufficient, calendar day as defined in the NPRM does not provide this clarification. Alaska Airlines instead recommended that a calendar day means a 24-hour period from 0000 through 2359 local time at the flightcrew member's home base.

Boeing Commercial Airplanes (Boeing) suggested a similar definition to address frequent transitions between time zones. Boeing further stated that rules such as the ones proposed in the NPRM are implemented in computerized optimization systems for crew scheduling, and as a result, ambiguities in the rules can lead to different interpretations.

The FAA has amended this term to include reference to Coordinated Universal Time or local time. This is consistent with the definition of calendar day in section 121.467(a) (Flight attendant duty period limitations and rest requirements: Domestic, flag, and supplemental operations).

6. Consecutive Night Duty Period

The FAA did not propose a definition for this term; ALPA, CAPA, SWAPA, Flight Time ARC, and Federal Express Air Line Pilots Association, International (FedEx ALPA) said that the proposed § 117.27 limits consecutive nighttime flight duty periods to three periods. To avoid confusion in applying § 117.27, the commenters believed that the term "consecutive night duty period" should be defined. They recommended that consecutive night duty period mean two or more night flight duty periods that are not separated by at least a part § 117.25 rest between the duty periods that encompasses a physiological night's sleep (1:00 am to 7:00 am at home base or acclimated local time). IPA suggested the adoption of a similar definition.

The FAA declines defining the term consecutive night flight duty period and instead includes a provision in § 117.27 to address the commenters' concerns. Section 117.27 now specifies that the consecutive-night provisions apply to consecutive flight duty periods that infringe on the WOCL. The WOCL is defined later in this section.

7. Deadhead Transportation

As proposed, "deadhead transportation" means transportation of a flightcrew member as a passenger, by air or surface transportation, as required by a certificate holder, excluding transportation to or from a suitable accommodation.

Air Transport Association of America, Inc. (ATA) suggested removing the word "passenger" from the definition because the FAA should not assume that deadhead transportation should be limited to flightcrew members characterized as passengers when not all carriers carry passengers. Similarly, UPS commented that the proposed definition fails to address deadhead transportation on aircraft not configured for passenger operations (i.e., all-cargo aircraft). UPS suggested that the FAA revise the definition as follows: "Deadhead transportation means transportation of a flightcrew member as a passenger, non-assigned flight deck occupant, or other additional flightcrew member by air or surface transportation, as required by the certificate holder, excluding transportation to or from a suitable accommodation."

The FAA agrees with the above commenters and has modified the term to apply to the transportation of a flightcrew member as a passenger or a non-operating flightcrew member. The FAA has also added two clarifying statements to the definition. The first is that all time spent in deadhead transportation is duty and is not rest. This provision was copied from proposed § 117.29 Deadhead transportation. Secondly, the FAA includes in this definition that deadhead transportation is not considered a segment for purposes of determining the maximum flight duty period in Table B.

8. Duty

The NPRM defines "duty" to mean any task, other than long-call reserve, that a flightcrew member performs on behalf of the certificate holder, including but not limited to airport/standby reserve, short-call reserve, flight duty, pre-and post-flight duties, administrative work, training, deadhead transportation, aircraft positioning on the ground, aircraft loading, and aircraft servicing.

Industry commenters largely rejected the proposition that short-call reserve be considered duty. They argued that this classification is inappropriate and unrelated to effective fatigue mitigation. They also stated that the only requirement or company task a pilot has on short call reserve is to be available to be contacted. Otherwise, the pilot is free to do what he or she wants and plans the day to take advantage of rest opportunities or any other activities as he or she desires, just as a lineholder would. Industry also largely objected to the classification of short-call reserve as duty. ALPA, CAPA, FedEx ALPA, SWAPA and APA all commented favorably on short call reserve being considered duty.

As stated in the NPRM, the FAA's rationale for this proposal was that while on short-call reserve, the flightcrew member can expect that he or she will not receive an opportunity to rest prior to commencing an FDP. Additionally, the flightcrew member is required to limit his or her action sufficiently so that he or she can report to the duty station within a fairly short timeframe. The FAA believed that this time should be accounted for under the cumulative limitations and therefore proposed that short-call reserve be considered duty.

However, the commenters argued that a flightcrew member on short-call reserve has the same predictable rest and sleep opportunities as a regularly-scheduled lineholder and that being on reserve cannot entail significant workload and thereby be fatiguing. The FAA accepts that while reserve cannot be categorized as "rest" it does not necessarily fit squarely with being considered duty either. As the commenters correctly pointed out, time spent on short-call reserve is simply not as fatiguing as time spent on an FDP. Therefore, this rule no longer includes short-call reserve as duty.

ATA, NACA, UPS, United, Continental Airlines, Inc. (Continental), Alaska Airlines, NAA, Delta Air Lines (Delta), and World Airways stated that the proposed definition of duty is too broad, operationally unworkable, and not clear regarding accountability. They objected to the inclusion of the terms "any task," "on behalf of the certificate holder," and "administrative work" in the definition. ATA provided the example of a professional pilot who routinely performs tasks such as refreshing outdated publications, watching videos for recurrent training, and reading and responding to e-mails. Because a flightcrew member can perform these tasks at a time and place of his or her choosing, the commenters argued that a certificate holder has no way of knowing or controlling the pertinent flightcrew member conduct.

ATA asserted that the inclusion of administrative but not labor-related work in the definition does not make sense because no material distinction exists between administrative tasks performed on behalf of management and similar tasks performed on behalf of labor.

Alaska Airlines said that the FAA in its clarifying document noted that the term "administrative work" is readily understandable; however, the commenter noted that the term's role in fatigue and in the context of the regulation is vague. The commenter believed that the term needs further clarification and should only include work associated with flight operations.

Continental and United said that the definition of duty considers administrative work in the same way that it assesses flight duty. They contend that this is inappropriate when applied to the cumulative duty restrictions discussed in proposed § 117.23.

Alaska Airlines suggested that the FAA make clear in the final rule that duty only includes activities that the carrier can directly control. ATA recommended clarifying the definition by replacing the phrase "on behalf of the certificate holder" with "directed by a certificate holder on company property." NACA, UPS, Delta, and World Airways suggested revising the definition of duty to mean "any task, other than long-call and short-call reserve, that is directed by the certificate holder…" NAA believed the term "on behalf of the certificate holder" should be replaced with "is assigned by the certificate holder."

UPS contended that the FAA must address the issue of management pilot duty and suggested that management pilot duty include all time spent during company business-related meetings and other business-related activity conducted on company property. UPS argued that if this is not addressed, management pilots will effectively become non-flying pilots.

NACA, World Airways, and NAA recommend deleting the term "administrative work" because it is too vague and inclusive of issues that have nothing to do with direction by the certificate holder or FDP fatigue mitigation. Continental and United recommended that the FAA remove administrative activity from the definition and add a provision to the regulation that applies administrative duty to specific FDPs. ATA and

Delta request that if the term is kept in the definition, the FAA should clarify that the definition treats management and labor-related administrative work in the same way.

In response to the above comments, the definition of duty has been further modified by replacing "on behalf" of the certificate holder with "as required" by the certificate holder. This addresses the certificate holders' concern that the administrative work accomplished by the flightcrew member is work that he or she is required to do, and appropriately included as duty. Lastly, the FAA agrees that performance of administrative management work is not distinguishable from any other type of administrative work, and therefore administrative management work is included in the term "administrative work" under this definition.

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9. Duty Period

As proposed, "duty period" means a period that begins when a certificate holder requires a flightcrew member to report for duty and ends when that crew member is free from all duties.

UPS said that defining the end of the duty period as "…free from all duties" is too ambiguous and uncertain since a certificate holder cannot control voluntary duties that a flightcrew member may decide to accomplish at the end of his or her FDP. UPS suggested that the definition be changed so that the end of the duty period occurs when the flightcrew member is "…released from all company directed duties." In light of the changes that have been made to this rule, the FAA has determined that it is no longer necessary to define this term, and therefore the proposed definition is withdrawn.

10. Early Start Duty

The NPRM did not propose a definition for this term, however, APA recommended including the term, which would mean an FDP that commences in the period 0500 to 0659 home base time or where acclimated. The FAA does not agree that adopting this term is necessary or useful.

11. Fatigue

Fatigue as proposed means physiological state of reduced mental or physical performance capability resulting from lack of sleep or increased physical activity that can reduce a flightcrew member's alertness and ability to safely operate an aircraft or perform safety-related duties.

ATA commented that the proposed definition of fatigue is inconsistent with ICAO's proposed definition. ATA noted that ICAO proposes to define fatigue as "a physiological state of reduced mental or physical performance capability resulting from sleep loss or extended wakefulness, circadian phase, or workload (mental and/or physical activity) that can impair a crew member's alertness and ability to safely operate an aircraft or perform safety related duties." ATA recommended adopting the ICAO definition because it captures the fatigue-inducing effects of the interaction of sleep loss, circadian phase, and workload, and provides a scientific basis for fatigue risk management.

In response to ATA's comments, the FAA notes that ICAO has not finalized its definition of fatigue, and the proposed definition may be subject to change. At this point, it is not prudent for the FAA to include a term that ultimately may be changed or not even adopted. Therefore, the FAA is adopting the definition of fatigue that was proposed.

12. Fit for Duty

As proposed, the definition of "fit for duty" means physiologically and mentally prepared and capable of performing assigned duties in flight with the highest degree of safety.

UPS commented that including "…duties in flight with the highest degree of safety" in the definition of "fit for duty" is not practical and too subjective. UPS further stated that it is unrealistic for any human to be at their "highest" level of performance during every possible FDP and suggests replacing "…highest degree of safety" with "…capable of performing duties that assure flight safety."

The FAA does not agree with UPS because every flightcrew member on every flight should be prepared and capable of performing the assigned duties at the highest degree of safety. Accordingly, the FAA has adopted the proposed definition in the final rule.

13. Flight duty period

The NPRM defines "flight duty period" to mean a period that begins when a flightcrew member is required to report for duty with the intention of conducting a flight, a series of flights, or positioning or ferrying flights, and ends when the aircraft is parked after the last flight and there is no intention for further aircraft movement by the same flightcrew member. A flight duty period would include deadhead transportation before a flight segment without an intervening required rest period, training conducted in an aircraft, flight simulator or flight training device, and airport/standby reserve.

ATA, UPS, World Airways, NAA, NACA, Delta, and Alaska Airlines objected to including all flight training in a flight simulator or training device in the definition of FDP. ATA, Delta, and Alaska Airlines commented that there is no scientific basis for such inclusion, and all seven commenters said there is no inherent safety basis for this decision. Alaska Airlines and Delta added that with simulator time included in the FDP, pursuant to section 117.27, flightcrew members would be unable to participate in simulator training on more than three consecutive nights. ATA further commented that there is no basis for including travel to a training site in the FDP unless the travel occurs before flight time.

ATA, Delta, and Alaska Airlines recommended that the FAA revise the proposed definition to state that only training and flight simulator time conducted before a flight without an intervening rest period is counted as part of the FDP. UPS said that it supports counting time spent in a simulator or flight training device as part of an FDP only if this time immediately precedes flight duty without an intervening rest period. UPS believed that there is an unintended consequence of treating simulator and flight training device training as part of an FDP, regardless of when the training occurs. That is, the practice of providing additional training to a flightcrew member who requests that training will be discontinued; thereby, affecting flight safety.

NACA, NAA and World Airways commented that an FDP "must involve a flight, or at a minimum, movement of an aircraft where the public is at risk where an aircraft accident potential immediately exists." They suggested revising the proposed definition to add the following phrases: "but not limited to" and "whenever these duties are performed in conjunction with duties involving flight without an intervening rest period." This would result in a definition that reads: "…A flight duty period includes, but is not limited to, deadhead transportation…and airport/standby reserve whenever these duties are performed in conjunction with duties involving flight without an intervening rest period."

The FAA clarifies that an FDP begins when the flightcrew member reports for duty and will include the duties performed by the flightcrew member on behalf of the certificate holder that occur before a flight segment or between flight segments without a required intervening rest period. The FDP ends when the aircraft is parked after the last flight and there is no intention for further aircraft movement by the same flightcrew member. Included in the FDP are any of the following actions if they occur before a flight segment or between flight segments without an intervening rest period: deadhead transportation, training conducted in an aircraft or flight simulator, and airport/standby reserve. Time spent in a flight training device that takes place after the aircraft has been parked after the last flight has been eliminated from this definition. For purposes of calculating the pertinent part 121 flight, duty, and rest limits, the FAA considers time spent on an FDP to be duty.

14. Flight Time

The NPRM did not propose a definition for this term; however, APA, ALPA, CAPA, FedEx ALPA, SWAPA, and Flight Time ARC recommended adding a definition for flight time to begin when the aircraft first moves with the intention of flight. These commenters argued that this term in § 1.1 is defined as the moment the aircraft first moves under its own power. However, the pilot in command (PIC) and required flight deck flightcrew members are always responsible and must perform their duties when the aircraft is moved by a tug or sits on a hardstand and that time should count, according to the commenters, as flight time if the movement is with the intention for flight. They also state that this definition would be consistent with Annex II, Subpart Q to the Commission of the European Communities Regulation No. 3922/91, as Amended (EU OPS subpart Q) which defines flight time as the time between an airplane first moving from its parking place for the purpose of taking off until it comes to rest on the designated parking position and all engines or propellers are stopped.

IPA suggested that the proposed definition be revised as follows: "Flight time means when the aircraft first moves with the intention of flight until it comes to rest on the designated parking position."

The FAA declines the commenters' recommendations. Numerous other regulations are based on the definition of flight time that is set out in § 1.1. Changing this term solely in the context of the flight and duty regulations would make this rule more complicated than necessary and create confusion between this rule and other regulations.

15. Late Finish Duty

The NPRM did not propose a definition for this term; however, APA said a definition of "late finish duty" is needed to provide for fatigue mitigation caused by consecutive early starts and late finishes. APA suggested that the term be defined as an FDP that ends during the period of 0000-0159, home base time or where acclimated. The FAA does not find that it is necessary or useful to adopt this term.

16. Night and Nighttime

The FAA did not propose definitions for either of these terms; however, NACA and NAA said that the FAA's intent for using the term "night" in the NPRM should be defined. If it is not defined, the commenters said that the FAA should always use the term "physiological night" in all text in the preamble and in the final rule. They recommended defining night to mean "the period between 0100 and 0700 at the flightcrew member's designated home base or acclimated location." The commenters noted that this would make the term compatible with the definition of "physiological night's rest."

Atlas said that the final rule should contain a definition of the terms "night" and "nighttime," so as to make the meanings comparable to references in proposed § 117.27, as well as to the definition of "physiological night's rest." It noted that while "physiological night's rest" refers to the hours of 0100 and 0700, the term "nighttime" referenced in proposed § 117.27 is interpreted to refer to operations that commence between 2200 and 0500, according to page 22 of the FAA's clarification document. Both definitions, the commenter said, differ from the definition of "night" in 14 CFR. §1.1, which is the time between the end of evening civil twilight and the beginning of morning civil twilight, as published in the American Air Almanac, converted to local time.

The FAA declines to adopt these terms. The FAA uses the word "physiological night's rest" when it is appropriate. In addition, please refer to the FAA's response to the term "Consecutive Night Duty Period."

17. Nighttime Flight Duty Period

The FAA did not propose a definition for this term; however, APA, ALPA, CAPA, FedEx ALPA, SWAPA, and Flight Time ARC said that to avoid confusion when conducting consecutive nighttime operations under § 117.27, the FAA should define "nighttime flight duty." They suggested that this term be defined to mean a duty period during which any part of the duty period falls within the home base or acclimated local time period of 0200 to 0459.

IPA suggested a definition of "nighttime flight duty" as follows: "a duty period during which any part of the duty period falls within the home base or acclimated local time period of 0200 to 0459."

Please see response to "6. Consecutive Night Duty Period." The FAA does not find it necessary to define the term as suggested.

18. Nighttime Operations

ATA said that the FAA should add a new definition of nighttime operations for purposes of part 117 to be consistent with the agency's document that responds to clarifying questions to the NPRM. The commenter believed that the definition should include operations that commence between 10:00 p.m. and 5:00 a.m. The FAA has clarified the pertinent provisions of section 117.27, and as such, it finds that a separate definition for nighttime operations is unnecessary.

19. Report Time

The NPRM defined "report time" as the time that the certificate holder requires a flightcrew member to report for a duty period. The FAA did not receive any comments with regard to this definition, and as such, this rule adopts the proposed definition.

20. Reserve Availability Period

The NPRM defined "reserve availability period" to mean a duty period during which a certificate holder requires a reserve flightcrew member on short call reserve to be available to receive an assignment for a flight duty period.

NACA objected to the premise that short call reserve is duty. It noted that ARC discussions were clear that short call reserve, which is a period of time when the only responsibility the crew member has is to answer the phone, is not a fatiguing event, and thus, it should not constitute duty for cumulative-duty purposes. NACA suggested revising the proposed definition so that it reads "reserve availability period means a period of time during which a certificate holder requires a reserve flightcrew member on short call reserve to be available to receive an assignment for a flight duty period."

As discussed in other portions of this preamble, cumulative-duty-period limits have been removed from this rule. This removal addresses the concern expressed in NACA's comment as short-call reserve is no longer subject to the cumulative-duty-period limits.

21. Reserve Duty Period

The NPRM defined "reserve duty period" as the time, applicable only to short call reserve, from the beginning of the reserve availability period to the end of an assigned flight duty period. In light of the changes that were made to the reserve status section, this definition is no longer necessary, and it has been removed from the final rule.

22. Reserve Flightcrew Member

The NPRM defined "reserve flightcrew member" as a flightcrew member who a certificate holder requires to be available to receive an assignment for duty. The FAA did not receive any comments with regard to this definition, and as such, this rule adopts the proposed definition.

23. Rest facility

The NPRM defines "rest facility" as a bunk, seat, room or other accommodation that provides a flightcrew member with a sleep opportunity. In determining what constitutes each specific type of rest facility, the FAA took note of a comprehensive evaluation of available onboard rest facilities, which was conducted by the Dutch government in 2007. Simons M, Spencer M., *Extension of Flying Duty Period By In-Flight Relief*. Report TNO-DV2007C362. TNO, Soesterberg, Netherlands, 2007 (TNO Report). The TNO Report was created in order to provide science-based advice on the maximum permissible extension of the FDP related to the quality of the available onboard rest facility and the augmentation of the flightcrew with one or two pilots.

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As defined in the NPRM, "Class 1 rest facility" means a bunk or other surface that allows for a flat sleeping position and is located separate from both the flight deck and passenger cabin in an area that is temperature-controlled, allows the flightcrew member to control light, and provides isolation from noise and disturbance. "Class 2 rest facility" means a seat in an aircraft cabin that allows for a flat or near flat sleeping position; is separated from passengers by a minimum of a curtain to provide darkness and some sound mitigation; and is reasonably free from disturbance by passengers or flightcrew members. “Class 3 rest facility” means a seat in an aircraft cabin or flight deck that reclines at least 40 degrees and provides leg and foot support.

ATA stated that the proposed rule was overly restrictive with respect to the facilities it deemed sufficient for conferring credit for in-flight rest on augmented flights. ATA, NACA, and UPS criticized the proposal for over-relying on the TNO Report. ATA and UPS emphasized that the TNO Report is only a single study that has not been adopted by any regulatory body. NACA asserted that “the TNO report is more than 10 years old and was proposed by a limited number of scientists and based upon limited studies.” NACA added that “[i]n the ARC discussions, Dr. Hursh stated that his [SAFTE/FAST] models value sleep on a bunk at approximately 66 to 80 percent of normal sleep.” APA stated that the TNO Report has not been validated in the aviation context.

ATA stated that the proposed rule’s adoption of the TNO report would have substantial adverse impacts on U.S. carriers because it would deviate from the less-restrictive criteria for rest facilities that the FAA set out in Advisory Circular (AC) 121-31. This is because, ATA asserted, many air carriers have invested a substantial amount of money developing rest facilities that comply with the guidelines set out in AC 121-31, and these facilities would not satisfy the more stringent criteria for rest facilities set out in the TNO Report. ATA noted that although it supports the concept of credit for in-flight rest, it does not support rest facility criteria derived from the TNO Report. It further noted that “the FAA should continue to accept AC 121-31 standards for all aircraft built prior to the imposition of the new rule, the use of current business class seats as Class 2 facilities and for credit being afforded to all-cargo aircraft that provide a 'horizontal sleep opportunity' to flightcrew members. Rest facilities in use today built to AC 121-31 standards are operationally validated as a means of fatigue mitigation that FAA has accepted and there is no evidence that such facilities should not be used in the future." To minimize costs, ATA recommended that "[a]t a minimum, the guidance in AC 121-31 should remain in effect for all aircraft built prior to the implementation date of the NPRM and a significant period allowed for newer aircraft to conform to any new standards."

UPS added that most air-cargo carriers would be unable to install rest facilities needed for the augmentation credit because air-cargo aircraft do not have passenger cabins. UPS asserted that it would be unable to install the rest facilities required by this rule in approximately 18% of its total fleet.

The existing advisory circular that provides guidance for onboard rest facilities (AC 121-31) was written in 1994 based on the science that existed at that time. The TNO Report, on the other hand, was written in 2007, and it provides the most comprehensive evaluation available to date of onboard rest facilities. This report may not yet have been adopted by other regulatory bodies because it is only four years old, and significant regulatory changes usually take place over a longer period of time. When drafting this rule, the FAA found the TNO Report to be more persuasive than AC 121-31 because the TNO Report performed a comprehensive evaluation of rest facilities, and because it was based on more recent scientific data than AC 121-31.

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The FAA understands that the TNO Report provides more conservative conclusions than the pertinent SAFTE/FAST data concerning onboard rest facilities.

However, in response to comments discussed above, the FAA has increased the augmented FDP limits in Table C. This increase should more accurately reflect the results of the SAFTE/FAST modeling for augmented operations.

The FAA has considered the fact that basing the definition of rest facilities on the TNO Report may pose hardships for air carriers who currently rely on AC 121-31 for guidance about onboard rest facilities. To mitigate this hardship, as well as for a number of other considerations, the FAA has decided to make the effective date of this rule two years from publication. This two-year window will provide air carriers with time to phase out their current onboard rest facilities and install/upgrade onboard rest facilities that comply with the provisions of this rule.

APA, FedEx ALPA, SWAPA, CAPA, and Flight Time ARC said that the definition of "rest facility" should include the following clarification: "A rest facility on an aircraft shall only be used for in-flight rest opportunities." The commenters said this statement will eliminate any temptation to have crews obtaining their part § 117.25 or part § 117.17 rest on the aircraft when it is on the ramp. Several of these commenters noted that a bunk or seat on an aircraft is not a suitable rest facility on the ground. APA further recommended that the FAA separate the definitions of an "in-flight, onboard rest facility" and a "ground-based rest facility" and clearly differentiate between a ground-based rest facility and a suitable accommodation.

The FAA agrees with the above commenters that rest in a rest facility should take place while an aircraft is in-flight. That is why the augmented FDP section, section 117.17, to which the rest-facilities definition applies, mandates that the required minimum augmentation rest take place in-flight. Because section 117.17 already requires that the minimum augmentation rest take place in-flight, there is no need to further amend the pertinent regulatory text.

Turning to APA's request for clarification concerning the distinction between onboard and ground-based rest facilities, the FAA notes that a rest facility is a facility that is installed in an aircraft. A suitable accommodation, on the other hand, is a ground-based facility. The FAA has amended the pertinent definitions to clarify this distinction between a suitable accommodation and a rest facility.

APA also stated that detailed minimum standards should be spelled out in regulatory requirements. At a minimum, the language in the Class 1 facility definition should be improved to indicate that other surfaces that allow for a flat sleeping position should be suitably padded and reasonably comfortable and suitable for sleeping. APA noted that the ARC's discussions described ground-based facilities primarily as bunkrooms and the like used by cargo carriers to provide rest during a package sort operation. APA urged the FAA to adopt the detailed recommendations regarding onboard rest facility requirements set out in the appendix included in its comment submission. APA added that it remains concerned that if such specifications are left to Advisory Circulars, and if important details are not followed, in-flight rest could be seriously compromised. Additionally, it noted that several studies have commented on sleep problems caused by low humidity or an improper temperature, but the FAA did not mention these factors nor list any requirement for them. APA suggested that a Class 1 rest facility should account for low humidity and improper temperatures.

Delta expressed concern with the following description of a Class 2 facility that, it said, is contained both in the preface and in Advisory Circular 121-31A: A Class 2 rest facility is "a seat in an aircraft cabin that allows for a flat or near flat sleeping position (around 80 degrees from the seat's vertical centerline)." Delta said that many U.S. carriers currently providing on board rest facilities on routes for which Class 2 seats would be used are using a passenger business class type seat, some of which have been slightly modified or enhanced. The commenter further noted that these types of facilities have been in use for many years mostly on flights governed by 14 CFR 121.483. According to Delta, the ARC discussed this issue and acknowledged that these existing seats have worked very well. Delta asserted that most of these seats do not recline to the 80 degree range nor is it known yet if it is feasible to modify them for this capability. Delta believed that business class type seats currently being used are more than adequate to allow for in-flight rest.

UPS and NACA said that the definition of a Class 2 rest facility fails to address rest facilities on aircraft configured without a passenger cabin (i.e., all-cargo aircraft). UPS suggested that the definition should read: "In an aircraft configured with a passenger cabin, Class 2 rest facility means a seat that allows for a flat or near flat sleeping position and is separated from passengers by a minimum of a curtain to provide darkness and some sound mitigation, and is reasonably free from disturbance by passengers or in-flight flightcrew members. In an aircraft not configured with a passenger cabin, Class 2 rest facility means a seat that allows for a flat or near flat sleeping position."

In response to these comments, the FAA notes that, as discussed above, the specific requirements for rest facilities were derived from the TNO Report, which analyzed how much rest would be obtained from each rest facility that complied with those requirements. Because various air carriers currently utilize different types of rest facilities, the FAA has determined that adding to the TNO Report's minimum rest-facility requirements would require more air carriers to replace their existing rest facilities without a demonstrated safety benefit to justify this cost. Accordingly, the FAA declines to add additional requirements to the rest-facility requirements set out in the NPRM.

The FAA has also decided not to expand the definition of a Class 2 rest facility beyond the recommendations of the TNO Report. The FAA is open to the possibility of expanding the definition of a Class 2 rest facility if additional data is provided as part of an FRMS, and if expanding this definition would not adversely affect safety. In response to UPS and NACA's concerns, the FAA has changed the phrase "passenger cabin" to "aircraft cabin" in the rest-facility definition in order to include rest facilities on aircraft without a passenger cabin.

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A number of industry groups and air carriers also objected to the fact that the NPRM did not consider economy-class seats to be a rest facility. These commenters stated that, in their operational experience, economy-class seats provided flightcrew members with significant amounts of restful sleep. The commenters cited a number of studies that, they claimed, indicate that an economy-class seat can provide restful sleep.

The decision to not consider an economy-class seat to be a rest facility was based on the TNO Report, which determined that "the probability of obtaining recuperative sleep in such a seat would be minimal."[21] The TNO Report's determination was based on the following considerations: (1) an economy-class seat does not recline more than 40 degrees "and has no opportunities for adequate foot and leg rest, which diminishes the probability of recuperative sleep;" (2) "space around the seat is not sufficient to create an adequate separation from the passengers (jostle in economy class), or guarantee any privacy;" and (3) "a majority of passengers are unable to sleep at all in an economy seat. With the help of sleeping aids or alcohol, some passengers succeed in obtaining some sleep, but they often feel a general malaise after sleeping in a cramped position."[22] The FAA agrees with the TNO Report's analysis of economy-class seats, and based on this analysis, which states that economy-class seats provide minimal amounts of recuperative sleep, the FAA has determined that economy-class seats should not be considered a rest facility in this rule.

Delta stated that it is unclear why the FAA is concerned with keeping crew rest facilities out of the coach or economy section of the aircraft. Delta believes that if the seat meets the NPRM definition requirements and the specifications provided in

AC 121-3A (now AC 117-1), the geographical location of the rest facility on the aircraft should be immaterial. Delta further noted that it attempted to locate a scientific or an operational basis for the exclusionary requirement and has been unable to find any; therefore, Delta believes this is an unjustified constraint and should be removed.

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As discussed in the preceding response, one of the reasons why an economy-class seat does not provide restful sleep is that space around the seat is not sufficient to create

[21] TNO Report at 17.

an adequate separation from the passengers (economy jostling). Because there are substantially more passengers in the economy section of an aircraft, that section is generally noisier and has more densely-packed people than the other sections of the aircraft. In addition, the FAA notes that economy cabins are generally located behind the aircraft engines, and thus, have to deal with louder engine noise. Due to all of these considerations, locating a rest facility in the economy section would reduce the restfulness of the sleep obtained by a flightcrew member.

Boeing stated it has concerns about the use of the phrase "sleep opportunity" in the definition. It noted that it considers a "sleep opportunity" to be a period of time during which sleep or rest can feasibly occur. Boeing suggested that the definition be revised to read: "Rest facility means a bunk, seat, room, or other accommodation that provides a flightcrew member with comfort and quiet so as to maximize sleep and rest within a sleep opportunity period."

Boeing's suggested definition of rest facilities has already been largely incorporated into the definitions for the Class 1 and 2 rest facilities. The FAA declines to incorporate the suggested definition for a Class 3 rest facility because there is no recommendation in the TNO Report that a Class 3 facility provide sound mitigation.

Boeing also said that it finds the new crew rest definitions to be overly prescriptive, and may drive design and configuration decisions that would run counter to the intent of the proposed rule. For example, all three classes of rest facility are defined by their location: Class 1 must be located "separate from both the flight deck and

[22] Id. at 18.

passenger cabin;" Class 2 must be in the passenger cabin; and Class 3 must be in the cabin or flight deck. Boeing notes that while these definitions may encompass most or many of the current airplane configurations, they preclude new and novel designs that might better match the intent of the rule. The commenter recommended that the FAA consider including a provision in the rule that would allow new or alternative designs to be qualified as "equivalent" to Class 1, 2, or 3, based on scientific data, such as:
"Rest facilities may be qualified to a higher Class if the quantity of sleep achieved in the facility can be demonstrated to be equal to or greater than the level achieved by that Class."

Boeing's recommendation for recognizing new rest facilities that provide a sleep opportunity that is equivalent to the rest facilities defined by this rule is addressed by the FRMS and exemption processes. If an air carrier can show that its rest facility provides the same benefits as a Class 1, 2, or 3 rest facility, the FAA may approve an FRMS or an exemption recognizing the rest facility in question as providing the same fatigue mitigation as the rest facilities regulated by this rule.

Atlas said that the proposed rule's definition of rest facility is unworkably vague and leaves a number of uncertainties, which the FAA declined to clarify in response to questions. In particular, NACA and Atlas stated that the definition of Class 1 rest facility needs to be revised, as it is impossible to provide complete "isolation from noise and disturbance" on an aircraft. Atlas said that it supports changing the definition of a Class 3 rest facility to include a common coach class seat or non-crew seat on the flight deck of an all-cargo aircraft.

The definition for a Class 1 rest facility does not require that the isolation from noise and disturbance be complete. The FAA will accept a Class 1 rest facility that minimizes noise and disturbance without eliminating it completely, as complete elimination of noise and disturbance onboard an aircraft is virtually impossible. As discussed above, the FAA has declined to accept an economy-class seat as a rest facility because the TNO Report has determined that these types of seat provide a minimal amount of restful sleep.

24. Rest Period

The NPRM defined "rest period" as a continuous period determined prospectively during which the flightcrew member is free from all restraint by the certificate holder, including freedom from present responsibility for work should the occasion arise. None of the comments raised any significant issues with regard to this definition, and as such, this rule adopts the proposed definition.

25. Scheduled

The NPRM stated that "scheduled" means times assigned by a certificate holder when a flightcrew member is required to report for duty.

UPS commented that the definition does not address reschedules that occur during an FDP but only schedules assigned when the flightcrew member reported for duty. UPS suggested revising the definition as follows: "Scheduled means times assigned by a certificate holder when a flightcrew member is required to report for duty or has been given a re-schedule during the FDP that fully complies with the requirements of this part."

The FAA agrees with UPS that the proposed definition was ambiguous. The pertinent definition has been amended for clarification purposes.

26. Schedule reliability

The NPRM defines “schedule reliability” to mean the accuracy of the length of a scheduled flight duty period as compared to the actual flight duty period.

FedEx ALPA, ALPA, CAPA, SWAPA, IPA, and Flight Time ARC proposed the following revised definition for schedule reliability: “Schedule reliability means the accuracy of the length of both a scheduled flight duty period and a scheduled flight segment as compared to the actual flight duty period and segment.” SWAPA offered the following rationale for the revised definition: “To achieve schedule reliability, the individual flight segments must be considered. If a given segment within a pairing causes the pairing to exceed the limits, the certificate holder can merely leave the offending segment and change the pairing mix to bring it within limits. The segment would never be corrected. We believe that a scheduling metric must be included in § 117.9. Certificate holders now provide on-time reports to the DOT on an individual flight segment so this should not be a burdensome requirement.”

UPS said that defining schedule reliability as a comparison of an actual FDP to a scheduled FDP has no fatigue or safety implications. It recommended revising the definition as follows to match the preamble description: “Schedule reliability means the accuracy of the length of a scheduled flight duty period as compared to the maximum FDP listed in either Tables B or C (as applicable).”

As discussed in other parts of this preamble, the FAA has largely removed the proposed schedule-reliability requirements from the final rule. As such, there is no longer a need to define schedule reliability, and that definition has been removed from this rule.

27. Short-call reserve

The NPRM stated that "short-call reserve" means a period of time in which a flightcrew member does not receive a required rest period following notification by the certificate holder to report for a flight duty period.

NACA said that the only task assigned during short-call reserve is answering the phone. Otherwise, flightcrew members are free to conduct their lives as if they were in a rest period. NACA recommended clarifying the definition by specifying that short-call reserve is not duty.

NACA, Atlas, and NAA asked the FAA to more clearly distinguish short-call reserve from airport/standby reserve. Atlas recommended revising the definition of short-call reserve to mean "a short, designated period of time (usually three hours or less), either at home or in a hotel, during which a flightcrew member is on reserve call-up for an assignment. Because the flightcrew member has not reported for assignment and rest is available, the time on short-call reserve is not to be considered part of FDP or duty." NAA recommended the following revision to the definition to address its concerns: "Short-call reserve means a period of duty time in which a flightcrew member does not receive a required rest period following notification by the certificate holder to report for a flight duty period, but is provided more than one hour notice of the required reporting time."

In response to the above comments, the FAA notes that the distinctive feature of short-call reserve is that the flightcrew member on short-call reserve is assigned a reserve availability period. Accordingly, the definition of short-call reserve has been amended to clarify that this definition only applies to a flightcrew member who is assigned to a reserve availability period. As discussed in the pertinent portions of this preamble, the FAA has removed the cumulative-duty-period limits from this rule, in part, in response to concerns raised by commenters about the way that this cumulative limit impacted short-call reserve.

28. Split duty

The NPRM defines "split duty" as a flight duty period that has a scheduled break in duty that is less than a required rest period.

NACA said that the definition of split duty should make clear that the term "scheduled" is used only where it is clearly applicable to the situation intended. For non-scheduled operations, NACA believed that a schedule begins when the flightcrew member shows up for an FDP. As such, NACA argued that split-duty credit should be provided for a break in nonscheduled operations that was not foreseen. Additionally, according to NACA, a scheduled split duty break should not be strictly enforced because it may be intended in a nonscheduled FDP at the time the flightcrew member shows up for the FDP but not used for real-time operational reasons.

NACA further said that the fatigue-mitigating rest must be provided in the FDP in which the split-duty credit is actually used. According to NACA, the split-duty rest can only be used if the split duty rest opportunity is actually provided. NACA recommended that the definition be revised as follows, to include the phrase "an actual" to address its concerns: "split duty means a flight duty period that has an actual scheduled break in duty that is less than a required rest period." Atlas added that, for clarity and to strengthen split duty as a fatigue mitigation vehicle, the phrase "a scheduled break" in the split duty definition should be changed to "an actual break."

RAA said that the definition should be revised as follows: "split duty means a flight duty period that has a scheduled break in duty in a suitable accommodation that is less than a required rest period."

The FAA agrees with the above commenters that split duty should be based on actual and not just scheduled rest. In light of the commenters' concerns, the split duty section has been amended to clarify that actual split-duty rest may not be less than the amount of split-duty rest that was scheduled. With regard to NACA's concerns about the term "scheduled," as discussed in the split-duty section of this preamble, air carriers are required to schedule split-duty before the beginning of a split-duty FDP so that flightcrew members can accurately self-assess their ability to safely complete the FDP before the FDP begins.

29. Suitable Accommodation

The NPRM defines "suitable accommodation" to mean a temperature-controlled facility with sound mitigation that provides a flightcrew member with the ability to sleep in a bed and to control light.

APA, ALPA, CAPA, SWAPA, FedEx ALPA, and Flight Time ARC said that operational experience has demonstrated that a single-occupancy room is required. Otherwise, disruptions such as the other person's reading, watching television, snoring, etc., will disrupt the roommate's rest. To address these concerns, the commenters recommend revising the definition as follows so that it only applies to single occupancy: "Suitable accommodation means single occupancy facility with sound mitigation that provides a flightcrew member with the ability to sleep in a bed and to control light." APA recommended the following revised definition: "suitable accommodation means a single-occupancy hotel room or equivalent with a bed, sound mitigation and light and temperature controls that is reasonably free from disturbances."

In response to the above commenters, the FAA notes that it is unaware of any scientific data showing that single-occupancy rooms are essential for split-duty rest. Until there is more data showing the safety benefits of single-occupancy rooms, the FAA will not impose the cost of obtaining these types of rooms on air carriers. In addition, upon reevaluation of the definition of suitable accommodation, the FAA has determined that a chair that allows for a flat or near flat sleeping position would also provide significant recuperative split-duty rest. Therefore, the definition of suitable accommodation has been amended accordingly.

In addition, as discussed further in the definition of “rest facilities,” a suitable accommodation only applies to ground facilities and does not apply to rest facilities onboard aircraft because the use of onboard rest facilities as a suitable accommodation raises concerns regarding flightcrew member safety. The use of onboard rest facilities requires that the aircraft’s environmental systems be turned on and that someone monitor the continuing operation of these systems. However, if an onboard rest facility is used as a suitable accommodation while the aircraft is on the ground, there would be no one awake to monitor the continuing safe operation of these environmental systems. Consequently, the use of onboard rest facilities for ground-based sleep poses a safety risk, which is also discussed in the aircraft flight manual, and as such, this rule does not consider onboard rest facilities to be a suitable accommodation.

30. Theater

The NPRM states that “theater” means a geographical area where local time at the flightcrew member’s flight duty period departure point and arrival point differ by no more than 4 hours.

Flight Time ARC, ALPA, CAPA, IPA, and FedEx ALPA said that the definition should provide for instances where countries such as China have just one time zone. These commenters recommended amending the definition as follows to address such instances: “Theater means a geographical area where local time at the flightcrew member’s flight duty period departure point and arrival point differ by no more than 4 time zones or 60 degrees of longitude.” APA and SWAPA commented similarly, except they recommended referencing three time zones instead of four so that the definition reads: "Theater means a geographical area where local time at the flightcrew member's flight duty period departure point and arrival point differ by no more than three time zones or sixty (60) degrees of longitude whichever is most restrictive."

In support of its recommendation, APA and SWAPA said that they believe the intent of the NPRM is to define a theater as an area four time zones in width. Thus, this would be a difference of three time zones from the flightcrew member's point of origin. APA further commented that it recommended three time zones because while the United States is four time zones wide, the difference between the east and west coast is three hours or three time zones. APA believed that specifying more than this amount would be contrary to most scientific recommendations about theater and acclimation. APA also believed that its revised definition addresses the irregularities of daylight savings time.

Theater is now defined as "a geographical area where the flightcrew member's flight duty period departure point and arrival point differ by more than 60 degrees longitude." The FAA has chosen to eliminate the reference to time zones in this definition because, as the commenters correctly pointed out, time zones do not provide a uniform method of measurement, as they tend to vary in different geographic regions.

31. Unacclimated

The FAA did not propose a definition for this term; however, several commenters recommended that such a definition be included in the final rule.

Flight Time ARC, ALPA, CAPA, SWAPA, IPA, APA and FedEx ALPA said that the FAA should define this term because it is used throughout the NPRM. Each of these commenters (except APA and SWAPA) defined the term as follows: "A pilot becomes unacclimated if he has traveled to a location more than 4 time zones or more than 60 degrees of longitude from the location at which he was last acclimated." APA suggested the same definition except it referenced three time zones instead of four. SWAPA defined the term as follows: "A pilot becomes unacclimated if he has a legal rest period less than 36 consecutive hours within a 72 hour period at a location more than 60 degrees of longitude from the location at which he last acclimated and has not spent 72 consecutive hours in that theater."

The commenters believed that defining acclimated in terms of time zones is subject to the whim of government policy. For example, China has one time zone but spans five normal time zones in width. Also, 60 degrees of longitude is equivalent to four normal time zones and should be included as a supplement to the time zone metric. APA added that a location more than three time zones away is in fact in the fourth time zone or further.

In response to the above comments, the FAA notes that this rule defines "acclimated," and under that definition, it lists the conditions that are necessary for a flightcrew member to be considered acclimated. If a flightcrew member does not meet those conditions, it logically follows that the flightcrew member is unacclimated. Accordingly, it is unnecessary to provide a separate definition for "unacclimated."

32. Unforeseen operational circumstance

The NPRM defines "unforeseen operational circumstance" as an unplanned event beyond the control of a certificate holder of insufficient duration to allow for adjustments to schedules, including unforeseen weather, equipment malfunction, or air traffic delay.

Alaska Airlines commented that it disagrees with the following explanation from the FAA's Response to Clarifying Questions document:

> To the extent the NPRM uses the term "unforeseen circumstances," the agency intended the term to have the same meaning as "unforeseen operational circumstances." This term does not differ significantly from the current application of "beyond the control of the certificate holder" in § 121.471(g) except that in the NPRM the FAA is clear that even if a situation is beyond the certificate holder's control, it may not extend beyond the general limits if the circumstances were reasonably foreseeable.

The commenter said that it disagrees with the FAA's clarification because there is a major difference between the proposed definition and the current authorization in section 121.471(g). Alaska Airlines stated that the proposed definition was extremely vague because it did not definitively state whether situations such as bad weather would always constitute unforeseen circumstances.

UPS expressed concern that the definition is not used consistently. It notes that in proposed §§ 117.15 and 117.19, the term "unforeseen circumstance" is used, but the related wording does not match what is used in the defined term. To address its concern, UPS suggested maintaining the current definition of "beyond the control of the certificate holder."

The FAA agrees with the above commenters that the proposed definition of "unforeseen operational circumstances" is unclear. To make the definition more definitive, "beyond the control of the certificate holder" was removed from the definition.

As such, under the provisions of the final rule, an event constitutes an unforeseen operational circumstance as long as it was unplanned and long enough in duration that the issues associated with that event could not be resolved through minor schedule adjustments. The "beyond the control of the certificate holder" safeguard was moved into the reporting requirement for various FDP extensions where it is easier to understand, and it is discussed in more detail in the pertinent portions of this preamble.

Atlas, World Airways, NAA, and NACA said that while the FAA's definition works well for scheduled service, it does not work for nonscheduled service. These commenters noted that nonscheduled service includes significant unforeseen circumstances where customers determine departure airports, arrival airports, and departure times. They also included instances where ground service providers typically give low priority to low frequency ad hoc or non-scheduled operations even though service contracts are assured before aircraft arrival. NAA and NACA added that the proposed definition also does not include other operational irregularities like Minimum Equipment List issues.

To address their concerns, Atlas, World Airways, NAA, and NACA recommended the following revised definition: "Unforeseen operational circumstance means an unplanned event beyond the control of a certificate holder of insufficient duration to allow for adjustments to schedules, including, but not limited to, un-forecast weather, equipment malfunction, or air traffic delay, charter customers' failure to present passengers and/or cargo at the scheduled time and place; and ground service providers that fail to provide services at the scheduled time."

In response to the concerns expressed above, the FAA emphasizes that the examples provided in the definition of "unforeseen operational circumstances" are not intended to be exclusive. As discussed in the preceding response, an event constitutes an unforeseen operational circumstance as long as it was unplanned and long enough that the issues associated with that event could not be resolved through minor schedule adjustments. This definition includes unplanned events that are specific to supplemental operations.

Alaska Airlines stated that the impact of all weather is unforeseeable, and the duration is always unknown and beyond the control of the certificate holder. It also stated that while many weather events are foreseeable, all are beyond the carriers' control. The commenter suggested eliminating the phrase "insufficient duration to allow for adjustments to schedules," and revising the definition as follows: "Unforeseen operational circumstance means an event beyond the control of a certificate holder, including unforecast weather, equipment malfunction, or air traffic delay."

In response to Alaska Airlines, the FAA notes that the phrase "insufficient duration to allow for adjustments to schedules" is intended to exclude unplanned events of relatively short duration. For example, the FAA would not consider a five-minute air traffic delay as an unforeseen operational circumstance that justifies the need for a two-hour FDP extension. Because relatively short unplanned events should not be used as a basis for extending an FDP, the FAA has decided to retain "insufficient duration to allow for adjustments to schedules" in the definition of unforeseen operational circumstances.

33. Window of circadian low

The NPRM defined window of circadian low as a period of maximum sleepiness that occurs between 0200 and 0559 during a physiological night. The FAA did not receive any comments with regard to this definition, and as such, this rule adopts the proposed definition.

C. Fitness for Duty

The goal of proposed section 117.5 was to address situations in which a flightcrew member complies with the other provisions of this proposal, but still shows up for an FDP too fatigued to safely perform his or her assigned flight duties. The proposed section 117.5 would have made fatigue mitigation the "joint responsibility of the certificate holder and the flightcrew member." 75 Fed. Reg. at 5587. This section sought to discourage certificate holders from pushing the envelope with fatigue-inducing practices such as "scheduling right up to the maximum duty limits, assigning flightcrew members who have reached their flight time limits additional flight duties under part 91, and exceeding the maximum flight and duty limits by claiming reasonably foreseeable circumstances are beyond their control." Id. The proposed section 117.5 also sought to discourage flightcrew-member practices such as "pick[ing] up extra hours, moonlight[ing], report[ing] to work when sick, commut[ing] irresponsibly, or simply not tak[ing] advantage of the required rest periods." Id.

To discourage the above practices, the proposed section 117.5 contained a number of restrictions. First, this section would have prohibited flightcrew members from accepting an assignment that would consist of an FDP if they were too tired to fly safely. Second, this section would have prohibited flightcrew members from continuing subsequent flight segments if they were too fatigued to fly safely. Third, the proposed section would have required the certificate holder to assess a flightcrew member's state when he or she reported for work, and, if the flightcrew member was showing signs of fatigue, this section prohibited the certificate holder from allowing that flightcrew member to fly. Fourth, this section would have required flightcrew members to report to management about other flightcrew members who they believed were too tired to fly, and in those instances, it required management to perform an evaluation to determine whether the flightcrew member in question was indeed too tired to fly safely. Fifth, this section would have required certificate holders to develop and implement an internal evaluation and audit program to monitor whether flightcrew members were reporting to work fatigued.

The FAA received numerous comments regarding the proposed section 117.5. For the sake of clarity, the FAA will analyze the substantive issues raised by the comments as those issues pertain to each of the proposed provisions of 117.5.

Proposed § 117.5(a)

Each flightcrew member must report for any flight duty period rested and prepared to perform his or her assigned duties.

Two commenters stressed the importance of pilots being fit for duty. IPA, ALPA, Flight Time ARC, and one other commenter supported the proposed provision, and emphasized that this provision does not create a policing environment in which certificate holders track or monitor flightcrew members' off-duty activities. Fifteen pilots requested the removal of the above provision, arguing that this provision unfairly places the burden of showing up fit for duty solely on the flightcrew member. Multiple commenters also emphasized that tracking fitness for duty must be the joint responsibility of the certificate holder and the flightcrew member.

Several commenters included suggestions and requests for clarification. NJASAP sought clarification regarding the repercussions of a flightcrew member reporting for duty without being properly rested. NAA and UPS recommended including the statement that flightcrew members need to be prepared to work "up to the prescribed FDP limits in Tables B or C" when they begin an FDP.

Section 117.5(a) does not place the burden of showing up fit for duty solely on the flightcrew member. Section 117.5(a), in conjunction with the other provisions of this rule, places a joint responsibility on the certificate holder and each flightcrew member. In order for the flightcrew member to report for an FDP properly rested as required by this section, the certificate holder must provide the flightcrew member with a meaningful rest opportunity that will allow the flightcrew member to get the proper amount of sleep. Likewise, the flightcrew member bears the responsibility of actually sleeping during the rest opportunity provided by the certificate holder instead of using that time to do other things. The consequences of a flightcrew member reporting for duty without being properly rested are addressed by subsections (b) and/or (c) of this section, which prohibit the flightcrew member from beginning or continuing an FDP until he or she is properly rested.

Turning to NAA and UPS' suggestion, the FAA has declined to add the proposed language to subsection 117.5(a). The adopted language of subsection 117.5(a) requires each flightcrew member to report for an FDP "rested and prepared to perform his or her assigned duties." These assigned duties will not always extend to the outer limits prescribed in tables B and C of this rule. Indeed, a certificate holder will find it difficult to comply with the cumulative limits specified in section 117.23 if it always assigns duties at the outer limits of tables B and C. Therefore, the text of this subsection reflects the fact that a flightcrew member needs to be rested and prepared to safely perform the duties that are actually assigned to him or her.

Proposed § 117.5(b)

> No certificate holder may assign and no flightcrew member may accept assignment to a flight duty period if the flightcrew member has reported for a flight duty period too fatigued to safely perform his or her assigned duties or if the certificate holder believes that the flightcrew member is too fatigued to safely perform his or her assigned duties.

Peninsula Airways, Pinnacle Airlines, and Southern Air stated that the flightcrew is the best source of determining fatigue, and as such, an air carrier should not be responsible for monitoring fatigue symptoms and assessing fatigue. ATA, CAA, NACA, and a number of other commenters stated that the proposed subsection would be impossible to implement because it places the burden of determining flightcrew member fatigue on air carriers without providing the air carriers with an objective scientific standard for measuring fatigue. ATA and Delta added that when a flightcrew member reports for duty at the beginning of an FDP, it is impossible for an airline to determine whether that flightcrew member will be fatigued toward the end of the FDP.

The NTSB supported enabling flightcrew members to self-report fatigue. NJASAP and Boeing stated that flightcrew members cannot subjectively self-assess whether they are too fatigued to safely carry out their assigned FDPs. NJASAP based its assertion on NASA fatigue research showing that when a person is fatigued, he or she suffers from impaired judgment, and may lack the ability to self-assess his or her level of alertness. Boeing asked the FAA to include non-subjective factors in the fatigue determination requirement, such as time of day and the amount of sleep received in a 24-hour period. Alaska Airlines asked that the phrase "too fatigued" be defined more clearly. Boeing was also concerned about flightcrew members who self-assess at the beginning of an FDP improperly assessing their competency to actually complete the FDP.

CAPA, SWAPA, and APA recommended that the FAA add a non-retaliation provision to the proposed subsection in order to prevent disciplinary action against flightcrew members who self-report fatigue. One commenter stated that fatigue reporting should be voluntary. Two commenters argued that the entire crew should be assessed to determine fitness for duty.

The FAA agrees with the commenters who stated that at this time sleep science cannot support a general regulatory standard under which air carriers would be required to monitor the exact level of flightcrew member fatigue. As these commenters correctly pointed out, there does not currently exist an objective standard for determining fatigue levels. As such, requiring air carriers to suspend flightcrew members who they "believe" are too fatigued would create a vague and difficult-to-apply regulatory standard. To address this concern, the FAA has eliminated the following provision from the proposed subsection: "or if the certificate holder believes that the flightcrew member is too fatigued to safely perform his or her assigned duties." The remaining language in this subsection places a limited burden on the certificate holder – it prohibits the certificate holder from assigning an FDP to a flightcrew member who has informed the certificate holder that he or she is too fatigued to safely perform his or her assigned duties.

The discussion in the preceding paragraph should not be construed to imply that air carriers cannot identify flightcrew member fatigue. As the proposed AC 120-FIT (finalized as AC 117-3) pointed out, there are objective signs that could be used to identify flightcrew member fatigue. The FAA has simply chosen not to impose a mandatory regulatory requirement because the signs used to identify fatigue cannot be synthesized into a general objective standard. However, the FAA encourages air carriers to voluntarily evaluate flightcrew members who are showing signs of fatigue.

NJASAP and Boeing's concerns about the subjective nature of flightcrew member self-assessment and self-reporting are mitigated by the fact that, pursuant to statutorily-mandated Fatigue Risk Management Plans (FRMP), flightcrew members will undergo fatigue education and training. The information that the flightcrew members learn during this training will increase each flightcrew member's ability to self-assess his or her fatigue levels.

In response to the comment that fatigue reporting should be made voluntary, the FAA has decided to make fatigue reporting mandatory because allowing a flightcrew member to accept an assignment to an FDP when that flightcrew member knows that he or she is too tired to fly safely poses an unacceptable safety risk. However, the FAA cannot, at this time, impose an objective requirement on self-reporting fatigue because, as the other commenters pointed out, there is no objective science-based standard that could be used to measure fatigue levels. The FAA also cannot further define the phrase "too fatigued" because defining this phrase requires the creation of an objective fatigue-measurement standard, which does not exist at this time. Instead of creating a single objective fatigue-measurement standard, the above subsection requires each flightcrew member to utilize the information provided during his or her statutorily-mandated fatigue training to self-assess whether he or she feels well-rested enough to safely complete his or her assigned FDP. The FAA also emphasizes that flightcrew members who feel alert at the beginning of an FDP can immediately terminate the FDP, under subsection (c) of section 117.5, if they feel themselves becoming too fatigued to safely continue their assigned duties.

The FAA also considered the possibility of adding a non-retaliation provision to the above text, but ultimately decided against adding such a provision. As the NPRM pointed out, "[c]arriers are entitled to investigate the causes for an employee's fatigue." 75 Fed. Reg. at 55858. "If a carrier determines that the flightcrew member was responsible for becoming fatigued, it has every right to take steps to address that behavior." Id. However, if the flightcrew member's fatigue is a result of the carrier not following the regulatory requirements of this rule, the FAA may initiate enforcement action against the carrier.

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Turning to concerns about fatigue affecting other air carrier employees, as discussed in the NPRM, the FAA "has decided to take incremental steps in addressing fatigue." 75 Fed. Reg. at 55857. In accordance with this decision, the NPRM proposed a flight, duty, and rest rule that was only applicable to flightcrew members. Because the proposed rule was not applicable to other flight crewmembers, such as flight attendants, expanding the rule to those flight crewmembers at this point in time would exceed the scope of this rulemaking. However, the FAA emphasizes that its incremental approach contemplates "future rulemaking initiatives [that] may address fatigue concerns related to flight attendants, maintenance personnel, and dispatchers." Id.

Proposed § 117.5(c)

> No certificate holder may permit a flightcrew member to continue a flight duty period if the flightcrew member has reported himself too fatigued to continue the assigned flight duty period.

The FAA did not receive any comments that were specific to this subsection. To the extent any of the comments discussed in the preceding subsection are applicable to this subsection, the FAA's response to those comments can be found above.

Proposed § 117.5(d)

> Any person who suspects a flightcrew member of being too fatigued to perform his or her duties during flight must immediately report that information to the certificate holder.

ATA, NACA, Delta, Alaska Airlines, and UPS stated that requiring persons to report other people who they believe to be fatigued could result in persons with no training or with ill will making erroneous reports. Multiple commenters emphasized that there is no objective scientific standard to guide personnel about when they need to make a report about another flightcrew member's fatigue. ATA stated that the proposed subsection will shift liability to airlines and impose significant costs in the form of training and retraining tens of thousands of employees.

The FAA agrees with the commenters who stated that, because there is no objective scientific standard to guide personnel about when they need to report other flightcrew members' fatigue, having a mandatory reporting requirement could lead to a multitude of erroneous reports. To address this concern, the FAA has eliminated the above subsection from the final rule. However, even though the FAA has decided not to impose a mandatory reporting requirement, each flightcrew member and covered employee is encouraged to voluntarily inform their employer when they observe a fatigued flightcrew member.

Proposed § 117.5(e)

> Once notified of possible flightcrew member fatigue, the certificate holder must evaluate the flightcrew member for fitness for duty. The evaluation must be conducted by a person trained in accordance with § 117.11 and must be completed before the flightcrew member begins or continues an FDP.

Numerous commenters stated that there is no objective scientific standard under which a certificate holder could evaluate a flightcrew member's fitness for duty. The commenters also emphasized that the proposed subsection would create difficulties at remote airports where the certificate holder lacks personnel qualified to conduct a fitness-for-duty evaluation.

The FAA agrees with the commenters that there is no objective scientific standard that an air carrier could use to evaluate a flightcrew member's continued fitness for duty. Accordingly, the FAA has eliminated the above subsection from the final rule.

Proposed § 117.5(f)

As part of the dispatch or flight release, as applicable, each flightcrew member must affirmatively state he or she is fit for duty prior to commencing flight.

RAA stated that there was no benefit to requiring each flightcrew member to sign a document stating that he or she is fit for duty. Instead, RAA suggested that the PIC sign the fitness for duty affirmation on behalf of the entire crew. NJASAP asked (1) how the flightcrew members would affirm fitness for duty via the flight release, and (2) whether this requirement would apply to each flight segment.

As the FAA and other commenters pointed out elsewhere, there is no objective scientific test that the PIC could use to measure the fatigue levels of other flightcrew members. Because the PIC has no way to objectively measure other flightcrew members' fatigue, the FAA has determined that each flightcrew member should be required to monitor his or her own fatigue level. As such, each flightcrew member must either make a written affirmation that he/she is fit for duty or terminate the assigned FDP pursuant to subsection 117.5(c).

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The requirement that flightcrew members make a written affirmation about their continued fitness for duty applies to each flight segment of the assigned FDP. This is because a flightcrew member who is alert at the beginning of an FDP may become dangerously fatigued once the FDP is underway. Requiring a written fitness for duty affirmation before each flight segment will help ensure that flightcrew members continuously monitor their fatigue levels during the course of an FDP. If, during the course of this monitoring, flightcrew members determine that they cannot safely continue their assigned duties, section 117.5(c) would require them to terminate their assigned FDP prior to the beginning of the next flight segment.

The affirmation on the dispatch or flight release simply needs to state that the undersigned flightcrew members affirm that they are fit for duty. The dispatch or flight release containing the affirmation must be signed by each flightcrew member. This requirement applies to each flight segment and each air carrier should inform its flightcrew members about the significance of signing a fitness-for-duty affirmation.

Proposed § 117.5(g)

Each certificate holder must develop and implement an internal evaluation and audit program approved by the Administrator that will monitor whether flightcrew members are reporting for FDPs fit for duty and correct any deficiencies.

Alaska Airlines stated that the audit requirement is duplicative of the current FRMP process. Delta added that the audit requirement is unclear about how a carrier is supposed to monitor which flightcrew members are showing up fit for duty. ATA asserted that the evaluation and audit requirement is unworkable and impossible to implement because there are no objective scientific standards that a certificate holder could apply to "monitor" which flightcrew members are reporting for an FDP fit for duty.

ATA added that the proposed subsection is unclear about what constitutes a "deficiency" and how a certificate holder is supposed to correct a "deficiency."

The FAA agrees with Delta and ATA that the proposed subsection does not provide a workable standard for the internal evaluation and audit program. Therefore, the FAA has removed the above subsection from the final rule.

D. Fatigue Education and Training

As part of the NPRM, the FAA proposed a fatigue education and training program. Studies have shown that fatigue degrades all aspects of human performance and impedes the exercise of sound judgment.[23] Studies have also shown that, depending on the operating environment, it can be difficult for an individual to recognize that he or she is fatigued and that his or her judgment may be compromised.[24] Given the impact that fatigue has on the performance of flight-related duties, the FAA was concerned that the existing regulatory structure did not properly educate air carrier personnel about fatigue and its impact flight safety.[25]

In order to raise awareness of fatigue-related issues and provide training on fatigue mitigation strategies, the FAA proposed that certain air carrier personnel be

[23] See, e.g., NASA, Crew Factors in Flight Operations X: Alertness Management in Flight Operations, at 16 (Apr. 1999), http://human-factors.arc.nasa.gov/zteam/PDF_pubs/ETM.TM8_99rev.pdf ("Sleepiness can degrade essentially every aspect of human performance").

[24] The NASA fatigue report stated that:

> The level of underlying physiological sleepiness can be concealed by an environment in which an individual is physically active, has consumed caffeine, or is engaged in a lively conversation. Whereas these factors may affect the self-reported rating of sleepiness (usually individuals will report greater alertness than is warranted), they do not affect the underlying sleep need expressed by the level of physiological sleepiness.

Id. at 17.

[25] The National Institute for Occupational Safety and Health (NIOSH) provides one example of the unacceptable effects that the current lack of fatigue education has on flight safety. In its comment, NIOSH

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required to undergo a fatigue education and training program. First, the proposed fatigue education and training provisions would have required fatigue education and training for each person involved with scheduling aircraft and crews, as well as all flightcrew members and individuals who conduct management oversight over covered personnel. Second, the proposed section would have required an initial 5-hour-long training session for all newly-hired covered employees and a 2-hour-long annual recurrent training session for all other covered employees. Third, this section set out a training curriculum that would have informed covered personnel about fatigue and fatigue countermeasures. Fourth, the proposed fatigue education and training section would have required certificate holders to make changes to their fatigue education and training programs after being notified of the need to do so by the Administrator.

Alaska Airlines suggested that the FAA eliminate the proposed fatigue education and training section and instead rely on the FRMP to provide the necessary fatigue-related information to airline personnel. The FAA agrees with Alaska Airlines that the fatigue education and training program proposed in the NPRM was unnecessarily cumulative.

Part 121 air carriers are currently statutorily-required to annually provide, as part of their FRMP, fatigue-related education and training to increase the trainees' awareness of: (1) fatigue; (2) "the effects of fatigue on pilots;" and (3) "fatigue countermeasures." See Pub. L. 111-216 sec. 212(b)(2)(B). Today's rule adopts the same standard of training as required by the statute. In addition, today's rule adopts a mandatory update of the

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points out that "[i]n a survey of pilots working for large operators in Alaska, 22% responded that they made carriers' education and training program every two years, as part of the update to their FRMP. See Pub. L. 111-216 sec. 212(b)(4)(A) and (B). Both of these regulatory provisions merely place the existing statutory requirements in the new flight and duty regulations for the ease and convenience of the regulated parties and the FAA.

The statute does not limit the required training to flightcrew members; however, the FRMPs developed by carriers and accepted by the FAA have generally been so limited. Today's rule would require an expansion of the training portion of the FRMPs to all employees responsible for administering the provisions of the new rule, including flightcrew members, dispatchers, individuals directly involved in the scheduling of flightcrew members, individuals directly involved in operational control, and any employee providing direct management oversight of those areas.[26] As discussed below, the FAA continues to believe that personnel responsible for crew scheduling and who play a role in assuring the carrier has operational control need to understand the causes of fatigue as well as the risk that pilot fatigue poses to safe operations.

In response to comments from ATA, Atlas Air and NAA, among others, the FAA has amended the regulatory text to clarify that the fatigue education and training requirement only applies to individuals who are directly involved in flightcrew scheduling and/or operational control and their direct supervisors. The reason for designating such a broad category of covered personnel is to ensure that each individual who has the power to alter a flightcrew member's schedule and/or change the manner in

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a decision to fly fatigued either weekly or monthly." NIOSH Comments to DOT at 2.

[26] Because the statute requires FRMPs to be updated every two years, the FAA anticipates that carriers will simply expand the group of employees subject to training in their next update, scheduled for the summer of 2013.

which operational control is exercised is fully aware of how his or her actions will affect flightcrew fatigue and flight safety. Direct management personnel were ultimately included in this category because a manager could order his or her immediate subordinate(s) to change flightcrew member schedules and/or change the manner in which operational control is exercised.

The FAA has decided not to limit the scope of covered personnel to specific enumerated positions because air carriers may employ individuals who exercise significant control over flightcrew scheduling and/or operational control while not occupying one of the positions commonly associated with this type of authority. To ensure that these individuals receive the appropriate fatigue-related education and training, the FAA has retained the requirement that all individuals directly involved in flightcrew scheduling and/or operational control, as well as their direct supervisors, receive the training required under this section.

In response to a question by ATA and Alaska Airlines about whether an air carrier's CEO would be required to undergo fatigue education and training, that CEO would have to undergo fatigue education and training only if he or she is either (1) directly involved in scheduling flightcrew members/exercising operational control, or (2) directly manages someone who is directly involved in scheduling flightcrew members/exercising operational control. Business decisions made by the CEO that only indirectly affect flightcrew scheduling/operational control would not trigger the fatigue education and training requirements of this section.

Alaska Airlines and Delta asserted that they already have fatigue education and training programs. Alaska Airlines asked whether the proposed education and training requirements are cumulative with regard to the existing Advanced Qualification Program (AQP).[27] UPS suggested that the FAA rely on the AQP and FRMS to provide fatigue-related information to airline personnel.

Delta requested that it be permitted to include material from its existing training program in the program now required by this section and that it be given credit for the training that its employees have already received. ATA and Alaska Airlines asked whether, in the case of an employee that changes employers, training received from a prior employer would count towards the requirements of this section. These commenters asserted that because the proposed training subject areas are generic and untethered to a specific airline's operations, fatigue training from a prior employer should count toward fulfilling the requirements of this section.

The FAA has determined that the problem with simply relying on AQP and FRMS to carry out the goals of the proposed fatigue education and training section is that both AQP and FRMS are programs that have been designed as alternatives to general requirements imposed on part 121 certificate holders. An air carrier can opt into an AQP program as an alternative to general training requirements that it would otherwise be subject to. See 14 CFR 121.901(a). Likewise, under section 117.7(a) of this rule, an air

[27] AQP is a systematic methodology for developing the content of training programs for air carrier flightcrew members and dispatchers. It replaces programmed hours with proficiency-based training and evaluation derived from a detailed job task analysis that includes crew resource management. The AQP provides an alternate method of qualifying and certifying, if required, pilots, flight engineers, flight attendants, aircraft dispatchers, instructors, evaluators, and other operations personnel subject to the training and evaluation requirements of 14 CFR parts 121 and 135.

carrier can opt into an FRMS program as an alternative to some of the restrictions imposed by this rule. If the FAA was to rely on AQP and FRMS to take the place of the proposed fatigue education and training section, it would have to change AQP and FRMS to make them mandatory non-alternative programs in order to ensure that air carriers who currently choose not to participate in these programs have properly-trained personnel. This would destroy the alternative nature that is at the core of these programs, and as such, the FAA has decided against this approach.

It should be emphasized, however, that air carriers that had fatigue education and training programs prior to development of their FRMP did not necessarily need to design a new separate program to accommodate the statutory requirement for training and may not need to do so in order to provide education and training to all personnel covered by today's rule. Instead, these carriers may have simply supplemented their existing programs to meet the additional requirements imposed by the statute. For example, an existing fatigue education and training program that was offered as part of an air carrier's AQP could have been amended so that it also met the requirements for an FRMP. That program would then satisfy the statute and the requirement adopted today, as well as the air carrier's AQP-related fatigue education and training obligations.

The FAA agrees with ATA and Alaska Airlines that, when changing employers, covered personnel do not need to repeat non-operation-specific fatigue training that they received from their previous employer if that training meets the requirements of this section.

RAA objected to the proposed method of Administrator-required revisions to the fatigue education and training program. RAA argued that the proposed language "would open the door for changes directed at an airline's fatigue training program from any number of individuals in [FAA] field offices, without standardization and coordination among those directives and at the risk of creating confusion in the important fatigue risk mitigation programs, messages and strategies that are sought though this regulation." RAA suggested that the FAA update fatigue education and training programs by either: (1) initiating a new rulemaking each time that the programs need to be updated, or (2) using its OpSpec authority under 14 CFR 119.51 to require changes to the fatigue education and training programs.

Since the regulatory requirements adopted today will be administered through the carrier's FRMP, the FAA has adopted the same language as the statute, to wit, the education and training programs must be updated every two years and the FAA will either approve or reject the updates within 12 months of submission. If an update is rejected, the FAA will provide suggested modifications for resubmission of the update.

RAA asked that this section be renamed "Fatigue Training Program" because the word "education" does not have a well-understood regulatory meaning. NJASAP asked whether distance learning would be permitted to satisfy the fatigue education and training requirements or whether the training must be conducted in person. With regard to NJASAP's question about distance learning, this section does not prohibit distance learning.

The FAA has also decided to retain the word “education” in the name of this program. The Merriam-Webster Dictionary defines “educate” as: (1) to train by formal instruction and supervised practice, or (2) to provide with information. Because covered personnel will receive formal instruction and be provided with information, the term “education” aptly describes the program that is required by this section. To further clarify the goals of this program, the FAA has amended the program’s name to the “Fatigue Education and Awareness Training Program.”

E. Fatigue Risk Management System

The FAA proposed a Fatigue Risk Management System (FRMS) as an alternative regulatory approach to provide a means of monitoring and mitigating fatigue. Under an FRMS, a certificate holder develops processes that manage and mitigate fatigue and meet an equivalent level of safety.

Under proposed § 117.7, an FAA-approved FRMS would include: (1) a fatigue risk management policy; (2) an education and awareness training program; (3) a fatigue reporting system; (4) a system for monitoring flightcrew fatigue; (5) an incident reporting process; and (6) a performance evaluation. In addition, if the Administrator determines that revisions were necessary to a carrier’s FRMS, the certificate holder must make the requested changes upon notification.

Most commenters generally supported the concept of an FRMS as a way to manage fatigue and incorporate risk mitigation. Commenters questioned the scope and implementation of FRMS, and whether FRMS is a mature process that can be used

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effectively. There were few commenters, including Southern Air, who flatly disagreed that the FRMS would be effective.

Commenters were split between two approaches: those who endorsed the concept of FRMS as an alternative approach to the regulatory provisions adopted in this rule; and those who argued that FRMS should not permit certificate holders to deviate from the prescriptive measures, but rather supplement the regulatory requirements.

ATA contended that the FAA should wait for ICAO and international standards because the ambiguities presented in the proposal, as well as possible certificate holder reliance on future FAA determinations, could competitively disadvantage U.S. carriers. Furthermore, ATA commented that the timing and approval of an FRMS is critical as operators that want to use an FRMS should be able to do so immediately once these rules are in place. UPS argued that the FRMS approval process must be available for least 12 months prior to the implementation of any final rule so that carriers can transition to an FRMS on the day that the requirements are effective. Lynden Air Cargo (Lynden) believed that the FRMP and FRMS processes are redundant and sought further explanation on the necessity of the two processes.

ALPA, IPA, FedEx ALPA, APA, SWAPA and the Flight Time ARC specifically stated that the FRMS needs to be an equal partnership that includes the FAA, the certificate holder, and the pilot body. APA further commented that successful safety programs such as Aviation Safety Action Program (ASAP)[28] and the Flight Operational

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[28] The objective of the ASAP is to encourage air carriers and repair station employees to voluntarily report safety information that may be critical to identifying potential precursors to accidents. Under an ASAP, safety issues are resolved though corrective action rather than through punishment or discipline. The ASAP provides for the collection, analysis, and retention of the safety data that is obtained. An ASAP

Quality Assurance (FOQA)[29] are based on a three-way partnership and that FRMS should be treated the same way. ATA, however, argued for a collaborative approach, similar to that of an AQP as a relationship between the carrier and FAA with no other parties involved. The Flight Time ARC argued that pilot representatives must have the right to suspend or terminate participation in the FRMS if they determine that the program's safety purpose is not being met. Multiple entities commented that the FRMS should provide for an open reporting system and non-punitive environment.

A number of commenters questioned the process by which an FRMS is to be amended and which FAA office would provide this oversight. ATA commented that the process of the FRMS should be centrally located at the headquarters level, to provide a uniform approval scheme. RAA, however, interpreted the proposed language as enabling FAA field offices to require certificate holders to makes changes to their FRMS, which creates standardization and coordination problems and possibly confusion. NACA commented that industry must have a clear understanding of the parameters and implementation of FRMS so that competitive advantages cannot be gamed through differing interpretations and implementation of FRMS.

Some commenters, including RAA, believed that the approval of FRMS programs can best be accomplished via the same Operations Specifications authority that was established for each airline's recently filed FRMP under § 119.51. Additionally, RAA

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is based on a safety partnership that will include the FAA and the certificate holder, and may include a third party, such as the employee's labor organization.

[29] FOQA is a voluntary safety program that is designed to make commercial aviation safer by allowing commercial airlines and pilots to share de-identified aggregate information with the FAA so that the FAA can monitor national trends in aircraft operations and target its resources to address operational

stated that generally the process for incorporating new science or advances regarding a program such as FRMS is through Advisory Circular process, where it can be presented as a new best practice. RAA further stated that if the FAA finds that future FRMS changes cannot be accommodated through the Advisory Circular process, then the agency should undertake appropriate rulemaking action and not simply skip the rulemaking process. ATA commented that the proposed regulatory text and draft AC120-103 do not provide the criteria used to approve a submitted FRMS.

APA and ALPA argued that FRMS should be limited to specific certificate holders' data and scheduled city pairs or substantially similar city pairs in terms of FDP length, start time and block, which must be scientifically and operationally validated by all stakeholders. ATA commented that in the NPRM, the FAA appears to suggest that FRMS will disfavor a system-wide approach.

Some commenters sought stronger regulatory text describing the FRMS as active, data-driven and scientifically based.

In response to the above comments, the FAA notes that, as stated in the NPRM, the option of an FRMS provides flexibility for certificate holders to conduct operations using a process that has been approved by the FAA based upon an equivalent level of safety for monitoring and mitigating fatigue for certain identified operations. A certificate holder may decide to use FRMS as a supplement to the requirements adopted in the rule, or it may use the FRMS to meet certain elements of this rule for which the adopted regulatory standard is not optimal.

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risk issues. The fundamental objective of this new FAA/pilot/carrier partnership is to allow all three

The FAA has decided to adopt subsections (a) and (b) of the regulatory text as proposed. Subsection (a) provides for a certificate holder to use an approved FRMS as an alternative means of compliance with the flight duty regulations provided that the FRMS provides at least an equivalent level of protection against fatigue-related accidents or incidents. Subsection (b) specifies the components of an FMRS.

The FAA has also decided to extend the voluntary FRMS program to all-cargo operations, which are not required to operate under part 117. Under the FRMS provisions that this rule adds to subparts Q, R, and S of part 121, an all-cargo operator that does not wish to operate under part 117 can nevertheless utilize an FRMS as long as it has the pertinent FAA approval.

The implementing guidance in AC 120-103 details each component, the minimum necessary tools for a complete and effective FRMS, the steps in the FRMS process and the roles and responsibilities of all the participants. An FRMS is a data-driven and scientifically based process that allows for continuous monitoring and management of safety risks associated with fatigue-related error. See AC 120-103 at p.3. Furthermore, an FRMS is an effective mitigation strategy when the organization bases it on valid scientific principles. Id.

ICAO requires member states to implement some alternative means of compliance with existing rules and has recently issued Standards and Recommended Practices (SARPs) (effective December 15, 2011) that authorize the use of FRMS. In addition, ICAO, IATA and the International Federation of Air Line Pilots' Association

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parties to identify and reduce or eliminate safety risks, as well as minimize deviations from the regulations.

(IFALPA) jointly issued the *Implementation Guide for Operators, 1st Edition*, in July, 2011 to provide carriers with information on implementing an FRMS that is consistent with the ICAO SARPs. The FAA concludes that incorporating an FRMS element is critical to implementing a comprehensive regulatory schedule addressing fatigue. Therefore, this rule incorporates the ability of a certificate holder to use an FRMS. The provisions adopted in this rule are consistent with the ICAO standards and AC 120-103 provides a means by which the operator may comply with these provisions.

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The FAA agrees that certificate holders should be able to use an approved FRMS on the effective date of these regulations. The FAA understands that this rule may impact collective bargaining agreements and that time is needed for those changes to be adopted and for certificate holders to submit and receive approval for an FRMS. Therefore, the effective date of this rule is two years after publication date. This should allow adequate time for certificate holders to take the necessary steps prior to the effective date.

The FAA indicated in the NPRM that it anticipates that all the FRMS proposals would be evaluated and approved at headquarters by individuals within Air Transportation Division, Flight Standards Service (AFS-200), who are dedicated to ensuring the continued quality of FRMS. The FAA has determined that the above course of action remains the best process to ensure consistency in the approval process.

The process of evaluating FRMS proposals will generally proceed as follows. The certificate holder will request a meeting with AFS-200 to express its interest in pursuing an FRMS authorization. During this meeting, the certificate holder will outline its plans for an FRMS. AFS-200 will then review the certificate holder's plans for an

FRMS. Based upon the requirements for data collection identified by the certificate holder, the certificate holder, working in concert with AFS-200, will identify the applicable limitations from which the certificate holder may need a limited exemption for the sole purpose of data collection.

Once the certificate holder has petitioned for this exemption, AFS-200 will review the petition providing an analysis and developing applicable limitations and conditions for the exemption based upon the certificate holder's data collection plan. If AFS-200 grants the requested exemption, the resulting exemption will be limited in duration and scope for the purpose of the necessary data collection. Once the data has been collected, the data will be submitted to AFS-200 for data validation and evaluation of FRMS policies and procedures and FRMS training requirements. The FAA will publish guidance for review and approval of an FRMS authorization.

A successful FRMS will require a shared responsibility among management and the flightcrew members. In particular, developing mitigation strategies and schedule adjustments is going to be the result of a collaborative management process that includes all the stakeholders. In FAA Advisory Circular No. 120-103 Fatigue Risk Management Systems for Aviation Safety, the FAA identified four basic tools for a complete, workable, effective, and accountable FRMS: (1) fatigue-related data; (2) fatigue analysis methods; (3) identification and management of fatigue drivers; and (4) application of fatigue mitigation procedures. As flightcrew member input is critical to implementing these tools, the FAA finds that the FRMS philosophy is consistent with the approach of the identified voluntary programs, such as ASAP and FOQA and requires participation by more than just the FAA and the certificate holder.

The FAA does not agree with the Flight Time ARC on imposing a requirement that the FRMS must be terminated or suspended if pilot representatives disagree with the program's purpose. This issue is beyond the scope of the NPRM and pilot representatives independently may raise their issues with the certificate holder.

In managing fatigue risk, the FAA has identified two types of operational evidence that are available to operators. (See AC No. 120-103, para (6)(1) and (2).) The first is monitoring flightcrew member duty schedules, which provides indirect evidence of potential fatigue resulting from inadequate or poorly timed opportunities to sleep. The second type of operational evidence is a non-punitive reporting system. Flightcrew members and other employees will be more encouraged to report subjective fatigue and to request relief from duties as necessary because of chronic fatigue. This reported information can be critical, in conjunction with other information about the conditions that contributed to fatigue, such as the work schedule for the week prior to the report.

The FAA agrees with the commenters and has deleted the proposed paragraph in § 117.7 that would have required a certificate holder to make necessary changes to its FRMS upon notification by the Administrator. Once approved by the FAA, an FRMS will be incorporated into the certificate holder's operations specifications and as contemplated in the NPRM, the FAA will use the process outlined in § 119.51 to amend operations specifications, if changes are necessary to a certificate holder's FRMS.

The FAA agrees with RAA that the use of advisory circulars is appropriate to incorporate new science or advances regarding fatigue as it relates to aviation operations. The regulations adopted in this rulemaking provide the baseline requirements for mitigating fatigue and instituting rest requirements. In the future, if the FAA concludes that the baseline regulations for flight and duty need to be revised, a rulemaking will be initiated. An approved FRMS can take advantage of the gains in science and experience, and if approved by the FAA, can permit certificate holders to exceed the baseline requirements.

The regulatory text provides the mechanism for a certificate holder to use an FRMS and the elements that must be addressed in the FRMS. The implementing guidance addresses how the certificate holder may proceed with documentation and scientific analyses to support its request to deviate from the standards adopted in this rule. The analyses and supporting documentation needed for approval are driven by how the certificate holder intends to use the FRMS and the elements of the flight and duty regulations that the FRMS is intended to supplement.

The FAA clarifies that a certificate holder may use an FRMS for any of the elements of the flight and duty requirements provided under this rule. While the FAA did state in its response to clarifying questions that "validating an FRMS will be costly and likely to be used only on a 'route specific' basis," the agency was not attempting to discourage the use of an FRMS. The FAA encourages the use of an FRMS for certificate holders that can optimize their operations by doing so.

The FAA has updated its guidance in AC No. 120-103, Fatigue Risk Management Systems for Aviation Safety,[30] as a result of this rule. This AC is available at www.faa.gov. The FAA fully expects that as the program matures, certain carriers may apply the system to more than specific operations.

In accordance with Public Law 111-216, each part 121 air carrier had to submit to the FAA an FRMP. An FRMP is statutorily required for each part 121 air carrier; whereas, an FRMS is an optional approach to fatigue mitigation. The FRMP outlines the certificate holder's policies and procedures for managing and mitigating day-to-day fatigue from within a regulatory structure. This plan addresses the carrier's flightcrew members. The FRMP consists of three elements with respect to managing pilot fatigue: (1) current flight time and duty period limitations; (2) a rest scheme that enables the management of fatigue and includes annual training to increase awareness of fatigue and fatigue countermeasures; and (3) the development and use of a methodology that continually assesses the effectiveness of the program.

While this plan is required under the statute, the simple adherence to this plan would not permit for any allowances by the certificate holder outside the adopted flight and duty regulations. An FRMS requires a process to apply to other individuals responsible for flightcrew fatigue other than pilots. As stated previously, there is a variety of positions held by individuals who are responsible for addressing fatigue other than pilots. The FRMS requires the process to include all applicable individuals. Furthermore, the FRMS is a means to permit a carrier to meet the requirements of this

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[30] AC No. 120-103 was issued on August 3, 2010.

rule through an alternative measure. The FRMP does not contain adequate elements to allow the FAA to authorize operations or specific operations to be conducted outside the regulatory baseline requirements. Therefore, it is necessary to retain both the FRMS section and the FRMP requirement. These two processes, while sharing similar information, pose two distinct purposes.

F. Flight Duty Period—Unaugmented

One of the regulatory concepts that this rule introduces is the restriction on flightcrew members' maximum FDP. In creating a maximum FDP limit, the FAA attempted to address three concerns: (1) flightcrew members' circadian rhythms, (2) the amount of time spent at work, and (3) the number of flight segments that a flightcrew member is scheduled to fly during his or her FDP.

First, flightcrew members' circadian rhythms needed to be addressed because studies have shown that flightcrew members who fly during their window of circadian low experience severe performance degradation.[31] Second, the amount of time spent at work needed to be taken into consideration because longer shifts increase fatigue.[32] Third, the number of flight segments in a duty period needed to be taken into account because flying more segments requires more takeoffs and landings, which are both the most task-intensive and the most safety-critical stages of flight. These takeoffs and landings require more time on task, and as pilots generally appear to agree, "flying several legs during a single duty period could be more fatiguing." 75 Fed. Reg. at 5858.

[31] See, e.g., NASA, supra note 22, at 19-34.
[32] Folkard, supra note 15, at 98 (analyzing three studies that reported a trend in risk over successive hours on duty).

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To address the concerns listed above, the FAA proposed a table limiting maximum FDP based on the time of day and the number of segments flown during the FDP period. This table was based on the conservative proposal articulated by the Flight Time ARC members representing labor, which in turn was based on the approach used by foreign flight, duty, and rest regulations such as United Kingdom Civil Aviation Authority Publication 371 (CAP-371) and European Aviation Safety Agency (EASA) Notice of Proposed Amendment No. 2009-02A. Under the FAA's proposal an FDP would begin when a flightcrew member is required to report for duty that includes a flight and would end when the aircraft is parked after the last flight and there is no plan for further aircraft movement by the same flightcrew member. Under the proposal, the maximum FDP limit would be reduced: (1) during nighttime hours to account for being awake during the WOCL; (2) when an FDP period consists of multiple flight segments in order to account for the additional time on task; and (3) if a flightcrew member is unacclimated to account for the fact that the unacclimated flightcrew member's circadian rhythm is not in sync with the theater in which he or she is operating.

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In filed comments, Drs. Belenky and Graeber stated that "there is no scientific basis" for the different FDP limits assigned during different departure times. NACA and Atlas Air also stated that the different FDP limits are too complex and not based on science. Conversely, the National Institute of Occupational Safety and Health (NIOSH), Delta, APA, NJASAP, and three individual commenters endorsed the FAA's approach of varying FDP limits based on the time of day. In support, NIOSH pointed out that studies have shown that long night shifts significantly increase the risk of an accident, as compared to day shifts. Delta stated that its pilot working agreement has used a time-of-day-based approach "to mitigate fatigue for many years."

ATA, UPS, and Southwest Airlines also asserted that the reduction of the daily FDP limit to account for additional segments flown during the FDP is not supported by science or any other evidence. ATA argued that anecdotal evidence was not sufficient to support reducing the FDP limit in response to multiple flight segments assigned during the FDP. The SkyWest Airlines Pilot Association also stated that reducing FDP based on the number of flight segments disproportionately affected regional air carriers. Southwest stated that an FDP reduction based on the number of flight segments would also significantly raise the operational costs of its point-to-point business model.

Conversely, RAA stated that "[i]t is also intuitive that there is likely correlation between the number of flight segments flown during an FDP and the level of fatigue that a flightcrew member will experience, although the exact science for that relationship remains under research." FedEx ALPA agreed, stating that "[w]e also know that additional flight segments significantly increase fatigue and workload." APA's comment pointed to a number of scientific studies indicating that flying multiple segments is more fatiguing than flying a single segment. APA argued that Table B should reduce FDPs after the first segment instead of after the first 2-4 segments. The Families of Continental Connection Flight 3407,[33] as well as three individual commenters, also stated that flying additional flight segments, with the corresponding additional takeoffs and landings, adds to fatigue.

[33] Continental Connection Flight 3407 was operated by Colgan Air.

ATA, CAA, Capital Cargo, and UPS also argued that some of the limits set out in Table B are unreasonable and overly restrictive. These commenters asserted that the 9-hour limit is unscientific, and significantly lower than the 11-hour nighttime limit established by CAP-371 and EU Rules Subpart Q. UPS emphasized that the 9-hour FDP limit constitutes a 44% reduction from the current regulations. CAA also argued that the Campbell-Hill report indicates that regulation of FDPs under 15 hours is unnecessary because the FAA's regulatory impact analysis indicates that the rate of accidents begins to increase only after 15 hours on duty.

CAA submitted an alternative proposal in which nighttime FDPs are limited to 11 hours. Capital Cargo emphasized that, if this rule built in additional rest requirements, the longer FDPs in the CAA proposal could be implemented without decreasing safety. ATA added that the 9-hour limit for night operations is unreasonable because air carriers that regularly operate nighttime operations provide mitigation to their crews that would allow those crews to exceed the 9-hour limit. Grand Canyon Airlines argued that the 9-hour nighttime limit is unreasonable because flightcrew members who repeatedly fly at night will acclimate to working during their WOCL. SkyWest Airlines asked that the FAA increase the nighttime FDP limit to 14 hours to accommodate overnight continuous duty operations. SkyWest asserted that these types of operations are safe because "most all [continuous duty operation] pairings provide at least 5 hours of sleep between the periods of 11:30pm-4:30am, spanning a 12-13-hour duty period."

NIOSH, on the other hand, suggested that the FDP limit for night shifts be decreased to 8 hours. In support of its suggestion, NIOSH pointed out that, in general, studies have shown that "[r]isk for worker errors and injuries are 15% higher for evening shifts and 28% higher for night shifts, as compared to day shift[s]." NIOSH also stated that "[w]hen compared with 8-hour shifts, 10-hour shifts increased the risk by 13% and 12-hour shifts increased risk by 28%." NIOSH thus concluded that permitting night shifts consisting of long hours could result in risk ranging from 41% to 55%, as compared to 40-hour-week day shifts. NJASAP stated that "it is prudent to keep the FDP at 9 hours or less when the FDP touches the [window of circadian low]."

A number of individual commenters wrote in suggesting maximum FDP limits ranging from 10 to 16 hours. Washington State University (WSU), at the behest of RAA, examined the parts of the FAA-proposed FDP limits that were different from the FDP limits proposed by the Flight Time ARC members representing industry. As part of its examination, WSU ran the different limits through its own unvalidated model, as well as the SAFTE model. Both the WSU and SAFTE models showed that, in the 0400-1759 timeframe, the FAA-proposed FDP limits were more restrictive than necessary as compared to the industry ARC members' proposed FDP limits. As a result of WSU's findings, RAA suggested: (1) that the Table B limits in the 0400 through 1059 timeframe be adjusted upward to reflect the industry ARC members' proposal, and (2) that the Table B limits for a 5-flight-segment FDP in the 1700 through 2159 timeframe be adjusted downward to reflect the industry ARC members' proposal. Continental also urged the FAA to adopt the industry ARC members' FDP-limit proposal.

In addition, ATA argued that the limits for the 0500-0559 and 0600-0659 blocks are unreasonable. ATA stated that these block times would involve flying mostly during daytime hours, and that they would involve flightcrew members who received most of their sleep during the window of circadian low. ATA emphasized that the costs associated with these limits cannot be justified in light of the fact that there is no scientific basis for the specific daily FDP limits proposed by the FAA.

Conversely, APA argued that the FDP limits for early morning and late evening duty periods should be reduced because flightcrew members on those FDPs will either (1) receive truncated window-of-circadian-low sleep, or (2) have been awake for an extended period of time. NJASAP added that the FDP limits proposed by labor ARC members promote a higher level of safety than the FDP limits proposed by industry ARC members.

In response to the above comments, the FAA finds that, as NIOSH correctly pointed out, studies have shown that human performance varies significantly depending on the time of day. Thus, for example, a NASA report on fatigue in flight operations found that "75% of night workers experience sleepiness on every shift, and 20% report falling asleep."[34] To account for these time-of-day-based variations of human performance, Table B sets FDP limits that are higher for FDPs taking place during peak circadian times and lower for FDPs taking place during the WOCL.

Studies have also shown that after a person works for approximately eight or nine hours, the risk of an accident increases exponentially for each additional hour worked.[35] According to a series of studies that examined the national rate of accidents as a function of the amount of hours worked, the risk of an accident in the 12th hour of a work shift is

[34] See NASA, supra note 22, at 28.

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"more than double" the risk of an accident in the 8th hour of a work shift.[36] To account for this data, the flight time limits in Table A restrict a flightcrew member's time on task to either 8 or 9 hours. Because Table A does not allow a flightcrew member's time on task to exceed 9 hours, the maximum FDP limits in Table B permit an FDP that is up to 14 hours, depending on the time of day.

Turning to the complex nature of the FDP limits, the reason for Table B's complexity is to avoid regulating to the lowest common denominator. As an alternative to the different FDP limits listed in Table B, the FAA could have set an across-the-board FDP limit of 9 hours. This limit would have been simple to understand, and it would have provided the necessary protection for multi-segment FDPs that take place during the WOCL. However, this limit also would have effectively reduced flight times, since with a 9-hour FDP, a flightcrew member would never reach a full 9-hour flight time. Such an approach would also fail to recognize the flexibility required for multi-segment operations, which incorporate some "down-time" into intermittent time-on-task. Thus, in order to provide air carriers with additional scheduling flexibility and avoid unnecessarily restricting all FDPs to the lowest common denominator, the FAA ultimately decided to utilize the somewhat more complex FDP limits listed in Table B.

Turning to the comments concerning flight segments, each flight segment that is flown by a flightcrew member includes a takeoff and a landing, which are the most task and safety-intensive parts of the flight. A flightcrew member whose FDP consists of a single flight segment only has to perform one takeoff and landing, while a flightcrew

[35] See, e.g., Folkard, supra note 15, at 98.

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member whose FDP consists of six flight segments will have to perform six sets of takeoffs and landings. Because takeoffs and landings are extremely task-intensive, it logically follows that a flightcrew member who has performed six sets of takeoffs and landings will be more fatigued than the flightcrew member who has performed only one takeoff and landing.

While there are no studies measuring the objective performance of pilots who have flown multiple flight segments, there are studies that are based on subjective pilot reporting of fatigue that support a link between fatigue and the number of flight segments. For instance, a 2008 study of fatigue in two-pilot operations found that "the most important influences on pilot fatigue were the number of sectors and the length of the duty period."[37] A 2007 study of pilot fatigue in short-haul operations found that "[d]uty length and the number of sectors increased fatigue in a linear fashion."[38] A 2003 study of perceived fatigue for long and short-haul flights found that "time pressure, number of legs per day, and consecutive days on duty contributed to increased fatigue."[39] Based on these studies, its operational experience, and the logical connection between fatigue and additional flight segments, the FAA has decided to retain, in Table B, the FDP-decreases caused by FDPs with multiple flight segments.

However, while there is a link between FDP and multiple flight segments, it is unclear exactly how much fatigue is caused by each flight segment. As such, Table B

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[36] Id.

[37] David Powell, et. al., Fatigue in Two-Pilot Operations: Implications for Flight and Duty Time Limitations, Aviation, Space, and Environmental Medicine, Vol. 79, No. 11, Nov. 2008, at 1047.

[38] David Powell, et. al., Pilot Fatigue in Short-Haul Operations: Effects of Number of Sectors, Duty Length, and Time of Day, Aviation, Space, and Environmental Medicine, Vol. 78, No. 7, Jul. 2007, at 701.

does not utilize the method employed by other civil aviation authorities of a linear FDP-limit decrease after the first flight segment. Instead, Table B generally does not decrease FDP limits until a flightcrew member is assigned an FDP that has five or more flight segments. For several FDP limits that are unusually high and/or that take place during critical circadian times, Table B decreases FDP limits after the first two flight segments to account for the additional fatigue caused by those FDPs.

The FAA understands that an FDP-limit decrease linked to multiple flight segments will disproportionately affect regional air carriers and point-to-point operations, such as the one employed by Southwest. That is why, given the lack of information on the specific amount of fatigue caused by each flight segment, Table B does not follow the approach taken by CAP-371 and the EU OPS subpart Q of reducing FDP after the first flight segment. However, as discussed above, there appears to be a link between fatigue and the number of flight segments, and the flightcrew members working for Southwest and regional carriers are as susceptible to multiple-flight-segment-caused fatigue as other flightcrew members. Because a flight duty and rest rule must take into account the increased fatigue caused by performing multiple takeoffs and landings in a single FDP, Southwest and regional air carriers cannot be exempted from this portion of Table B.

The FAA also agrees with NIOSH that long duty periods that take place during the WOCL substantially increase the risk of an accident. As discussed above, studies have found that human beings who work during the WOCL experience substantial

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[39] Samira Bourgeois-Bougrine, et. al., Perceived Fatigue for Short- and Long-Haul Flights: A Survey of 739 Airline Pilots, Aviation, Space, and Environmental Medicine, Vol. 74, No. 3, Oct. 2003, at 1076.

degradation in their ability to safely perform their assigned duties.[40] Studies have also found that each additional hour worked after approximately 8 or 9 hours exponentially increases the risk of an accident.[41] Given this data, the FAA has restricted nighttime FDPs to 9 hours. Because a 9-hour FDP is relatively safe, the FAA has decided not to reduce the nighttime FDP limit any further. However, given the significantly increased risk of an accident posed by long nighttime FDPs, the FAA has also decided not to raise the nighttime FDP limit above 9 hours, even though this means that in many instances the flightcrew member would not reach the allowable flight limit.

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In addition, the FAA has determined that there is little evidence that a flightcrew member who repeatedly works on nightshifts will experience substantial safety-relevant changes to his or her circadian rhythm through acclimation. Acclimation consists of changes to a person's circadian rhythm that are made in response to external environmental factors, such as receiving sunlight at a time when one's body is used to experiencing nighttime darkness. While people who continuously work at night may experience some acclimation, that acclimation is neither complete nor long-lasting. The nightshift acclimation also generally disappears after only a few days off.

Similarly, it does not appear likely at this time that a longer rest period would necessarily decrease the substantial risk associated with longer nighttime FDPs. This is because daytime sleep is less restful than nighttime sleep, and the additional rest provided to a nightshift flightcrew member would be taken during the day. However, the FAA is open to the possibility of allowing air carriers to exceed the 9-hour nighttime FDP limit if

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[40] See, e.g., NASA, supra note 22, at 19-34.

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they can establish through an FRMS that additional daytime sleep would allow their flightcrew members to safely work on longer nighttime FDPs.

The FAA has also considered CAA's argument concerning the Campbell-Hill report's analysis, which states that the accident rate only statistically increases in the 15th hour of duty and beyond. The FAA finds the peer-reviewed studies analyzing the national accident rate to be more persuasive.[42] This is because the national-accident-rate analyses are based on the overall national accident rate, which provides a far larger sample than the number of aviation incidents on which the Campbell-Hill analysis is based. As discussed above, according to the peer-reviewed national-accident-rate studies, the risk of an accident increases exponentially for each hour worked after 8 hours.[43] Even CAA, which submitted the Campbell-Hill report, appears to have implicitly recognized that report's limitations because the alternative proposal that CAA submitted to the FAA did not use the 15-hour FDP limit suggested by Campbell-Hill. Instead, CAA's proposal limited nighttime FDPs to 11 hours and daytime FDPs to 13 hours.[44]

The FAA has also recognized that CAP-371 and EU OPS subpart Q permit higher nighttime FDP limits in some situations. However, these foreign regulators are able to safely allow higher nighttime FDP limits because their operating environment allows them to mitigate the risk associated with nighttime FDPs in other ways. For example, CAP-371 sets general nighttime FDP limits to 11 hours for one-segment nighttime FDPs.

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[41] See Folkard, supra note 15, at 98.

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[42] See id.

[43] Id.

[44] See Comments of the Cargo Airline Association, Attachment C at 5 (Nov. 15, 2010).

However, if a flightcrew member is scheduled for nighttime duty on five consecutive nights, CAP-371 reduces that flightcrew member's nighttime FDP limit to eight hours and imposes substantial additional rest requirements.[45] CAP-371 also imposes a mandatory split duty rest period for flightcrew members who have a nighttime FDP for at least two consecutive nights.[46] This rule, on the other hand, only requires a mid-duty rest period if a flightcrew member has a nighttime FDP for at least four consecutive nights.

Similarly, EU OPS subpart Q also appears to set slightly higher FDP limits for nighttime operations.[47] However, in exchange for these higher limits, Subpart Q limits FDP extensions to 1 hour and requires a minimum of 12 hours' rest between FDP periods.[48] This rule, on the other hand, permits FDP extensions of 2 hours and only requires 10 hours' rest between FDP periods. As these examples illustrate, some of the key provisions of this rule are fundamentally different from the provisions of its international counterparts. These differences are a result of the different operating environments in which these rules regulate, and, by themselves, these differences are insufficient to justify increasing the nighttime limits of Table B.

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With regard to comments about nightshift carriers providing mitigation to their crews and continuous duty operations that employ mitigation measures, this rule takes nighttime mitigation into account through the split duty and augmentation credits. If an air carrier employs mitigation measures not addressed by this rule, that air carrier may submit its mitigation measures for FAA evaluation as part of an FRMS program.

[45] CAP-371 section 7.3.1.
[46] Id. section 7.3.
[47] EU Rules, Subpart Q, OPS 1.1105, sections 1.3 and 1.5.
[48] Id. OPS 1.1105, section 2.1; OPS 1.1110, section 1.1.

The FAA agrees with RAA that SAFTE modeling shows that the proposed FDP limits in the 0400 through 1059 timeframe were excessive and did not increase the degree of safety as compared to the industry-ARC-members' proposal. As such, these limits have been adjusted upward to reflect the industry-ARC-members' suggested FDP limits for these timeframes. The FAA also agrees with ATA that the proposed limits for the 0500-0659 timeframe were set unreasonably low. This is because flightcrew members who fly during those times obtain most of their sleep at night and sleep through most of their WOCL. The upward adjustment that the FAA made in response to RAA's SAFTE modeling increases the FDP limits in this timeframe to a reasonable level, and should address ATA's concerns in this area.

The FAA declines to make a downward adjustment to the five-segment FDP limit in the 1700-2159 timeframe.[49] This is because the flight time limits contained in Table A substantially restrict a flightcrew member's time on task. The time-on-task restriction allows the FAA to safely impose a higher FDP limit for a five-segment FDP in this timeframe. As such, the FAA has not made downward adjustments to this limit.

In addition, the FAA declines APA's suggestion of decreasing FDP limits for early morning and late evening FDPs. The primary time-of-day safety concern on which Table B is based is that flightcrew members who fly during the WOCL suffer a severe degradation of performance. FDPs that begin in the early morning or end late in the evening do not infringe on the WOCL, and thus, do not trigger this concern. Also, as ATA correctly pointed out, flightcrew members assigned to these FDPs are able to obtain most of their sleep at night, and nighttime sleep is the most restful type of sleep. Moreover, as discussed above, RAA's SAFTE modeling showed that a slight upward adjustment to early morning FDPs would not decrease safety. For all these reasons, the FAA has decided not to decrease the FDP limits for FDPs that begin early in the morning or end late in the evening.

UPS stated that because the FDP limits are determined by actual pilot reporting time and not the pilot's scheduled reporting time, air carriers are put in an untenable position of having to track the fluctuating and unpredictable FDPs of individual pilots. The Aerospace Medical Association (AMA) asserted that the different FDP limits were inefficient and would crowd departure times at busy airports. AMA suggested that, instead of changing FDP limits based on reporting time, duty time that takes place during the window of circadian low be counted as time-and-a-half or double time. APA suggested that FDP limits not be associated with specific reporting times, but that they instead be determined through a linear function, which could then be utilized by modern scheduling software. This approach, APA argued, would be better than the FAA-suggested approach in which a 1-minute reporting difference can result in a 1-hour FDP limit difference.

The FAA has determined that an approach to daily FDP limits that requires a linear function or mathematical computations in order to determine the applicable limit would be unduly complex. Under the FAA's approach to Table B, a flightcrew member can determine his or her FDP limit simply by finding the cell in Table B that applies to

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[49] The FAA has actually increased the FDP limit in question to account for concerns expressed by

his or her scheduled FDP. Given that some commenters find even this approach to be unduly complex, the FAA has decided not to add any more complexity to this section.

In response to UPS' concern, the FAA clarifies that FDP limits are determined by scheduled reporting time and not by actual reporting time. Thus, an air carrier can determine a flightcrew member's maximum FDP limit simply by looking at that flightcrew member's schedule. The labels for Tables B and C are amended to clarify that the applicable limits are based on scheduled start time.

The FAA also emphasizes that FDP is defined as beginning at the time that a flightcrew member is "required" to report for duty. Thus, if a flightcrew member is late for an FDP, the FDP begins to run at the time that the flightcrew member was scheduled to report for an FDP, not the time that he or she actually reported for the FDP.

Aloha Air Cargo (AAC) recommended upward modifications to the proposed maximum FDPs. At AAC, flightcrews report for night flight duty between 1935 and 2142 local time and end at 0700 each morning. To support flightcrew rest periods occurring at the same time each day, AAC schedules its crews to assure that flightcrews complete their duty by 0700 each morning. This system naturally reduces the FDP for later report times without artificially constricting earlier report times. AAC has evaluated this fatigue mitigation process for over nine months through daily reviews of FRMP crew data, and through selective crew debriefs when FRMP data results flagged elevated fatigue risk. AAC asserted that this method has proven to be more reliable in mitigating fatigue risk within AAC's flight operation than the FAA's current proposal. Therefore,

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supplemental carriers. The increases based on supplemental-carrier comments are discussed more fully

AAC recommended that the FAA consider the table below as an alternative to the proposed table, and that the FAA include "Time of Completion" (the end of the FDP) as an additional criterion to support adequate rest in consideration of the flightcrew's circadian rhythms.

Time of Start (Home Base or Acclimated)	Maximum Flight Duty Period (hours) For Lineholders Based on Number of Flight Segments						
	1	2	3	4	5	6	7+
1300-1659	12	12	12	12	11.5	11	10.5
1700-2159	**12**	**12**	**11**	**11**	**10.5**	**10**	**10**
2200-2259	**11.5**	**11.5**	**10.5**	**10.5**	**10**	**10**	**9.5**
2300-2359	**10.5**	**10.5**	**10**	**10**	**9.5**	**9.5**	**9**

Proposed changes in **BOLD.**

The FAA has declined to adopt AAC's suggestion of requiring FDPs to terminate at a certain time. This rule applies to many different air carriers with differing business models, and the approach taken by AAC may not work for an air carrier conducting supplemental operations whose schedule is subject to the demands of its clients. In order to take into account the diverse business models subject to this rule, the FAA has chosen not to include a "Time of Completion" as part of its FDP restrictions. The FAA notes that, because Table B sets higher FDP limits for FDPs that begin earlier in the evening, AAC will be able to retain its existing business model if it opts to operate its all-cargo operations under part 117 so long as each scheduled FDP complies with the limits set out in Table B.

Turning to the specific FDP limits proposed by AAC, the FAA has chosen not to make further upward adjustments to FDPs in the 1700 to 2359 timeframe. FDPs that

below.

begin during this timeframe will infringe on the WOCL, and, as discussed above, this infringement raises significant safety concerns.

NACA and a number of other commenters stated that the limits in the proposed Table B unduly focus on domestic scheduled service and do not recognize the needs of non-scheduled operations currently flown under Subpart S. These commenters suggested the following alternative to the FAA-proposed Table B:

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	Acclimated Segments			
Time of start	**1 - 4**	**5**	**6**	**7+**
0000-0559	**12**	**11**	**10**	**9**
0600-1159	**14**	**13**	**12**	**11**
1200-1259	**13**	**12**	**11**	**10**
1300-2359	**12**	**11**	**10**	**9**

The SkyWest Airlines Pilot Association similarly asked the FAA to increase the FDP limits to avoid disproportionately impacting regional air carrier pilots. SkyWest Airlines stated that the proposed FDP limits would significantly increase its operating expenses, as well as the amount of time that its flightcrew members spend resting away from home. SkyWest, NAA, and Northern Air Cargo suggested that the FAA permit air carriers to schedule FDPs that are either 12 or 14 hours, depending on whether they infringe on the window of circadian low. Allegiant also supported permitting a 14-hour FDP for FDPs that included two or less flight segments.

Conversely, American Airlines and American Eagle Airlines supported the FDP limits set out in Table B. The Families of Continental Connection Flight 3407 also endorsed the maximum 13-hour FDP limit, asserting that it effectively limits the fatigue exposure of regional airline pilots. APA supported the 13-hour maximum FDP limit, citing studies showing a higher likelihood of an accident for each additional hour worked, a conclusion supported by the crash of American Airlines Flight 1420, in which fatigue was a causal factor, and which occurred at the 13:06 point in the flightcrew members' FDP. APA added that duty days that exceed 13 hours could result in flightcrew members being awake for 16 to 17 hours before the beginning of their FDP. APA cited a study showing that a person who has been awake for 17 hours exhibits the same level of performance as a person who is legally drunk. NJASAP expressed concern over increasing the maximum FDP limits, citing a NASA study in which a poll of corporate pilots revealed fatigue concerns for duty time over 8 and 10 hours.

Due to the WOCL considerations discussed above, the FAA has declined the suggestion by air carriers conducting supplemental operations to increase nighttime FDP limits to 12 hours. However, the FAA notes that these concerns do not apply to daytime FDPs that begin in the morning, especially since flightcrew members' time on task is restricted by the flight time limits of Table A. As such, and in response to the comments made by regional carriers, and those conducting only supplemental passenger operations, the FAA has made upward adjustments to some of the FDP limits in Table B.

First, the FAA has increased the one-and two-segment FDP limits in the 0600 to 0659 timeframe from 12 to 13. However, the FAA did not further increase the FDP limits for FDPs with four or less segments in this timeframe to 14 hours (as the supplemental carriers suggested) because an early morning FDP that starts between 0600 and 0659 does not start during peak circadian alertness. As such, without additional

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FRMS-provided data, the FAA cannot justify permitting longer multi-segment early morning FDPs.

Second, the FAA has increased most of the FDP limits in the 0700 to 1659 timeframe to reflect the limits suggested by NACA's proposal. The reason for this increase is that the FDPs in this timeframe mostly take place during the day and do not infringe on the WOCL. Given the 8 and 9-hour flight time restrictions contained in Table A, the FAA has determined that an increase to the FDP limits in the 0700 to 1659 timeframe would not have a detrimental effect on safety.

It should also be noted that, in the 0700 to 1159 timeframe, the FAA has only allowed one- and two-segment FDPs to go to 14 hours. The reason that the FAA did not follow NACA's suggestion of allowing three- and four-segment FDPs to be 14 hours long is because, as discussed above, additional flight segments increase fatigue. Since a 14-hour FDP is a very long FDP, the FAA has chosen to disallow 14-hour-long multi-segment FDPs without additional data showing that a multi-segment FDP greater than 2 segments of this duration does not decrease safety. The FAA has also chosen not to increase the FDP limit to 14 hours for FDPs that begin after 1159 because this type of increase would result in more FDPs infringing on the WOCL.

Third, the FAA has reevaluated the FDP limits in the 1700 to 2359 timeframe and has made slight upward adjustments to those limits to reflect the safety mitigation provided by the time on task restrictions of Table A. These adjustments are not as high as the supplemental air carriers recommended because FDPs that begin during these times infringe on the WOCL.

The FAA has considered the concern raised by APA, NJASAP, and the Families of Continental Connection Flight 3407 about raising the maximum FDP limit above 13 hours. However, there are a number of reasons why the FAA considers a 14-hour FDP limit for FDPs that begin in the morning to be safe. First, most of the 14-hour FDP would take place during the day after a flightcrew member has had a full night's sleep and thus, this type of FDP does not raise any circadian-rhythm concerns.

Second, the flight time restrictions in Table A have been adjusted downward to 9 hours in order to restrict the amount of time on task that a flightcrew member can be subjected to in a 14-hour FDP. Thus, a flightcrew member in a 14-hour FDP can only be asked to fly an aircraft for 9 of those hours, and the remaining 5 hours must be spent on non-flight activities. The FAA notes that the studies cited by APA in support of a 13-hour-maximum FDP limit did not impose any time-on-task (flight-time) restrictions. The FAA agrees with APA that a 14-hour unaugmented FDP in which a flightcrew member spends the entire 14 hours flying an aircraft would be unsafe, which is why, as discussed more fully elsewhere, the FAA has decided to retain the flight-time limits set out in Table A.

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Finally, the cumulative limits in this rule limit the frequency at which an air carrier can assign long FDPs to its flightcrew members. For example, under the 60-hour weekly FDP limit set out in section 117.23(c)(1), if an air carrier insists on repeatedly assigning a 14-hour FDP to its flightcrew members, those flightcrew members will reach their weekly FDP limit after slightly more than four days of work, and will be unable to accept an FDP for the remainder of the week. Under the 190-hour monthly FDP limit set out in section 117.23(c)(2), if an air carrier regularly assigns 14-hour FDPs, its flightcrew members will reach their monthly limits after slightly over 13 days, and will be unable to accept an FDP for the remainder of the month. Thus, the cumulative FDP limits contained in section 117.23(c) severely limit the frequency at which air carriers can assign the longer FDPs permitted by Table B. Given these numerous safeguards, a 14-hour FDP that consists of only one or two flight segments and takes place during peak circadian times does not raise significant safety concerns.

UPS objected to basing the FDP limits for an unacclimated flightcrew member on the time at that flightcrew member's home base. UPS stated that, under this approach, an unacclimated flightcrew member could be assigned a long FDP during a local night. UPS added that the FAA's acclimation approach does not take into account flightcrew members who change their acclimation status mid-pairing. UPS provided an example of an international flight arriving early and, as a result, the flightcrew on that flight having enough time in a new theater to unexpectedly become acclimated. Because this unexpected acclimation could lead to a reduced FDP limit for the return trip, UPS argued that this type of scenario was "patently absurd" because in this scenario a flightcrew that unexpectedly received additional rest would be subjected to a lower FDP limit.

In response, the FAA notes that this section does not determine unacclimated flightcrew members' FDP limits based on local time. This is because the circadian rhythm of flightcrew members who are unacclimated is not synchronized to the theater in which they are operating. Consequently, in order to accurately take into account each flightcrew member's WOCL and general circadian rhythm, this section determines FDP limits based on the local time at the theater with which a flightcrew member's circadian rhythm is synchronized.

With regard to mid-pairing acclimation, the FAA has amended the language in section 117.13(b)(2) to state that an unacclimated flightcrew member's FDP limit is determined by the local time at the theater in which that flightcrew member was last acclimated. The reason for this change is that a flightcrew member may be away from his or her home base for a significant amount of time. If that happens, the flightcrew member's circadian clock will not be synchronized with his or her home base, but rather, with the theater in which he or she was last acclimated.

Turning to UPS' scenario, it is indeed possible that a flightcrew member who arrives in a new theater unexpectedly early will experience unanticipated acclimation. Depending on the local hours, this acclimation may reduce that flightcrew member's FDP limit for the return trip. The reason for this reduction is that the longer amount of time that this flightcrew member will spend in-theater will result in his or her body becoming synchronized with the local time in that theater. Once this synchronization takes place, the flightcrew member will experience the circadian penalties associated with working during non-peak local times. As such, this rule prevents acclimated flightcrew members from accepting longer FDPs during non-peak local times. This result is not "patently absurd" because the shorter FDPs that may stem from unexpected acclimation are not a result of longer rest, but rather, a result of more time that a flightcrew member spends in-theater.

NACA and NAA also stated, without elaboration, that when a pilot is unacclimated, the FDP in Table B should be decreased by one hour instead of half an hour. The 30-minute FDP-limit reduction for unacclimated flightcrew members was imposed to account for the additional fatigue experienced by these flightcrew members. However, at this time, the FAA is unaware of any reasons for increasing this reduction to one hour.

NJASAP sought clarification of how acclimation is determined when a flightcrew is made up of flightcrew members who are based in different time zones. In response, the FAA emphasizes that acclimation and FDP limits are specific to each flightcrew member. As such, the unacclimated flightcrew members on a flightcrew are subject to subsection (b) of this section. However, the acclimated flightcrew members on that flightcrew are only subject to subsection (a) of this section.

Drs. Belenky and Graeber criticized the maximum FDP limits for not taking into account onboard rest facilities, which, they argued, allowed a flightcrew to obtain rest onboard the aircraft prior to descent. Boeing also endorsed the concept of controlled napping. AMA stated that controlled in-cockpit naps should be "vigorously encouraged," but should not be allowed to increase the maximum FDP. In response, the FAA notes that there is currently insufficient data about whether a controlled nap could safely be taken by a flightcrew member during an actual unaugmented flight. As such, the FAA is not prepared to regulate for controlled napping as a mitigation measure at this time. Once more data becomes available, the FAA may conduct a rulemaking to add controlled napping to the flight, duty, and rest regulations.

NACA and NAA stated that the time-of-day windows in Tables A and B are not synchronized. However, the reason that Tables A and B are not synchronized is that Table B uses many different FDP limits ranging from 9 to 14 hours, and multiple rows were necessary to clearly distinguish each different set of FDP limits. Table A, on the other hand, only uses 8 and 9 hours as flight time limits, and as such, fewer rows were necessary to clearly convey the flight time limits for each phase of the day.

G. Flight Time Limitations

As discussed above, studies indicate that if a person works for longer than 8 or 9 hours, the risk of an accident increases exponentially for each additional hour worked.[50] Given this data, the FAA was hesitant to eliminate current flight time regulations, which generally limit flightcrew members to 8 hours of flight time regardless of the time of day. Thus, instead of relying solely on FDP limits to regulate acute fatigue, the FAA proposed flight time limits ranging from 8 to 10 hours (depending on the time of day) for unaugmented flights. The FAA also proposed a 16-hour flight time limitation for augmented flights.

ATA, NACA, CAA, RAA, and multiple air carriers objected to including daily flight time limits in this rule. ATA, RAA, International Air Transport Association (IATA), and a number of other commenters argued that the daily flight time limits were arbitrary, not scientifically justified, inconsistent with leading international standards, operationally unwieldy, unduly burdensome to carriers, and against the public interest.

[50] See Folkard, supra note 15, at 98.

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The above commenters stated that the daily flight time limits were unnecessarily redundant. The commenters emphasized that this rule creates a large number of regulatory limitations, and an additional limitation on flight time limits only unnecessarily adds complexity to this rule. These commenters stated that flight time is considered to be part of an FDP, and thus, flight time is subject to the FDP limits. The commenters emphasized that being awake is what causes fatigue, and this fatigue factor is addressed through FDP limits better than through flight time limits.

ATA stated that this rule also indirectly regulates flight times through mandatory rest periods because a flightcrew member cannot fly an aircraft during a rest period. UPS stated that industry ARC members' acceptance of FDP limits was predicated on the abolition of flight-time limits.

In filed comments Drs. Belenky and Graeber stated that there was no justification for flight time limits in addition to FDP limits apart from regulating for "differences in workload." Drs. Belenky and Graeber stated that the differences in workload are taken into account in the FDP limits through the different limitations on circadian timing and the number of flight segments. As such, Drs. Belenky and Graeber concluded that there was no remaining justification for retaining flight time limits in this rule. ATA, CAA, and a number of air carriers supported Drs. Belenky and Graeber's analysis.

ATA, IATA, CAA, and a number of air carriers noted that other regulatory regimes, such as CAP-371 and EU OPS subpart Q, have largely eliminated the concept of daily flight-time limits. These commenters argued that this demonstrates that a flight-time limit is unnecessary, and that imposing this limit on U.S. carriers will make them less competitive with carriers operating under other regulatory regimes. The commenters asked the FAA to eliminate the daily flight-time limit to make this rule more consistent with the other regulatory regimes.

Conversely, NJASAP, AAC, and a number of labor groups supported the flight time limits. NJASAP emphasized that "[m]ultiple stressors are present in flight operations such as weather and [air traffic control] that take a cumulative toll on fatigue levels."

In response, the FAA notes that existing regulations generally limit flight time to 8 hours. Studies have shown that fatigue accumulated by working longer than 8 or 9 hours significantly increases the risk of an accident.[51] Given this data, the FAA needs to ensure that flightcrew members are not permitted to fly an aircraft for longer than 8 or 9 hours. This rule accomplishes this goal by setting flight-time limits at 9 hours for peak circadian times, and 8 hours for all other times.

As the industry commenters correctly pointed out, the FDP limits in this rule also limit flight time. However, abolishing flight-time limits and relying solely on FDP limits to regulate flight time poses a significant problem. This problem arises from the fact that the FDP limits do not differentiate between flight time and non-flight activities. For example, if a flightcrew member spends 5 total hours flying an aircraft and 4 hours sitting in an airport on a layover, that flightcrew member's FDP is 9 hours. However, if another flightcrew member spends 8 total hours flying an aircraft and 1 hour sitting in an airport on a layover, that flightcrew member's FDP is also 9 hours. Thus, the FDP limits would treat the above two flightcrew members identically, even though one of them spent an additional 3 hours engaged in the more fatiguing activity of flying an aircraft.

To resolve the above problem and differentiate between flight time and less-fatiguing non-flight activity conducted on behalf of the certificate holder, the FAA has decided to impose flight-time limits in addition to FDP limits. Setting flight-time limits at 8 or 9 hours ensures that flightcrew members do not fly an aircraft for longer periods of time. This also allows the FAA to provide air carriers with more scheduling flexibility by setting higher FDP limits because with flight-time limits in place, longer FDPs will simply include more non-flight activities instead of longer flight times.

An alternative approach that the FAA considered was eliminating flight-time limits, and setting lower FDP limits to ensure that flightcrew members do not fly an aircraft for longer than 8 or 9 hours. However, the FAA ultimately rejected this approach because it would have resulted in peak-circadian-time FDP limits of approximately 10 or 11 hours, which would have greatly hampered the scheduling flexibility of air carriers. This approach also would have unnecessarily limited non-flight activities, which are generally not as fatiguing as flying an aircraft.

The FAA also considered ATA's comment that rest requirements indirectly limit flight time. However, the problem with relying solely on rest requirements to regulate flight time is the same as the problem with relying solely on FDP limits – neither provision differentiates between non-flight and flight activities. In addition, the proposed rest requirements do not even closely approximate levels that would effectively limit

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[51] See id.; John A. Caldwell, Fatigue in aviation, Travel Medicine and Infectious Disease, 3, at 88-90

flight time to acceptable levels. As such, the FAA has chosen not to use the rest requirements in this rule as a replacement for flight-time limits.

Turning to UPS' comment that industry ARC members' acceptance of FDP limits was predicated on the abolition of flight-time limits, the FAA notes that the ARC's recommendations are advisory.[52] Thus, for example, in response to industry concerns that were raised in the comments, the FAA has increased some of the FDP limits in Table B beyond the levels suggested by the ARC members. Similarly, to address scientific data showing that the risk of an accident greatly increases after a person has worked for 8 or 9 hours,[53] the FAA has decided to set firm flight-time limits to ensure that flightcrew members do not fly an aircraft for longer than 8 or 9 hours.

As Drs. Belenky and Graeber correctly pointed out, the number of flight segments flown by a flightcrew member is taken into account by the FDP limits. However, while takeoffs and landings associated with multiple flight segments are the most task-intensive portions of a flight, they are not the only task-intensive portion of the flight. When flying an aircraft after takeoff, a flightcrew member must, among other things, keep track of weather patterns, communicate with air traffic control, and respond to unforeseen developments that may arise during the flight. All of these tasks (as well as the constant alertness needed to perform these tasks) increase fatigue, and they are not fully taken into account by the FDP limits, which do not distinguish between a flightcrew member flying

(2005).

[52] The FAA also notes that the near-total lack of consensus among ARC members as to the appropriate levels to adopt indicates that the ARC members understood that the FAA could not assume either industry or labor support of all aspects of its proposal.

[53] See supra note 50.

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an aircraft and a flightcrew member sitting at an airport during a layover. To account for these fatigue-inducing tasks, the FAA has decided to retain flight-time limits in this rule.

Turning to the foreign aviation standards cited by some of the commenters, the FAA notes that the Administrative Procedure Act requires the FAA to consider the specific operating environment that it is regulating instead of simply following the foreign standards. The FAA notes that while other regulatory regimes have eliminated daily flight-time limits, the elimination of these limits has resulted in more stringent requirements elsewhere. For example, EU OPS subpart Q sets the maximum FDP limit at 13 hours and requires 12 hours of rest between FDP periods.[54] This rule, on the other hand, sets a maximum FDP limit at 14 hours (for peak circadian times) and requires a rest period of only 10 hours between FDP periods. One of the reasons why some provisions of this rule are less stringent than their EU OPS counterparts is because this rule contains a daily flight-time limit that regulates how long flightcrew members can fly an aircraft.

The FAA also notes that the other regulatory regimes did not completely eliminate flight-time limits. While other regulations do not contain daily flight-time limits, many of them still retain cumulative flight-time limits.[55] These cumulative flight-time limits are significantly lower than the cumulative flight-time limits imposed by this rule.[56]

Over 1,300 individual commenters objected to the proposed 10-hour flight-time limit for the 0700-1259 timeframe. These commenters emphasized that the 10-hour limit constitutes a 25% flight time increase over existing limitations, and as such, will increase

[54] EU Rules, Subpart Q, OPS 1.1100, section 1.3 and OPS 1.1110, section 1.1.

fatigue. A number of commenters stated that flight time limitations should not be greater than 8 hours. NJASAP emphasized that existing regulations limit flight time to 8 hours, and, given studies that show the risk of an accident increasing exponentially for each additional hour worked, there is no reason to increase the existing flight-time limits. The Families of Continental Connection Flight 3407, Captain Sullenberger, International Brotherhood of Teamsters (IBT) Local 1224, and multiple labor groups stated that there are no scientific findings supporting an increase in flight time to 10 hours, and that this type of increase should be permitted only if it is supported by FRMS-provided data. NTSB cautioned the FAA about increasing flight-time limits to 10 hours without first studying adverse consequences that could result from this increase. Many of the above commenters recommended reducing the 10-hour flight-time limit to 9 hours, emphasizing that this would still be a 12.5% increase over existing flight-time restrictions. A number of labor groups recommended that the early morning and late evening flight-time limits be reduced to 7 hours "to reflect the unanimous view of the ARC."

Conversely, RAA stated that there is no scientific evidence that a small increase in the current flight time limits would adversely affect safety. SkyWest objected to decreasing the flight time limits, arguing that it would impose additional hardships upon air carriers. Delta stated that increasing flight time limits beyond 8 hours is safe because the maximum FDP limits reduce the amount of time that flightcrew members spend at work.

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[55] See, e.g., EU Rules, Subpart Q, OPS 1.1100, section 1.2.
[56] See id.; CAP-371, section 21.1.

The FAA agrees with the overwhelming number of commenters who stated that a 10-hour flight-time limit is not justified by current scientific data. A series of studies examining the national accident rate has shown that 10 hours spent at work pose a much greater risk of an accident than 8 or 9 hours spent at work.[57] A study examining the number of aviation accidents determined that "[f]or 10-12 hours of duty time, the proportion of accident pilots with this length of duty period is 1.7 times as large as for all pilots."[58] Another study found that "20% of all US commercial aviation mishaps appear to occur at the 10th hour [of pilot duty] and beyond."[59] Because scientific data shows that the risk of an accident substantially increases when a person's time on task is 10 hours, the FAA has decided to limit flight-time that begins during 0700-1259 to 9 hours.

The FAA has also decided not to reduce any of the proposed 9-hour flight-time limits to 8 hours. The existing regulations impose an across-the-board 8-hour flight-time limit. However, that limit regulates to the lowest common denominator because it does not take into account the fact that people are capable of safely working longer hours during periods of peak circadian alertness. Accordingly, this rule retains the 8-hour flight-time limit for shifts encompassing non-peak circadian times, but increases the flight-time limit to 9 hours for shifts encompassing periods of peak circadian alertness.

Turning to comments about the ARC recommendations, the FAA notes that the ARC's recommendations are advisory and there was no consensus on the hourly limitations with industry generally supporting more generous limits and labor generally

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[57] See Folkard, supra note 15, at 98.

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[58] Jeffrey H. Goode, Are pilots at risk of accidents due to fatigue?, Journal of Safety Research, 34, at 311 (2003).

[59] Caldwell, supra note 50, at 90.

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supporting more restrictive limits. The existing regulations impose an 8-hour flight-time limit, and the FAA has been administering this limit for over 50 years. Based on its operational experience, the FAA does not believe that an 8-hour flight-time limit for non-peak circadian times is unsafe, especially if that limit is based on actual and not scheduled flight time. As such, the FAA has decided not to decrease any of the flight-time limits below 8 hours.

ATA, IATA, UPS, United, and a number of other air carriers also objected to the lack of an extension for daily flight-time limits. These commenters stated that an inflexible daily flight time limit would severely restrict scheduling because air carriers would have to build in large scheduling buffers to account for unforeseen circumstances occurring after takeoff. IATA emphasized that the prohibition on continuing an FDP that exceeds the flight-time limits may result in flightcrew members unsafely rushing to complete preflight activities to avoid violating the flight time limits. UPS stated that, without a flight time extension, unforeseen delays could leave crews stranded in international destinations. United asserted that an inflexible flight-time limit may, as a result of unforeseen delays, result in cancellations of multi-leg itineraries after some of the legs have been completed. Southwest stated that large numbers of flights would be disrupted by an inflexible flight-time limit because small delays would eventually build up during the day, and these would require air carriers to cancel flights in order to comply with the rigid flight-time limits. The above commenters suggested that flight time limits be based on scheduled and not actual flight time.

Conversely, ALPA, FedEx ALPA, IBT Local 1224, and a number of other labor groups supported the lack of a flight-time extension, arguing that air carriers currently do not build sufficient buffers into their schedules. These commenters stated that air carriers currently schedule flights up to the last permissible limit of flight time, even when the air carriers know that a high possibility of a delay makes their schedules unrealistically optimistic. These commenters emphasized that an inflexible flight-time limit was particularly important in this case because this rule does not have a compensatory rest provision.

The flight-time limits apply to actual and not scheduled flight time because actual flight time is what impacts safety. Flight-time calculations are based on the en route times contained in the flight plan. Once a flightcrew member flies an aircraft for a certain amount of time, that flightcrew member's risk of being involved in an accident increases exponentially for each additional hour worked.[60] This exponential increase in risk is based on actual hours worked and not the hours that someone was scheduled to work. Thus, a flightcrew member who flies an aircraft for 11 hours does not have a lower risk of an accident simply because he or she was scheduled to fly the aircraft for only 9 hours. In order to account for the factors that control accident risk, the flight-time limits in this rule are based on actual and not scheduled flight time.

Turning to the concerns expressed by industry commenters, the FAA notes that air carriers currently utilize schedules that are unrealistically optimistic and do not include sufficient buffers for unforeseen circumstances. It has been the FAA's

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[60] See Folkard, supra note 15, at 98.

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experience that an air carrier subject to an 8-hour scheduled flight-time limit will sometimes schedule a flight that, on paper, lasts 7 hours and 59 minutes when the air carrier knows that the actual flight will likely take well over 8 hours to complete. Because many current air carrier schedules are unreasonably optimistic, air carriers can prevent many of the pre-takeoff situations listed in their comments simply by incorporating reasonable buffers for unforeseen circumstances into their scheduling practices.

However, in evaluating the above comments, the FAA noted that different considerations apply after an aircraft has taken off. If unexpected circumstances significantly increase the length of the flight while an aircraft is in the air, the only way for a flightcrew member to comply with the flight-time limits imposed by this rule would be to conduct an emergency landing instead of piloting the aircraft to its intended destination. Because this is not the preferred method of complying with flight-time limits, the FAA has amended this section to provide a post-takeoff flight-time extension to the extent necessary to safely land the aircraft at its intended destination airport[61] if unexpected circumstances occur after takeoff. To monitor the use of this post-takeoff extension, the FAA is requiring certificate holders to report their flightcrew members who exceed the flight-time limits and describe the circumstances surrounding the exceeded flight time.[62]

The FAA emphasizes that this extension only applies to unexpected circumstances that arise after takeoff. If a flightcrew member becomes aware, before

[61] If the destination is unavailable, the aircraft would land at the designated alternate airport.

takeoff, that he or she will exceed the applicable flight-time limit, that flightcrew member may not take off, and must return to the gate.

One hundred sixty-seven individual commenters opposed increasing the augmented flight-time limit to 16 hours. AMA supported the 16-hour flight-time limit for augmented operations, stating that peer review studies and SAFTE/FAST modeling show that after 16 hours on duty crew performance falls off dramatically.[63] NJASAP stated that flight-time limitations are necessary for augmented operations, and that use of an FRMS to extend maximum flight times should be subject to high levels of scrutiny and oversight. Conversely, Continental asked that augmented FDPs be allowed to exceed the 16-hour flight-time limit. Atlas Air stated that, for some augmented FDPs, the 16-hour FDP flight time would exceed the applicable FDP limit.

Continental submitted supplemental comments objecting to the 16-hour flight time limit for augmented flights. Continental objected to this limitation on ultra long range (ULR) flights, and it submitted new studies, which it claimed showed that ULR flights do not pose additional fatigue risk. ALPA submitted a response to Continental's supplemental submission, pointing out that "[f]lights over 16 hours block conducted by U.S. carriers are rare so there is only limited actual experience with the fatigue factors of such flights." ALPA also asserted that the studies submitted by Continental were actually a single study (based on the composition of the subjects), and that the study suffered from a number of biases, including an age, gender, and volunteer participation. ALPA also

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[62] The "FDP Extensions" section contains a more detailed discussion of the reporting requirements that apply to flightcrew members who exceed the applicable FDP and/or flight-time limits.
[63] Citing Colquhoun, P., Psychological and Psychophysiological Aspects of Work and Fatigue, Activitas Nervosa Superior, 1976, 18:257-263.

stated that the sample size that the study examined was too small to provide meaningful data for a system-wide standard.

A 16-hour flight-time limit was proposed for augmented operations because, for a four-pilot crew working in shifts of two, a 16-hour flight time supposes that each pilot will be at the duty station for about 8 hours. In response to industry comments, the FAA has concluded that a slight increase of the limit for four-pilot augmented FDPs would not impact safety. As such, the augmented flight-time limit for a four-pilot crew has been increased to 17 hours. Seventeen hours was selected as the limit because each member of a four-pilot crew that works on a 17-hour flight in shifts of two would only be at the duty station for 8.5 hours. Eight and a half hours of manning the duty station falls within the 8-to-9-hour flight-time range that, as discussed above, the FAA considers to be safe.

Upon reevaluation of the augmented flight-time limit, the FAA has also concluded that a separate flight-time limit is necessary for a three-pilot flightcrew. This is because if a three-pilot crew works in shifts of two on a 17-hour flight, each flightcrew member will be at the duty station for approximately 11 hours. Because this falls outside the 8-to-9-hour flight-time range that the FAA considers to be safe, the flight-time limit for three-pilot augmented flightcrews has been reduced to 13 hours. A 13-hour flight-time limit ensures that each member of a 3-pilot crew only needs to be at the duty station for approximately 8.5 hours.

Turning to Continental's supplemental comment, as ALPA correctly pointed out, there are currently very few flights that exceed 16 hours of flight time, and as such, there is little data concerning the safety issues presented by these very long flights. The studies put forward by Continental are not particularly helpful in this regard because they analyzed a small sample of flights. Due to the small size of this sample, the data provided by these studies is not sufficient to justify further increasing the augmented flight-time limits. However, the FAA may relax the limits for ULR flights (through either an FRMS or a future rulemaking) if more data is provided showing that longer flight times do not adversely affect safety.

H. Flight Duty Period—Augmented

In formulating this rule, the FAA considered the fact that augmentation is currently used by air carriers to mitigate fatigue. An augmented flight is staffed by more than the minimally-required number of flightcrew members, and the extra staffing allows the flightcrew members to work in shifts and rest during the flight. Existing regulations allow higher flight times for augmented flights, and this allows air carriers to conduct longer flights.

Augmentation has three significant impacts on flight safety. First, flightcrew members on augmented flights work in shifts, and therefore, do not spend as much time engaged in the fatiguing task of piloting an aircraft. For example, on a 17-hour flight staffed by 4 flightcrew members working in shifts of 2, each flightcrew member will only be on the flight deck for approximately 8.5 hours. This is in contrast to unaugmented flights, in which each flightcrew member must be on the flight deck for the full length of the flight.

Second, when they are not on the flight deck, flightcrew members on an augmented flight have access to an onboard rest facility, which will allow them to sleep during the flight. This in-flight rest will, depending on the quality of the rest facility, help mitigate against some of the fatigue accumulated during the FDP. Third, the redundancy created by augmentation allows fatigued flightcrew members to ask for assistance from other flightcrew members. Thus, if a flightcrew member discovers, mid-flight, that he or she is unduly fatigued, that flightcrew member can ask one of the extra flightcrew members to take over his or her duties and safely land the aircraft at its intended destination.

Because augmentation significantly mitigates fatigue, the FAA has found that longer FDPs can safely be permitted for augmented flights. In determining the specific FDP limits, the FAA took note of the recommendations set out in the TNO Report. The TNO Report was created to provide science-based advice on the maximum permissible extension of the FDP related to the quality of the available onboard rest facility and the augmentation of the flightcrew with one or two pilots. The TNO Report recommended that: (1) an aircraft with a Class I rest facility provide an FDP extension equal to 75% of the duration of the rest period; (2) an aircraft with a Class II rest facility provide an FDP extension equal to 56% of the duration of the rest period; and (3) an aircraft with a Class III rest facility provide an FDP extension equal to 25% of the duration of the rest period.[64]

Based on the TNO Report, the FAA proposed Table C, which set out separate FDP limits for augmented flights. These limits were generally based on the unaugmented FDP limits, and then were increased in accordance with the available rest facility by the

[64] TNO Report at 19.

TNO-Report-recommended extension. If a flightcrew member was unacclimated, the augmented FDP limits were reduced by 30 minutes, and the applicable FDP limits were determined based on the local time at the flightcrew member's home base. Because augmented FDPs were generally intended to be used for longer flights, the proposal limited augmented FDPs to three flight segments. In addition, to ensure sufficient in-flight rest for augmented flightcrew members, the proposal would have required: (1) two consecutive hours of in-flight rest during the last flight segment for flightcrew members who would be manipulating the controls during landing, and (2) ninety consecutive minutes of in-flight rest for all other flightcrew members. The proposal also would have required that at all times during flight, at least one flightcrew member with a PIC type-rating must be alert and on the flight deck.

Drs. Belenky and Graeber stated that "there is no scientific basis for the different hours assigned as limits for different departure times." They asserted that "[u]npublished alertness modeling data provided to the ATA (and presumably the ARC) demonstrated that a rest provided during the second half of a long-haul flight equal to (flight time minus two hours) divided by two produced roughly equivalent alertness regardless of time of departure." Drs. Belenky and Graeber concluded that, based on the modeling data, there is no need to differentiate between the different departure times so long as in-flight rest was provided during the second half of the flight. ATA added that augmented flights departing later in the day would provide in-flight sleep during the WOCL for flightcrew members who would be manipulating the controls during landing, and thus, that in-flight sleep would be more restful.

NACA and a number of air carriers who conduct supplemental operations submitted the following FDP limits as an alternative to the proposed Table C.

NACA Proposed

Table C to Part 117—Flight Duty Period: Augmented Operations

Acclimated	Maximum Flight Duty Period (hours) Based on Rest Facility and Number of Pilots					
	Class 1 Rest Facility		Class 2 Rest Facility		Class 3 Rest Facility	
	3 Pilots	4 Pilots	3 Pilots	4 Pilots	3 Pilots	4 Pilots
0000-2359	18	20	17	19	16	18

The above proposal for augmented operations extends the flight duty period limits for augmented operations by four to six hours, depending on the number of pilots used and the type of rest facilities available onboard the aircraft. Because in-flight rest is provided through onboard rest facilities, the proposal made by the air carriers who conduct supplemental operations does not decrease a flightcrew member's flight duty period limits when the pilot flies during the WOCL.

UPS suggested that "four person augmented operations with a class one rest facility should provide a 16-hour FDP regardless of report time." UPS asserted that this type of augmented FDP limit "would allow U.S.-based certificate holders to compete globally without an FRMS."

Atlas Air asserted that most of its augmented flights have FDPs lasting between 18 and 20 hours, many of which are single-stop and nonstop flights in support of AMC missions. Atlas Air stated that it would not be able to keep operating those flights under the limits set out in Table C. As such, Atlas Air suggested that the FAA increase the FDP limits in Table C.

Conversely, ALPA, IPA, CAPA, Flight Time ARC, and other labor groups submitted the following alternative to the proposed Table C, arguing that, in applying the TNO Report, Table C utilized a rounding process "that doesn't adequately represent the actual calculations used in the ARC process."

Revised Table C—Flight Duty Period: Acclimated Augmented Flightcrew

Time of Start (Local Time)	Maximum Flight Duty Period (hours) Based on Rest Facility and Number of Pilots					
	Class 1 Rest Facility		Class 2 Rest Facility		Class 3 Rest Facility	
	3 Pilots	4 Pilots	3 Pilots	4 Pilots	3 Pilots	4 Pilots
0000-0559	13:50	16:05	12:55	14:20	11:45	12:15
0600-0659	15:10	17:40	14:10	15:40	12:55	13:25
0700-1259	16	18	15:25	17:05	14	14:30
1300-1659	15:10	17:40	14:10	15:40	12:50	13:20
1700-2359	13:50	16:05	12:55	14:20	11:45	12:15

APA criticized the proposed Table C for not applying the TNO Report's rationale to the unaugmented FDP limits for the late evening and early morning hours. APA's alternative to Table C had significantly lower FDP limits for the late evening and early morning hours. APA also stated that the TNO Report has not been validated in the aviation context, and that consequently, the FAA should proceed more cautiously in increasing the existing limits for augmented operations.

Table C differentiates between different FDP departure times because of the type of rest that flightcrew members receive prior to beginning the FDP. As discussed in more detail below, section 117.25 requires a 10-hour rest period with a minimum 8-hour sleep opportunity immediately before a flightcrew member begins his or her FDP. Based on this requirement, flightcrew members who begin an FDP in the morning will obtain their pre-FDP sleep at night during the WOCL. Conversely, flightcrew members who begin an FDP later in the day or at night will obtain their pre-FDP sleep during the daytime. Because sleep taken at night during the WOCL is more restful than sleep taken during the day,[65] flightcrew members who begin their FDP in the morning will be better rested than flightcrew members who begin their FDP later in the day or at night. Accordingly, Table C sets higher FDP limits for augmented FDPs that begin in the morning and lower FDP limits for augmented FDPs that begin later in the day or at night.

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In selecting the specific timeframes for Table C, the FAA was primarily concerned with the quality of pre-FDP rest obtained by the flightcrew members, and not with whether those flightcrew members' FDP required them to work during the WOCL. This is because the redundancy inherent in an augmented operation ensures that there are extra flightcrew member(s) available to take over the duties of someone who becomes unduly fatigued during the WOCL. Since the timeframes of the unaugmented FDP limits in Table B were calibrated to ensure that unaugmented flightcrew members with long FDPs do not work during the WOCL, the specific timeframes of the augmented FDP limits in Table C (which address a different concern) are different from the timeframes of Table B.

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[65] See, e.g., James K. Wyatt, et. al., Circadian temperature and melatonin rhythms, sleep, and neurobehavioral function in humans living on a 20-h day, Am. J. Physiol. 277 (4), at R1160–62 (1999); Torbjorn Akerstedt & Mats Gillberg, The Circadian Variation of Experimentally Displaced Sleep, Sleep, Vol. 4, No. 2, at 159-69 (1981).

The FAA has considered Drs. Belenky and Graeber's suggestion that, based on unpublished modeling data studying long-haul flights, there is no need to differentiate between the different departure times so long as in-flight rest was provided during the second half of the flight. The FAA notes that the modeling data cited by Drs. Belenky and Graeber relies on in-flight rest being provided during the second half of the flight. However, in order to provide operational flexibility to air carriers, this rule requires that only the pilot who will be flying the aircraft during landing receive his or her in-flight rest during the second half of the FDP. As such, the FAA is unpersuaded by the fatigue modeling data cited by Drs. Belenky and Graeber because that data does not take into account the fatigue levels of all the members of the augmented flightcrew.

The FAA has also considered ATA's argument that augmented flights leaving later in the day would provide in-flight sleep during the WOCL for flightcrew members who would be manipulating the controls during landing. However, there is little real-world data concerning the extent of the mitigation provided by in-flight sleep during the WOCL. The FAA is particularly concerned about whether the benefits of in-flight WOCL sleep would outweigh the less-restful daytime sleep obtained by flightcrew members who begin FDPs later in the day. Consequently, the FAA has decided to retain the shorter FDP limits for augmented FDPs that begin later in the day, but this position may change if FRMS-provided real-world data addresses the FAA's concerns in this area.

The FAA has decided to retain the departure-time-based approach in Table C because, as discussed above, that approach is necessary to take into account the quality of rest that a flightcrew member receives immediately prior to beginning an FDP. However, in response to industry concerns, the FAA has determined that a slight upward adjustment to the FDP limits in Table C would not have an adverse effect on safety. This is because, as discussed in the Flight Time section, the flight-time limits for augmented operations effectively limit the time that each augmented flightcrew member spends flying an aircraft to approximately 8.5 hours. Accordingly, the FAA has increased each of the FDP limits in Table C by one hour. The FAA is also open to the possibility of further increasing the FDP limits in Table C if additional data is provided, as part of the FRMS process, showing that longer augmented FDPs do not have an adverse impact on safety.

The FAA has considered the labor groups' concern that the specific limits in Table C somewhat deviate from the TNO Report's rationale. However, the FAA believes that these deviations are justified in light of the fact that the flight-time limits in this rule curtail the time that flightcrew members spend engaged in the fatiguing activity of piloting an aircraft. As discussed above, each of the augmented flight-time limits has been calibrated so that each flightcrew member only spends approximately 8.5 hours flying the aircraft. Because the remainder of each flightcrew member's FDP is spent either resting or doing less-fatiguing activities, the FAA has determined that an upward deviation from the TNO Report is justified in this case.

The FAA agrees that the TNO Report has not yet been validated in the aviation context. However, the TNO Report contains the latest scientific evaluation of onboard rest facilities, and the report also contains the most comprehensive evaluation of these facilities. Consequently, the FAA finds the TNO Report to be persuasive in this case.

The FAA understands the need to proceed cautiously with setting the limits for augmented operations. That is why this rule largely retains the existing flight-time limits for augmented flights. These flight-time limits curtail the time-on-task of each flightcrew member and serve as a crucial mitigation measure against fatigue. The specific flight-time limits are set at levels with which the FAA has significant operational experience and that have scientifically been shown to be relatively safe.[66] As discussed above, given the time-on-task mitigation provided by the flight-time limits, the FAA has determined that a slight increase to the proposed FDP limits would have no adverse impact on flight safety.

NACA stated that the proposed language was unclear as to whether the two-hour in-flight rest opportunity was required for each augmented flight segment. Drs. Belenky and Graeber criticized the proposed requirement that flightcrew members manipulating the controls during landing receive their in-flight rest during the last flight segment. They stated that the last flight segment on an augmented flight may be short, in which case the flightcrew members manipulating controls during landing would not receive their in-flight sleep during the most optimal FDP time. As an alternative, Drs. Belenky and Graeber suggested allowing in-flight rest to occur before the last flight segment, but then limiting the flightcrew members to only conducting one more landing after their in-flight rest. ATA and CAA endorsed Drs. Belenky and Graeber's analysis.

ATA, CAA, Atlas Air, Delta, and UPS criticized the proposed requirement that in-flight rest for flightcrew members manipulating the controls occur during the last flight

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[66] See Folkard, supra note 15, at 98 (showing an exponential increase in accident risk after the 8th and 9th

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segment. ATA stated that to accommodate this requirement, the last flight segment would have to be at least 3.5 hours long, which would not accommodate some current operations. ATA and UPS added that turbulence or other factors affecting the final leg—such as a diversion—may also prevent the landing pilot from receiving a full two hours' rest on the last leg. UPS stated that a customer in a supplemental operation may require a short final segment. Atlas Air stated that some of its customers request short flight segments as the last segments of an FDP.

Deleted: CAA stated that the final flight segment is generally less than four hours in all-cargo operations.

ATA and Delta recommended that the in-flight rest for flightcrew members landing the aircraft be permitted to take place during the last six hours of the FDP. UPS recommended that the required in-flight rest for the landing flightcrew take place during the last eight hours of the FDP.

NACA recommended doing away with the two-hour and ninety-minute in-flight rest requirements altogether, arguing that shorter amounts of rest were also recuperative. In support, NACA cited a NASA study showing that a short in-cockpit nap mitigated short-term fatigue. NACA also stated that NTSB records do not reveal a single accident involving an augmented crew in which fatigue was a factor.

Drs. Belenky and Graeber also argued that the 2-hour required in-flight rest opportunity could be broken up and distributed over multiple flight segments. In support, they cited the 2003 Bonnet and Arand clinical review for the proposition that rest of less than 2 hours would be beneficial in the augmentation context. They also cited a NASA study showing that short cockpit naps could be used to mitigate short-term fatigue.

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hour of work.

ALPA, IPA, CAPA, Flight Time ARC, and other labor groups suggested that the 2-hour sleep requirement for the flightcrew member manipulating the controls during landing apply to both flightcrew members who will be occupying a control seat during landing. These commenters emphasized that both flightcrew members manipulate the controls, i.e., the non-flying pilot normally operates flaps, landing gear and radios and performs monitoring so he must be equally alert. The commenters added that there are also other high workload circumstances where both pilots are manipulating the controls such as when a landing must be rejected or decision-making is required for diversion. Conversely, Delta stated that only one flightcrew member actually manipulates the controls to land an aircraft while the other flightcrew member at the control station performs secondary functions.

NJASAP asked whether the 2-hour and 90-minute rest requirements for augmented operations were cumulative. Specifically, NJASAP asked whether flightcrew members who will be manipulating the controls during landing are required to have in-flight rest totaling 3.5 hours. NJASAP and North American Airlines also asked whether there was a minimum length for a flight segment in an augmented FDP. NJASAP suggested that each flight segment in an augmented FDP should be long enough for a flightcrew member to gain sufficient amounts of in-flight rest. North American Airlines suggested that subsections 117.19(c) and (d) be eliminated in order to prevent confusion. NJASAP also asked when the flightcrew member who will land the plane should end his or her in-flight nap and take his or her space at the flight controls.

The reason that the proposed rule required two hours of rest during the last flight segment for flightcrew members who will be manipulating the aircraft controls during landing was to ensure that the landing flightcrew members obtain fatigue-mitigating rest close to the time that they begin the landing. However, the FAA agrees with commenters that requiring the rest to take place during the last flight segment unnecessarily limits existing operations, some of which use a short flight segment as the last segment of an augmented operation. As such, this section has been amended to require that the flightcrew member who will be flying the aircraft during landing receive his or her in-flight rest during the second half of the FDP. This amendment allows air carriers flexibility with scheduling flight segments for augmented FDPs while at the same time ensuring that the landing flightcrew member receives at least two hours of continuous rest close to the time that he or she will be landing the aircraft.

The FAA has also considered the NASA study cited by NACA. This NASA study showed that a 40-minute sleep opportunity resulting in a 20-26 minute nap created a relative improvement in alertness for the 90-minute period following the nap. However, this study does not justify eliminating the requirement that the flightcrew member who will be flying the aircraft during landing receive two hours of rest during the second half of the FDP. This is because the NASA study did not establish whether the 20-26 minute nap mitigated fatigue for more than 90 minutes after the nap was taken. As such, if a landing flightcrew member takes his or her in-flight rest at the beginning of the FDP, it is unclear from the results of the NASA study whether the benefits from the short in-flight nap would still exist at the end of that flightcrew member's FDP when that flightcrew member is engaged in the safety and work-intensive task of landing an aircraft.

The FAA also notes that it is retaining the requirement that the 2 hours of rest be continuous. This is because there is an overhead cost associated with getting to sleep, and a person waking up from a nap also does not immediately become fully alert upon waking up. Consequently, if a person takes only one continuous nap, the going-to-sleep/waking-up costs only have to be paid once. However, if a single nap is split up into multiple naps, those costs have to be paid each time a nap is taken. Because augmented flights will only be in the air for a limited amount of time, the additional going-to-sleep/waking-up costs would reduce the total amount of time available for recuperative in-flight rest. As such, to maximize the amount of recuperative rest obtained by augmented flightcrew members and minimize the costs associated with going to sleep and waking up, the minimum in-flight rest requirements in this section require that the rest be continuous.

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As Delta pointed out, only one flightcrew member actually flies the aircraft during landing while the other flightcrew member on the flight deck performs secondary functions. While these secondary functions are important, they are not as task-intensive as landing an airplane. Therefore, this section only requires two hours of in-flight rest in the second half of the FDP for the pilot who will be flying the aircraft during landing. The regulatory language in this section has been clarified accordingly. The regulatory language in this section has also been amended to clarify that the ninety-consecutive-

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minute rest opportunity is only necessary for the pilot who will be performing the secondary monitoring duties on the flight deck during landing.

In addition, the 2-hour and 90-minute rest requirements for augmented operations are not cumulative. If a flightcrew member only performs secondary monitoring duties during landing, that flightcrew member is only required to have a minimum of 90-minutes of in-flight rest. If a flightcrew member flies an aircraft during landing, that flightcrew member is required to have a minimum of 2 hours of in-flight rest in the second half of his or her FDP.

Based on these rest requirements, at least one flight segment in the second half of the augmented FDP of a flightcrew member who will be flying an aircraft during landing must exceed two hours so that the flightcrew member can obtain his or her minimum continuous in-flight rest. This flight segment need not be the last flight segment of the FDP. The two hours of in-flight rest simply needs to take place in the second half of the FDP of the flightcrew member who will be flying the aircraft during landing.

The flightcrew member who will be flying the aircraft during landing should end his or her in-flight nap and assume control of his or her duty station before the top of the descent, which is about 45 minutes to 1 hour before landing. This is will allow the flightcrew member to take into account all of the surrounding circumstances before reducing the aircraft's altitude in preparation for an eventual landing.

NJASAP asked whether certificate holders could use augmentation on domestic operations. ATA asked that the FAA "affirmatively state in the rule text that for the purposes of operational reliability and flexibility, carriers can augment any flight that would not otherwise require and/or qualify for augmentation." A number of air carriers stated that augmentation on domestic flights should be permitted because the science underlying domestic and international augmentation is the same.

Conversely, three individual commenters, APA, NJASAP, and Captain Sullenberger stated that augmented flightcrews should be used only on international and not domestic flights. NJASAP emphasized that "[a]ugmented crews were intended to allow an aircraft to fly to a destination which was too far to reach under the flight rules governing two flightcrew members, meaning a flight route too long over a geographical region which prohibited the allowing of changing crews." APA stated that domestic flights are capable of replacing the crew between flight segments, and thus, they do not have the same need for augmentation as international flights.

This rule permits augmentation on domestic and international FDPs that meet the criteria set out in section 117.17. This is because, as the air carriers correctly pointed out, augmentation mitigates fatigue the same way on both domestic and international flights. Therefore, augmentation allows air carriers to safely schedule longer FDPs both domestically and internationally.

While augmentation was originally designed to allow air carriers to schedule longer flights, that is not a sufficient justification to limit augmentation to international flights. As an initial matter, some domestic flights are longer than some international flights. Thus, for example, a flight from Atlanta to Mexico City, which is an international flight, is shorter than a flight from Washington D.C. to Los Angeles, which is a domestic flight. In addition, augmentation provides safety benefits on shorter flights as well as longer flights. A flightcrew member working on an 8-hour augmented FDP will be able to obtain in-flight rest and all of the other benefits of augmentation. Consequently, the augmented flightcrew member will have a less-fatiguing FDP than an unaugmented flightcrew member working on a similar FDP.

The FAA has determined that the ability to replace flightcrew members between flight segments is also not a sufficient justification for prohibiting augmentation on domestic flights. Many of the air carriers that fly international routes have a substantial international presence and could easily replace flightcrew members between flight segments on international flights. Conversely, some air carriers do not have a substantial presence at some of the smaller domestic airports, and these air carriers may find it more difficult to replace flightcrew members between domestic flight segments involving those airports.

Because augmentation provides the same amount of fatigue mitigation on both domestic and international flights and because there is no meaningful justification for prohibiting augmentation on domestic flights, this rule permits augmentation on both domestic and international flights.

NACA, CAA, North American Airlines, and Capital Cargo objected to augmented flights being limited to three flight segments. Capital Cargo stated that multi-segment augmented FDPs are safe because flightcrew members on those FDPs receive in-flight rest. Conversely, ALPA, IPA, CAPA, NJASAP, Flight Time ARC, and other labor groups stated that the TNO report was only intended for one-segment flights, and as such, multi-leg augmentation should only be allowed when no crew change is possible.

ALPA emphasized that "[m]ulti-leg augmentation should never be allowed solely for the purpose of extending a flight duty period." NJASAP asserted that multi-leg domestic augmentation is counter to the intent behind augmentation. IPA, CAPA, and IBT Local 1224 suggested that only two flight segments should be permissible for an augmented FDP.

As discussed in the Unaugmented FDP section, there is evidence that additional flight segments increase flightcrew member fatigue. Because existing augmented operations generally do not exceed three flight segments, the FAA has little data concerning the effects of FDPs consisting of more than three flight segments on the fatigue levels of augmented flightcrew members. As such, the FAA has decided to permit augmented FDPs of three flight segments or less, which are used in existing operations, and to require additional FRMS-provided data from air carriers wishing to exceed the three-flight-segment limit.

ATA and UPS stated that the FDP limits for four-pilot crews are counter to science because they permit longer FDPs for pilots who land during the WOCL than for pilots who do not land during the WOCL. As such, ATA suggested that the limits for four-pilot operations "be adjusted to uniformly reflect the maximum values currently set forth in the table." ATA stated that such an adjustment would make this rule similar to other standards like CAP-371.

Conversely, IPA, CAPA, IBT Local 1224, and Flight Time ARC suggested that the FAA not allow four-pilot augmentation for flights with a Class 3 rest facility. These commenters argued that a Class 3 rest facility only provides marginal rest, and placing more pilots on board with this type of facility would just increase the likelihood that there will be more fatigued pilots.

As discussed above, the specific timeframes in Table C were calibrated to take into account only the quality of rest received by each flightcrew member before beginning an FDP. Because of the redundancy safeguards inherent in augmentation, the FAA determined that there was less of a safety concern associated with augmented pilots flying an aircraft during the WOCL.

Turning to the distinction between three- and four-pilot flightcrews, the reason that Table C sets lower limits for three-pilot crews than it does for four-pilot crews is that, in a three-pilot crew, each pilot spends more time piloting the aircraft. Take, for example, a 12-hour flight segment. Because two pilots are required to operate the aircraft, pilots in a four-pilot crew working in shifts of two would each spend 6 hours on the flight deck. Conversely, pilots in a three-pilot crew working in shifts of two would each spend 8 hours on the flight deck. Because pilots working as part of a three-pilot crew spend more time piloting the aircraft and less time resting, Table C sets lower FDP limits for three-pilot crews.

The FAA understands that this distinction makes this rule different from other regulatory rules, such as CAP-371, which do not distinguish between three and four-pilot augmented crews. Here, while CAP-371 does not distinguish between three- and four-pilot crews, it addresses the safety issues associated with augmentation flights in other

Deleted: However, as discussed above, the Administrative Procedure Act requires the FAA to consider the specific operating environment that it is regulating instead of simply following the requirements imposed by other civil aviation authorities.

ways by requiring three hours of in-flight rest during augmented operations[67] instead of the ninety minutes to two hours required by this rule.

The FAA has also decided to retain augmentation for four-pilot flightcrews on flights with a Class 3 rest facility because, even though these flights have a lower-quality rest facility, each of the pilots in the four-pilot flightcrew will spend less time piloting the aircraft than the pilots in a three-pilot flightcrew. Consequently, the members of the four-pilot augmented flightcrew will accumulate less fatigue during their flight than the members of the three-pilot augmented flightcrew. The lower quality of the Class 3 rest facility is instead reflected in the relatively-low FDP limits associated with that facility.

APA suggested amending subsection 117.19(e) to add a requirement that the PIC-type-rated flightcrew member be fully qualified and landing current. APA stated that the flightcrew member(s) flying the aircraft need to be capable of performing a landing because unforeseen circumstances during the flight may require the flightcrew member(s) in the cockpit to make a prompt emergency landing. NJASAP stated that all flightcrew members in an augmented operation should be type-rated.

In response to APA's concern, the language in section 117.19(e) has been amended to require that at least one flightcrew member on the flight deck must be qualified in accordance with 14 CFR 121.543(b)(3)(i). A flightcrew member qualified in accordance with section 121.543(b)(3)(i) will be both fully qualified and landing current.

Turning to NJASAP's concern about all flightcrew members being type-rated, the FAA notes that the existing regulations require the second in command (SIC) to be type-

[67] CAP-371, section 15.3.

rated for all non-domestic flights. See 14 CFR 61.55(a)(3). While these regulations do not require the SIC to be type-rated on domestic flights, the FAA has determined that 14 CFR 121.543(b)(3)(i) requires a high degree of training, and having at least one flightcrew member on the flight deck who is qualified in accordance with this section provides sufficient staffing to safely operate the aircraft and respond to any unforeseen circumstances that may arise.

Boeing asked for clarification about whether FDPs consisting of a mix of augmented and unaugmented flights are subject to Table B or Table C.

The FDP and flight-time limits for augmented operations were set at higher levels based on the assumption that flightcrew members working on those operations would obtain the fatigue-mitigation benefits of augmentation. A flightcrew member who works on an unaugmented flight does not obtain these fatigue-mitigation benefits. As such, if an FDP contains both an augmented and an unaugmented flight, that FDP is subject to the unaugmented FDP-limits set out in Table B and the unaugmented flight-time limits set out in Table A.

IPA, CAPA, Flight Time ARC, and other labor groups also suggested that, to ensure proper in-flight rest, this rule require a Class I rest facility for any augmented FDP in which the flight time exceeds 12 hours.

As discussed in the Flight Time section, the flight-time limits for augmented FDPs have been set so that each flightcrew member flies the aircraft for approximately 8.5 hours. Because this flight-time restriction limits each flightcrew member's time-on-task to acceptable levels, there is no need to impose minimum rest facility limitations for sub-categories of augmented operations.

NACA suggested, without elaboration, that the FDP limits for unacclimated flightcrew members be decreased by 1 hour instead of the proposed 30 minutes. ALPA, IPA, IBT Local 1224, and Flight Time ARC argued that the proposed 30-minute reduction for unacclimated flightcrew members is too simplistic. As an alternative, these commenters proposed a Table D, containing FDP limits for unacclimated flightcrew members, which decreased unacclimated flightcrew member FDP times by values ranging from 20 to 50 minutes (depending on the time of day).

The 30-minute FDP-limit reduction for unacclimated flightcrew members was imposed to account for the additional fatigue experienced by these flightcrew members. The FAA is unaware of NACA's reasons for suggesting that the FDP reduction for unacclimated flightcrew members be increased to one hour.

Turning to the suggestions put forward by the labor groups, because the unacclimation reductions set out in the commenters' suggested Table D are relatively close to the FAA-proposed 30-minute reduction, the FAA has decided to retain the 30-minute reduction for the sake of regulatory simplicity. As commenters have pointed out elsewhere, parts of this rule are somewhat complex, and as such, the FAA has determined that adding another table solely for unacclimated flightcrew members would add undue complexity to this section.

ALPA, IPA, CAPA, and IBT Local 1224 recommended changing the label in Table C for "Time of start" to clarify that the timeframes specified in Table C are based on home base or acclimated time. The FAA adopts this recommendation, and the label in Table C has been changed to clarify that the "Time of start" in Table C is based on home base or acclimated time.

I. Schedule Reliability

In the NPRM, the FAA proposed reporting requirements to facilitate realistic scheduling by the certificate holders. Proposed § 117.9, Schedule reliability, would have required the certificate holder to adjust (1) its system-wide FDPs if the total actual FDPs exceed the scheduled FDPs more than 5% of the time; and (2) a specific FDP if it is shown to exceed the schedule 20% of the time. The certificate holder would have to adjust its schedule within 60 days for any FDP(s) that exceeded the above-stated percentages.

The FAA also proposed that each certificate holder must submit a report every two months detailing the adjustments described above (the overall schedule reliability and pairing-specific reliability) and include the following information: (1) the carrier's entire crew pairing schedule for the previous two-month period, including the total anticipated length of each set of crew pairings and the regulatory limit on such pairings; (2) the actual length of each set of crew pairing; and (3) the percentage of discrepancy between the two data sets on both a cumulative, and pairing-specific basis.

No commenters supported the requirements for schedule reliability as proposed. Many commenters argued that the proposed requirements were unnecessary as they would not do anything to mitigate transient, cumulative or chronic fatigue. Others believe that the proposal was seriously flawed and that adjustments to the proposed requirements were necessary.

Pinnacle, RAA, ATA, Alaska Airlines, Continental, American Airlines and Capital Cargo International Airlines (CCIA) contend that the schedule reliability section should be deleted entirely. They argue that these proposed requirements do not advance fatigue mitigation and present unjustified costs and burdens on certificate holders. RAA stated that the NPRM did not set forth any discussion of a statistical basis/reality check for the selection of a 5% FDP "late arrival" rate for the certificate holder's operation as a whole, or as the trigger point for when the certificated holder must take action to "adjust." Similarly, RAA states that there is no discussion to support the selection of 20% for a particular FDP that actually exceeds the scheduled time. RAA also commented that there is limited likelihood that the flightcrew member FDP reliability analysis under the NPRM would differ greatly from an airline's on-time arrival statistics even if the proposed regulatory text is changed to reflect a 14-minute "grace period" that DOT affords in its on-time reporting statistics.

Several commenters, including CAA, UPS, World Airways, American Eagle Airlines (AE), and ALPA, also objected to the schedule reliability provision and suggested that instead of reporting when actual FDPs exceed scheduled FDPs, certificate holders should only report FDPs that exceed the maximum limits under the regulations. They argue that as long as the flightcrew member's FDP falls within the parameters of the maximum permitted under the regulation, the certificate holder must have the operational flexibility to manage schedules as they determine. The commenters also stated that a reporting schedule which requires a certificate holder to detail occurrences that exceed the maximum limits provided in Tables B and C, and to adjust the schedules that consistently exceed those limits, is reasonable.

Commenters also submitted varying timeframes for the reporting. Some recommended 30 days, other suggested quarterly reporting. There were various comments on how long the certificate holder had before taking corrective action.

IBT Local 1224, IPA, the Flight Time ARC, and FedEx ALPA recommended that the schedule reliability section extend to flight segments as well.

IATA commented that any reporting requirements should relate directly to fatigue and not to compliance with published schedules. UPS stated that the reporting requirements should be seasonal to comport with schedule changes. UPS also argued that schedule reliability would actually increase fatigue because certificate holders would pad time spent on the ground during multi-segment FDPs, which would result in a corresponding reduction in restorative layover rest. UPS and NAC contend that this section addresses domestic scheduled operations and is illogical for others, particularly non-scheduled operators.

The FAA acknowledged in its Response to Clarifying Questions that the NPRM discussion on schedule reliability was confusing. The FAA also acknowledges that this section as proposed raised considerable concerns from virtually all commenters. After reviewing the comments, the FAA concludes that the concept of schedule reliability is better addressed by the simpler approach recommended by the group of commenters, who suggested reporting actual FDPs that exceed the maximum regulatory limits. This is discussed in detail in the next section.

J. Extensions of Flight Duty Periods

The FAA agrees that FDPs that exceed the maximum FDP permitted under Table B are the ones that directly impact fatigue and must be addressed by the certificate holder. Adopting this approach will make the certificate holder accountable for scheduling FDPs realistically. While a certificate holder can schedule FDPs up to the maximum presented in the tables, it is unlikely to do so because of the cumulative limits (weekly and monthly) on FDPs. This approach addresses a significant portion of the commenters' concerns. Proposed section 117.9 is deleted and the FAA adopts new § 117.19 Flight Duty Period Extensions.

This new section sets forth the limits on the number of FDPs that may be extended; implements reporting requirements for affected FDPs; and distinguishes extended FDPs due to unforeseen operational circumstances that occur prior to takeoff from those unforeseen operational circumstances that arise after takeoff. For purposes of maintaining all requirements for FDP extensions in a single section, the provisions permitting extended FDPs based on unforeseen circumstances proposed in § 117.15 FDP: Un-augmented operations and § 117.19 FDPs: Augmented flightcrew are now codified in § 117.19.

RAA, Southwest Airlines and World Airways object to the pilot in command being the decision maker on whether to extend an FDP. Continental, however, recommends that the decision to extend a FDP should be a joint decision between the pilot in command and the certificate holder. APA commented that the decision of the pilot in command is crucial in determining whether to extend an FDP.

The FAA agrees that the responsibility for determining whether a FDP needs to be extended rests jointly with the pilot in command and the certificate holder. This ensures that one party is not taking excessive action over another party, and that proper considerations are factored into the decision-making. Paragraph (a)(1) of this section permits, under unforeseen operational circumstances that arise prior to takeoff, the pilot in command and the certificate holder to extend the maximum FDP permitted in Table B and C by two hours.

In the NPRM, the FAA specifically questioned whether the proposed two-hour extension was appropriate. SWAPA opposed any extension beyond the free 30-minute extension and argued that this would invite abuse. NJASAP supported one extension up to two hours, as long as compensatory rest was applied following the extension. IPA supported the two-hour extension as reasonable but opposed the three-hour extension for augmented operations because greater rest opportunities are not provided for those operations. APA supports the limits on extensions and argues in particular that the 12-13 hour period repeatedly has been cited as a point at which accident risk increased dramatically. APA also commented, however, that there are certain circumstances in which a FDP can be safely extended beyond the two hours contemplated in the NPRM. NACA supports a two-hour extension for both augmented and unaugmented operations.

The FAA agrees that an extension must be based on exceeding the maximum FDP permitted in Table B and C. It is unreasonable to limit extensions on FDPs that are less than what the certificate holder can legally schedule. In addition, there is a 30-minute buffer attached to each FDP to provide certificate holders with the flexibility to deal with delays that are minimal. However, after the 30-minute buffer, any time that the FDP needs to be extended, the requirements and limitations of this section apply. In the NPRM, the FAA proposed a two-hour FDP extension for unaugmented operations due to unforeseen operational circumstances and a three-hour FDP extension for augmented operations under similar situations. The FAA concludes that there is no distinction for FDP extension based on whether the operation is conducted by an augmented flightcrew. The difference between unaugmented and augmented operations is accounted for by the different hourly limits in Tables B and C. The hourly limits of Table C were developed in consideration of the extra flightcrew members and rest facilities onboard the aircraft for augmented operations that mitigate the effects of longer FDPs. There is no further mitigation that warrants an additional hour for an augmented crew. The FAA believes that two hours is reasonable and provides the certificate holder with sufficient operational flexibility to adjust for unforeseen operational circumstances. If an unforeseen operational circumstance occurs prior to takeoff, a flightcrew member cannot accept an extended FDP if the completion of that FDP would be more than two hours beyond the maximum FDP permitted under Table B and C for that flight.

In the NPRM, the FAA proposed that an extension of an FDP of more than 30 minutes may occur only once in any 168 consecutive hour period. Hawaiian Airlines, IPA, IBT Local 24, Alaska Airlines, Aloha Air Cargo and several individual commenters supported this proposal. One commenter suggested one extension in a 90-day period.

SkyWest, United, FedEx Express, ATA, and CAA argue that one extension is too restrictive and does not allow any operational flexibility to recover a schedule after an event. SkyWest suggested up to three extensions per week with a total of eight per month. ATA argued that the once in 168 hours rule "is another example of a requirement made unnecessary by other mitigations in the NPRM and which will result in unjustified adverse impacts." ATA and CAA support the statements submitted from Drs. Belenky and Graeber, who commented "that clear science supports that extended work hours over consecutive work days reduces the opportunity for sleep, which can lead to cumulative sleep loss and fatigue. However, there is no scientific evidence to support limiting an extension to once in seven days." They further comment that extensions should not be permitted on consecutive days in order to allow for sleep recovery and no more than two extensions within any one 168 hour period. RAA, Continental, North American, Southwest and two individuals requested two extensions in a 168 consecutive hour period. Kalitta Air and North American Airlines support two non-consecutive extensions in 168 hours, with a 16-hour rest period required if the second extension actually occurs.

Lynden Air Cargo, Southern Air and NACA object to the limit on extensions. They argue that supplemental, non-scheduled operations require flexibility to schedule their operations that is not needed by the domestic scheduled community because they have crews on reserve for use in lieu of extensions.

The FAA is not persuaded by the commenters that more than one extension is appropriate within a 168 consecutive hour period with one exception, discussed below. The elements of the flight and duty requirements adopted in this rule present a conceptual departure from the practice that is in place under the current rules. Under the current rules, extensions of flight time were largely unrestricted as long as a flightcrew member was provided with compensatory rest. Under the requirements adopted today, rest is prospective and the certificate holders are responsible to schedule realistically so that FDP limits can be maintained. Permitting weekly extensions simply encourages scheduling to those extensions and undercuts the purposes of strict limits on FDPs.

In response to the commenters however, the FAA is modifying one aspect of this requirement. In the NPRM, an FDP extension was limited to once every 168 consecutive hour period. While this limited potential abuse of extensions, it did result in an illogical outcome based on certain facts. For example, a flightcrew member that has an FDP extended on Day 1 and then has two days off would be unable to accept another extended FDP on Day 4. After having 48 hours rest, that flightcrew member would not be subject to fatigue based on a two-hour extended FDP. Paragraph (a)(2) provides that an extension of the FDP of 30 minutes or more may occur only once prior to receiving a rest period described in § 117.25(b).[68] This provides certificate holders with one extended FDP but resets the clock for the 168 consecutive hours limit if a rest period of 30 hours or more has been received. Furthermore, the FAA is mindful of the daily tracking and recordkeeping/compliance burden placed on both individual flightcrew members and the certificate holders by a rolling 168 consecutive hour period. This modification will alleviate this tracking requirement.

[68] Section 117.25(b) provides that before beginning any reserve or FDP, a flightcrew member must be given at least 30 consecutive hours free from all duty in any 168 consecutive hour period, subject to certain limitations.

The FAA has included, in paragraph (a)(3), that a flightcrew member's FDP may not be extended due to unforeseen operational circumstances that occur prior to takeoff if such extension could cause the flightcrew member to exceed the cumulative FDP limits specified in § 117.23(c). The basis for this provision is that prior to takeoff a flightcrew member will know whether the delay will result in the flightcrew member exceeding the cumulative limits. If so, the flightcrew member cannot continue the flight.

In lieu of the reporting requirements proposed under the schedule reliability, the FAA adopts a two-prong requirement for reporting extended FDPs. In addressing unforeseen operational circumstances, it is critical to distinguish those situations that arise prior to takeoff and those that arise after takeoff. Under both situations, the certificate holder must report to the FAA within 10 days any FDP that exceeded the maximum FDP permitted by Table B or C by more than 30 minutes. In this report, the certificate holder must describe the FDP and the circumstances surrounding the need for an extension. If the situation giving rise to the extension occurred prior to takeoff, the certificate holder must address in this report whether the circumstances giving rise to the extension were within its control. Since it is prior to takeoff, once the certificate holder becomes aware of such issue, the certificate holder and pilot-in-command have discretion to evaluate the situation and determine whether it is permissible and appropriate to extend the applicable FDPs and continue with the flight or whether it is more appropriate to replace the affected flightcrew member. Therefore, in situations where the circumstances were within the certificate holder's control, the certificate holder must include in its report the corrective actions that it intends to take to minimize the need for future extensions. The certificate holder then has 30 days to implement such corrective actions. For situations that are not within the certificate holder's control, it is unlikely that there is a corrective action that can be taken. Therefore, under these scenarios, the certificate holder must simply report the extension within 10 days and provide the details surrounding the need for the extended FDP.

Similarly for situations that arise after takeoff, the certificate holder and pilot in command have very little discretion concerning FDPs and flight time limits. Therefore, if an FDP or flight time needs to be extended due to unforeseen circumstances that occur after takeoff, the pilot-in-command and the certificate holder may extend the subject FDPs and flight time, to the extent necessary to safely land the aircraft at the next destination airport or alternate airport, if appropriate. In addition, the extended portion of the flightcrew member's FDP and flight time will be permitted in the flightcrew member's weekly and annual cumulative limits on FDP and flight time limitations. The certificate holder also must report the extension to the Administrator within 10 days of occurrence with the same level of detail as described above.

The reports for extended FDPs and flight time will be forwarded to the appropriate certificate-holding district office where the FAA will monitor all extensions filed. The FAA will review the circumstances surrounding the need for the extensions and if appropriate, whether the circumstances were, in fact, beyond the certificate holder's control. As explained in the NPRM, this determination is on a case-by-case basis. Certificate holders must be aware of scheduling operations into and out of chronically delayed airports. Similarly, certificate holders must be mindful of anticipated weather conditions, e.g., predicted snow storms/blizzards affecting certain airports in the winter. Obviously, not all weather occurrences, ATC delays, or a variety of other situations can be anticipated and addressed by the certificate holder. However, situations that result from inadequate planning are within the certificate holder's control and will warrant corrective action.

The FAA believes that the above requirements will result in realistic scheduling of FDPs. The FAA selected 10 days for the time period to file a report because it is within the time period for retrieval of ATC and weather data in the event that data is necessary for an investigation. This information may be necessary in addressing extended FDPs so it is critical that the FAA receive the report within the same timeframe. In addition, when situations occur that require an extension, the certificate holder must look at the offending segment and identify whether adjustments are needed.

It must be noted that the FAA will investigate each filed report denoting an extended FDP and flight time. This investigation would be conducted by the certificate management office responsible for day-to-day oversight of the air carrier. If the circumstances are found to be within the certificate holder's control, the certificate holder has responsibility to determine the corrective action and to implement that corrective action within the time period required under the regulations. Failure to adhere to the adopted requirements may result in enforcement by the FAA.

K. Split Duty

Sleep studies show that sleep which takes place during the day is less restful than sleep that takes place at night.[69] Other studies indicate that working during the WOCL substantially degrades the ability of a flightcrew member to safely perform his or her duties.[70] One of the problems that this rule was intended to address is the performance degradation experienced by flightcrew members who conduct overnight FDPs and perform their duties during the WOCL after receiving less-restful daytime sleep. This rule addresses this problem by incentivizing fatigue mitigation measures.

One of these fatigue mitigation measures is split duty which is based on the premise that there are times during an unaugmented nighttime FDP when a certificate holder could reasonably provide a flightcrew member with an opportunity for rest. This rest opportunity (opportunity to sleep) would allow a flightcrew member to get some sleep during the night. The nighttime sleep could be used to mitigate the performance degradation created by working through the WOCL.

To incentivize split duty rest, the FAA proposed that a flightcrew member who received a split duty rest opportunity be allowed to extend his or her FDP by 50% of the available split duty rest opportunity. Under the FAA's proposal, the split duty rest opportunity had to be at least 4 hours long, and it could not be used to extend an FDP beyond 12 hours. The rest opportunity had to be calculated from the time that the flightcrew member actually reached the suitable accommodation (sleep facility).

NJASAP opposed the proposed split duty extension, but noted that the proposed rule presented an improvement over existing limitations on such operations. NJASAP

[69] See, e.g., Wyatt, supra note 64, at R1160-62; Akerstedt, supra note 64 at 159-69.

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argued that split duty sleep is a theoretical concept that may result in cumulative fatigue and circadian disruption. In support of its argument, NJASAP cited to a study showing that pilots who obtained 7 hours of sleep at night scored consistently worse than pilots who obtained 9 hours of sleep at night. Given this study and the theoretical nature of split duty, NJASAP cautioned the FAA against awarding an FDP extension based on split duty rest.

Conversely, ATA stated that "science and operational experience supports the concept that a flightcrew member can recuperate because of the opportunity to sleep during a period of their FDP." CAA strongly supported the recognition of split duty as a fatigue mitigation measure. One individual commenter also supported the extension of FDPs through split duty schedules.

NJASAP also asked whether the four-hour threshold was mandatory or whether split duty credit could be obtained for split duty rest that was less than four hours. ATA and UPS argued that the four-hour split duty threshold is arbitrary and not science-based. ATA also criticized as unscientific the NPRM's assumption that there is increased overhead involved with falling asleep during a split duty rest. Conversely, FedEx ALPA supported the four-hour split duty threshold, stating that the four-hour threshold is a valid conservative approach until more scientific data is collected.

Drs. Belenky and Graeber cited a 2003 Bonnet and Arand clinical review for the proposition that "any sleep longer than 20 minutes provides full minute-by-minute recuperative value." Based on this review, Drs. Belenky and Graeber asserted that, for

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[70] See NASA, supra note 22, at 19-34.

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night operations, "any time behind the door of more than 30 minutes would have recuperative value." As such, Drs. Belenky and Graeber argued that the four-hour split duty threshold is not supported by science. ATA, CAA, and FedEx supported this conclusion.

NACA, Kalitta Air, Atlas Air, and NAA cited a NASA study, which states that a 45-minute cockpit nap, including use of a jump seat, with a 20-minute recovery resulted in increased alertness for a minimum of 90 minutes of the flight. These commenters argued that, if this type of benefit could be achieved through a cockpit nap, it could definitely be achieved through a ground rest facility.

The FAA agrees with ATA and CAA that split duty is a valid fatigue mitigation measure. Science has shown that naps can serve to mitigate fatigue.[71] Consequently, split duty naps taken at night will permit a flightcrew member to obtain restful nighttime sleep in the middle of his or her FDP. This restful nighttime sleep will decrease that flightcrew member's fatigue level, and will allow him or her to safely work for a longer period of time. As such, the FAA has retained the split duty FDP extension in this rule.

In response to comments about specific split duty provisions, the FAA conducted further SAFTE/FAST modeling to examine the safety-relevant effects of changing the provisions of the split duty section. The SAFTE/FAST model works by predicting flightcrew member effectiveness on a 0 to 100 scale for each minute of that flightcrew member's FDP. Lower predicted flightcrew member effectiveness results in a lower

[71] See Daniel J. Mollicone, et. al., Optimizing sleep/wake schedules in space: Sleep during chronic nocturnal sleep restriction with and without diurnal naps, Acta Astronautica 60, at 354-61 (2007) (examining the fatigue mitigation potential of naps taken during the day).

SAFTE/FAST number. An effectiveness level of 77 is approximately equivalent to the effectiveness of someone with a blood alcohol concentration of 0.05.

With regard to the 4-hour threshold, that threshold was included in the proposal to ensure that all flightcrew members obtain a minimum amount of restful sleep during split duty. Upon further modeling, the SAFTE/FAST model showed that a split duty break of less than 3 hours with the corresponding FDP extension would, over a 5-night period, result in flightcrew member effectiveness dropping below 77 for a portion of the FDP. Conversely, a split duty break of at least 3 hours resulted in flightcrew member effectiveness consistently staying above 77 over a 5-night period. Accordingly, this section has been amended to reduce the threshold for the split duty extension to a 3-hour split duty break. In response to NJASAP's question, split duty rest that is less than 3 hours simply counts as part of a flightcrew member's FDP and does not serve to extend the maximum FDP limits.

The FAA disagrees with Drs. Belenky and Graeber's assessment of the Bonnet and Arand clinical review. The studies examined in this clinical review tested the impact that sleep fragmentation had on restfulness and the potential resultant daytime sleepiness. During the course of the studies, subjects would be allowed to fall asleep, and their sleep would then be intermittently disrupted. The studies found that if one's sleep is interrupted every 20 minutes following sleep onset during the night (when one is normally sleeping), that person's daytime sleepiness, as measured by the Mean Sleep Latency Test (MSLT), is the same as someone who has not had their sleep interrupted.

There are two problems with applying the Bonnet and Arand clinical review to split duty. The first problem is that the MSLT results measured by the studies analyzed in the clinical review do not necessarily mean that the performance capabilities of subjects who had their sleep interrupted at 20-minute intervals were equivalent to subjects who did not have their sleep interrupted. All the MSLT results mean is that, when MSLT measurements were taken of subjects who had their sleep interrupted, these subjects did not fall asleep within the MSLT's protocol termination at 20 minutes.

The second problem with applying these studies to split duty sleep is that split duty sleep does not involve sleep fragmentation, but rather a restriction on the total amount of sleep provided during the night. A flightcrew member engaging in split duty sleep will presumably not have his or her sleep cycle intermittently disrupted. Instead, that flightcrew member's total split duty sleep amount may be significantly lower than the 8-hour minimum necessary to recover from fatigue. Because the Bonnet and Arand clinical review did not analyze any studies that actually examined the "recuperative value" of receiving less than 8 hours of sleep, that review is not applicable to the minimum threshold necessary to ensure a sufficient amount of split duty sleep.[72]

As the commenters correctly pointed out, a NASA study showed that a 40-minute sleep opportunity resulting in a 20-26 minute nap created a relative improvement in alertness for the 90-minute period following the nap. However, there are three problems with using this study to justify extending a night FDP. First, the NASA study was

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[72] In a previous Bonnet article, the author also states that "…[i]t does appear that any repetitive stimulation of sufficient magnitude to precipitate any changes in ongoing EEG is sufficient to make sleep nonrestorative." Bonnet MH. Sleep restoration as a function of periodic awakening, movement, or electroencephalographic change. Sleep, Vol. 10, at 371 (1987).

conducted to see if alertness might be maintained or improved long enough to more safely complete a scheduled flight. The NASA study was not conducted to determine the conditions necessary to extend the flight duty period. Second, the study did not establish whether the 20-26 minute nap mitigated fatigue for more than 90 minutes after the nap was taken.

The third problem with using the above study to extend an FDP is that this study did not explore the full extent of the fatigue mitigation created by the 20-26 minute nap. For example, if a 20-minute split-duty nap was to be used to extend an FDP so that it infringes deeper into the WOCL, would the 20-minute rest provide sufficient mitigation to counter the extra fatigue created by the additional infringement on the WOCL? Because the study concerning the 20-26 minute nap did not provide an answer to the issues discussed above, the FAA has declined to utilize it in determining the threshold rest amount for the split duty FDP extension.

NJASAP asked whether the split duty rest must be scheduled in advance or whether it could be adjusted as necessary by the certificate holder. ATA stated that the 4-hour threshold is operationally unsound because split duty periods are "calculated dynamically in real time, based upon the actual amount of rest opportunity afforded." ATA provided an example of "split duty rest periods [that] may occur during breaks at a hub while cargo is loaded on an aircraft." In those cases, "[c]rewmembers [would] receive rest in ground facilities during the aircraft loading process." UPS disagreed with the extension being based on the flightcrew member's actual rest time "behind the door" because it removes an air carrier's ability to shorten split duty rest in response to an unforeseen circumstance, such as a weather event. UPS stated that this is a significant change from current practice because, currently, split duty rest most often occurs during an unforeseen circumstance. To adjust for this change, UPS asserted that air carriers would have to delay outbound flights, which will increase pilot fatigue by delaying the onset of post-FDP rest.

The FAA has amended the split duty section to clarify that split duty rest must be scheduled in advance, and that the actual split duty rest break may not be less than the scheduled split duty break. The reason for the advance scheduling requirement is that section 117.5(b) requires flightcrew members to determine at the beginning of their FDP whether they are sufficiently rested to safely perform the assigned FDP. In order to accurately perform this assessment at the beginning of their FDP, flightcrew members need to know approximately when their FDP is going to end. Thus, flightcrew members must be notified of any planned split duty extensions before they begin their split duty FDP so that they can accurately self-assess, at the beginning of the FDP, whether they are capable of safely performing their duties throughout the entire FDP. Thus, for example, a flightcrew member who feels fit to accept an overnight FDP that contains five hours of split duty sleep may not feel fit to accept an overnight FDP that contains only three hours of split duty sleep.

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. Split duty rest breaks must be scheduled in advance, and the actual split duty rest breaks may not be shorter than the scheduled split duty rest breaks. The rationale for this is, as discussed above, flightcrew members must, at the beginning of their FDP, evaluate their ability to safely complete their entire assigned FDP. In order to do so, they must not only know the length of the FDP, but any scheduled split duty rest breaks that they will receive during the FDP.

In addition, knowing in advance about split duty rest allows a flightcrew member to prepare for, and to maximize, the rest opportunity. For example, a flightcrew member who does not know whether he or she will have a split duty break may drink a cup of coffee only to subsequently find out that he or she must take a three-hour split duty rest

20 minutes later. In contrast, a flightcrew member who knows in advance when he or she is taking a split duty break will not drink coffee shortly before the break. Because flightcrew members must determine their fitness for duty before beginning an FDP and because they must conduct themselves in a way that maximizes their rest opportunities, they must be informed prior to commencing an FDP, about the full extent of the split duty rest that they will receive during the FDP.

The FAA understands that this departs from the current air carrier practice of reducing split duty rest in order to recover a schedule during unforeseen circumstances. To mitigate the impact of this change and account for unforeseen circumstances, this rule provides air carriers with a two-hour FDP extension (discussed previously) that they can use to recover their schedules if unforeseen circumstances arise.

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NJASAP asked whether an air carrier could obtain the split duty credit if its flightcrew members do not actually occupy the suitable accommodation during the split duty rest opportunity. UPS criticized the split duty regulation as not taking into account the actual amount of sleep that a pilot receives.

Split duty rest taken under this section does not begin to count until the flightcrew member reaches the suitable accommodation. If the flightcrew member never reaches the suitable accommodation, then that flightcrew member's split duty break will not qualify for a longer FDP. The FAA also emphasizes that, as discussed above, section 117.5(a) requires a flightcrew member to report for duty rested. By virtue of that requirement, flightcrew members must take advantage of any rest periods that are provided, and use them for their intended purpose, which is to sleep.

The FAA has considered UPS' suggestion of amending the split duty extension to track the actual amount of sleep that a flightcrew member receives instead of the length of the split duty break. However, this type of standard would be very difficult to implement because air carriers would need to track when each flightcrew member actually falls asleep. Because this would place a substantial burden on air carriers, the FAA ultimately decided to give credit for the length of the split duty rest opportunity instead of the amount of actual sleep received by the flightcrew members.

Drs. Belenky and Graeber asserted that the 50% split-duty credit was unreasonably conservative for split-duty rest that is taken during usual bedtime hours. However, Drs. Belenky and Graeber cautioned that the 50% credit "may be warranted for split duties that require daytime sleep." ATA stated that the 50% credit was unjustified because a sleep opportunity longer than 20 minutes provides a full minute-by-minute recuperative value. ATA criticized the NPRM's underlying assumption that a four-hour sleep opportunity would only result in two hours of sleep, arguing that this assumption did not apply to ground-based suitable accommodations.

Northern Air Cargo asked for a more generous split duty credit. ATA proposed a split duty credit that increases in proportion to the length of the split duty rest. CAA and FedEx proposed a split duty credit ranging from 100 to 300%, based on the time of day in which the credit is given.

As stated above, in response to comments, the FAA conducted further SAFTE/FAST modeling to determine whether the split duty provision could be modified without decreasing safety. The modeling has revealed that a 100% credit for split duty rest would not result in flightcrew member effectiveness dropping below 77 for any portion of a series of 5-night FDPs. As such, the split duty credit has been increased to provide for an extension equal to 100% of the split duty rest. The FAA has considered CAA and FedEx's suggestion of providing more than a 100% credit, but, due to the concerns associated with nighttime flying, the FAA would need additional data to provide more than a 100% credit for split duty.

The FAA was also concerned with the fact that the above comments appear to show some misunderstanding of how the split duty section works. In order to clarify the meaning of the split duty section, the FAA has amended this section as follows.

First, the split duty framework, as set out in the NPRM, would count split duty rest as part of a flightcrew member's FDP, and then extend that FDP by the amount of the split duty credit. Now that the split duty credit has been increased to 100%, the FAA has determined that the NPRM's split duty framework is needlessly complicated. As such, this section has been amended so that split duty rest that meets the requirements of this section will simply not count as part of the FDP.

Second, split duty rest was intended to be taken at night so that it could provide flightcrew members with restful nighttime sleep. See 75 Fed. Reg. at 55866. To ensure that the split duty rest credit is not awarded for rest taken during the day, this section has been amended to require that split duty rest only be taken between 22:00 and 05:00 local time.

Third, as the name implies, "split duty" rest should be provided in the middle of a flightcrew member's FDP. To ensure that split duty rest is not taken earlier, the FAA has added a condition that split duty rest cannot be provided before the completion of the first flight segment in an FDP. Finally, the FAA has moved all of the split duty conditions into subsections to improve their readability. These changes should provide additional clarity, and ensure that the split duty section is used in the intended manner.

UPS, Kalitta Air, and ATA stated that the credit given for split duty rest in ground-based suitable accommodations was less than the credit given for some augmented flights, which provide a lower quality rest in aircraft-based rest facilities. UPS pointed out that, under the proposed rule, "[a] 90-minute rest opportunity for a relief officer on an augmented flight in an aircraft with a Class I rest facility permits five additional hours of operation versus an un-augmented flight." UPS added that this disparity between augmented flights and split duty "is even more illogical given that at a ground facility, all flightcrew members receive the same sleep opportunity, whereas while on board, only one pilot can sleep at a time." NACA proposed a split duty credit that is consistent with the credit given for Class 1, 2, and 3 rest facilities in augmented FDPs.

Augmented flights and split duty provide different amounts of credit because they pose different safety risks. An augmented flight contains more than the minimum number of flightcrew members, which allows the flightcrew members to work in shifts during a flight to safely fly the aircraft. If, during the flight, a flightcrew member realizes that he or she is too tired to safely perform his or her duties, the extra flightcrew member(s) can simply take over those duties and safely land the flight at its intended destination.

Split duty, on the other hand, applies only to unaugmented flights, which contain the minimum number of flightcrew members necessary to safely fly an aircraft. If, during an unaugmented flight, a flightcrew member realizes that he or she is too tired to safely perform his or her duties, there is no one there who could take over those duties. Instead, the fatigued flightcrew member must eventually land the aircraft to the best of his or her ability. Because a fatigued flightcrew member on an unaugmented flight presents a far greater safety risk than a fatigued augmented flightcrew member, the FAA used a more conservative approach in determining the split duty credit than it did in determining the limits for augmented operations. However, the FAA is open to the possibility of awarding greater credit for split duty within the scope of an FRMS if a certificate holder is able to provide data that shows that additional credit would not reduce safety.

ATA suggested that the FAA allow split duty FDPs to extend beyond the proposed limit on split duty extensions in order to consistently apply the principles that underlie augmented operations. RAA criticized the 12-hour split-duty FDP limit as arbitrary, arguing that it unnecessarily limits FDPs that contain a large amount of restful split duty sleep. RAA also pointed out that the 12-hour limit permits greater split duty extensions for less-safe overnight flights that have a shorter FDP limit. RAA proposed abolishing the limit on split duty extensions. SkyWest proposed setting the split duty FDP limit at 14 hours if the split duty rest is at least 4 hours long. CAA and FedEx stated that the split duty FDP limit should be set at 15 hours.

The SAFTE/FAST modeling that was conducted in response to comments shows that there are no safety concerns with increasing the split duty limit to 14 hours. This section has been amended accordingly. However, the FAA has reservations about a split duty limit that exceeds 14 hours. This is because section 117.25 now requires a 10-hour rest period, and if an FDP is longer than 14 hours, a flightcrew member's FDP/rest cycle will exceed 24 hours. This type of cycle, if done consecutively, will result in the beginning of a flightcrew member's FDP being pushed back each day by the number of hours that the previous day's FDP/rest cycle exceeded 24.

As an example, take an FDP that begins at 5:00 pm. That FDP is normally 12 hours long, but with a 7-hour split duty break, that FDP would end at noon. The flightcrew member must then obtain 10 hours of rest, which means that he or she would start the next day's FDP at 10:00 pm. The 10:00 pm FDP is normally 11 hours, but with 6 hours of split duty rest, it would end at 3:00 pm the next day. The flightcrew member would then receive 10 hours of rest, which would result in his or her next FDP starting at 1:00 am. Thus, with no limit on split duty FDPs, a flightcrew member could, in three days, go from a 5:00 pm to a 10:00 pm to a 1:00 am FDP start time. This type of shifting of FDP start times could have serious adverse effects on cumulative fatigue, and without more data, the FAA has determined not to take the risk of allowing split duty FDPs to exceed 14 hours.

NACA, Atlas Air, and NAA stated that, because section 117.5 gives a flightcrew member the discretion to terminate an FDP, there is no need to further restate the flightcrew prerogative to accept or decline split duty accommodations or FDP extensions here.

The FAA agrees with the above commenters, and this section has been amended accordingly. The FAA once again emphasizes that, as discussed above, section 117.5(a) requires a flightcrew member to report for duty rested. By virtue of that requirement, flightcrew members must use their rest periods for the intended purpose which is to obtain sleep.

L. Consecutive Nights

As discussed above, one type of fatigue that this rule addresses is cumulative fatigue. In formulating this rule, the FAA was particularly concerned about cumulative fatigue caused by repeatedly flying at night. See 75 Fed. Reg. at 55867. SAFTE/FAST modeling showed substantially deteriorating performance after the third consecutive nighttime FDP for flightcrew members who worked nightshifts during the WOCL and obtained sleep during the day. Id. However, the FAA noted that if a sleep opportunity is provided during each nighttime FDP, that sleep opportunity may sustain flightcrew member performance for five consecutive nights.

To account for the above factors, the FAA proposed to limit nighttime FDPs to three consecutive nights. However, the FAA proposal allowed a flightcrew member to exceed the three-night limit if that flightcrew member received at least four hours of split duty rest during each of his or her nighttime FDPs.

ATA, NACA, AAC, five individual commenters, and a number of air carriers objected to the consecutive-night limit, arguing that it was unreasonable and ignored operational experience. ATA stated that "[t]he industry's substantial experience with nighttime operations shows that pilots who frequently perform night duty are well suited to consecutive night duties because they have training and experience specific to such operations." NACA, NAA, and Kalitta Air suggested completely removing the consecutive-night limit, arguing that restricted nighttime FDP limits made the consecutive-night limit redundant. AAC also suggested removing the consecutive nighttime limit, arguing that some pilots are capable of adjusting their circadian rhythm to effectively sleep during the day. AAC asserted that a three-consecutive-night limit would unfairly penalize those pilots.

Conversely, one individual commenter stated that consecutive nighttime operations lower alertness. NJASAP, IPA, and IBT Local 1224 supported the consecutive-nights limit. IPA and IBT Local 1224 indicated that, according to science and operational experience, a flight duty period encompassing the hours of 0200 and 0600 is challenging, as fatigue is more likely. These commenters stated that the additional fatigue is a result of working during the WOCL and having the rest period occur during the daytime.

Nighttime operations are particularly fatiguing because flightcrew members who work during these operations do so during the WOCL after obtaining less-restful daytime sleep. Studies have shown that this type of work not only leads to transient fatigue, but also leads to cumulative fatigue if repeated over a series of consecutive nights.[73]

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[73] See Philippa H. Gander, et. al., Flight Crew Fatigue IV: Overnight Cargo Operations, Aviation, Space, and Environmental Medicine, Vol. 69, No. 9, Sec. II (Sep. 1998) (discussing sleep debt that builds up over successive nighttime work shifts); Philippa H. Gander, et. al., Crew Factors in Flight Operations VII:

SAFTE/FAST modeling also shows flightcrew member effectiveness decreasing after a flightcrew member works on consecutive nighttime FDPs. In addition, a study conducted by the Federal Motor Carrier Safety Administration (FMCSA) found in a laboratory setting that working five nights in a row while sleeping during the day leads to impaired continued performance even if a 34-hour "restart" rest period is provided at the conclusion of the five-night work period.[74] This study indicates that simply relying on the required 30 hour rest period in a rolling 168 hour (one week) period is insufficient to assure sustained performance for individuals working nighttime FDPs.

In order to address cumulative fatigue caused by consecutive nighttime FDPs, the FAA has decided to retain the consecutive-night limitation. This limitation is necessary because the restricted nighttime FDP limits in Table B only address the transient fatigue caused by working at night. The limits in Table B remain the same regardless of how many consecutive nighttime FDPs a flightcrew member works, and as such, they do not address the cumulative fatigue caused by repeatedly working through the nighttime hours. With regard to AAC's suggestion that some flightcrew members can effectively sleep during the day, this suggestion (which may be true for certain individuals) generally goes against scientific evidence showing that working on consecutive nighttime FDPs creates a sleep debt.[75] Since regulations are drafted to address the majority of the population, the FAA believes the approach adopted here is appropriate.

Psychophysiological Responses to Overnight Cargo Operations, NASA Technical Memorandum 110380 (Feb. 1996) (discussing the impact of night shifts on flightcrew members).
[74] See Hans P.A. Van Dongen, Gregory Belenky, Investigation Into Motor Carrier Practices to Achieve Optimal Commercial Motor Vehicle Driver Performance, Report No: FMCSA-RRR-10-005.
[75] Id.

Drs. Belenky and Graeber cited the Mollicone 2007 and 2008 laboratory studies for the proposition that a sleep period that was split into two naps (one at night and one during the day) had the same effect as a single continuous block of sleep taken at night. Drs. Belenky and Graeber suggested that 2 hours of split duty rest "should sustain performance across more than three consecutive nights" as long as flightcrew members obtained at least 5 hours of sleep during the day. ATA, CAA, and UPS endorsed Drs. Belenky and Graeber's analysis and recommendation.

RAA, ATA, UPS, FedEx and a number of other air carriers added that requiring a 4-hour split duty break in order to exceed 3 consecutive nights would result in more first-night shifts and more day and night duty schedule switches because air carriers will schedule pilots for multiple 3-night series of FDPs rather than a single 5-night FDP series. SkyWest stated that a consecutive-night restriction may disrupt its continuous duty operations, which operate at night and provide flightcrew members with a 4-6 hour rest opportunity. UPS emphasized that the proposed consecutive-night restriction would significantly disrupt its existing business operations. Atlas Air added that cargo air carriers cannot reasonably provide a 4-hour mid-duty break under their current business models.

ATA and CAA emphasized that the consecutive-night limit would disproportionately impact the cargo industry because that industry relies heavily on night operations. UPS stated that, during a night shift, its "flightcrew members typically enjoy, on average, at least a two hour rest in [its] state of the art sleep facilities." FedEx stated that its flightcrew members are typically provided mid-duty rest ranging from 2 to 4.5

hours while freight is offloaded, sorted, and reloaded. UPS asked the FAA to recognize the recuperative value of mid-duty sleep that exceeds 20 minutes.

The Mollicone studies cited by Drs. Belenky and Graeber have, at best, only a limited applicability to the consecutive-night limit because the subjects in those studies received a large block of anchor sleep at night and mid-duty rest breaks during the daytime. In contrast, flightcrew members working on night shifts receive their large block of anchor sleep during the daytime, which, as other studies have shown, provides them with sleep that is less restorative than nighttime sleep.[76]

The FAA was concerned, however, with comments indicating that the 4-hour-mid-duty rest threshold for exceeding the 3-consecutive-night limit was operationally unworkable. The FAA notes that, even though all-cargo operations are not required to abide by part 117, those all-cargo operations that opt into part 117 would be subject to the consecutive-night limit. In response to concerns raised by the commenters, the FAA conducted further SAFTE/FAST modeling to examine the safety ramifications of changing the length of the mid-duty rest break necessary to exceed the 3-consecutive-night limit. The SAFTE/FAST modeling showed that a 5-night FDP, in which a flightcrew member was provided with a 2-hour mid-duty rest break each night, was actually safer than a 3-night FDP with no rest break. The modeling also showed that breaks of less than 2 hours were insufficient to account for the cumulative fatigue of working on multiple consecutive nights.

[76] See Wyatt, supra note 64; Akerstedt, supra note 64.

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In response to the data provided by the SAFTE/FAST modeling, the FAA has amended the consecutive-night limit to allow a flightcrew member to work for up to 5 consecutive nights if he or she receives a 2-hour mid-duty rest break each night. This amendment will greatly reduce the burden of the consecutive-night limit on cargo industry that opts into this rule because FedEx and UPS' comments indicate that these carriers already provide their crewmembers who work nightshifts with an average of 2 hours of mid-duty rest. This will allow continuous duty operations to be conducted 5 nights a week if these operations provide flightcrew members with at least 2 hours of mid-duty rest.

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RAA, Kalitta Air, Kalitta Charters, Capital Cargo, and four individual commenters suggested amending the consecutive-night limit to permit four nights without any mid-duty rest breaks. ALPA, IPA, SWAPA, IBT Local 1224, and Flight Time ARC suggested allowing four consecutive nighttime FDPs if there is a 12-hour rest period after each FDP. UPS suggested that, if the FAA restricts consecutive nighttime operations, unaugmented flightcrews should be allowed to operate at Table C FDP limits so long as they have received a sleep opportunity in a rule-compliant ground-based facility.

This rule does not allow 4 consecutive nighttime FDPs without a mid-duty rest break because flightcrew member performance deteriorates after a third consecutive nighttime FDP. Increasing the length of the rest between FDP periods is not the preferred way of resolving the issue because nightshift workers get their between-FDP rest during the daytime. Because daytime sleep is less restful than nighttime sleep, the FAA has chosen to focus its regulatory efforts on nighttime mid-duty rest breaks instead of longer daytime rest breaks. However, if air carriers provide the FAA with FRMS data showing that longer daytime breaks can sufficiently mitigate cumulative fatigue, the FAA may allow those air carriers to exceed the consecutive-night limit. In addition, as discussed in the preceding section, the FAA has reduced to 2 hours the mid-duty-break threshold necessary to work during 5 consecutive nights. This reduction will greatly reduce the burden of the consecutive-night limit on air carriers.

The FAA also declines UPS' proposal of allowing an unaugmented flightcrew working a nightshift to work at the FDP levels specified in Table C. As discussed above, the augmented FDP limits in Table C are higher than the unaugmented FDP limits in Table B because augmentation provides a number of fatigue-mitigation benefits. In contrast, the consecutive-night limit is simply intended to account for the cumulative fatigue caused by working at night and does not replicate the benefits provided by augmentation. Accordingly, imposition of the consecutive-night limit is not sufficient to allow unaugmented flightcrews to work on the longer FDPs that are permitted for augmented flightcrews.

A number of commenters asked the FAA to define "nighttime FDP." Many of the commenters suggested that "nighttime FDP" be defined as an FDP that infringes on the WOCL. The consecutive-night limit is intended to apply to FDPs that infringe on the WOCL because operations conducted during the WOCL significantly increase cumulative fatigue. Consistent with the commenters' suggestion, the consecutive-nighttime-operations section has been amended to clarify that the consecutive-night limit only applies to FDPs that infringe on the WOCL. In addition, in light of the amendments that have been made to the split-duty section, the consecutive-nighttime-operations section has also been amended to clarify that an FDP whose split-duty rest infringes on the WOCL counts as a nighttime FDP for the purposes of this section.

NJASAP asked the FAA for clarification about how the rule determines whether two nighttime FDPs are "consecutive." Consecutive nights are determined based on calendar nights. Thus, if a flightcrew member works on a WOCL-infringing FDP during one night, and then works during a WOCL-infringing FDP during the following night, that flightcrew member will have worked on two consecutive nights. If, however, the flightcrew member works one night, has the next night off, and then works the following night, these nighttime FDPs would not be considered "consecutive" for the purposes of this section.

ATA also objected to applying the consecutive-night limit to augmented operations. It stated that augmented flightcrew members receive significant inflight rest, and that the consecutive-night limit was redundant as applied to augmented FDPs.

Rest on the ground in a suitable accommodation is superior to rest onboard an aircraft while that aircraft is in flight. As such, any augmented operations that span more than three consecutive nights must mitigate the fatigue of these operations by providing flightcrew members with the two hours of mid-duty rest in a suitable accommodation required by this section.

ATA stated that, because simulator training is now considered part of an FDP, the consecutive-night limit would also limit training opportunities for flightcrew members.

ATA argued that this is an unnecessary burden because flightcrew members would receive a full rest period after training.

Simulator training is only considered to be part of an FDP if it takes place before a flightcrew member flies an aircraft and there is no intervening rest period taken pursuant to section 117.25. This is because all duty after a legal rest and prior to flight is part of an FDP. If the simulator training does not take place before a flightcrew member flies an aircraft, the simulator training is not considered to be part of an FDP, and it is unaffected by the consecutive-night limit.

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Two individual commenters asked the FAA to prohibit air carriers from switching pilots from night to day shifts. These commenters also asked that circadian rhythms not be shifted by more than two hours from the prior day. However, these suggestions are outside the scope of this rulemaking.

M. Reserve

As stated in the NPRM, the term "reserve" has not been addressed in the part 121 regulations; however this term has been the subject of several legal interpretations which include a determination of when a flightcrew member is on duty and whether the required rest associated with a duty period is impeded by a flightcrew member being in a reserve status. The FAA proposed that unless specifically designated otherwise, all reserve is considered long-call reserve. Additionally, the time that a flightcrew member spent on airport/stand-by reserve would be part of that flightcrew member's FDP. For short-call reserve, the NPRM proposed that all time spent within the reserve availability period is duty; the reserve availability period may not exceed 14 hours; no flightcrew member on

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short call reserve may accept and no certificate holder may schedule the flightcrew member's next reserve availability period unless that flightcrew member is given at least 14 hours rest; and the maximum reserve duty period for an unaugmented operation is the lesser of:

-16 hours, as measured from the beginning of the reserve availability period;

-the assigned FDP, as measured from the start of the FDP;

-the FDP in Table B of this part plus 4 hours, as measured from the beginning of the reserve availability period; or

-If all or a portion of a reserve flightcrew member's reserve availability period falls between 0000 and 0600, the certificate holder may increase the maximum reserve duty period by one-half of the length of the time during the reserve availability period in which the certificate holder did not contact the flightcrew member, not to exceed 3 hours.

For an augmented operation, the NPRM proposed that the maximum FDP is the lesser of the assigned FDP, as measured from the start of the FDP; the FDP in Table C plus 4 hours, as measured from the beginning of the reserve availability period; or if the reserve availability period falls between a portion of 0000-0600, the maximum reserve availability period may be increased by one-half the length of the time during which the certificate holder did not contact the flightcrew member but capped at 3 hours.

The FAA proposed that long-call reserve does not count as duty and that a flightcrew member would need to receive a 12-hour notice of report time from the certificate holder if the flightcrew member is being assigned an FDP that would begin before and operate into his or her WOCL.

Lastly, the NPRM proposed provisions that would permit a certificate holder to shift a flightcrew member's reserve availability period subject to meeting certain conditions.

Commenters stated overall that the entire section was overly complicated and complex, with some commenters stating that it also was confusing and illogical. Industry largely objected to the classification of short-call reserve as duty. ALPA, COPA, FedEx ALPA, SWAPA and APA all commented favorably on short-call reserve as part of duty. These comments were addressed in the Definitions section, which removed short-call reserve from the definition of the term "duty."

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NACA, Atlas, NAA, and Kalitta argue that limiting short call reserve to 14 hours is unwarranted for their operations. Kalitta separately recommended that the reserve availability period should be 16 hours followed by 8 hours off. Under Kalitta's recommendation, if a flightcrew member on short-call reserve is called out within the first six hours of that reserve availability period, he or she can utilize the entire maximum FDP, as described in Table B or C. If the flightcrew member is called out after the first six hours of the reserve availability period, then all the time in short-call reserve should be subtracted from the maximum FDP, unless the un-interrupted short-call reserve included the flightcrew member's WOCL. Then the full period of the WOCL should be considered rest. Kalitta argues that this will permit long-haul, non-scheduled operators the ability to continue current operations.

NACA, Atlas, and NAA also argue the proposal is too restrictive because the controlling limitation will always be the assigned FDP, which is a maximum of 13 hours. UPS and ATA state that there is no justification for limiting unaugmented short call reserve to assigned FDP. They contend that this restriction materially deviates from the ARC recommendation concerning this element of reserve.

ATA further comments that using the FDP to set the maximum reserve duty period directly contradicts the NPRM's definition of "reserve duty period" as the reserve availability period plus the flight duty period.

RAA proposed instead that for unaugmented operations, if a flightcrew member is given an FDP while on short-call reserve, the FDP, measured from the time for reporting for assignment, is limited to the Table B maximum FDP minus the full time spent on reserve during the Reserve Availability Period (RAP) up to the report time. Northern Air Cargo (NAC) contends that there is no logic in not allowing for the full FDP after callout. Delta argued that while on reserve, limiting reserve duty periods to scheduled FDP rather than maximum is overly restrictive.

ALPA, COPA, FedEx ALPA, SWAPA and APA submitted the chart below depicting the maximum FDP permissible based on the start of time of the reserve availability period:

Table E—Short Call Reserve Duty Period

Time of Start of RAP (Home Base or Acclimated Local Time)	Maximum Flight Reserve Duty Period (hours) Based on Number of Flight Segments						
	1	2	3	4	5	6	7+
0000-0359	13	13	13	13	13	13	13
0400-0459	14	14	13	13	13	13	13
0500-0559	15	15	15	15	14	13.5	13
0600-0659	16	16	16	16	15	15	14.5
0700-1259	16	16	16	16	16	16	15
1300-1659	16	16	16	16	15.5	15	14.5
1700-2159	15	15	14	14	13.5	13	13
2200-2259	14.5	14.5	13.5	13.5	13	13	13
2300-2359	13.5	13.5	13	13	13	13	13

They argue that the maximum reserve duty period, which would include phone availability and/or FDP assignments, is measured from the start of the RAP and ends at the earlier of the start of the RAP time plus the value in Table E or the FDP in Table B. The purpose of this process is to ensure that the reserve pilot does not have an allowable FDP limit that is greater than the FDP of the line holder whom that reserve flightcrew member is paired with and does not impact the certificate holder because the line holder and reserve flightcrew member end point will be the same.

Peninsula Airways questions whether under this section, a flightcrew member on short-call reserve must have had 14 hours of rest period at the beginning of the current reserve availability period.

The FAA agrees that the proposed reserve provisions were overly complicated and has made numerous changes to reduce the complexity. The ARC came to a number of conclusions during its discussion of reserve. The FAA has decided to rely on the expertise represented in the ARC to address the issue of reserve duty. The FAA does not support Kalitta's proposal described above, which would increase the permissible reserve availability period to 16 hours. Kalitta has not provided supporting rationale that warrants modifying the collective opinion of the ARC. Therefore, this rule adopts the proposal that limits the short-call reserve availability period, in which the flightcrew member is not called to report to work, to 14 hours.

The FAA has modified the regulatory provisions addressing the reserve duty period and unaugmented FDPs. Under the NPRM, the maximum reserve duty period would be the lesser of 16 hours, the assigned FDP, or the FDP under Table B plus four hours. The FAA agrees with the commenters that limiting the reserve duty period to the assigned FDP was overly restrictive and could result in situations where the reserve duty period was unnecessarily short, and would be unworkable for the certificate holders. The FAA has deleted that provision but retains the other two proposed limitations for unaugmented operations. Therefore, the adopted regulatory provisions addressing reserve and unaugmented operations provide that the total number of hours a flightcrew member may spend in a flight duty period and reserve availability period may not exceed 16 hours or the maximum applicable flight duty period in Table B plus four hours, whichever is less. This will allow most FDPs to be accommodated by a flightcrew member on short-call reserve. Additionally, the proposed provisions for giving credit for not calling during the window of circadian low are complicated and unnecessary given the above adopted modifications. Therefore, the credit provisions have been dropped from this rule.

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In response to the question posed by Peninsula Airways regarding whether the flightcrew member, who has concluded a reserve availability period, must have a 14 hour rest period before beginning the next reserve availability period, the FAA modified this provision in accordance with the amendments in § 117.25 Rest period. A flightcrew member must be given a 10 consecutive hour rest period immediately before beginning the reserve or flight duty period. The regulation governing reserve has been adjusted for consistency with the rest provisions. Therefore, if a flightcrew member completes a reserve availability period, he or she must receive a rest period, as required in § 117.25(e), prior to accepting a subsequent reserve availability period.

The FAA also does not agree with the comments from the labor organizations that another Table is necessary for the short-call reserve duty period. Those organizations argue that incorporating the above chart would ensure that the reserve flightcrew member would not have an allowable FDP that is greater than the line holder with whom he or she is paired. This argument is not persuasive. Each flightcrew member is subject to the maximum permissible FDP given that flightcrew member's recent assignments and rest requirements. Consequently, it isn't reasonable to artificially limit a reserve pilot to the FDP limit of the line holding pilot when no such limit applies to the line holding flightcrew members.

Kalitta and UPS questioned why a flightcrew member on long-call reserve and assigned an FDP that begins before and operates in the WOCL, would require a 12-hour rest. These commenters argue that a line holder may be scheduled for duty during the

WOCL with 9 hours rest and that the long-call reserve flightcrew member should have similar treatment as the line holder.

This provision simply requires that the affected flightcrew member must receive 12 hours notice that he or she will be on duty during the WOCL and will need to plan his or her rest during the day. This way, the flightcrew member can structure the rest period in order to provide the best sleep opportunity. As daytime rest is not as restorative as nighttime rest, the flightcrew member may choose to take multiple naps rather than attempting to get a full consecutive 8 hours of sleep during the day. This is comparable to a lineholder who knows in advance that he or she is scheduled for duty during the WOCL, and adjusts his or her sleep opportunity accordingly.

NJASAP questions why the rule does not limit long-call reserve. APA also added that flightcrew members on long call reserve should receive a rest period that includes a physiological night prior to assignment. There is no reason to limit long-call reserve because, by definition, the certificate holder must notify the flightcrew member prior to receiving rest under 117.25(e). Similarly, as the flightcrew member is receiving a 10 hour rest period prior to the flight, it is not reasonable to limit that rest to only the hours between 0100 and 0700. This would unnecessarily restrict the certificate holder's ability to use long-call reserve.

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Kalitta and UPS oppose the provisions limiting the shifting of reserve availability periods. RAA also opposes these provisions and argues that they actually hinder fatigue reduction by forcing more flightcrew schedule disruptions through delay or cancellations than would otherwise be necessary. NACA, Atlas, and NAA contend that the provisions addressing the shift of reserve availability periods are unworkable because it restricts forward shifts to a maximum of 12 hours, which can ultimately result in stranded flights. These commenters illustrate, as an example, if a flight is delayed for 13 hours, this rule would require the aircraft to sit on the ground for hours because the reserve flightcrew would be unable to operate the next flight until they have completed the required rest.

The organizations representing labor also seek to limit, to once in a rolling 168 hour period, the provision that would require a short call reserve flightcrew member coming off of a 14 hour reserve availability period to have a 14 hour rest before accepting an FDP that begins before the flightcrew member's next reserve availability period. The commenters contend that without this once per 168 hour limitation, a flightcrew member could be in a cycle of continuous reserve availability periods.

Since the rest requirements mandate a rest period prior to accepting any short-call reserve period and given the above modifications to the rule, the FAA concludes that the limits on shifting reserve availability periods are unnecessary and would have added a level of complication that is not warranted. This provision is not adopted.

N. Cumulative Limits

In formulating this rule, the FAA found that "[s]cientific studies suggest that long periods of time on duty infringe upon an individual's opportunity to sleep, thus causing a 'sleep debt' which is also known as cumulative fatigue."[77] To limit the accumulation of cumulative fatigue by flightcrew members, the FAA proposed a cumulative duty-period limit of 65 hours in a 168-hour period (7 days) and a limit of 200 hours in a 672-hour

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[77] 75 Fed. Reg. at 55871 and n.42 (citing scientific studies).

period (28 days). These cumulative duty-period limits were slightly increased for short-call reserve and for deadhead transportation in a seat that allows for a flat or near flat sleeping position.

The FAA also proposed cumulative FDP limits based on the standards of other aviation authorities. The proposed cumulative FDP limits restricted FDP to 60 hours in a 168-hour period and 190 hours in a 672-hour period. In addition, the FAA proposed retaining the existing cumulative flight-time limits, which are 100 hours in a 28-day period and 1,000 hours in a 365-day period.

Alaska Airlines stated that the proposed subsection 117.23(a) concerning cumulative FDP limits was ambiguous and arguably made this section apply to flights that a flightcrew member conducted on his or her days off. Alaska Airlines and Delta argued that an air carrier should not be held responsible for flights that a flightcrew member performs on his or her days off that are not assigned by the air carrier. Conversely, SWAPA stated that, due to the complexity of the cumulative limits, the certificate holder should have the sole responsibility of determining whether flightcrew members are in compliance with the applicable cumulative limits.

The cumulative limits in section 117.23 include any flying performed by the flightcrew member on behalf of any certificate holder, or 91K Program Manager during the applicable periods. It does not include personal flying. Subsection 117.23(a) has been amended to clarify this point. The reason that this section includes all flights conducted for a certificate holder or program manager is because a flightcrew member accumulates fatigue on those flights. A flightcrew member accumulates fatigue

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whenever he or she flies an aircraft. The flightcrew member does not accumulate less cumulative fatigue simply because the flying is conducted for another operator.

The FAA has considered the air carriers' argument that the proposed subsection 117.23(a) may affect their scheduled flights as a result of flights that they do not assign to their flightcrew members. However, the FAA believes that its cumulative-limit approach is justified in light of the fact that compliance with this rule is a joint obligation that applies to flightcrew members as well as air carriers. Thus, the FAA expects flightcrew members to inform their employing air carriers of flying that they conduct on days off that would impact the cumulative limits set out in this rule, thus allowing all parties to abide by the applicable cumulative limits.

The FAA also declines SWAPA's suggestion that air carriers bear sole responsibility for determining compliance with the cumulative limits. As discussed in the preceding paragraph, without flightcrew member assistance, air carriers may not even know about some of the flying performed by flightcrew members. While the rolling time periods used in this section may not be as easy to keep track of as calendar periods, the FAA expects both flightcrew members and air carriers to be aware of how many hours the flightcrew members have worked and to abide by the cumulative limits of this section.

RAA opposed the cumulative duty-period limits, arguing that duty was a nebulous concept that was hard to define, and that cumulative duty-period limits are unnecessary in light of the cumulative FDP limits. NACA and NAA stated that an air carrier should be able to assign additional duty time if no further FDPs are contemplated because "[t]here is no further risk of an aviation accident unless flight is involved." NACA, UPS, and a number of other air carriers added that the inclusion, in duty limitations, of administrative duties adversely affected flight-qualified management personnel and addressed work-life issues that had nothing to do with aviation safety. IPA disagreed, arguing that "[j]ust as the certificate holder tracks flight time and flight duty periods, administrative duties should also be tracked." IPA stated that subordinate officials who work in an office all day and fly at night are more likely to be fatigued.

ATA and UPS stated that the proposed rule unfairly expands the concept of duty to "circumstances beyond the carriers' control such as, random drug tests." RAA stated that the duty-period limits essentially limited the time that flightcrew members spend on non-flying tasks, but that this was not a significant factor in flightcrew scheduling. These commenters added that air carriers could not always control the types of seats available to deadheading flightcrew members, and that they should not be penalized for being unable to provide deadheading flightcrew members with flat or near flat seats.

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The FAA agrees with industry comments that cumulative duty-period limits are unnecessary in this rule. Cumulative duty-period limits were intended to address the following: (1) deadheading, (2) short-call reserve, and (3) air carrier directed non-flight activities that lead to fatigue during flight. As discussed in other portions of this preamble, the FAA has amended other parts of this rule to address fatigue-related concerns raised by deadheading and short-call reserve.

Turning to the fatigue-related issues of non-flight activities, on reevaluation, the FAA has determined that the FDP limits in this rule fully address the non-flight activities that could contribute to flightcrew member fatigue. This is because the only non-flight activities that have a significant impact on fatigue during flight are activities that occur immediately before the flight without an intervening rest period. Since there is no intervening rest between the non-flight activities and piloting an aircraft, the fatigue accumulated while performing these non-flight activities remains with the flightcrew member when that flightcrew member pilots an aircraft. Therefore, all non-flight activities that occur immediately before a flight without an intervening rest period are part of an FDP and are appropriately restricted by the FDP limits.

The other non-flight (non-FDP) activities do not significantly affect the fatigue experienced during flight because there is an intervening rest period between these activities and the beginning of an FDP. Consequently, the FAA has eliminated the cumulative duty period limits from this rule.

RAA, NACA, and a number of air carriers opposed the cumulative flight-time limits, arguing that FDPs were the actual source of flightcrew member fatigue. Because FDPs are limited by the proposed cumulative FDP limits, these commenters argued that the cumulative flight-time limits are unnecessary.

Existing regulations impose 30-day flight-time limits of 100 hours and calendar-year flight-time limits of 1,000 hours. The FAA has administered these cumulative flight-time limits for over four decades, and based on its operational experience, the FAA has found that cumulative flight-time that falls within these limits is safe. Because the FAA is unaware of any data showing that flight times exceeding these limits are safe, the

FAA has decided to retain cumulative flightcrew member flight-time limitations within the existing limits.

As the commenters correctly point out, because FDPs include flight time, the FAA could have addressed the concern discussed in the preceding paragraph by calibrating the cumulative FDP limits. However, as discussed in the Flight Time Limits section of this preamble, the FAA chose to retain the concept of flight-time limits in order to set higher FDP limits and provide air carriers with more flexibility. If the FAA eliminated the cumulative flight-time limits from this rule, it would need to drastically reduce the cumulative FDP limits from the limits that were proposed. This is because without cumulative flight-time limits, the proposed cumulative FDP limits would allow flightcrew members to accumulate flight time that significantly exceeds the cumulative flight time permitted by existing regulations. To keep that from happening and provide air carriers with more scheduling flexibility, this rule largely retains the existing flight-time cumulative limits and sets higher cumulative FDP limits than would otherwise have been permissible.

ATA, RAA, and a number of air carriers stated that imposing cumulative limits for three different regulatory concepts (FDP, duty, and flight time) was unjustified and overly burdensome. ATA stated that cumulative limits would result in additional flight cancellations that inconvenience the general public. RAA stated that the multiple limits overlapped to a significant degree, and the numerous cumulative regulatory restrictions would be very difficult to keep track of in practice.

RAA stated that the standards of other authorities were not applicable to this rulemaking because, instead of simply being concerned with safety, "CAP-371 and the EASA regulations envision a system of 'fair and equitable' crew scheduling that is justified in a European context by its intent of spreading more fatiguing assignments among the entire flightcrew member community." While RAA accepted the proposition that some cumulative restrictions were necessary, it believed that this proposal included too many cumulative restrictions.

As discussed above, the FAA has decided to eliminate the cumulative duty-period limits, which should greatly simplify compliance with this section. Thus, the only remaining cumulative limits are FDP and flight-time limits. The FAA has decided to retain both of these cumulative limits because (1) the FDP limits restrict the amount of cumulative fatigue that a flightcrew member accumulates before and during flights, and (2) the flight-time limits allow the FAA to provide air carriers with more scheduling flexibility by setting higher cumulative FDP limits in this rule. This additional scheduling flexibility justifies the added complexity of the cumulative flight-time limits, which can easily be tracked by scheduling programs currently in use throughout the industry. The FAA also notes that complying with the cumulative flight-time limits in addition to the FDP limits should not present a significant burden to many air carriers because they are already required to keep track of pilot flight time in order to comply

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with a statutory provision that limits flight time on interstate domestic flights to 85 hours per month.[78]

The FAA understands that standards such as CAP-371 and EASA were drafted to achieve goals that may be somewhat different from the safety goals of this rule. In light of this fact and the requirements of the Administrative Procedure Act, while the FAA has examined the provisions of the various standards of other authorities, the FAA ultimately made its own independent decisions based on the needs and concerns of the stakeholders and the FAA about how to structure this rule. That is why some of this rule's provisions are similar to other standards and other provisions are very different from the standards adopted by other aviation authorities.

RAA, NACA, AMA, Boeing, and a number of air carriers opposed the 365-day cumulative flight-time limit, arguing that there was no safety-based justification for this limit. These commenters stated that the 28-day flight-time limits, as well as the other proposed cumulative limits, restricted cumulative fatigue to acceptable levels on a continuing basis without the need for an annual flight-time limit. Four individual commenters and SWAPA suggested that the 365-day flight-time limit be increased to 1,200 hours. SWAPA noted that the proposed regulations allow a flightcrew member to have 100 flight-time hours in a month, and "[i]f flying 100 hours per month for ten months in a row does not create a cumulative fatigue problem, we find it hard to imagine that there would be a cumulative fatigue issue in month 11 or 12." One individual

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[78] 49 USC 42112(b)(1). This statutory provision incorporates National Labor Board Decision number 83, which, among other things, limits monthly flight time to 85 hours.

commenter asserted that the individual monthly flight-time limits should add up to the annual limit.

The 1,000-hour 365-day flight-time limit comes from existing regulations, which limit yearly flight-time to 1,000 hours and monthly flight time to 100 hours. To meet the 1,000-hour limit, air carriers must restrict the average monthly flight times of flightcrew members to approximately 83 hours. However, because the 1,000-hour limit is a yearly limit, air carriers have the flexibility to exceed the 83-hour monthly average and fly up to 100 hours during peak months so long as they fly a reduced number of hours during off-peak months.

The FAA has significant operational experience with the 1,000-hour annual limit, and based on this experience, the FAA has determined that a flight-time average of approximately 83 hours per month is safe. For the sake of regulatory simplicity, the FAA has also considered eliminating the 1,000-hour annual flight-time limit and reducing the monthly flight-time limit to 83 hours. However, the FAA ultimately determined that such a reduction would unnecessarily limit air carriers by prohibiting them from scheduling extra flight-time hours during peak months. Thus, in order to preserve existing air carrier scheduling flexibility, this rule retains the 1,000-hour flight-time limit imposed by the existing regulations.

A number of commenters suggested using calendar periods for cumulative limits instead of rolling periods of hours and calendar days. Boeing, Allegiant, and a number of individual commenters suggested that the annual flight-time limit be based on calendar months instead of 365 days. Boeing and Allegiant stated that the existing regulations have a 12-calendar-month limit, and switching to a 365-day limit would: (1) increase costs because air carriers would have to change their existing scheduling systems; and (2) make it more difficult for individual flightcrew members to keep track of the annual limit.

Boeing also argued that the cumulative FDP limits should, for the sake of regulatory simplicity, use 28 calendar days as a time-period measurement instead of 672 hours. SkyWest also suggested using calendar periods instead of hourly limits for the sake of simplicity. Conversely, NJASAP supported the use of hourly time periods instead of calendar days or months as a cumulative-limit measurement. IPA supported the use of hourly time periods for daily and weekly limits, but stated that the monthly and annual limits should be based on calendar days. AMA also supported the proposal's use of rolling calendar day and hourly cumulative time periods, asserting that the use of calendar periods would be subject to abuse.

The FAA has largely used consecutive hours to express time periods in this section in order to create a consistent and uniform enforcement standard. One problem with calendar periods is that different air carriers use calendar periods in different ways. Thus, for example, one air carrier's calendar day may start at midnight, while another air carrier's calendar day may start at 9am.

Another problem with calendar periods is that a single calendar period can cover different lengths of time. Thus, a calendar month could cover a time period ranging from 28 to 31 days. A calendar year would also present problems if it is measured in months instead of days because a 28-31-day monthly period would create lookback problems. To avoid these types of issues with calendar periods, this section expresses the cumulative time periods largely as a function of consecutive hours, which are an unchanging uniform standard that applies the same way to all air carriers. The FAA does not believe that this will create an undue burden for air carriers and flightcrew members because modern scheduling programs and spreadsheets can easily keep track of time periods consisting of consecutive hours.

In light of its preference for consecutive hours, the FAA has amended subsection 117.23(b)(1) so that it expresses the corresponding cumulative limit as a function of consecutive hours instead of calendar days. However, the FAA has decided to retain the flight-time limit in subsection 117.23(b)(2) as an expression of calendar days because expressing 365 days as a function of hours would result in a very high number of hours that would be difficult to apply in practice.

Boeing, Kalitta Air, and Omni Air objected to the FDP limits for the 672-hour (28-day) time period, arguing that cumulative fatigue is already taken into account by the 168-hour cumulative limits. Boeing stated that there is no scientific evidence “proving that an event 672 hours ago has a predictable effect on alertness now.” Conversely, NACA and a number of labor groups supported the concept of cumulative limits for 28-day periods.

The different cumulative FDP limits work on the same flexibility principle as the 672-hour and 365-day cumulative flight-time limits. The cumulative FDP limit for the 672-hour period is 190 hours. To comply with this 190-hour limit, an air carrier has to average approximately 47.5 cumulative hours of FDP in each 168-hour period. However, the 60-hour cumulative FDP limit for each 168-hour period allows air carriers to exceed the 47.5-hour FDP average during peak weeks as long as they go below this average during off-peak weeks. Just like the different flight-time limits, this system provides air carriers with scheduling flexibility while keeping the average weekly cumulative FDP times within acceptable bounds.

APA asked that the FAA add in a cumulative flight-time limit for the 168-hour period, arguing that, without this limitation, air carriers could schedule a significant amount of flight time in this period of time.

The existing regulations for domestic and flag operations impose 30-32 hour cumulative flight-time limits for 7-day periods. However, the existing regulations for supplemental operations do not impose cumulative flight-time limits for 7-day periods. Based on its operational experience administering supplemental operations without a 7-day cumulative flight-time limit, the FAA has determined that there is no need to impose a 168-hour flight-time limit in addition to the other cumulative limits in this rule.

NACA, NAA, and Northern Air Cargo asked the FAA to increase the cumulative FDP limits to match the limits suggested for cumulative duty periods, arguing that the proposed limits did not take into account the needs of supplemental operations. Conversely, AAC, AFA-CWA, ALPA, and a number of other union groups asserted that the proposed cumulative limits were appropriate. ALPA stated that the proposed limits should neither be expanded nor reduced and AAC stated that the FAA should not impose additional cumulative limits.

The proposed cumulative-duty-period limits in this rule were higher than the proposed cumulative FDP limits because duty encompassed more non-flight activities than FDP. Since most of the additional non-flight activities covered by duty did not raise significant fatigue-related concerns, the FAA set the cumulative-duty-period limits at a higher level. As discussed above, because duty periods did not have a significant effect on aviation safety independent of FDPs, cumulative-duty-period limits have been eliminated from this rule.

The FAA has also decided against increasing the proposed cumulative FDP limits. Because this rule retains cumulative flight-time limits, the cumulative FDP limits in this section are set at sufficiently high levels that should allow air carriers full utilization of the cumulative flight-time limits in this section. Thus, for example, the cumulative FDP limit for the 672-hour period is 190 hours, which is almost double the cumulative flight-time limit of 100 hours for this time period. Because the proposed cumulative FDP limits were already set at relatively high levels, the FAA has decided against increasing these limits further without additional FRMS-provided data.

NJASAP asked whether the time spent on reserve will count towards the cumulative FDP limits of this section. Only the time that is spent on airport/standby reserve is considered to be FDP. As such, only the time that is spent on this type of reserve counts toward the cumulative FDP limits of this section.

O. Rest

Rest is a significant element of this rule because it is the most critical component of fatigue mitigation. In this rulemaking, the FAA has addressed the following concerns with the present regulatory scheme governing rest: (1) part 121, subparts Q, R, and S provide rest limits within a 24-hour period, however certificate holders conducting operations with airplanes having a passenger seating configuration of 30 seats or fewer and a payload capacity of 7,500 pounds or less, may comply with the less stringent requirements of 14 CFR §§ 135.261 and 135.273; (2) the lack of any mechanism to assure that rest is provided prior to flight; and (3) no clear requirement that the 9 hour rest period must provide for an 8 hour sleep opportunity. The FAA also sought to specifically articulate what it means for a flightcrew member to be free from duty, as this and other related issues under the current scheme have resulted in more than 55 legal interpretations issued by the FAA regarding rest.

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Sleep science has settled on the following points: The most effective fatigue mitigation is sleep; an average individual needs to have an 8-hour sleep opportunity to be restored; 8 hours of sleep requires more than 8 hours of sleep opportunity; and daytime sleep is less restorative than nighttime sleep.[79] For most people, 8 hours of sleep in each 24 hours sustains performance indefinitely.[80] There is a continuous decrease in performance as sleep is lost. Examples of this reduction in performance include complacency, a loss of concentration, cognitive and communicative skills, and a

[79] Akerstedt, T., & Gillberg, M. (1981). The circadian variation of experimentally displaced sleep. Sleep, 4 (2), 159-1659. Akerstedt, T., & Gillberg, M. (1990). Subjective and objective sleepiness in the active individual. International journal of neuroscience, 52 (1-2), 29-37. Gander, P.H., De Nguyen, B.E., Rosekind, M.R., & Connell, L.J. (1993). Age, circadian rhythms, and sleep loss in flight crews. Aviation, Space, and Environmental Medicine, 64 (3), 189-195.
[80] Rosekind, M.R., Gander, P.H., Gregory, K.B., Smith, R.M., Miller, D.L., Oyung, R., Webbon, L.L., & Johnson, J.M. (1996). Managing fatigue in operational settings 1: Physiological considerations and countermeasures. Behavioral Medicine, 21, 157-165.

decreased ability to perform calculations. All of these skills are critical for aviation safety.[81]

In the Flight Time ARC meetings, scientific presenters stated that during long pairings with significant time zone shifts, a minimum of 24 hours off would be necessary for flightcrew members to find an adequate sleep opportunity, and sufficient time free from duty.[82] A minimum of two nights of sleep might be necessary to acclimate to a different time zone.[83]

The scientific presenters also noted that an individual's circadian clock is sensitive to rapid time zone changes. They added that long trips present significant issues requiring mitigation strategies.[84] Twenty-four or 48 hours of rest may not be adequately restorative during a trip pairing where a flightcrew member is working 20 days separated by 24-hour layovers. In some cases, shorter rest periods, such as 18 hours or less, may be more restorative because of circadian issues.

In the NPRM, the FAA proposed requirements for FDP/reserve period rest, acclimation rest upon returning to home base, and reduced rest under limited conditions.

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81 Caldwell, J.A., Mallis, M.M., Caldwell, J.L., Paul, M.A., Miller, J.C., & Neri, D.F. (2009). Fatigue countermeasures in aviation. Aviation, Space, and Environmental Medicine, 69 (1), 29-9.

82 Gander, P.H., Myhre, G., Graeber, R.C., Anderson, H.T., and Lauber, J.K. (1985). Crew factors in flight operations: I. Effects of 9-hour time-zone changes on fatigue and the circadian rhythms of sleep/wake and core temperature (NASA/TMm 1985-88197). Moffett Field, CA. NASA Ames Research Center.

83 Lamond, N., Petrilli, R.M., Dawson, D., and Roach, G.D. (2006). Do short international layovers allow sufficient opportunity for pilots to recover? Chronobiology International, 23(6), 1285-1294. Lamond, N., Petrilli, R.M., Dawson, D., and Roach, G.D. (2005). The impact of layover length on the fatigue and recovery of long-haul flight crew. Adelaide/Whyalla, Australia: University of South Australia, centre for Sleep Research.

84 \49\ See also, Gander, P.H., Graeber, R.C., Connell, L.J., and Gregory, K.B. (1991). Crew factors in flight operations: VIII. Factors influencing sleep timing and subjective sleep quality in commercial long-haul flight crews (NASA/TMm 1991-103852). Moffett Field, CA: NASA Ames Research Center. Rosekind, M.R., Gander, P.H., Gregory, K.B., Smith, R.M., Miller, D.L., Oyung, R., Webbon, L.L. and Johnson, J.M. (1996). Managing fatigue in operational settings 2: An Integrated Approach. Behavioral medicine, 21, 166-170.

For pre-FDP/reserve assignments, the FAA proposed that prior to accepting a reserve duty period or FDP, the flightcrew member must be given a rest period of at least 9 consecutive hours measured from the time the flightcrew member reaches the hotel or other suitable accommodation.

In addition, the FAA proposed that a flightcrew member must be given at least 30 consecutive hours free from all duty in any 168 consecutive hour period prior to beginning a reserve period or FDP. This provision included two exceptions. The first is that during an FDP or series of FDPs, if a flightcrew member crosses more than 4 time zones on FDPs that exceed 168 consecutive hours, that flightcrew member must be given a minimum of three physiological nights' rest upon return to home base. The second is if a flightcrew member is operating in a new theater, he or she must receive 36 consecutive hours of rest in any 168 consecutive hour period.

The proposal also would have permitted a one-time reduction in the pre-FDP/reserve rest period from 9 to 8 consecutive hours in any 168 consecutive hour period. Additionally and in the event of unforeseen circumstances, the pilot in command and the certificate holder could reduce the 9 hour rest period to 8 consecutive hours. Lastly, the FAA proposed that during a rest period, the certificate holder could not assign and no flightcrew member could accept any assignment for reserve or duty.

Commenters raised two issues concerning the proposed pre-FDP/reserve rest requirement. The first issue was the FAA's selection of the 9 hour rest period. The second issue was the beginning measurement of the rest period. As these two issues interrelate, the comments for both are summarized below.

In the NPRM, the FAA noted that the ARC members supported a domestic rest requirement of 10 hours that was comprised of an 8 hour sleep opportunity, with 30 minutes on each end for transportation and 30 minutes on each end for physiological needs such as eating, exercising and showering. The ARC members also discussed whether the rest requirement should be increased to 12 hours for international operations. The ARC members cited the following reasons for the two added hours for international operations: to provide a longer layover rest period for non-acclimated flightcrews; potential to address increased stress associated with communicating with air traffic control in countries where English is not the native language; and time to transit customs/immigration or travel a long distance to hotel accommodations in foreign destinations.

The FAA decided not to propose two different rest periods and instead put forth one standard rest period for all operations. The FAA was not persuaded that added rest was necessary to deal with air traffic control communications in a foreign airspace. Furthermore, acclimation for determining the length of an FDP was addressed by other provisions in the proposal. Lastly, the time to clear customs/immigration was addressed by refining the point where rest begins.

The FAA received over 2,500 comments from individuals who contend that the proposed 9 hour rest period was inadequate and did not allow sufficient time to eat, bathe, exercise or unwind, and still have an opportunity for 8 hours rest. The NTSB strongly encouraged the FAA to increase the duration of the required rest period to accommodate an opportunity for 8 hours of sleep. CAPA, APA, and SWAPA pointed to FAA Advisory Circular No. 120-FIT, which recognizes that 9 hours of rest typically does not yield 9 or 8 hours of sleep. Peninsula Airways, the Families of Continental Connection Flight 3407, APA, IPA, Southwest Airlines, SWAPA, AE and Delta Air Lines supported a 10 hour rest period for domestic operations.

Approximately 150 individual commenters believe that the rest period for international operations should be 12 hours. Other commenters suggested varying times of 13, 14, and 20 hours respectively for operations that travel across multiple time zones. Pinnacle Airlines suggested a rest period of 48 hours. ALPA advocated a minimum of 13 hours rest period for flightcrew members that fly to a new theater--once they become acclimated, they go back to 10 hours rest. ATA commented that the terminology should be changed from “domestic” and “international” to “in theater” and “in new theater” (and use the term “theater” as defined in the NPRM). ATA argues that the distinction of domestic/international in this context is not relevant and provides the following example. A pilot completing a north-south flight between the U.S. mainland and Canada or the Caribbean that crosses no time zones should not be treated differently than one that makes the same north-south trip within the continental U.S. APA, CAPA, SWAPA and Kalitta Air endorsed a 12 hour rest period for non-acclimated flights.

Conversely, Hawaiian Airlines supported the single hour rest requirement of 9 hours, and commented that this provision is not competitively disadvantageous for its operations. CCIA supported a longer rest period than that provided under the present regulations. American Airlines supported the proposed 9 hours and Alaska Airlines simply argued that the proposed rest provisions should be withdrawn, reevaluated, and republished for comment.

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For the NPRM, the FAA chose to begin the rest period at the time that the flightcrew member reached the hotel or suitable accommodation. The basis for this tentative decision largely rested on the premise that transportation is not rest and therefore, cannot be factored into the rest period. In addition, the time spent in transportation may vary widely.

Commenters were divided with respect to the proposal's measurement of when the rest period begins. Most commenters representing industry did not support measuring the rest period from the time the flightcrew member reached the hotel or suitable accommodation. These commenters described this aspect as wholly unworkable, and open to too many variables that would be beyond the certificate holder's control, e.g. vehicular breakdowns, accidents, unexpectedly heavy traffic and lost or overbooked facility reservations. In addition, they state that the certificate holder would be responsible to account for the flightcrew member's whereabouts throughout the rest period. They argue that the certificate holder's responsibility is to control the scheduling of compliant rest periods, not to control an individual's private life and activities when off duty.

The labor organizations and the Families of Continental Connection Flight 3407 supported the proposed beginning measurement of the rest period. These entities were concerned with being able to "get 9 hours behind the door," which would provide a better opportunity for a meaningful 8 hour sleep opportunity. APA also recommended, in addition to the proposal, that the FAA add language that to be compliant with this rest requirement, the hotel room must be available for immediate occupancy upon arrival. A number of pilot groups commented that rest time can be spent waiting for check-in or delay in getting room keys. Conversely, a number of certificate holders stated that check-in sometimes occurs in the vehicle on the way to the hotel, or that hotels offer separate check-in counters for flightcrew members.

As discussed above, the FAA was not persuaded at the NPRM stage to pursue a separate rest period for international operations. The agency concluded that an additional two hours of rest was not warranted to address potential fatigue from communicating with air traffic controllers in foreign airspace, nor did it support added rest due to time to clear customs and immigration. A number of airports have custom and immigration queues devoted to processing flightcrew members quickly.

The adopted regulations providing FDP limits for augmented and unaugmented operations address acclimation. For an unacclimated flightcrew member, the maximum flight duty period in Table B is reduced by 30 minutes and the flightcrew member enters the applicable FDP table based on the local time at the theater in which the flightcrew member was last acclimated. Under these provisions, the determined FDP limits take into account the flightcrew member's WOCL and general circadian rhythm. As long as the flightcrew member is receiving an 8 hour sleep opportunity, the nature of whether the FDP was international is not relevant. The FAA has decided to retain a single standard rest period provision that applies to all FDPs and reserve periods.

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Based on the comments received from the certificate holders, the FAA agrees that using the time when a flightcrew member reaches the hotel or other suitable accommodation would present more issues for implementation than it actually solved. The FAA's main objective with this provision was to ensure that flightcrew members have an 8 hour sleep opportunity. Building from that and mindful of the comments received, the FAA has decided to adopt a 10 consecutive hour rest requirement that immediately precedes the beginning of a reserve or FDP measured from the time the flightcrew member is released from duty. At this point, if the flightcrew member cannot have 8 uninterrupted hours of rest opportunity, the flightcrew member cannot report for the assigned FDP until he/she receives that rest. If the reason for the shortened rest opportunity is travel delays, reservation confusion, or the flightcrew member's actions, the certificate holder is free to address the root cause. However, it must provide the required 8-hour rest opportunity.

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The FAA finds that the modifications adopted in this rule address concerns raised by the labor organizations, the NTSB and the Families of Continental Connection Flight 3407 concerning an actual 8 hour opportunity devoted to sleep. Furthermore, it provides reasonable time for travel to the hotel, check-in, and meals. The FAA acknowledges there will be unforeseen circumstances that are beyond the control of either the certificate holder or the flightcrew member and these situations are difficult to capture in a regulatory standard. In situations such as this, where the flightcrew member ultimately is not provided with the necessary rest period and/or sleep opportunity, the flightcrew member must notify the certificate holder that he/she will be unable to obtain the required rest. It is advisable that the flightcrew member alert the certificate holder as soon as possible in order for the certificate holder to make alternative arrangements that may include adjusting the next FDP or flight departure time, or calling in a reserve crew.

NACA, Kalitta Air, NAA and Atlas disagree with the proposed rest requirement for a flightcrew member that crosses more than four different time zones and is away from home base for more than 168 consecutive hours. These commenters specifically state that three physiological nights' rest is excessive, not based on science, and that only a 30 hour rest period is necessary because fatigue has been mitigated throughout the flightcrew member's trip. They also commented that there is no justification for a different standard for rest at home and that rest at home generally is more fatigue mitigating than rest at operating locations. UPS also objected to the use of three physiological nights' rest upon return to home base. UPS contends that rest at home should be treated the same as rest in layover cities and that off-duty time between pairings "is traditionally, and correctly, addressed via the collective bargaining process."[85]

NACA and Kalitta Air also recommended a reduced rest period of 30 hours, instead of the proposed 36 consecutive hours of rest, in any 168 consecutive hours for flightcrew members operating in a new theater.

The FAA adopts as proposed the requirement that a flightcrew member must be given at least 30 consecutive hours free from duty in any 168 consecutive hour period. The NPRM included two exceptions to this requirement. The first exception was a longer rest period upon return to home base after a flightcrew member has been away for more than 168 consecutive hours and has crossed at least four time zones. The second exception was for flightcrew members operating in a new theater to receive 36 hours of rest.

In the NPRM, the FAA stated that it was "proposing to require a greater rest opportunity when a flightcrew member has been away from his or her home base for more than 168 hours. In this instance, the FAA proposes to require a rest period that includes 3 physiological nights, rather than 36 hours free from duty or permitting the flightcrew member to fly during that approximately 72 hour period." 75 Fed. Reg 55862. The corresponding regulatory text proposed three physiological nights' rest. By using three physiological nights' rest, the FAA intended this provision to provide for a minimum 56-hour rest period, as indicated in the NPRM preamble discussion. As proposed, the regulatory text would permit a flightcrew member, upon return to home base after 168 hours away from home and crossing numerous time zones, to be assigned to FDPs that would occur during the day only, but require the flightcrew member to sleep at home for three nights. The intention was for that flightcrew member to receive a minimum of 56 consecutive hours of rest.[86]

The FAA does not agree with the commenters that a 30 consecutive hour rest period is adequate for flightcrew members that have flown a schedule that has the flightcrew member crossing several time zones and is away from home for more than 168

[85] The FAA notes that not all pilot groups are organized and therefore, do not have a collective bargaining process.
[86] If a flightcrew member begins this rest at 1:00 a.m. on day 1 and concludes this rest at 7:00 a.m. on day 3, this provides a minimum of 56 hours of rest.

hours. This longer rest period serves an important purpose. The longer rest period provides a recovery period that facilitates the restoration of the flightcrew member's circadian rhythms. Sleep loss or sleep disturbance can significantly deteriorate performance. Moreover, performance impairment can occur when the sleep-wake cycle has only been phase-advanced by 2-4 hours and maintaining a normal sleep period. These results suggest that performance deterioration can directly result from circadian rhythm disturbance and not only solely from sleep loss that would occur with time zone changes. The onset of sleep and the duration of that sleep can "…depend upon the circadian body temperature phase and provides a physiological basis for the performance deterioration or circadian desynchronization."[87] Typically, flights across multiple time zones involve a differential restructuring in an internal circadian desynchronization and associated symptoms.[88]

Flightcrews routinely deal with multiple time zone adjustments and work schedule changes. Flight operations involve night and "shift work" in general and exposures to different social and environmental cues can vary after both the outbound and inbound segments of flights, which can make the prediction of an individual's resynchronization very difficult. "Advances" in rhythms occur with eastward travel and "delays" with westward travel. Flights of multiple time zones involve circadian adjustments that vary in length depending on the direction of travel. Physiological,

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[87] Winget CM, Deroshia CW, Markley CL, Holley DC. (1984). A review of human physiological and performance changes associated with desynchronosis of biological rhythms. *Aviat. Space Envion. Med.* 1984; 55:1085-96, p. 1090..
[88] Id at p. 1085.

performance, and subjective measures are also found to adjust at different rates to changes in time zones.[89]

Some studies also indicate that a complete adjustment following six time zone transitions was found to take up to 13 days after eastbound flights, and 10 days in westbound flights.[90] Other research indicates that there is considerable variation in the rates of resynchronization of individual rhythms. After a time shift, such as that experienced by pilots flying several days in a new theater, with all rhythms phase-adjusted, upon return to their domicile, a resynchronization process begins anew and is not complete until each rhythm has rephrased back to the home time zone. "The different rates of rhythm readjustment lead to transient internal dissociation, in which the normal phase relationships between rhythms are disrupted."[91]

Consequently, the FAA finds it critical to address the desynchronization/ resynchronization of circadian rhythms that occurs when transiting multiple time zones. This recovery rest not only acclimates flightcrew members but also resets the circadian rhythms before the next assigned flight duty period. The FAA corrects the regulatory text to provide for a 56 consecutive hour rest instead of the three physiological nights' rest, as previously discussed. Depending upon when the rest period begins, this requirement provides for 2 to 3 physiological nights' rest.

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[89] Wegmann HM, Klein KE. Jet lag and aircrew scheduling. In: Folkard S, Monk TH, eds. Hours of work. Chichester; John Wiley & Sons Ltd., 1985; 263-76

[90] Wegmann HM, Gundel A, Naumann M, Samel A, Schwartz E, Vejvoda M. Sleep, sleepiness, and circadian rhythmicity in aircrews operating on transatlantic routes. *Aviat. Space Environ. Med.* 1986; 57(12, Suppl.); B53-64.

[91] Winget et al (1984) at page 1087.

With respect to the NACA and Kalitta's concern with using the higher value of 36 hours rest instead of 30 hours to acclimate, the FAA is not persuaded by the comment. The ARC members agreed that a flightcrew member should have at least 30 to 36 continuous hours free of duty (rest) in any 168 consecutive hours and that once a flightcrew member is given this rest, he or she is considered acclimated to the local time. As rest is critical, the FAA choose to propose the more conservative 36 hour rest period, given that adequate rest provides the most fatigue mitigation. NACA and Kalitta do not offer information supporting 30 hours instead of 36 hours. However, an approved FRMS may appropriately determine whether additional mitigations may permit the limited reduction in rest.

For clarity, the regulatory text in this section has been restructured. Paragraph (b) of this section adopts the 30 consecutive hour minimum rest requirement per week as proposed. Under paragraph (c), if a certificate holder gives a flightcrew member operating in a new theater 36 consecutive hours of rest, then that flightcrew member is acclimated and must enter the FDP Table for his/her next assignment as acclimated to the local time in that new theater. A certificate holder does not need to provide the 36 hour rest once a flightcrew member is in a new theater unless the carrier wants to acclimate that flightcrew member. The flightcrew member may be given a 10 hour rest period in accordance with paragraph (e) of this section and then be assigned a subsequent FDP based on the home base time. However, if the flightcrew member has received 36 consecutive hours of rest, that flightcrew member is acclimated at that point to the new theater, and subsequent FDP assignments must be made according to the acclimated time.

The text also specifies that if a flightcrew member has received 36 consecutive hours of rest under this paragraph, then that rest meets the requirements of paragraph (b) for the required rest in any 168 hour period and that resets the 168 hour period. Paragraph (d) now contains that provision that requires at least 56 consecutive hours of rest if a flightcrew member traverses 60º longitude[92] during an FDP or a series of FDPs that require him or her to be away from home base more than 168 consecutive hours. This rest must encompass three physiological nights' rest based on local time.

ALPA, APA, CAPA, and SWAPA argued that where flightcrew members are not acclimated, a recovery period must be provided upon return to home base to ensure a flightcrew member's body clock has recovered home base local time before the start of the next day. They propose that Table F, provided below, be used to determine the number of nights required to re-acclimate. They also propose that Table F be used to provide "recovery rest" for time away from home when operating in a different theater for less than 168 consecutive hours away from home. They cite the current regulations[93] as providing this rest for international operations over a period less than 168 consecutive hours.

[92] This change is consistent with the modification to the term theater in the definitions section, discussed earlier.
[93] See 14 CFR 121.483, 121.485, 121.523 and 121.525.

Table F – Number of Local Nights for Recovery on Return to Home Base

Elapsed Time Since Leaving Home base (h)	Maximum Time Difference from Home Base (h)					
	4	5	6	7	8-9	10-12+
60-84h	1*	2*	2*	2*	2*	3
84-108h	2*	2*	3	3	3	3
108-132h	3	3	3	3	3	3
132-156h	3	3	3	3	3	3
156+h	3	3	3	3	3	3

Note 1: The values in Table F refer to eastward transitions (eastward outbound/westward homebound) only. * denotes that for westward transitions (westward outbound/eastward homebound) one extra day is required to be added to the value depicted.

Note 2 : When the elapsed time away from home base is less than 60 hours one full physiological night's recovery rest should be provided on return to base, except when the returning flight duty period encroaches the WOCL, then an additional physiological nights rest will be added.

The FAA cannot support the inclusion of Table F. First and as a practical matter, it is not clear that the Table could be accommodated given the rest period that was proposed without seriously constraining the certificate holder's ability to schedule operations. As discussed previously, the FAA agrees and adopts a provision that specifically addresses the resynchronization of circadian rhythms. That rest however, must also be balanced with the certificate holder's flexibility to schedule operations, particularly those carriers conducting supplemental operations. The FAA used 168 hours as the minimum trigger point for when this rest must be provided for flightcrews returning home after completing FDPs that crossed multiple time zones. Under Table F, flightcrew members would have to be provided a minimum of two nights' rest at home every week. This is an unrealistic constraint on the certificate holder's ability to set and

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maintain a schedule. Under the concept furthered by this rulemaking, the cumulative limits on FDP during the same 168 hour period, coupled with cumulative rest requirement, should adequately mitigate the effect of cumulative fatigue.

Not unexpectedly, the provisions proposed in the NPRM permitting a limited reduction in rest generally were opposed by the entities representing labor groups and either supported or expanded by the industry groups. ALPA accepted the proposal. SWAPA commented that reduced rest should never be permitted since science supporting reduced rest assumes that one is starting from a full sleep bank, which is not always the case. SWAPA further commented that reduced rest is likely to follow an extended FDP and that if the FAA retains a reduced rest provision it should never be permitted after an FDP has been extended past the maximum provided in Table B. APA only supports reduced rest if restorative rest is provided. In addition, APA argues that if the FAA allows a reduction in rest it should be limited to only once in a 168 consecutive hour period, due to unforeseen circumstances subject to pilot in command concurrence, and never if associated with an extended FDP. FedEx ALPA argued that only a one-hour reduction in rest be permitted and only in cases of unforeseen circumstances. AE supports a permitted one-hour reduction in rest. AA supports the one-hour reduction but never on consecutive nights. Delta commented that the once in 168 consecutive hour period be reset after a 30-hours rest is given.

Conversely, UPS supported multiple reductions in rest without concurrence by the pilot in command. UPS contends that one reduction in a 168 consecutive hour window simply is not feasible. UPS also argues that requiring PIC concurrence will complicate the certificate's holder ability to utilize the reduced rest provisions and its ability to return a disrupted system back to a more normal state.

In view of the comments, the FAA has decided to remove the provisions that would permit a reduction in rest. As one of the stated goals of this rulemaking was to ensure that flightcrew members had an eight hour sleep opportunity, the FAA has reconsidered incorporating criteria in the regulations to permit a reduction in this sleep opportunity. While it is reasonable to anticipate that unforeseen circumstances may warrant a limited extension of an FDP, particularly for situations that arise after takeoff, the flightcrew members at this point have already had the benefit of an eight hour rest opportunity. The FDPs limits implemented by this rule were derived under the premise that flightcrew members were reporting for duty with a full rest. Permitting reduced rest undercuts that premise. This rule includes provisions for extensions of FDPs and flight time, as necessary to accommodate the situations that cannot be planned. Otherwise, certificate holders should not be scheduling FDPs to the point that a rest period needs to be reduced.

P. Deadhead transportation

In the NPRM, the FAA proposed that all time spent in deadhead transportation is duty. The FAA further proposed that time spent in deadhead transportation would be considered part of an FDP if it occurred before a flight segment without an intervening required rest period. Lastly, the proposal provided a rest requirement for deadheading flightcrew members: the time spent in deadhead transportation during a duty period may not exceed the flight duty period in Table B for the applicable start time plus 2 hours unless the flightcrew member is given a rest period equal to the length of the deadhead transportation but not less than the required rest in § 117.25 upon completion of such transportation.

Several commenters contend that this proposed rest requirement should be deleted because it is punitive and not supported by science. They argue that this provision implies that the certificate holder should prevent a flightcrew member from deadheading home at the end of an FDP, even if the flightcrew member requests to do so.

The FAA has made changes to the section addressing deadhead transportation. Paragraphs (a) and (b) of proposed § 117.31 have been moved. Paragraph (a) provided that all time spent in deadhead transportation is duty and that statement is relocated to the definition for deadhead transportation. Paragraph (b), which provided that deadhead transportation is part of an FDP if it occurred before a flight segment without an intervening required rest period, is deleted as that information is already contained in the definition of the term "flight duty period."

The FAA agrees with the commenters that the proposed text for § 117.29(c), Deadhead transportation, does not correctly articulate the purpose of rest relative to deadhead transportation. The rest is appropriate if the deadhead transportation occurs prior to the FDP. The situation that FAA sought to address in the NPRM was a flightcrew member deadheading on a long flight and then going onto a FDP without the appropriate rest. The language as proposed would require a rest period for a flightcrew member who is deadheading home after completion of an FDP. The FAA has corrected the regulatory text to provide that before beginning a flight duty period, if a flightcrew member has engaged in deadhead transportation that exceeds the applicable flight duty period in Table B, the flightcrew member must be given a rest period equal to the length of the deadhead transportation but not less than 10 consecutive hours.

Q. Emergency and Government Sponsored Operations

This rulemaking also addresses various supplemental operations that require flying into or out of hostile areas, and politically sensitive, remote areas that do not have rest facilities. These operations range from moving armed troops for the U.S. military, conducting humanitarian relief, repatriation, Air Mobility Command (AMC), and State Department missions.[94] The discussions during the ARC recognized that these operations are unique and need to be specifically addressed in this rulemaking. Flights operated by a certificate holder under contract with a U.S. Government agency must comply with the flight and duty regulations in parts 121 and 135, as appropriate, unless the Administrator has granted a deviation under 14 CFR 119.55 or 14 CFR 112.57.

Deleted: A number of these AMC and emergency operations are conducted today under a deviation authority set forth in 14 CFR §§ 119.55 and 119.57.

The FAA proposed that certificate holders may extend the applicable maximum FDPs to the extent necessary to allow flightcrew members to fly to a destination where they can safely be relieved from duty by another flightcrew or can receive the required rest before beginning the next FDP. Upon reaching the destination, the flightcrew members will receive the required rest, which would be equal to the length of the actual FDP or 24 hours, whichever is less. Furthermore, the proposal would not permit extensions of the cumulative FDP or cumulative flight time limits. In the event that an FDP was extended pursuant to this section, the NPRM provided reporting requirements.

A number of commenters disagreed with the FAA's use of the title "Operations in unsafe areas" as the title of this section. Commenters, including UPS, Atlas Air, NAA, NACA, and NAC recommended various terms instead such as "Unique areas," "Enhanced Security Consideration Area: Prescriptive Exemption," and "Designated Areas."

In addition, Atlas questioned the FAA's statement that under this section, the flightcrew members' FDP can be extended to permit them to continue the flight operation and land at the nearest suitable airport. See FAA Response to Clarifying Questions at page 24. Atlas commented that this airport may not be operationally feasible or economically viable.

RAA commented that operations may need to use this section to rapidly remove or recover aircraft and crews from an airport about to be impacted by a heavy storm, hurricane, or blizzard.

In the NPRM, the preamble discussion for this proposed section was titled "Exception for Emergency and Government Sponsored Operations." The FAA regrets that the title was not carried over to regulatory text. Introducing the term "unsafe areas" could be subject to differing interpretations within the industry. Section 117.29 is now titled "Emergency and government sponsored operations," which is an accurate depiction of the operations addressed in this section and is consistent with the discussion of the proposal.

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[94] This could also apply to the Civil Reserve Air Fleet (CRAF). However CRAF is only activated by presidential order in a time of war. The last time CRAF was activated was in 2003. Currently no operations are being conducted under the CRAF program.

The purpose of this section is to address true emergency situations and operations that are being conducted under contract with the U.S. Government that pose exceptional circumstances that would otherwise prevent a flightcrew member from being relieved from duty or safely provided with rest at the end of the FDP. This section is not meant to address self-induced emergencies that arise from inadequate planning. Certificate holders must be responsible for having appropriate onboard rest facilities or the proper number of flightcrew members available for the length of the duty day, if necessary.

The FAA reviewed the regulatory text and determined that this clarification warrants certain modifications. First, the applicability provision of this section now specifically articulates the two categories of operations that are affected. This section applies to operations conducted pursuant to contracts with the U.S. Government department and agencies. A number of these types of flights are conducted under contract with the Departments of Defense, State, Homeland Security, Justice, FEMA, and Customs and Immigration. This provision is not limited to operations conducted pursuant to § 119.55, which permits certificate holders to deviate from the requirements of parts 121 and 135, as authorized by the Administrator in order to conduct operations pursuant to a military contract. Rather, this provision could apply to multiple government agencies depending on the mission. The FAA also recognizes that there are operations in which the Department of Defense may need relief from the flight and duty regulations even though the circumstances do not meet the certification requirements of § 119.55.

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This section also applies to operations conducted pursuant to a deviation issued by the Administrator under § 119.57 that authorizes an air carrier to deviate from the requirements of parts 121 and 135 to perform emergency operations. For example, under this section the FAA issued operations specifications for emergency operations during Hurricane Katrina to allow humanitarian flights into and out of New Orleans. This authority is issued on a case-by-case basis during an emergency situation as determined by the Administrator.

Upon review, the FAA concludes that these two categories are the only types of operations that warrant separate consideration because of the unique operating circumstances that otherwise limit a certificate holder's flexibility to deal with unusual circumstances. Therefore, unless a certificate holder's operations fall under either category, the ability to extend an FDP under this section does not apply.

In response to RAA's comment as to this section regarding moving aircraft and crews from an airport about to be impacted by a blizzard or hurricane, these certificate holders have recourse to extend an FDP as necessary under § 117.19. The FAA's modifications to this section are to allow for true emergency situations and to address the uniqueness of certain government contract operations.

Second, this section adopts the provision permitting the FDP and the flight time for a particular operation to be extended if deemed necessary by the pilot-in-command. This provision was slightly modified to allow for an extension to the flightcrew members' flight time limitations if necessary. In addition, the pilot-in command is given the authority to determine the closest destination to safely land the aircraft and allow for the flightcrew to be relieved and afforded the proper rest. The FAA does not expect the flightcrew to extend the FDP simply to complete the next commercially scheduled leg.[95]

Third, the FAA has addressed the reporting requirements for situations when a FDP is extended. Under the NPRM, the FAA proposed two different reporting requirements depending upon whether the operation was conducted pursuant to a U.S. government contract. This section has been modified to incorporate the reporting requirements listed in § 117.19 Flight Duty Period Extensions. Therefore, the certificate holder must file within 10 days any extended FDP and flight time that exceed the maximum permitted under the adopted regulations. The report must contain a description of the extended FDP and flight time limitations and the circumstances surrounding the situation requiring the extension. In addition, if the circumstances surrounding the situation were within the certificate holder's control, the report must contain information on the certificate holder's intended course of corrective action. This action must be implemented within 30 days from the date that the FDP was extended.

The reporting of FDP extensions in this manner can facilitate the certificate holder and the FAA's determination as to whether the certificate holder is properly planning its operations and mitigating the chances of its flightcrews exceeding the FDP limits. If a certificate holder cannot restructure its operations so that very few of these operations need to take advantage of this provision, the certificate holder is advised to develop an FRMS to address these operations.

[95]FAA Response to Clarifying Questions.

Several commenters were concerned with the proposal's prohibition on any extension of the cumulative FDP and flight time limits if an extension to a daily FDP was triggered under this section. The FAA partially agrees with the commenters. For operations conducted pursuant to a deviation authorized under § 119.57, the FAA agrees that these circumstances may necessitate the flightcrew member's ability to exceed the cumulative flight time and FDP limitations respectively found in §§ 117.23(b) and (c). Therefore, this section permits an extension of the flightcrew member's FDP and flight time limitation even if it exceeds the cumulative requirements in 117.23 for operations that are conducted pursuant to a deviation authorized under § 119.57.

The FAA does not make such finding with respect to other operations conducted pursuant to a U.S. government contract. Even though these operations may fly into and out of hostile areas or areas that preclude the flightcrew members from proper rest facilities, the certificate holder is well aware of the operating environments where it is agreeing to conduct such operations. Therefore, these situations must be taken into account during the planning stages. A certificate holder needs to have considered and planned for whether the operations under contract will necessitate staging crews at other airports or installing rest facilities onboard the aircraft to enable augmentation, in order to ensure that flightcrews will not exceed FDP limit. For these operations, the cumulative limits on FDP and flight time apply.

R. Miscellaneous Issues

The FAA has also received a number of comments raising other significant issues. These comments, and the associated responses, are discussed below.

Statutory Authority

ATA stated that this rule exceeds the FAA's statutory authority and that this rule cannot be promulgated pursuant to the authority delegated to the FAA in 49 USC 44701(a)(5) because this rule does not increase aviation safety or national security.

As the NPRM indicated, the authority for this rulemaking stems from 49 USC 44701(a)(5), which requires the Administrator to promulgate "regulations and minimum standards for other practices, methods, and procedure the Administrator finds necessary for safety in air commerce and national security." Subsection 44701(a)(5) "grants the FAA 'broad authority to regulate civil aviation.'" Gorman v. National Transp. Safety Bd., 558 F.3d 580, 590 (D.C. Cir. 2009) (quoting Ass'n of Flight Attendants-CWA v. Chao, 493 F.3d 155, 157 (D.C.Cir.2007)).[96]

Here, the FAA finds that this rulemaking is necessary for safety in air commerce. As discussed in other portions of this preamble, the existing flight, duty, and rest regulations permit flightcrew members to accumulate unsafe amounts of fatigue. This unsafe accumulation of fatigue undermines aviation safety by increasing the risk of an accident.[97] This rulemaking addresses this issue by imposing limits that will ensure that flightcrew members' fatigue stays within safety-acceptable bounds. This will decrease the risk of an aviation accident, and thus, this rulemaking will increase safety in air

[96] See Drake v. Laboratory Corp. of America Holdings, 458 F.3d 48, 56 (2d Cir. 2006) (stating that "Congress granted the FAA broad authority over aviation safety"); Kraley v. National Transp. Safety Bd., 165 F.3d 27 (6th Cir. 1998) (unpublished opinion) (stating that "Congress vested the Administrator of the FAA with broad power to prescribe regulations, standards, and procedures relating to aviation safety").

[97] See, e.g., Goode, supra note 17, at 311 (stating that 16-hour unaugmented FDPs, which are permissible under the existing regulations, result in an accident rate that is over five times higher than the accident rate for shorter FDPs).

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commerce. Because this rulemaking will increase safety in air commerce, it is authorized by 49 USC 44701(a)(5).

As the NPRM also notes, additional authority for this rulemaking stems from 49 USC 44701(a)(4). Subsection 44701(a)(4) requires the Administrator to promulgate "regulations in the interest of safety for the maximum hours or periods of service of airmen and other employees of air carriers." This rule reduces the fatigue experienced by flightcrew members during flight by limiting the maximum FDP and flight-time hours of airmen and other covered employees of air carriers. Because this reduction in fatigue will increase aviation safety, the flight, duty, and rest limits that make up this rule are also authorized by subsection 44701(a)(4).

<u>Constitutional Due Process</u>

UPS argued that this rule is unconstitutional because its provisions substantially impair the collective bargaining agreement between UPS and IPA. Although UPS conceded that the Contracts Clause is not applicable to the federal government, UPS argued that "similar principles apply [to the federal government] under the Due Process Clause." UPS concluded that this rule violates the Fifth Amendment's Due Process Clause because, UPS alleged, there is no justification for the contractual impairment imposed by this rule.

The FAA agrees with UPS that the Contracts Clause is not applicable to actions, such as this rulemaking, that are undertaken by the federal government. <u>Pension Ben. Guar. Corp. v. R.A. Gray & Co.</u>, 467 U.S. 717, 732 n.8 (1984). With regard to UPS' Fifth Amendment argument, the Supreme Court has explicitly rejected the premise that the Fifth Amendment's Due Process Clause is "coextensive" with the Contracts Clause. Id. at 733. The Court emphasized that "to the extent that recent decisions of the Court have addressed the issue, we have contrasted the limitations imposed on States by the Contract Clause with the less searching standards imposed on economic legislation by the Due Process Clauses." Id. Thus, under the standard set out by the Supreme Court, a federal regulation does not offend the Due Process Clause so long as that regulation is not "arbitrary and irrational." Id.

This rule is neither arbitrary nor irrational. While the FAA initiated this rulemaking by establishing an ARC, we subsequently received a Congressional directive, which came about because the existing flight, duty, and rest regulations allowed flightcrew members to accumulate dangerous levels of fatigue. To address this issue and keep flightcrew-member fatigue within reasonable bounds, this rule: (1) limits daily FDP and flight-time hours based on a flightcrew member's circadian rhythm, (2) sets minimum rest requirements, and (3) encourages fatigue-mitigating measures such as split-duty rest and augmentation. This rule also contains a number of other provisions, which are based on specific fatigue and operational concerns and which are discussed in other parts of this preamble. In addition, each of the proposed provisions in this rule was amended, where possible, to respond to the specific concerns raised by the commenters. Because each provision in this rule has been carefully calibrated to mitigate flightcrew-member fatigue while providing air carriers with as much scheduling flexibility as possible, this rule is neither arbitrary nor irrational. Accordingly, this rule does not violate the Fifth Amendment's Due Process Clause.

Administrative Procedure Act

ATA and a number of other industry commenters criticized the timetable used for this rulemaking. These commenters stated that the ARC for this rulemaking met on an unreasonably compressed schedule that did not provide it with sufficient time to carefully consider the pertinent issues and come to a consensus as to the proper resolution of those issues. CAA stated that, rather than provide the ARC with sufficient time to come up with a comprehensive set of recommendations, "the overwhelming majority of all regulatory activity has focused exclusively on reductions to the current limitations on hours of duty and flight time limits without ever determining whether such hours of service considerations are in fact the underlying cause of any fatigue." CAA concluded that "[a]s a result, the proposals contained in the NPRM are, on the whole, simply designed to reduce the flightcrew hours of service."

The industry commenters also stated that the NPRM was an "incomplete and ambiguous document" that did not provide them with sufficient detail to make meaningful comments. A number of commenters argued that the regulatory impact analysis used to develop the NPRM omitted important information, and thus, precluded the commenters from providing meaningful critique of this analysis.

CAA also stated that the FAA should have waited to publish an NPRM until the National Research Council's Committee on the Effects of Commuting on Pilot Fatigue provided a final report on the fatigue-related effects of pilot commuting. CAA stated that commuting is the primary cause of pilot fatigue, and that an understanding of pilot commuting is a necessary part of any flight, duty, and rest rule.

In addition, the industry commenters argued that the FAA did not provide them with sufficient time to evaluate the NPRM and submit their comments. They stated that the FAA unreasonably refused their requests to extend the 60-day comment period and provided responses to their numerous clarification questions with less than 30 days left in the comment period. Some commenters also stated that the FAA did not release a technical document that was used in the regulatory evaluation until there were only 23 days left in the comment period. The commenters pointed out that when the FAA conducted a similar rulemaking in 1995, it extended the comment period, citing "the scope and complexity of the proposal." The commenters also stated that an analogous rulemaking conducted by the Department of Transportation Federal Motor Carrier Safety Administration to establish rules on hours of service for commercial motor vehicles permitted an extension of the comment period for that rulemaking. The industry commenters stated that the existence of the ARC was not a sufficient justification for the short comment period because this rule includes a number of provisions that the ARC never considered.

RAA suggested that the FAA issue a supplemental NPRM instead of finalizing this rule. RAA emphasized that the FAA received a large number of comments asking that substantial changes be made to this rule, and to account for the number and breadth of the comments, the FAA should issue a supplemental NPRM setting out its proposed resolution to the issues raised by the comments.

In response to the above comments, the FAA notes that while it began this rulemaking by establishing an ARC, we subsequently received a Congressional directive contained in the Airline Safety and Federal Aviation Extension Act (ASFAEA). Section 212 of ASFAEA required the FAA to issue new flight, duty, and rest regulations. This section, in subsection 212(a)(3), set a deadline of 180 days for the FAA to publish an NPRM and 1 year for the FAA to issue a final rule.

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Under normal circumstances, the FAA has broad discretion to extend the timeframe for some parts of the rulemaking process. As the above commenters correctly pointed out, the FAA has used this discretion in the past to extend the timeframe for parts of other rulemakings. However, in this case, the FAA has recognized that implicit within the shortened statutory deadline that Congress set for completing this rulemaking was a presumption against extending the timeframe for any part of this rulemaking.

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The FAA limited the ARC's schedule to approximately six weeks. The ARC actually met on a weekly basis for at least 2 days per week. The FAA recognizes the tremendous amount of effort expended by the ARC members during this time. At the six-week point, the FAA found that the ARC had achieved its goal of highlighting issues for the FAA to consider as part of the FAA's subsequent rulemaking deliberations. Because most of these issues elicited strong divergent opinions from the labor and industry ARC members and because these divergent opinions could not be reasonably reconciled, the FAA concluded that extending the ARC's timeframe would not result in a consensus set of ARC recommendations.

The FAA disagrees with CAA's assertion that the ARC's timeframe was not extended because the FAA wanted to design a rule that "reduce[s] the flightcrew hours of service." While some parts of this rule reduce flightcrew members' hours of service, other parts increase those hours in a way that is consistent with safety considerations. Thus, for example, this rule increases the existing 8-hour unaugmented daily flight-time limit to 9 hours for periods of peak circadian alertness.

Turning to the length of the comment period that was used for this rulemaking, the FAA chose not to extend this rule's comment period due to the detailed comments that it received and the implicit statutory presumption against extensions in this rulemaking. At the end of the 60-day comment period, the FAA examined the comments that were submitted in response to the NPRM, and determined it was unlikely that an extension of the comment period would have a significant effect on comment quality. During the 60-day comment period, thousands of comments were submitted in response to this rulemaking, and many of those comments contained lengthy comprehensive analyses of every single part of the NPRM, as well as a critique of the regulatory evaluation. A number of commenters hired their own experts to provide detailed substantive reports on the NPRM, and these reports were submitted to the FAA during the 60-day comment period. Based on the comprehensive and detailed comments received during the 60-day comment period, the FAA determined that it had received sufficient information to proceed with this rulemaking. In light of this fact and the need to comply with the statutory deadline for this rulemaking, the FAA chose not to extend the comment period.

The FAA also notes that, as the NPRM pointed out, the FAA has a policy of considering comments that are "filed after the comment period has closed if it is possible to do so without incurring expense or delay." 75 Fed. Reg. at 55884. Thus, for example, as part of its consideration of augmented FDPs, the FAA took into account Continental and ALPA's comments about ULR flights, even though those comments were filed four months after the comment period closed. Because the FAA has a very liberal late-filed-comments policy, if the affected parties had important new comments that they wanted to file after the 60-day comment period closed, those parties had ample opportunity to file their comments after the closure of the comment period.

As the commenters pointed out, about halfway through the comment period, the FAA provided answers to clarifying questions that the commenters submitted, as well as a technical report that was referred to by the regulatory evaluation. While this information, which was provided with over 23 days left in the comment period, was important, it was not a central component of the NPRM. Moreover, the commenters appear to have fully incorporated this information into their filed comments, as the comments contained a comprehensive analysis of both the clarifying answers and the regulatory evaluation.

Turning to the sufficiency of the NPRM, the FAA finds that the NPRM provided enough detail for the commenters to provide the FAA with meaningful comments. The NPRM set out the regulatory provisions that the FAA proposed for the new flight, duty, and rest regulations, and the NPRM also explained the rationale for each of those provisions. After reading the NPRM and the accompanying regulatory evaluation, the affected parties provided the FAA with thousands of comments, many of which analyzed in detail every provision of the NPRM and provided a critique of the FAA's rationale for each of those provisions. While many of the commenters disagreed with parts of the

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NPRM, most of them appear to have had a clear understanding of the NPRM. The affected parties also submitted very detailed critiques of the regulatory evaluation that accompanied the NPRM which showed an understanding of the regulatory evaluation.

As a result of the comprehensive and detailed analyses that were submitted by the commenters, the FAA incorporated many of the commenters' suggestions into the final rule and the final Regulatory Impact Analysis. This process improved the final rule and accomplished the requirements of the Administrative Procedure Act.

Turning to CAA's comment, the FAA notes that since commencing this rulemaking activity, the National Research Council has completed its report. The authors of the report independently determined that it is premature to initiate rulemaking related to commuting. See *The Effects of Commuting on Pilot Fatigue*, National Research Council, July 6, 2011.[98] While pilot commuting is an important fatigue-related issue, this rulemaking does not foreclose the FAA from conducting a rulemaking in the future to address pilot commuting issues should better and more complete information of the risks posed by commuting and methods to alleviate that risk become available.

The FAA has also decided not to issue a supplemental NPRM as part of this rulemaking. As discussed above, the FAA received numerous thorough and high-quality comments in response to the original NPRM. Many of the comments have been

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[98] In addition to reviewing the possibility of regulating pilot commuting, the National Research Council determined that fatigue mitigation needed to take into account multiple factors, including the duration of work periods within a single day and over time; the time of day that work occurs; duration of sleep on work days and non-work days, the volume and intensity of the work; and the different vulnerabilities of individuals to these factors (among others). This assessment is consistent with the FAA's assessment of fatigue risk.

[100] Citing 67 Fed. Reg. at 61719 (Oct. 1, 2002).

incorporated into the final rule. We have made no changes that were not either originally contemplated in the NPRM or a logical outgrowth of that document.

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Information Quality Act and OMB Bulletin M-05-03

ATA asserted that the NPRM violated the Information Quality Act (IQA), as applied by the Department of Transportation's (DOT) Information Dissemination Quality Guidelines (Guidelines).[100] ATA argued that the Guidelines require FAA rulemakings to meet defined standards of quality, objectivity, utility and integrity. ATA then argued that "[d]espite the IQA's clear mandate and DOT's guidance, however, the present NPRM contains no accurate, clear, objective and unbiased information supporting the FAA's proposed overhaul of the existing flightcrew member flight and duty time limitations and rest requirements." ATA stated that the scientific information used to support the provisions of the NPRM could not meet the standards set out in the Guidelines because it was not validated in the aviation context. CAA added that the FAA's failure to provide additional regulatory-impact information requested by CAA was also a violation of the IQA. UPS argued that the scientific information used in this rulemaking violated OMB Bulleting M-05-03 because it was not subjected to peer review.

The DOT Guidelines state that, in the context of a rulemaking, the method by which an agency should correct alleged violations of the IQA is by responding to the pertinent public comments in the preamble to the final rule. Guidelines section VIII. In this case, a number of commenters argued that certain provisions of the NPRM were not supported by scientific information. A significant number of scientific studies were referenced in the NPRM. However, in response to the commenters' scientific concerns,

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the FAA has included either additional scientific information supporting the studies cited in the NPRM or an explanation for why the scientific information and operational experience cited in the NPRM is sufficient to justify the pertinent regulatory provision.

Deleted: located additional scientific information to support the final rule's provisions. For example, a number of commenters stated that the NPRM did not contain scientific studies justifying the unaugmented-FDP-limit reductions for additional flight segments. In response, the pertinent portion of this preamble now cites a number of scientific studies showing that additional flight segments increase flightcrew member fatigue.[101] Other parts of this preamble also contain

The FAA notes that, while some of the studies used in the final rule have not been validated in the aviation context, the major provisions of this rule are based on uncontroversial scientific findings that apply to all human beings. As the NPRM pointed out, sleep science, while still evolving, is clear in several important respects:

> most people need eight hours of sleep to function effectively, most people find it more difficult to sleep during the day than during the night, resulting in greater fatigue if working at night; the longer one has been awake and the longer one spends on task, the greater the likelihood of fatigue; and fatigue leads to an increased risk of making a mistake.

75 Fed. Reg. at 55857. These uncontroversial scientific findings form the basis for almost all of the major provisions in this rule. The FAA has concluded that, even though some of these findings were not based on aviation data, flightcrew members have the same fatigue concerns as other human beings, and as such, there is no reason to believe that these findings would not apply to flightcrew members.

However, in the process of considering the comments, the FAA found that some of the provisions of the NPRM, such as portions of the proposed fitness-for-duty section and the cumulative duty-period limit, were not justified by scientific studies and operational experience. Consequently, these provisions were removed from the final rule. Because, in this preamble, the FAA responded to comments questioning the scientific basis for the NPRM and removed regulatory provisions that could not be justified through scientific findings or operational experience, this rule does not violate the IQA and the DOT Guidelines. [102]

Turning to OMB Bulletin M-05-03, this Bulletin requires that "[t]o the extent permitted by law, each agency shall conduct a peer review on all influential scientific information that the agency intends to disseminate." OMB Bulletin M-05-03, section II(1). The studies cited in this document were not conducted on behalf of the FAA and only generally note trends in sleep science. As noted earlier in this document, sleep science does not now, and likely never will, reach the level of certainty that would allow an agency to make public policy decisions based solely on scientific studies. While the science is informative, final decisions will necessarily be based on a balancing of interests in the real world rather than on rigid adherence to scientific studies. This rule complies with this Bulletin because almost all of the scientific information cited in this preamble comes from peer-reviewed scientific journals. Two notable exceptions are the TNO Report and the SAFTE/FAST modeling that was used in parts of this rule. However, the FAA has determined that both the TNO Report and the SAFTE/FAST model have been evaluated sufficiently to provide useful information to the agency in making policy decisions on how best to balance the needs of carriers to maximize their operations while still providing sufficient and meaningful rest opportunities to mitigate the risk of fatigue to those operations. The TNO Report's findings were reviewed by the

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[102] The FAA also notes that the DOT Guidelines are simply the "policy views of DOT." Guidelines

Scientific Review Board of the Netherlands Organization for Applied Scientific Research, Department of Behavioral and Social Sciences (which complies with ISO 9001:2000 certification standards) and the review board of the Directorate General Transport and Aviation of the Netherlands Ministry of Transport. Turning to the SAFTE/FAST model, as the NPRM pointed out "[t]his model is widely used, with approximately 14 major carriers and sixteen governmental agencies world-wide having used the model to evaluate fatigue in aviation and other industrial settings." 75 Fed. Reg. at 55867 n.35. The NPRM also noted that a copy of the technical report evaluating this model has been placed on the docket, and, in addition, the NPRM cited a number of studies that either evaluated or utilized the SAFTE/FAST model. See id. n.34.

Deleted: Accordingly, because most of the scientific information used in this rulemaking has been peer-reviewed and the remaining information is reliable, this rulemaking complies with OMB Bulletin M-05-03.

Executive Order 12866

A number of industry commenters stated that this rulemaking does not comply with Executive Order 12866 because: (1) its benefits do not justify its costs, (2) it is not based on scientific information, (3) the FAA has not assessed alternatives, and (4) the rule is unduly burdensome.

The commenters stated that the FAA admitted that sleep science has not been validated in the aviation context and portions of this rule, such as cumulative duty-period limits and lower unaugmented FDP limits for additional flight segments, are not based on scientific evidence. ATA and UPS argued that this rule also violated Section 212 of the Airline Safety and Federal Aviation Extension Act because, according to ATA and UPS, this rule is not based on the best science.

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section III. These Guidelines "are not intended to be, and should not be construed as, legally binding

ATA and RAA criticized the FAA's approach to this rulemaking. RAA stated that the ARC members whose recommendations were used in this rulemaking have considerable operational experience, and that the less conservative, air carrier ARC recommendations were based on this experience and did not undermine safety. RAA added that some of the specific limits set out in this rule could have been increased due to the fact that this rule contains significant safety oversight provisions.

The industry commenters also stated that the FAA has not considered alternatives to this rule because its "one-size fits all" proposal does not take into account "the unique needs of individual carriers or types of operations." ATA stated that this rule is unduly burdensome because the NPRM "improperly treats passenger, cargo, short-haul, long-haul, domestic, and international carriers and operations the same despite their crucial, differing operational demands and crew scheduling requirements."

NACA asserted that the FAA never considered the alternative proposals submitted by supplemental air carriers. NACA added that the FAA never explained why it excluded part 135 operators from this rule, but did not exclude other small business entities such as supplemental air carriers. ATA stated that the FAA did not carefully consider the impact that maintaining the status quo would have on small business entities, and that this violated the Regulatory Flexibility Act.

Executive Order 12866 requires, among other things, that a federal agency: (1) "propose or adopt a regulation only upon a reasoned determination that the benefits of the intended regulation justify its costs;" (2) base its decision on the best available scientific

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regulations or mandates." Id.

information; (3) consider alternatives to the proposed regulation; and (4) "tailor its regulations to impose the least burden on society, including individuals, businesses of differing sizes."

The FAA has determined that the benefits of this rule justify its costs. A detailed discussion explaining the FAA's basis for this determination is contained in the Regulatory Impact Analysis. The FAA has also used the best available scientific information as the basis for this rule. As discussed in the preceding section, most of the provisions in this rule are supported by the latest peer-reviewed scientific studies. While some of these peer-reviewed studies have not been validated in the aviation context, as discussed above, the major provisions of this rule are based on uncontroversial scientific findings that apply to all human beings.

The FAA acknowledges that the proposed cumulative duty-period limits were largely unnecessary, which is why they have been removed from the final rule. With regard to lower unaugmented FDP limits for additional flight segments, as the pertinent section of this preamble points out, a number of scientific studies support the premise that an increase in the number of flight segments leads to an increase in flightcrew member fatigue.[103] The FAA also acknowledges that certain provisions of the NPRM were unduly conservative, and these provisions have been amended in response to concerns expressed by the commenters. For example, the unaugmented FDP limits, which were based on the most conservative ARC recommendation, have been amended in accordance with higher FDP-limit alternatives that were proposed by industry commenters.

[103] See supra notes 36-38.

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The FAA has also considered alternatives to the provisions set out in the NPRM. As the NPRM stated, the FAA has considered the alternative of maintaining the status quo, but rejected that alternative because the status quo subjects society to an "unacceptably high aviation accident risk." 75 Fed. Reg. at 55882. For example, as discussed in the Applicability section of this preamble, some of the FDPs permitted by the existing regulations can result in a five-fold increase to accident risk.

The FAA has also considered the alternative of differentiating between different types of part 121 operations. As a result, the FAA has decided to make the provisions of this rule voluntary for all-cargo operations, as subjecting all-cargo operations to the same mandatory flight, duty, and rest regulations as passenger operations would result in costs that far outweigh the commensurate societal benefit.

The FAA also considered differentiating between the different types of part 121 passenger operations. However, the FAA ultimately decided against this approach because, as discussed in the Applicability section, the factors that lead to fatigue are universal and, unlike all-cargo operations, imposing this rule on passenger operations is cost-justified. A flightcrew member who is working on a 16-hour unaugmented FDP will feel the same level of fatigue regardless of the type of operation that he or she is participating in. Accordingly, this rule uniformly regulates the universal fatigue factors in passenger operations regardless of the specific part 121 passenger operation that is involved.

The FAA has also considered the impact that this rule would have on supplemental passenger operations, and it has incorporated a number of suggestions from carriers who conduct supplemental operations and organizations that represent those carriers, into the final rule. The reason that the FAA excluded part 135 businesses regardless of size, but did not exclude air carriers who conduct supplemental operations from this rule, is that the air carriers who conduct supplemental operations operate under part 121 which contains more stringent safety standards than those found in part 135. Pursuant to the Regulatory Flexibility Act, the FAA also considered the impact of this rule on small businesses, and the pertinent discussion can be found below.

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Throughout this rulemaking, the FAA has attempted to impose the least possible burden on air carriers, consistent with the need to improve safety. As many commenters pointed out, some provisions of this rule are complex because the FAA has consistently decided against imposing across-the-board flight, duty, and rest limitations, which would have been more stringent than necessary. Instead, this rule imposes stringent limits in safety-critical areas, such as the WOCL, and less stringent limits in other areas, such as unaugmented FDPs that begin in the morning.

The FAA also notes that the uniform approach used in this rulemaking provides additional scheduling flexibility to air carriers. For example, because this rule does not differentiate between international and domestic flights (aside from acclimation and time-zone-crossing issues), this rule permits augmentation on domestic flights, which existing regulations do not allow. In addition, because this rule does not differentiate between supplemental passenger operations and other part 121 passenger flights, this rule does not require supplemental passenger operations to provide flightcrew members with additional compensatory rest that is mandated by existing regulations. Accordingly, this rule complies with Executive Order 12866 because it: (1) has benefits that justify its costs, (2) is based on the best available scientific information, (3) was finalized after the FAA considered a number of other alternatives, and (4) is tailored to impose the least burden on society.

Voluntary Consensus

ATA argued that this rule should have used a voluntary consensus standard instead of a government-unique standard. ATA stated that OMB Circular A-119 requires agencies to use voluntary standards whenever possible, and that the short time span given to the ARC was not sufficient for the ARC to address the complex issues present in this rulemaking.

As an initial matter, the FAA notes that there is no voluntary consensus standard for the issues addressed by this rulemaking. The FAA disagrees with ATA's assertion that OMB Circular A-119 requires the FAA to use a voluntary consensus standard in this rulemaking. Subsection 6(c) of OMB Circular A-119 states that:

> This policy does not preempt or restrict agencies' authorities and responsibilities to make regulatory decisions authorized by statute. Such regulatory authorities and responsibilities include determining the level of acceptable risk; setting the level of protection; and balancing risk, cost, and availability of technology in establishing regulatory standards.

This rulemaking consists of the FAA exercising its regulatory responsibility and establishing the acceptable level of fatigue-related risk, setting the appropriate level of protection from fatigue, and balancing the risks of fatigue with the costs that will be borne by air carriers as a result of this rule. Because subsection 6(c) of OMB Circular A-119 excludes this type of agency action from the circular's requirements, OMB Circular A-119 does not preempt or restrict the FAA's statutory authority to conduct this rulemaking. See id.

Public Interest

ATA stated that this rule would also harm the public interest by: (1) reducing the number of U.S. jobs by hurting the competitive nature of the U.S. air carrier industry; (2) harm the U.S. economy by imposing excessive costs on air carriers; (3) disrupt air travel and waste passengers' air time as a result of additional cancelled and delayed flights; and (4) disrupt critical air deliveries.

As discussed above, this rule does not hurt the competitive nature of the U.S. air carrier industry. This rule simply reflects a different conceptual approach that the FAA utilized in light of its significant operational experience with daily flight-time limits. With regard to the remaining concerns expressed in the comments, as discussed in the Regulatory Impact Analysis, the costs that are imposed by this rule are justified by the associated benefits of reducing the risk that passengers will be involved in an accident.

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Two-year Effective Date

RAA also stated that a two-year effective date for this rule may be too short given the magnitude of the changes being proposed, and the complex process, development, training, and system programming, testing and implementation that would be required to effect those changes cannot be properly accomplished in such a time period. RAA emphasized that the changes being proposed by this rule "go to the very heart" of an airline's operations.

The FAA understands that this rule imposes complex new requirements that go to the heart of an airline's operations. That is why this rule provides air carriers with two years to make changes to their existing flight schedules and operations and if necessary, to address any labor agreement issues. The FAA has determined that two years is a substantial period of time, and that a longer effective date is unwarranted in light of the fact that, as discussed above, existing regulations allow flightcrew members in passenger operations to accumulate unsafe amounts of fatigue.

Federal Motor Carrier Safety Administration Hours of Service Rulemaking

FMCSA has been engaged in long-term rulemaking related to its hours of service regulations for commercial truck drivers. Like the FAA, FMCSA is working to address the universality of factors that lead to fatigue. However, the FAA has taken a different approach in addressing fatigue risk among pilots than FMCSA has with respect to commercial truck drivers. This is because the two industries operate differently both in terms of the likely number of days the affected individuals work per month and the respective operating environments. For example, pilots regularly cross multiple time zones in a very short period of time – something that is simply not possible in other modes of transportation. Additionally, pilots may work several days that are very long, but then be off for an extended period of time, a practice that naturally imposes a non-regulatory restorative rest opportunity. Finally, the nature of commercial flying is such that under typical conditions, the actual operation is likely to require intense concentration primarily during take-offs and landings, with a constant, but generally predictable level of concentration required for other phases of flight.

In contrast, commercial truck drivers face an environment where they are required to share the highways with drivers who have not received specialized training and are not subject to any regulatory constraints that pilots are subject to. This environment could logically lead to a regulatory approach with different fatigue mitigators for daytime operations on congested highways, compared to nighttime operations, where the roads are less crowded but the risk of fatigue is greater.

IV. Regulatory Notices and Analyses

A. Regulatory Evaluation

Changes to Federal regulations must undergo several economic analyses. First, Executive Order 12866 and Executive Order 13563 directs that each Federal agency shall propose or adopt a regulation only upon a reasoned determination that the benefits of the intended regulation justify its costs. Second, the Regulatory Flexibility Act of 1980 (Public Law 96-354) requires agencies to analyze the economic impact of regulatory changes on small entities. Third, the Trade Agreements Act (Public Law 96-39) prohibits agencies from setting standards that create unnecessary obstacles to the foreign commerce of the United States. In developing U.S. standards, the Trade Agreements Act requires agencies to consider international standards and, where appropriate, that they be the basis of U.S. standards. Fourth, the Unfunded Mandates Reform Act of 1995 (Public Law 104-4) requires agencies to prepare a written assessment of the costs, benefits, and other effects of proposed or final rules that include a Federal mandate likely to result in the expenditure by State, local, or tribal governments, in the aggregate, or by the private sector, of $100 million or more annually (adjusted for inflation with base year of 1995). This portion of the preamble summarizes the FAA's analysis of the economic impacts of this proposed rule. The FAA suggests readers seeking greater detail read the full regulatory impact analysis, a copy of which the agency has placed in the docket for this rulemaking.

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

Total Benefits and Costs over a 10 Year Period

We have analyzed the benefits and the costs associated with the requirements contained in this Final Rule over a 10 year period. We provide a range of estimates for our quantitative benefits. Our base estimate is $376 million ($ 247 million present value at 7% and $311 million present value at 3%) and our high case estimate is $716 million ($470 million present value at 7% and $593 million at 3%). The total estimated cost of

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the Final Rule is $390 million ($297 million present value at 7% and $338 million at 3%).

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Additionally, the FAA believes there are substantial, non-quantified health benefits associated with the final rule. The agency has not evaluated the effect of fatigue on the overall, long-term health of the pilot community because those health impacts are unlikely to have an impact on aviation safety in a quantifiable manner. However, as ALPA noted in one of its meetings with OMB under its E.O. 12866 procedures, the societal cost associated with long-term fatigued-related health problems can be substantial.[104] Decreasing these costs represents a societal benefit. While we have not quantified these potential benefits, they may well exceed the projected costs of the rule when added to our base case estimate.

The actual benefits of the final rule will depend upon the type and size of accident that the rule averts. We have provided a base case estimate, based on historical accidents and the regulatory structure in place at the time those accidents occurred, and a high estimate, based on a projection of future accidents that broadly reflect the historical accident profile. Neither estimate assumes a catastrophic accident aboard a large passenger aircraft. This is because no large passenger aircraft were represented in the historical accident analysis rather than because there is no fatigue-related risk to those operations. We note that preventing a single catastrophic accident with 61 people on board would cause this rule to be cost beneficial.

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Total Benefits over 10 Years			
	Nominal (millions)	PV at 7% (millions)	PV at 3% (millions)
Base	$ 376	$ 247	$ 311
High	$ 716	$ 470	$ 593

Total Costs over 10 Years			
	Nominal (millions)	PV at 7% (millions)	PV at 3% (millions)
Flight Operations	$236	$157	$191
Rest Facilities	$138	$129	$134
Training	$16	$11	$13
Total	$390	$297	$338

Benefits of the Rule

The benefit analysis first examines the nature of fatigue, followed by its causes and how it relates to transportation. Second, it summarizes some recent findings on fatigue and occupational performance. Third, it looks at the magnitude of crew fatigue in Part 121 commercial aviation by briefly examining fatigue reports in the context of this final rule. We then re-analyze the likely effectiveness of the requirements contained in this final rule and the potential to decrease these types of accidents in the future. The FAA projects a likely number of preventable events that will occur in absence of this

[104] See OMB submission from ALPA dated October 28, 2011. http://www.whitehouse.gov/omb/oira_2120_meetings/.

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final rule. Finally, the agency estimates the benefits that will be derived from preventing such events and a range of benefits based upon likely scenarios.

Here the FAA provides a quantitative benefit estimate of historical-based accidents (base case), and a high case of expected benefits from future averted accidents once this rule is promulgated. Generally our benefit analysis begins using past history as an important reference from which to begin the benefit analysis. We believe the base case benefit estimate, which is based solely on the outcome of past accidents, may be low because today passenger load factors and aircraft size are already greater than they were in the past decade. We also note that this estimate may not fully take into account changes in regulatory requirements that postdate those accidents and that may mitigate the projected risk. As such, our base case estimate represents a snapshot of risk.

Airplane accidents are somewhat random both in terms of airplane size and the number of people on board. For these reasons, projections of future fatalities may be based on future risk exposure, and our projections are typically based on expected distributions around the mean. Our typical scenario incorporates increasing airplane size, expected load factors, and a breakeven analysis. However, our evaluation of the historical accidents showed a disproportionate risk among smaller, regional carriers. Accordingly, as we discuss below, the FAA has decided to base its high case estimate on preventing an accident in a regional jet airplane.

In response to comments, we have reduced the analysis period from the 20 years provided in the proposed regulatory analysis to 10 years here. We received comments disputing the use of a 20 year time frame for accidents stating the accident rate has declined over time. While noting the wide range of operations over the last 20 years, we shortened the accident history to the last ten years. A reduction in the length of the sample period introduces other problems, most importantly with less time there are fewer observations. Observations are important, as the nature of aviation accidents is that while they are rare events, very often these accidents result in severe, high consequences.

The FAA Office of Accident Investigation assessed the effectiveness of this rule to prevent the 6 fatigue-related accidents which occurred on passenger-carrying aircraft in a recent ten year period. This office used the Commercial Aviation Safety Team (CAST) methodology to assign a value to how effective the rule will be at preventing each accident. On average, we expect this rule would have been 52.5 percent effective in preventing the types of accidents had it been in effect over the last 10 years.

Base Case Estimate

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The base case estimate only looks at the historical events as a specific reference point. In this estimate the exact number of fatalities for each past event is multiplied by the relative rule effectiveness score to obtain the historical number of deaths that would have been averted with the requirements contained in this final rule, had this rule been in effect at the time. The base case estimate supposes roughly six deaths will be averted annually. Multiplying six annual averted deaths by the $6.2 million value of statistical life equals $37 million annually. In addition, had the requirements been in place at the time of these historical accidents, $2 million in hull damage for each accident would have been averted, which equals $6 million for ten years or $0.6 million annually. When summed over the ten year period of analysis, the base case estimate is $376 million ($247 million present value at 7% and $311 million present value at 3%).

High Case Estimate

Because airplane accidents are relatively rare they are not necessarily representative of actual risk, especially with regard to airplane size and the number of people on-board. In addition, future conditions will be different than they were when the accident occurred. Thus, the base case represents a snapshot of the risk that fatigue introduces in the overall operating environment. It considers neither the forecasted increase in load factors nor the larger aircraft types. The future preventable events that this rule addresses will not exactly mirror the past events because the airplane types, utilization, and seating capacity have changed.

To quantify the expected benefits in the high case scenario, we narrowed the analysis to three of the six historic accidents which were catastrophic (all on board died). In this case the expected number of preventable catastrophic accidents equals the three accidents multiplied by the 52.5 percent effectiveness rate. Thus over a ten-year time period the expected number of preventable accidents is 1.575. Using the Poisson distribution there is roughly a 20 percent chance for no accident; however, there is also a 50 percent probability of two or more accidents.

While the 20 year accident history has a broader range of catastrophic accidents, in the shorter ten year historical period all the three catastrophic accidents were on regional airplanes. We recognize that as regional airplanes are smaller than the 'typical' passenger jet, assuming all future accidents would be on a regional jet may understate the relative risk across the fleet of aircraft affected by this rule. It does, however, represent historical accidents and may be somewhat representative actual future risk, since the mainline carriers typically have collective bargaining agreements that are already largely reflective of the requirements of this rule.[105]

The average size airplane in the forecast period is a B737/A320 with an expected number of passengers and crew of 123 given a forecasted 142 seat airplane and a load factor of 83 percent.[106] Even though there was a (relatively large) B757 passenger airplane accident in the 20 year history, if one looks at the past 10 years as truly representative of risk, the preventable accident would likely be on a regional airplane.

For the high case the FAA backed away from a benefit outcome based on mean fleet, flight hours, and occupant numbers because ultimately we were persuaded there was information which could not be ignored by the three regional passenger accidents occurring without a mainline passenger accident. For this reason, we selected an 88 seat regional jet (like an ERJ-175) to be the representative airplane for the high case. This size airplane is also consistent with the fact that regional operators are expected to fly somewhat larger airplanes in the future.

The expected benefit from this high case follows a simple methodology for estimating and then valuing the expected number of occupants in a prevented accident. With a total of 0.3 accidents per year over the ten year period multiplied by the 52.5

[105] It is unusual that collective bargaining agreements would closely mirror regulatory requirements. However, flight and duty limitations are unique because they address both safety considerations, which are regulatory in nature, and lifestyle considerations, which are properly addressed in collective bargaining agreements. Because of the impact of collective bargaining agreements on the number of hours that pilots work, those agreements were considered by the FAA in calculating both the costs and benefits of this rule.

[106] Table 6, FAA Aerospace Forecasts Fiscal Years 2011

percent effectiveness rate, the analysis assumes 0.1575 average accidents per year. The estimated occupant value for each averted accident equals the average number of seats (88) multiplied by the load factor of 77% plus 4 crew members for a total of 72 averted fatalities. Each of these prevented fatalities is multiplied by a $6.2 million value of statistical life. The expected value of a preventable accident equals the sum of the averted fatalities at $446.4 million added to the value of the airplane hull loss ($8.15 million replacement value), for a prevented accident benefit of $454.6 million.[107] Over a ten year period the value of preventing the expected 1.575 accidents equals approximately $716 million ($470 million present value at 7% and $593 million present value at 3%).

Cost of the Rule

The total estimated cost of the Final Rule is $390 million ($297 million at 7% present value and $338 million at 3% present value). The FAA classified costs into three main components and estimated the costs for each component. Data was obtained from various industry sources; the sources of the data used in cost estimation are explained in each section. Flight operations cost accounts for 53 percent of the total present value cost of the rule. Rest facilities and fatigue training accounts for approximately 43 percent and

[107] In contrast, the value of an averted all-cargo fatal accident would range between $20.35 million (loss of hull and 2 crewmembers) and $32.55 million (loss of hull and 4 crewmembers).

[111] As discussed in the International Compatibility section, there are no "international standards" to consider.

Deleted: For our base case estimate, we conservatively only look at the subset of fatigue related accidents where hull losses and passenger deaths occurred. Of the seven events in the most recent ten years, only three were "catastrophic" in nature where virtually everyone on the airplane was killed. We use those three catastrophic accidents as the minimum expected number of accidents for our period of analysis, and incorporate the expected average effectiveness of 58%. ¶
With a total of 0.3 events annually over the ten year period of analysis, and the corresponding 58% average effectiveness, 0.174 average annual events would be averted for our base case estimate. For the estimate of the number of individuals per airplane, we weight the twenty year historical accident proportions by industry segment. Using this historical data along with the forecast for the number of people on board a preventable accident, we estimate 66 people on each airplane.[108] Multiply the expected 66 people by the value of averting fatalities ($6.2 million), we estimate $409 million in benefits from averting fatalities. This benefit is added to the weighted average airplane value that would be involved in a preventable accident ($8.15 million). As such, the base case estimate from averting an event is roughly $417 million. ¶
When we multiply the average annual events that will be averted in our lower bound estimate (0.174) by the estimated benefit from averting an event, $404.15 (weighted average) million, the annual benefits are $72.6 million. When summed over the period of analysis, the total estimated lower bound benefits are $726 million ($477 million present value). ¶
High Estimate¶
There were a total of 7 events where the requirements contained in this Final Rule would have been on average 58% effective, if the requirements had been in place at the time of the accidents for this upper bound. We assume equal risk for every year of the analysis period, and an accompanying forecasted 10-year benefit period that mirrors the costs. The corresponding annual equivalent of seven events over the period of analysis equals 0.7 events per year. When multiplied by the effectiveness of 58%, the total estimated annual preventable events are 0.406. ¶ ... [41]

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4 percent, respectively. Each of the main cost components is explained in-depth in the Regulatory Evaluation.

Cost Component	Nominal Cost (millions)	PV at 7% (millions)	PV at 3% (millions)
Flight Operations	$236	$157	$191
Rest Facilities	$138	$129	$134
Training	$16	$11	$13
Total	**$390**	**$297**	**$338**

Alternatives Considered- The alternatives are shown in the section "Final Regulatory Flexibility Analysis"

B. Final Regulatory Flexibility Analysis

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

Agencies must perform a review to determine whether a proposed or final rule would have a significant economic impact on a substantial number of small entities. If the determination is that it would, the agency must prepare a regulatory flexibility analysis as described in the RFA.

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The FAA believes that this final rule will have a significant economic impact on a substantial number of small entities and therefore has performed final regulatory flexibility analysis in accordance with section 604(a)(1)–(5), highlighted below:

1. A succinct statement of the need for, and objectives of, the rule.

2. A summary of the significant issues raised by the public comments in response to the IRFA, a summary of the assessment of the agency of such issues, and a statement of any changes made in the proposed rule as a result of such comments.

3. A description and an estimate of the number of small entities to which the rule will apply or an explanation of why no such estimate is available.

4. A description of the projected reporting, recordkeeping, and other compliance requirements of the rule, including an estimate of the classes of small entities that will be subject to the requirement and the types of professional skills necessary for preparation of the report or record.

5. A description of the steps the agency has taken to minimize the significant adverse economic impact on small entities consistent with the stated objectives of applicable statutes, including a statement of the factual, policy, and legal reasons for selecting the alternative adopted in the final rule and why each of the other significant alternatives to the rule considered by the agency were rejected.

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We address each requirement.

1. A succinct statement of the need for, and objectives of, the rule.

This final rule amends the FAA's existing flight, duty and rest regulations applicable to certificate holders and their flightcrew members operating under 14 CFR

Part 121. The rule recognizes the universality of factors that lead to fatigue in most individuals. Fatigue threatens aviation safety because it increases the risk of pilot error that could lead to an accident. The new requirements eliminate the current distinctions between domestic, flag and supplemental operations as they apply to passenger operations. The rule provides different requirements based on the time of day, whether an individual is acclimated to a new time zone, and the likelihood of being able to sleep under different circumstances. The objective of the proposed rule is to increase the margin of safety for passengers traveling on U.S. part 121 air carrier flights. Specifically, the FAA wants to decrease diminished flight crew performance associated with fatigue or lack of alertness brought on by the duty requirements for flightcrew members

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2. A summary of the significant issues raised by the public comments in response to the IRFA, a summary of the assessment of the agency of such issues, and a statement of any changes made in the proposed rule as a result of such comments.

NAA, NJASAP, Southern Air, Lynden Air Cargo, NACA and U.S. Chamber of Commerce stated that RFA of the proposed rule failed to address the full burden to be borne by small entities, such as nonscheduled air carriers, and that the FAA did not follow RFA requirements in addressing alternative means of compliance that would lessen the economic burden on small entities.

Since the NPRM, the FAA has made substantial changes to the duty and rest requirements that will significantly reduce the cost to small entities.

3. A description and an estimate of the number of small entities to which the rule will apply or an explanation of why no such estimate is available.

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The final rule applies to all certificate holders operating under part 121 who conduct passenger operations. There are 67 such operators, of which 55 operators have fewer than 1,500 employees.

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4. A description of the projected reporting, recordkeeping, and other compliance requirements of the rule, including an estimate of the classes of small entities that will be subject to the requirement and the types of professional skills necessary for preparation of the report or record.

As described in the Paperwork Reduction Analysis, there are additional compliance requirements for reporting and recordkeeping.

5. A description of the steps the agency has taken to minimize the significant adverse economic impact on small entities consistent with the stated objectives of applicable statutes, including a statement of the factual, policy, and legal reasons for selecting the alternative adopted in the final rule and why each of the other significant alternatives to the rule considered by the agency was rejected.

Current crew schedules vary by operator, labor contract, and size of pilot pools. As such, the impact to small entity operators will vary. The agency understands that many smaller operators have maximized their pilot time in the cockpit and may have little flexibility with potential new flight and duty regulations and we have taken steps to minimize the economic impact on small entities. In response to several comments from small entities, the FAA has made significant changes from the proposal in this final rule which will minimize the economic impact on small entities. In addition, the FAA has largely removed schedule reliability from this rule. The FAA has instead adopted provisions that limit extensions of the FDP and requires reporting of FDP extensions and activities that were not otherwise permitted by the provisions of §117.11, §117.19 and §117.29 in the Final Rule. Under this amendment, costs to airline carriers are limited to reporting exceptional activities by sending electronic mails to the FAA.

Alternative – Require four hours' mid-duty rest to work on five consecutive nighttime FDPs

This final rule reduces (to two hours) the amount of mid-duty rest necessary to work on five consecutive nighttime FDPs. The FAA rejected the higher mid-duty rest requirement proposed in the NPRM because of the potential negative impact on small businesses and the safety risks that are discussed in the pertinent part of the preamble.

Alternative – Different Limitations on Supplemental Passenger Operations

The FAA has considered imposing different limitations on small supplemental passenger operations but has rejected this alternative. The FAA has decided to impose the same FDP limits on passenger supplemental operations as other part 121 operations. While there are relatively few supplemental passenger operations, the FAA has determined that these pilots should be as rested as those in scheduled service since the numbers of passengers onboard the aircraft are similar to those on board an aircraft operating as a scheduled service. Furthermore, a significant number of these operations involve the transport of troops. The United States government believes these passengers should not be exposed to a level of risk different from if they were transported via a scheduled service operation.

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Alternative – Exclude/Exempt Supplemental Passenger Operations

The FAA has also considered excluding supplemental passenger operations from this rule but rejected this alternative for the same reasons that it rejected the alternative of imposing different limitations on supplemental passenger operations. In addition, the FAA has noted that its decision to include supplemental operations in this rule was not specifically targeted at small businesses because many large air carriers also have supplemental authority.

Alternative – Require All-Cargo Operators to Comply With the Final Rule

The FAA has also considered requiring all-cargo operators to comply with part 117. However, the FAA decided to make compliance with this part voluntary for all-cargo operations because their compliance costs significantly exceed the quantified safety benefits.

C. International Trade Impact Assessment

A number of industry commenters argued that finalizing the NPRM as written would undermine the ability of U.S. air carriers to compete with foreign air carriers. These commenters stated that 49 USC 40101(a)(15) and (e)(1) require the Secretary of Transportation to ensure that U.S. air carriers compete on equal terms with foreign carriers. The commenters then pointed out that this rule contains provisions, such as daily flight-time limits, that are not a part of analogous foreign regulations, and that these provisions hurt the international competitive position of U.S. air carriers who are subject to this rule.

The industry commenters added that the imposition of daily flight-time limits, which are not contained in foreign aviation regulations, creates an unnecessary obstacle to the foreign commerce of the United States, and thus violates the Trade Agreements Act of 1979 (TAA) (codified at 19 USC sections 2531-2533). The commenters also argued that by imposing daily flight-time limits, the FAA did not properly consider other international standards, and thus violated the TAA, OMB Circular A-119, and Executive Order 12866, all of which require the FAA to consider international standards.

The Trade Agreements Act of 1979 (Public Law 96-39), as amended by the Uruguay Round Agreements Act (Public Law 103-465), prohibits Federal agencies from establishing standards or engaging in related activities that create unnecessary obstacles to the foreign commerce of the United States. Pursuant to these Acts, the establishment of standards is not considered an unnecessary obstacle to the foreign commerce of the United States, so long as the standard has a legitimate domestic objective, such the protection of safety, and does not operate in a manner that excludes imports that meet this objective. The statute also requires consideration of international standards and, where appropriate, that they be the basis for U.S. standards.[111] The FAA has assessed the potential effect of this final rule and determined that it would enhance safety and is not considered an unnecessary obstacle to trade.

The flight-time limits in this rule do not undermine the international competitive position of U.S. air carriers. While this rule sets daily flight-time limits that many foreign aviation rules do not contain, the additional fatigue mitigation created by the daily flight-time limits permits the FAA to set less stringent requirements in other parts of this rule.

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For example, this rule only requires a 10-hour rest period between FDPs instead of the 12-hour rest period required by many foreign flight, duty, and rest regulations. This rule also permits 14-hour FDPs for periods of peak circadian alertness while some foreign regulations, such as EU Rules, Subpart Q, only permit FDPs that do not exceed 13 hours.[112]

As the above examples demonstrate, the imposition of daily flight-time limits is simply the result of a different conceptual approach that was utilized by the FAA. The FAA chose this approach because it has significant operational experience administering daily flight-time limits, and the FAA chose to employ this experience to better calibrate the specific provisions of this rule. This difference in approach does not undermine the competitive position of U.S. air carriers because the imposition of daily flight-time limits permitted the FAA to make other parts of this rule less stringent than the analogous provisions of foreign flight, duty, and rest regulations.

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D. Unfunded Mandates Assessment

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

112 See EU Rules, Subpart Q, OPS 1.1100, section 1.3 and OPS 1.1110, section 1.1.

$143.1 million in lieu of $100 million. This final rule does not contain such a mandate; therefore, the requirements of Title II do not apply.

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E. Paperwork Reduction Act

The paperwork burden comprises of five areas, fatigue risk management system §117.7, fatigue training §117.9, flight time limitation §117.11, and flight duty period extension reporting §117.19 and Emergency and government sponsored operations §117.29. The following analyses were conducted under Paperwork Reduction Act of 1995 (44 U.S.C. 3501).

1) PRA analysis for reporting fatigue risk management system (FRMS) §117.7 provision

The final rule will allow each air carrier to develop a Fatigue Risk Management System (FRMS) if it wishes. FRMS is a voluntary program in the final rule. It will result in an annual recordkeeping and reporting burden if some of industry carriers eventually adopt the system so that they need to report the related activities to the FAA. Total FRMS annualized paperwork burden is determined by the numbers of FRMS to be developed and FRMS reporting cost per responders. FAA estimated that FRMS will incur the paperwork burden about $14,950 annually, $149,500 nominal cost for 10-years or $99,186 present value at 7 %. FAA took steps to arrive the estimate as follows.

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a. Number of respondents (air carriers): the FAA estimated approximately 20 carriers or respondents;

b. Estimated time of paperwork: about 11.5 hours per air carrier and 230 hours in total for data collection, annual FRMS record-keeping and reporting required by the FAA;

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c. Average hourly wage rate of a FRMS information respondent (manager level): $65 per hour for reporting and analyzing FRMS data;

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d. FRMS paperwork hour estimation: total 230 hours (11.5 hours x 20 estimated carriers);

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e. Total annualized cost of FRMS paperwork is about $14,950 ($1,253.50 x 20) for the estimated 20 carriers.

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f. The nominal cost for 10-year is $149,500 or $99,186 present value at 7 %.

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2) PRA analysis for fatigue training §117.9 provision

The fatigue training requirement in the final rule will also result in an annual recordkeeping and reporting burden. Total fatigue training annualized paperwork burden costs are determined by the numbers of responders and fatigue training reporting cost per responders. FAA estimated that the fatigue training will incur the paperwork burden approximately 2,345 hours, $152,425 for the first year, $1.5 million nominal cost for 10-years or $1 million present value at 7 %. FAA took steps to arrive the estimate as follows.

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a. Number of responders (dispatchers and managers): 67 operators;

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b. Estimated time needed for each responder: 35 hours, or 2,345 hours incurred by 67 responders;

c. Average hourly wage rate of trainee: $65 per hour;

d. Fatigue training paperwork cost: $152,425 per annum ($65 hourly wage rate x 2,345 hours) ;

3) PRA analysis for §117.11, §117.19 and §117.29 provisions

The FAA combined the cost estimates in one PRA analysis for three provisions of the final rule (§117.11, §117.19 and §117.29), since paperwork burdens for carriers to report activities that were not otherwise permitted by §117.11, §117.19 and §117.29 are the same. Reporting and recordkeeping by carriers can be done electronically by addressing the facts of events. Under the above provisions, carriers do not need to conduct complicated analyses, so that there will be no paperwork burden of analyses. In this analysis, the estimate of paperwork burden will be determined by the numbers of respondents, the frequencies of their reporting, hours required and the reporter's wage rate. The FAA estimated the final annual paperwork burden for three provisions is $92,250, and $0.9 million for the 10-years nominal cost, or the present value of $0.6 million at 7 %, by taking steps to arrive the estimate as follows.

a. Number of respondents (air carriers): there are 67 carriers or respondents;

b. Estimated frequencies for reporting requirements under each provision: Although a definitive frequency is unknown and will decrease as certificate

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<#>The time and cost estimation for paperwork related to curriculum development, collecting and recordkeeping: 20 hours per carrier, or 1,840 hours in total. The annualized total cost is about $2,180 per carrier, and $200,560 for 92 carriers in total.¶
<#>The estimated paperwork related hours is about 4,079. (2,239+1840) ¶
<#>Total annualized costs of fatigue training is about $346,111 ($145,551+ $200,560);¶
The paperwork of fatigue training needs approximately 1,840 hours, $1.2 million of 10 year nominal cost or $1.1 million present value at 7 %.

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holders adapt the changes, the FAA assumes an average of 6 times per year for each provision;

c. Estimated total frequencies of annual responses: 18 times (6 x 3) per carrier and 1,206 times (67 x 18) by 67 carriers for these three provisions of the final rule;

d. Estimated time needed for each report for each occurrence: 30 minutes, one hundred percent of these responses will be collected electronically. The time needed for each carrier to report is about 9 hours (18 x 30 minutes), and 603 hours in total by 67 carriers for these three provisions of the final rule;

e. Estimated hourly wage rate of reporting staff: $65 per hour;

f. The estimated total annual cost of reporting is about $39,195 (603 hours x $65);

g. The nominal cost for 10-years is about $0.4 million or the present value of $0.24 million at 7%.

Summarizing the above, the annualized cost is approximately $194,950 and the total nominal cost for 10-years about $2.1 million ($0.15 million +$1.5 million+ $0.4 million) or the present value of approximately $1.3 million at 7% ($0.1 + $1 million + $0.2 million). The public reporting burden is estimated to be an average of 47 hours for each Part 121 certificate holder and 3,178 hours, including the time for reviewing instructions, searching existing data sources, gathering and maintaining the data needed,

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and completing and reviewing the collection of information. The total annual cost burden is approximately $204,950 in total for 67 carriers. There will be no additional annualized cost to the Federal Government, because FAA will not add additional staff or pay additional contractors for collecting, viewing and keeping electronic report-emails.

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F. International Compatibility

In keeping with U.S. obligations under the Convention on International Civil Aviation, it is FAA policy to conform to International Civil Aviation Organization (ICAO) Standards and Recommended Practices to the maximum extent practicable. The FAA has determined that there are no ICAO Standards and Recommended Practices that directly correspond to these regulations.[113]

G. Environmental Analysis

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

V. Executive Order Determinations

A. Executive Order 12866 and 13563

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[113] Chapter 4 of ICAO 6, Amendment 33, section 4.2.10.2 states the following:

> Fatigue management. An operator shall establish flight time and duty period limitations and a rest scheme that enable it to manage the fatigue of all its flight and cabin crew members. This scheme shall comply with the regulations established by the State of the Operator, or approved by that State and shall be included in the operations manual.

This provision of ICAO is not inconsistent with this rule. Moreover, because the ICAO provision defers to the regulations promulgated by the State of the Operator, it does not even directly correspond to this rule.

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See the "Regulatory Evaluation" discussion in the "Regulatory Notices and Analyses" section elsewhere in this preamble.

B. Executive Order 13132, Federalism

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

C. Executive Order 13211, Regulations that Significantly Affect Energy Supply, Distribution, or Use

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

VI. How To Obtain Additional Information

A. Rulemaking Documents

An electronic copy of a rulemaking document may be obtained by using the Internet —

1. Search the Federal eRulemaking Portal (http://www.regulations.gov);
2. Visit the FAA's Regulations and Policies Web page at http://www.faa.gov/regulations_policies/ or

3. Access the Government Printing Office's Web page at http://www.gpoaccess.gov/fr/index.html.

Copies may also be obtained by sending a request (identified by notice, amendment, or docket number of this rulemaking) to the Federal Aviation Administration, Office of Rulemaking, ARM-1, 800 Independence Avenue SW., Washington, DC 20591, or by calling (202) 267-9680.

B. Comments Submitted to the Docket

Comments received may be viewed by going to http://www.regulations.gov and following the online instructions to search the docket number for this action. Anyone is able to search the electronic form of all comments received into any of the FAA's dockets by the name of the individual submitting the comment (or signing the comment, if submitted on behalf of an association, business, labor union, etc.).

C. Small Business Regulatory Enforcement Fairness Act

The Small Business Regulatory Enforcement Fairness Act (SBREFA) of 1996 requires FAA to comply with small entity requests for information or advice about compliance with statutes and regulations within its jurisdiction. A small entity with questions regarding this document, may contact its local FAA official, or the person listed under the FOR FURTHER INFORMATION CONTACT heading at the beginning of the preamble. To find out more about SBREFA on the Internet, visit http://www.faa.gov/regulations_policies/rulemaking/sbre_act/.

List of Subjects

14 CFR Part 117

Airmen, Aviation safety, Reporting and recordkeeping requirements, Safety.

14 CFR Part 119

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

14 CFR Part 121

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

The Amendment

In consideration of the foregoing, the Federal Aviation Administration amends chapter I of title 14, Code of Federal Regulations as follows:

1. Part 117 is added to read as follows:

PART 117—FLIGHT AND DUTY LIMITATIONS AND REST REQUIREMENTS: FLIGHTCREW MEMBERS

Sec.

117.29 Emergency and government sponsored operations.
Table A to Part 117 – Maximum Flight Time Limits for Unaugmented Operations
Table B to Part 117 – Flight Duty Period: Unaugmented Operations
Table C to Part 117 – Flight Duty Period: Augmented Operations

Authority: 49 U.S.C. 106(g), 40113, 40119, 44101, 44701-44702, 44705, 44709-44711, 44713, 44716-44717, 44722, 46901, 44903-44904, 44912, 46105.

§ 117.1 Applicability.

(a) This part prescribes flight and duty limitations and rest requirements for all flightcrew members and certificate holders conducting passenger operations under part 121 of this chapter.

(b) This part applies to all operations directed by part 121 certificate holders under part 91, other than subpart K, of this chapter if any segment is conducted as a domestic passenger, flag passenger, or supplemental passenger operation.

(c) This part applies to all flightcrew members when participating in an operation under part 91, other than subpart K of this chapter, on behalf of the part 121 certificate holder if any flight segment is conducted as a domestic passenger, flag passenger, or supplemental passenger operation

(d) Notwithstanding paragraphs (a), (b) and (c) of this section, a certificate holder may conduct under part 117 its part 121 operations pursuant to 121.470, 121.480, or 121.500.

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§ 117.3 Definitions.

In addition to the definitions in §§ 1.1 and 110.2 of this chapter, the following definitions apply to this part. In the event there is a conflict in definitions, the definitions in this part control.

Acclimated means a condition in which a flightcrew member has been in a theater for 72 hours or has been given at least 36 consecutive hours free from duty.

Airport/standby reserve means a defined duty period during which a flightcrew member is required by a certificate holder to be at an airport for a possible assignment.

Augmented flightcrew means a flightcrew that has more than the minimum number of flightcrew members required by the airplane type certificate to operate the aircraft to allow a flightcrew member to be replaced by another qualified flightcrew member for in-flight rest.

Calendar day means a 24-hour period from 0000 through 2359 using Coordinated Universal Time or local time.

Certificate holder means a person who holds or is required to hold an air carrier certificate or operating certificate issued under part 119 of this chapter.

Deadhead transportation means transportation of a flightcrew member as a passenger or non-operating flightcrew member, by any mode of transportation, as required by a certificate holder, excluding transportation to or from a suitable accommodation. All time spent in deadhead transportation is duty and is not rest. For purposes of determining the maximum flight duty period in Table B of this part, deadhead transportation is not considered a flight segment.

Duty means any task that a flightcrew member performs as required by the certificate holder, including but not limited to flight duty period, flight duty, pre- and post-flight duties, administrative work, training, deadhead transportation, aircraft positioning on the ground, aircraft loading, and aircraft servicing.

Fatigue means a physiological state of reduced mental or physical performance capability resulting from lack of sleep or increased physical activity that can reduce a flightcrew member's alertness and ability to safely operate an aircraft or perform safety-related duties.

Fatigue risk management system (FRMS) means a management system for a certificate holder to use to mitigate the effects of fatigue in its particular operations. It is a data-driven process and a systematic method used to continuously monitor and manage safety risks associated with fatigue-related error.

Fit for duty means physiologically and mentally prepared and capable of performing assigned duties at the highest degree of safety.

Flight duty period (FDP) means a period that begins when a flightcrew member is required to report for duty with the intention of conducting a flight, a series of flights, or positioning or ferrying flights, and ends when the aircraft is parked after the last flight and there is no intention for further aircraft movement by the same flightcrew member. A flight duty period includes the duties performed by the flightcrew member on behalf of the certificate holder that occur before a flight segment or between flight segments without a required intervening rest period. Examples of tasks that are part of the flight duty period include deadhead transportation, training conducted in an aircraft or flight simulator, and airport/standby reserve, if the above tasks occur before a flight segment or between flight segments without an intervening required rest period:

Home base means the location designated by a certificate holder where a flightcrew member normally begins and ends his or her duty periods.

Lineholder means a flightcrew member who has an assigned flight duty period and is not acting as a reserve flightcrew member.

Long-call reserve means that, prior to beginning the rest period required by § 117.25, the flightcrew member is notified by the certificate holder to report for a flight duty period following the completion of the rest period.

Physiological night's rest means 10 hours of rest that encompasses the hours of 0100 and 0700 at the flightcrew member's home base, unless the individual has acclimated to a different theater. If the flightcrew member has acclimated to a different theater, the rest must encompass the hours of 0100 and 0700 at the acclimated location.

Report time means the time that the certificate holder requires a flightcrew member to report for an assignment.

Reserve availability period means a duty period during which a certificate holder requires a flightcrew member on short call reserve to be available to receive an assignment for a flight duty period.

Reserve flightcrew member means a flightcrew member who a certificate holder requires to be available to receive an assignment for duty.

Rest facility means a bunk or seat accommodation installed in an aircraft that provides a flightcrew member with a sleep opportunity.

(1) Class 1 rest facility means a bunk or other surface that allows for a flat sleeping position and is located separate from both the flight deck and passenger cabin in an area that is temperature-controlled, allows the flightcrew member to control light, and provides isolation from noise and disturbance.

(2) Class 2 rest facility means a seat in an aircraft cabin that allows for a flat or near flat sleeping position; is separated from passengers by a minimum of a curtain to provide darkness and some sound mitigation; and is reasonably free from disturbance by passengers or flightcrew members.

(3) Class 3 rest facility means a seat in an aircraft cabin or flight deck that reclines at least 40 degrees and provides leg and foot support.

Rest period means a continuous period determined prospectively during which the flightcrew member is free from all restraint by the certificate holder, including freedom from present responsibility for work should the occasion arise.

Scheduled means to appoint, assign, or designate for a fixed time.

Short-call reserve means a period of time in which a flightcrew member is assigned to a reserve availability period.

Split duty means a flight duty period that has a scheduled break in duty that is less than a required rest period.

Suitable accommodation means a temperature-controlled facility with sound mitigation and the ability to control light that provides a flightcrew member with the ability to sleep either in a bed, bunk or in a chair that allows for flat or near flat sleeping position. Suitable accommodation only applies to ground facilities and does not apply to aircraft onboard rest facilities.

Theater means a geographical area where local time at the flightcrew member's flight duty period departure point and arrival point differ by more than 60 degrees longitude.

Unforeseen operational circumstance means an unplanned event of insufficient duration to allow for adjustments to schedules, including unforecast weather, equipment malfunction, or air traffic delay that is not reasonably expected.

Window of circadian low means a period of maximum sleepiness that occurs between 0200 and 0559 during a physiological night.

§ 117.5 Fitness for duty.

(a) Each flightcrew member must report for any flight duty period rested and prepared to perform his or her assigned duties.

(b) No certificate holder may assign and no flightcrew member may accept assignment to a flight duty period if the flightcrew member has reported for a flight duty period too fatigued to safely perform his or her assigned duties.

(c) No certificate holder may permit a flightcrew member to continue a flight duty period if the flightcrew member has reported him or herself too fatigued to continue the assigned flight duty period.

(d) As part of the dispatch or flight release, as applicable, each flightcrew member must affirmatively state he or she is fit for duty prior to commencing flight.

§ 117.7 Fatigue risk management system.

(a) No certificate holder may exceed any provision of this part unless approved by the FAA under a Fatigue Risk Management System that provides at least an equivalent level of safety against fatigue-related accidents or incidents as the other provisions of this part.

(b) The Fatigue Risk Management System must include:

(1) A fatigue risk management policy.

(2) An education and awareness training program.

(3) A fatigue reporting system.

(4) A system for monitoring flightcrew fatigue.

(5) An incident reporting process.

(6) A performance evaluation.

§ 117.9 Fatigue education and awareness training program.

(a) Each certificate holder must develop and implement an education and awareness training program, approved by the Administrator. This program must provide annual education and awareness training to all employees of the certificate holder responsible for administering the provisions of this rule including flightcrew members, dispatchers, individuals directly involved in the scheduling of flightcrew members, individuals directly involved in operational control, and any employee providing direct management oversight of those areas.

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(b) The fatigue education and awareness training program must be designed to increase awareness of:

(1) Fatigue;

(2) The effects of fatigue on pilots; and

(3) Fatigue countermeasures

(c) (1) Each certificate holder must update its fatigue education and awareness training program every two years and submit the update to the Administrator for review and acceptance.

(2) Not later than 12 months after the date of submission of the fatigue education and awareness training program required by (c)(1) of this section, the Administrator shall review and accept or reject the update. If the Administrator rejects an update, the Administrator shall provide suggested modifications for resubmission of the update.

§ 117.11 Flight time limitation.

(a) No certificate holder may schedule and no flightcrew member may accept an assignment or continue an assigned flight duty period if the total flight time:

(1) Will exceed the limits specified in Table A of this part if the operation is conducted with the minimum required flightcrew.

(2) Will exceed 13 hours if the operation is conducted with a 3-pilot flightcrew.

(3) Will exceed 17 hours if the operation is conducted with a 4-pilot flightcrew.

(b) If unforeseen operational circumstances arise after takeoff that are beyond the certificate holder's control, a flightcrew member may exceed the maximum flight time specified in paragraph (a) of this section and the cumulative flight time limits in 117.23(b) to the extent necessary to safely land the aircraft at the next destination airport or alternate, as appropriate.

(c) Each certificate holder must report to the Administrator within 10 days any flight time that exceeded the maximum flight time limits permitted by this section. The report must contain the following:

(1) A description of the extended flight time limitation and the circumstances surrounding the need for the extension; and

(2) If the circumstances giving rise to the extension were within the certificate holder's control, the corrective action(s) that the certificate holder intends to take to minimize the need for future extensions.

(d) Each certificate holder must implement the corrective action(s) reported in paragraph (c)(2) of this section within 30 days from the date of the extended flight time limitation.

§ 117.13 Flight duty period: Unaugmented operations.

(a) Except as provided for in § 117.15, no certificate holder may assign and no flightcrew member may accept an assignment for an unaugmented flight operation if the scheduled flight duty period will exceed the limits in Table B of this part.

(b) If the flightcrew member is not acclimated:

(1) The maximum flight duty period in Table B of this part is reduced by 30 minutes.

(2) The applicable flight duty period is based on the local time at the theater in which the flightcrew member was last acclimated.

§ 117.15 Flight duty period: Split duty.

For an unaugmented operation only, if a flightcrew member is provided with a rest opportunity (an opportunity to sleep) in a suitable accommodation during his or her flight duty period, the time that the flightcrew member spends in the suitable accommodation is not part of that flightcrew member's flight duty period if all of the following conditions are met:

(a) The rest opportunity is provided between the hours of 22:00 and 05:00 local time.

(b) The time spent in the suitable accommodation is at least 3 hours, measured from the time that the flightcrew member reaches the suitable accommodation.

(c) The rest opportunity is scheduled before the beginning of the flight duty period in which that rest opportunity is taken.

(d) The rest opportunity that the flightcrew member is actually provided may not be less than the rest opportunity that was scheduled.

(e) The rest opportunity is not provided until the first segment of the flight duty period has been completed.

(f) The combined time of the flight duty period and the rest opportunity provided in this section does not exceed 14 hours.

§ 117.17 Flight duty period: Augmented flightcrew.

(a) For flight operations conducted with an acclimated augmented flightcrew, no certificate holder may assign and no flightcrew member may accept an assignment if the scheduled flight duty period will exceed the limits specified in Table C of this part.

(b) If the flightcrew member is not acclimated:

(1) The maximum flight duty period in Table C of this part is reduced by 30 minutes.

(2) The applicable flight duty period is based on the local time at the theater in which the flightcrew member was last acclimated.

(c) No certificate holder may assign and no flightcrew member may accept an assignment under this section unless during the flight duty period:

(1) Two consecutive hours in the second half of the flight duty period are available for in-flight rest for the pilot flying the aircraft during landing.

(2) Ninety consecutive minutes are available for in-flight rest for the pilot performing monitoring duties during landing.

(d) No certificate holder may assign and no flightcrew member may accept an assignment involving more than three flight segments under this section.

(e) At all times during flight, at least one flightcrew member qualified in accordance with § 121.543(b)(3)(i) of this chapter must be at the flight controls.

§ 117.19 Flight duty period extensions.

(a) For augmented and unaugmented operations, if unforeseen operational circumstances arise prior to takeoff:

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(1) The pilot in command and the certificate holder may extend the maximum flight duty period permitted in Tables B or C of this part up to 2 hours.

(2) An extension in the flight duty period under paragraph (a)(1) of this section of more than 30 minutes may occur only once prior to receiving a rest period described in § 117.25(b).

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(3) A flight duty period cannot be extended under paragraph (a)(1) of this section if it causes a flightcrew member to exceed the cumulative flight duty period limits specified in 117.23(c).

(4) Each certificate holder must report to the Administrator within 10 days any flight duty period that exceeded the maximum flight duty period permitted in Tables B or C of this part by more than 30 minutes. The report must contain the following:

(i) A description of the extended flight duty period and the circumstances surrounding the need for the extension; and

(ii) If the circumstances giving rise to the extension were within the certificate holder's control, the corrective action(s) that the certificate holder intends to take to minimize the need for future extensions.

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(5) Each certificate holder must implement the corrective action(s) reported in paragraph (a)(4) of this section within 30 days from the date of the extended flight duty period.

(b) For augmented and unaugmented operations, if unforeseen operational circumstances arise after takeoff:

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(1) The pilot in command and the certificate holder may extend maximum flight duty periods specified in Tables B or C of this part to the extent necessary to safely land the aircraft at the next destination airport or alternate airport, as appropriate.

(2) An extension of the flight duty period under paragraph (b)(1) of this section of more than 30 minutes may occur only once prior to receiving a rest period described in § 117.25(b).

(3) An extension taken under paragraph (b) of this section may exceed the cumulative flight duty period limits specified in 117.23(c).

(4) Each certificate holder must report to the Administrator within 10 days any flight duty period that exceeded the maximum flight duty period limits permitted by Tables B or C of this part. The report must contain a description of the circumstances surrounding the affected flight duty period.

§ 117.21 Reserve status.

(a) Unless specifically designated as airport/standby or short-call reserve by the certificate holder, all reserve is considered long-call reserve.

(b) Any reserve that meets the definition of airport/standby reserve must be designated as airport/standby reserve. For airport/standby reserve, all time spent in a reserve status is part of the flightcrew member's flight duty period.

(c) For short call reserve,

(1) The reserve availability period may not exceed 14 hours.

(2) For a flightcrew member who has completed a reserve availability period, no certificate holder may schedule and no flightcrew member may accept an assignment of a reserve availability period unless the flightcrew member receives the required rest in § 117.25(e).

(3) For an unaugmented operation, the total number of hours a flightcrew member may spend in a flight duty period and a reserve availability period may not exceed the lesser of the maximum applicable flight duty period in Table B of this part plus 4 hours, or 16 hours, as measured from the beginning of the reserve availability period.

(4) For an augmented operation, the total number of hours a flightcrew member may spend in a flight duty period and a reserve availability period may not exceed the flight duty period in Table C of this part plus 4 hours, as measured from the beginning of the reserve availability period.

(d) For long call reserve, if a certificate holder contacts a flightcrew member to assign him or her to a flight duty period that will begin before and operate into the flightcrew member's window of circadian low, the flightcrew member must receive a 12 hour notice of report time from the certificate holder.

(e) A certificate holder may shift a reserve flightcrew member's reserve status from long-call to short-call only if the flightcrew member receives a rest period as provided in § 117.25(e).

§ 117.23 Cumulative limitations.

(a) The limitations of this section include all flying by flightcrew members on behalf of any certificate holder or 91K Program Manager during the applicable periods.

(b) No certificate holder may schedule and no flightcrew member may accept an assignment if the flightcrew member's total flight time will exceed the following:

(1) 100 hours in any 672 consecutive hours and

(2) 1,000 hours in any 365 consecutive calendar day period.

(c) No certificate holder may schedule and no flightcrew member may accept an assignment if the flightcrew member's total Flight Duty Period will exceed:

(1) 60 flight duty period hours in any 168 consecutive hours and

(2) 190 flight duty period hours in any 672 consecutive hours.

§ 117.25 Rest period.

(a) No certificate holder may assign and no flightcrew member may accept assignment to any reserve or duty with the certificate holder during any required rest period.

(b) Before beginning any reserve or flight duty period a flightcrew member must be given at least 30 consecutive hours free from all duty in any 168 consecutive hour period.

(c) If a flightcrew member operating in a new theater has received 36 consecutive hours of rest, that flightcrew member is acclimated and the rest period meets the requirements of paragraph (b) of this section.

(d) If a flightcrew member travels more than 60º longitude during a flight duty period or a series of flight duty periods that require him or her to be away from home base for more than 168 consecutive hours, the flightcrew member must be given a minimum of 56 consecutive hours rest upon return to home base. This rest must encompass three physiological nights' rest based on local time.

(e) No certificate holder may schedule and no flightcrew member may accept an assignment for any reserve or flight duty period unless the flightcrew member is given a rest period of at least 10 consecutive hours immediately before beginning the reserve or flight duty period measured from the time the flightcrew member is released from duty. The 10 hour rest period must provide the flightcrew member with a minimum of 8 uninterrupted hours of sleep opportunity.

(f) If a flightcrew member determines that a rest period under paragraph (e) of this section will not provide eight uninterrupted hours of sleep opportunity, the flightcrew member must notify the certificate holder. The flightcrew member cannot report for the assigned flight duty period until he or she receives a rest period specified in paragraph (e) of this section.

(g) If a flightcrew member engaged in deadhead transportation exceeds the applicable flight duty period in Table B of this part, the flightcrew member must be given a rest period equal to the length of the deadhead transportation but not less than the required rest in paragraph (e) of this section before beginning a flight duty period.

§ 117.27 Consecutive nighttime operations.

A certificate holder may schedule and a flightcrew member may accept up to five consecutive flight duty periods that infringe on the window of circadian low if the certificate holder provides the flightcrew member with an opportunity to rest in a suitable accommodation during each of the consecutive nighttime flight duty periods. The rest opportunity must be at least 2 hours, measured from the time that the flightcrew member reaches the suitable accommodation, and must comply with the conditions specified in § 117.15(a), (c), (d), and (e). Otherwise, no certificate holder may schedule and no flightcrew member may accept more than three consecutive flight duty periods that infringe on the window of circadian low. For purposes of this section, any split duty rest that is provided in accordance with § 117.15 counts as part of a flight duty period.

§117.29 Emergency and government sponsored operations.

(a) This section applies to operations conducted pursuant to contracts with the U.S. Government and operations conducted pursuant to a deviation under § 119.57 of this chapter that cannot otherwise be conducted under this part because of circumstances that could prevent flightcrew members from being relieved by another crew or safely provided with the rest required under § 117.25 at the end of the applicable flight duty period.

(b) The pilot-in-command may determine that maximum applicable flight duty periods must be exceeded to the extent necessary to allow the flightcrew to fly to the closest destination where they can safely be relieved from duty by another flightcrew or can receive the requisite amount of rest prior to commencing their next flight duty period.

(c) A flight duty period may not be extended for an operation conducted pursuant to a contract with the U.S. Government if it causes a flightcrew member to exceed the cumulative flight time limits in § 117.23(b) and the cumulative flight duty period limits in § 117.23(c).

(d) The flightcrew shall be given a rest period immediately after reaching the destination described in paragraph (b) of this section equal to the length of the actual flight duty period or 24 hours, whichever is less.

(e) Each certificate holder must report within 10 days:

(1) any flight duty period that exceeded the maximum flight duty period permitted in Tables B or C of this part, as applicable, by more than 30 minutes; and

(2) any flight time that exceeded the maximum flight time limits permitted in Table A of this part and § 117.11, as applicable.

(f) The report must contain the following:

(1) a description of the extended flight duty period and flight time limitation, and the circumstances surrounding the need for the extension; and

(2) if the circumstances giving rise to the extension(s) were within the certificate holder's control, the corrective action(s) that the certificate holder intends to take to minimize the need for future extensions.

(g) Each certificate holder must implement the corrective action(s) reported pursuant to paragraph (e)(2) of this section within 30 days from the date of the extended flight duty period.

Table A to Part 117
Unaugmented Operations

Maximum Flight Time Limits

Time of Report (Acclimated)	Maximum Flight Time (hours)
0000-0459	8
0500-1959	9
2000-2359	8

Table B to Part 117
Maximum Flight Duty Period Limits for Unaugmented Operations

Scheduled Time of Start (Acclimated Time)	Maximum Flight Duty Period (hours) For Lineholders Based on Number of Flight Segments						
	1	**2**	**3**	**4**	**5**	**6**	**7+**
0000-0359	9	9	9	9	9	9	9
0400-0459	10	10	10	10	9	9	9
0500-0559	12	12	12	12	11.5	11	10.5
0600-0659	13	13	12	12	11.5	11	10.5
0700-1159	14	14	13	13	12.5	12	11.5
1200-1259	13	13	13	13	12.5	12	11.5
1300-1659	12	12	12	12	11.5	11	10.5
1700-2159	12	12	11	11	10	9	9
2200-2259	11	11	10	10	9	9	9
2300-2359	10	10	10	9	9	9	9

Table C to Part 117
Maximum Flight Duty Period Limits for Augmented Operations

Scheduled Time of Start (Acclimated Time)	Maximum Flight Duty Period (hours) Based on Rest Facility and Number of Pilots					
	Class 1 Rest Facility		Class 2 Rest Facility		Class 3 Rest Facility	
	3 Pilots	4 Pilots	3 Pilots	4 Pilots	3 Pilots	4 Pilots
0000-0559	**15**	**17**	**14**	**15.5**	**13**	**13.5**
0600-0659	**16**	**18.5**	**15**	**16.5**	**14**	**14.5**
0700-1259	**17**	**19**	**16.5**	**18**	**15**	**15.5**
1300-1659	**16**	**18.5**	**15**	**16.5**	**14**	**14.5**
1700-2359	**15**	**17**	**14**	**15.5**	**13**	**13.5**

PART 119— CERTIFICATION: AIR CARRIERS AND COMMERCIAL OPERATORS

2. The authority citation for part 119 continues to read as follows:

Authority: 49 U.S.C. 106(g), 1153, 40101, 40102, 40103, 40113, 44105, 44106, 44111, 44701–44717, 44722, 44901, 44903, 44904, 44906, 44912, 44914, 44936, 44938, 46103, 46105.

3. Amend § 119.55 to revise paragraph (a) to read as follows:

(a) The Administrator may authorize a certificate holder that is authorized to conduct supplemental or on-demand operations to deviate from the applicable requirements of this part, part 117, part 121, or part 135 of this chapter in order to perform operations under a U.S. military contract.

* * * * *

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

4. The Authority section for part 121 continues to read as follows:

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Authority: 49 U.S.C. 106(g), 40113, 40119, 44101, 44701-44702, 44705, 44709-44711, 44713, 44716-44717, 44722, 46901, 44903-44904, 44912, 46105.

5. Amend § 121.467 to revise paragraph (c) introductory text to read as follows:

Deleted: 3.

§ 121.467 Flight attendant duty period limitations and rest requirements: Domestic, flag, and supplemental operations.

* * * * *

(c) Notwithstanding paragraph(b) of this section, a certificate holder conducting domestic, flag, or supplemental operations may apply the flightcrew member flight time and duty limitations and requirements of part 117 of this chapter to flight attendants for all operations conducted under this part provided that—

(1) The flightcrew is subject to part 117;

(2) ***

* * * * *

Subpart Q

6. Amend § 121.470 and add § 121.473 to read as follows:

§ 121.470 Applicability.

This subpart prescribes flight time limitations and rest requirements for domestic all-cargo operations, except that:

(a) Certificate holders conducting operations with airplanes having a passenger seat configuration of 30 seats or fewer, excluding each crewmember seat, and a payload capacity of 7,500 pound or less, may comply with the applicable requirements of §§ 135.261 through 135.273 of this chapter.

(b) Certificate holders conducting scheduled operations entirely within the States of Alaska or Hawaii with airplanes having a passenger seat configuration of 30 seats or fewer, excluding each crewmember seat, and a payload capacity of 7,500 pound or less,

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may comply with the applicable requirements of subpart R of this part for those operations.

(c) A certificate holder may apply the flightcrew member flight time and duty limitations and requirements of part 117 of this chapter. A certificate holder may choose to apply part 117 to its –

(1) Cargo operations conducted under contract to a US government agency.

(2) All-cargo operations not conducted under contract to a US Government agency,

(3) A certificate holder may elect to treat operations in paragraphs (1) and (2) differently but, once having decided to include operations under paragraph (1) or (2) under part 117, may not segregate those operations between this subpart and part 117.

***

§ 121.473 Fatigue risk management system.

(a) No certificate holder may exceed any provision of this subpart unless approved by the FAA under a Fatigue Risk Management System.

(b) The Fatigue Risk Management System must include:

(1) A fatigue risk management policy.

(2) An education and awareness training program.

(3) A fatigue reporting system.

(4) A system for monitoring flightcrew fatigue.

(5) An incident reporting process.

(6) A performance evaluation.

Subpart R

7. Amend § 121.480 and add § 121.495 to read as follows:

§ 121.480 Applicability.

This subpart prescribes flight time limitations and rest requirements for flag all-cargo operations, except that:

(a) Certificate holders conducting operations with airplanes having a passenger seat configuration of 30 seats or fewer, excluding each crewmember seat, and a payload capacity of 7,500 pound or less, may comply with the applicable requirements of §§ 135.261 through 135.273 of this chapter.

(b) A certificate holder may apply the flightcrew member flight time and duty limitations and requirements of part 117 of this chapter. A certificate holder may choose to apply part 117 to its –

(1) All-cargo operations conducted under contract to a US government agency.

(2) All-cargo operations not conducted under contract to a US Government agency,

(3) A certificate holder may elect to treat operations in paragraphs (1) and (2) differently but, once having decided to include operations under paragraph (1) or (2) under part 117, may not segregate those operations between this subpart and part 117.

***

§ 121.495 Fatigue risk management system.

(a) No certificate holder may exceed any provision of this subpart unless approved by the FAA under a Fatigue Risk Management System.

(b) The Fatigue Risk Management System must include:

(1) A fatigue risk management policy.

(2) An education and awareness training program.

(3) A fatigue reporting system.

(4) A system for monitoring flightcrew fatigue.

(5) An incident reporting process.

(6) A performance evaluation.

Subpart S

8. Amend § 121.500, § 121.583(a), and add § 121.527 to read as follows:

§ 121.500 Applicability.

This subpart prescribes flight time limitations and rest requirements for supplemental all-cargo operations, except that:

(a) Certificate holders conducting operations with airplanes having a passenger seat configuration of 30 seats or fewer, excluding each crewmember seat, and a payload capacity of 7,500 pound or less, may comply with the applicable requirements of §§ 135.261 through 135.273 of this chapter.

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(b) A certificate holder may apply the flightcrew member flight time and duty limitations and requirements of part 117 of this chapter. A certificate holder may choose to apply part 117 to its –

(1) All-cargo operations conducted under contract to a US government agency.

(2) All-cargo operations not conducted under contract to a US Government agency,

(3) A certificate holder may elect to treat operations in paragraphs (1) and (2) differently but, once having decided to include operations under paragraph (1) or (2) under part 117, may not segregate those operations between this subpart and part 117.

***

§ 121.583 - Carriage of persons without compliance with the passenger-carrying requirements of this part and part 117

(a) When authorized by the certificate holder, the following persons, but no others, may be carried aboard an airplane without complying with the passenger-carrying airplane requirements in §§ 121.309(f), 121.310, 121.391, 121.571, and 121.587; the passenger-carrying operation requirements in part 117 and §§ 121.157(c) and 121.291; and the requirements pertaining to passengers in §§ 121.285, 121.313(f), 121.317, 121.547, and 121.573: * * *

***

§ 121.527 Fatigue risk management system.

(a) No certificate holder may exceed any provision of this subpart unless approved by the FAA under a Fatigue Risk Management System.

(b) The Fatigue Risk Management System must include:

(1) A fatigue risk management policy.

(2) An education and awareness training program.

(3) A fatigue reporting system.

(4) A system for monitoring flightcrew fatigue.

(5) An incident reporting process.

(6) A performance evaluation.

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Issued in Washington, DC on

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Michael P. Huerta
Acting Administrator

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J. Randolph Babbitt¶

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Benefit/Cost Summary

We have analyzed the benefits and the costs associated with the requirements contained in this final rule and our estimates are summarized below. We provide a range of estimates for our quantitative benefits. Our base estimate is $726 million ($477 million present value at 7% and $601 million at 3%) and our high estimate is $1.33 billion ($873 million present value at 7% and $1.1 billion at 3%) The static historical benefit estimate is $380 million ($249 million present value at 7% and $315 million at 3%). The total estimated cost of the final rule is $862 million ($606 million present value at 7% and $729 million at 3%).

Summary

	Benefits		
	Nominal (millions)	**PV at 7% (millions)**	**PV at 3% (millions)**
Base Estimate	$ 726	$ 477	$601
High Estimate	$ 1,330	$ 873	$1,102
Static/Historical Estimate	$ 380	$ 249	$315
	Cost Component		
Flight Operations	$ 627	$ 414	$521
Training	$ 20	$ 13	$16
Rest Facilities	$ 215	$ 179	$192
Total	**$ 862**	**$ 606**	**$729**

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ComponentCost Component			
Flight Operations	**Nominal (millions)**$ 627	**PV at 7% (millions)**$ 414	**PV at 3% (millions)**$521

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For our base case estimate, we conservatively only look at the subset of fatigue related accidents where hull losses and passenger deaths occurred. Of the seven events in the most recent ten years, only three were "catastrophic" in nature where virtually everyone on the airplane was killed. We use those three catastrophic accidents as the minimum expected number of accidents for our period of analysis, and incorporate the expected average effectiveness of 58%.

With a total of 0.3 events annually over the ten year period of analysis, and the corresponding 58% average effectiveness, 0.174 average annual events would be averted for our base case estimate. For the estimate of the number of individuals per airplane, we weight the twenty year historical accident proportions by industry segment. Using this historical data along with the forecast for the number of people on board a preventable accident, we estimate 66 people on each airplane.[1] Multiply the expected 66 people by the value of averting fatalities ($6.2 million), we estimate $409 million in benefits from averting fatalities. This benefit is added to the weighted average airplane value that would be involved in a preventable accident ($8.15 million). As such, the base case estimate from averting an event is roughly $417 million.

When we multiply the average annual events that will be averted in our lower bound estimate (0.174) by the estimated benefit from averting an event, $404.15 (weighted average) million, the annual benefits are $72.6 million. When summed over the period of analysis, the total estimated lower bound benefits are $726 million ($477 million present value).

<u>High Estimate</u>

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[1] FAA Aerospace Forecasts Fiscal Years 2011 & Form 41

There were a total of 7 events where the requirements contained in this Final Rule would have been on average 58% effective, if the requirements had been in place at the time of the accidents for this upper bound. We assume equal risk for every year of the analysis period, and an accompanying forecasted 10-year benefit period that mirrors the costs. The corresponding annual equivalent of seven events over the period of analysis equals 0.7 events per year. When multiplied by the effectiveness of 58%, the total estimated annual preventable events are 0.406.

For our high estimate, we consider a number of potential occupants in a part 121 operation. The most likely number of preventable fatalities would occur on an airplane which has an estimate of 142 forecasted seats[2] with a load factor of 83 percent[3] to arrive at 118 passengers per airplane. In addition to the 118 passengers, there would also be a pilot, copilot, and three flight attendants, which would total 123 people on board. This high estimate does not assume that all events will result in catastrophic events; rather we use the average historical "fatality rate" for the number of people that we estimate will be on an airplane. This ten year average historical fatality rate of 41% multiplied by the 123 people on board equals 50 people. This is the estimated number of preventable deaths that would occur in a fatigue related event in our upper bound scenario. The number of averted deaths multiplied by the $6.2 million (benefit from averting a fatality) and added to the value of an airplane ($17.6 million) equals a total benefit of $328 million per accident. This number represents the median size airplane operated in part 121 service.

To calculate the annual benefits, we multiply the total estimated annual preventable events (0.406) by $428 million to arrive at roughly $129 million. When

[2] Table 9 FAA Aerospace Forecasts Fiscal Years 2011.
[3] Table 6 FAA Aerospace Forecasts Fiscal Years 2011.

summed over the period of analysis, the total benefits are $1.33 billion ($873 million present value).

<u>Static/Historical Estimate</u>

The static estimate only looks at the historical events. As such this case forecasts eight accidents with roughly four averted. It takes neither the forecasted increase in seats nor the aircraft types into account. It is an unlikely future scenario. The future preventable events will not exactly mirror the past events because the airplane types, utilization, and seating capacity have changed. In this static estimate the exact number of fatalities for each past event is multiplied by the relative rule effectiveness score to obtain the historical number of deaths that would have been averted with the requirements contained in this final rule. The static estimate results in roughly six deaths being averted annually. Multiplying six annual averted deaths by the $6.2 million value equals $37 million annually. In addition, had the requirements been in place at the time of these historical accidents, $2 million in damages for each accident would also have been averted which equals $8 million for ten years or $0.8 million annually. When summed over the ten year period of analysis, the historical static estimate is $380 million ($249 million present value).

U.S. Department of Transportation

FEDERAL AVIATION ADMINISTRATION

Office of Aviation Policy and Plans

Washington, D.C. 20591

REGULATORY IMPACT ANALYSIS

Flightcrew Member Duty and Rest Requirements

PART 117

Final Rule

OFFICE OF AVIATION POLICY AND PLANS

November 18, 2011

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Disposition of Issues Raised by Comments

The following summarizes the FAA's responses to the comments on the economic analysis. These responses address the most substantive comments made in response to the Notice of Proposed Rulemaking (NPRM), including comments made by: Air Transportation Association (ATA), American Airlines, United Airlines, Cargo Airline Association (CAA), Federal Express, United Parcel Service (UPS), National Air Carriers Association (NACA), Atlas Air Worldwide Holdings, Lynden Air Cargo, Omni Air International, Inc., and Southern Air, Inc.

Commenters questioned the base year dollar and analysis period. The final rule analyzes current year (2011) with a two year delay in both benefits and costs. The benefits and costs are presented in a ten year stream and we have provided sensitivity analysis based upon a discount rate of both 7% and 3%. A ten year analysis is sufficient for the costs and benefits to be in a steady state.

The FAA also received comments questioning the validity of the accident set. To address the criticism of using the historical twenty-year analysis period, the FAA narrowed the accident set to the most recent ten years. However, while this approach addressed the issues raised by the commenters, narrowing of the analysis time period reduces the number of accidents/observations available for the benefit analysis. Consequently, while there is a sufficient accident basis to demonstrate a broad benefit basis justifying the cost of this rule, the sparse data does not permit accident analysis for every industry segment.[1] The benefit forecast includes the expected larger

[1] As discussed in the Regulatory Impact Analysis, the FAA was able to determine the societal benefit of applying this rule to all-cargo operations. The FAA ultimately concluded that this benefit did not justify the costs of requiring all-cargo operations to operate under part 117.

future airplanes and higher load factors. Even though the rate of accidents may have declined in the last ten years, the future consequences may well be more catastrophic.

Commenters questioned that the historical accident rate is significantly higher than the probable accident rate for the period of analysis because accidents have declined in recent years.

The requirements contained in this final rule only address the rates of pilot fatigue. As Table 4 in the Regulatory Impact Analysis shows, the preventable accident rate related to fatigue has not significantly decreased in the last ten years.

The Regulatory Impact Analysis also includes a list of appropriate accidents along with the final Commercial Aviation Safety Team (CAST) scoring. The accident appendix includes detailed fatigue information and the reasoning behind the final CAST scoring.

After considering the comments on the regulatory impact analysis (RIA) for the NPRM, the FAA took a different approach to evaluate the final rule. In the analysis for the NPRM, the FAA attempted to show through statistical analysis and simulation that a broader fatigue problem existed than what could be shown through NTSB accident findings. In response to industry comments objecting to this approach, the FAA Office of Aviation Safety began by narrowing the set of accidents to those with a strong correlation to fatigue and hence narrowed the benefit analysis from a broader fatigue problem to the specific regulatory changes. As a result, the FAA re-examined every accident used in the NPRM and applied the CAST methodology only to the accidents whose likelihood would have been reduced if the requirements in the final rule had been effective prior to the accident. Using this methodology, the FAA re-analyzed the effectiveness of the provisions in the final rule in mitigating accidents where fatigue was identified as a factor in the accident, and removed accident cases that were not closely correlated with fatigue factors from the NPRM. From this exercise, a smaller set of accidents was

2

determined appropriate for further economic analysis of the final rule. With a smaller number of accidents, a simulation methodology was no longer appropriate. Instead, the FAA used a commonly-used benefit methodology. This methodology is grounded in NTSB findings, uses the CAST methodology, and is also transparent and easily reproducible. The methodology is discussed in the full regulatory evaluation.

Industry questioned the use of $12.6 million for a statistical life value.

The use of $12.6 was for a sensitivity test. For the final rule, the FAA uses the $6.2 million as the value of an averted fatality as used commonly by the Department of Transportation.

Commenters also objected to the FAA's assumptions regarding the 25% cost-savings resulting from long-term scheduling optimization in RIA. As the FAA stated in the RIA, the assumption of the long-term schedule optimization factor was dropped because the operation cost was analyzed by the crew pairing optimizer. This different approach estimates operation and scheduling cost of the final rule by building duty and rest time restrictions changing from existing FAA regulations and industry scheduling data into a Cygnus, CrewPairing's (CP) crew scheduling optimization model. Cygnus has been used by more than 30 major airlines worldwide over the past 40 years and is currently used by a number of carriers. CP optimization used constraints contained in the final rule, pooling with the best available industrial data (wages, numbers of flightcrew members sourced from Form 41), to estimate costs of the final rule.

Commenters also contended that the FAA underestimated the NPRM costs related to flight operation in that carriers would be forced to hire new crewmembers and increase flight duty periods (FDP).

The FAA has re-estimated the costs reflecting final rule modifications and used the above-referenced crew scheduling model to better estimate whether the rule would force carriers to hire new crewmembers. The use of a crew pairing optimizer enabled FAA to more accurately model the impacts of the rule on industry crew scheduling costs than was possible during NPRM cost analysis. The data in the final rule RIA included full bid line and pairing information for each flightcrew member, and included both line holder and reserve flightcrew members. The crew pairing optimization did not show a need to hire new crewmembers to comply with this rule because the flightcrew members currently used in reserve allow certificate holders to conduct operations under this rule without hiring additional flightcrew members.

Commenters did not support the costs related to schedule reliability and argued that they were underestimated. One commenter stated the costs would be as high as $9.6 billion. They argued that by excluding the cost of schedule buffering required by multiple provisions of the NPRM, the FAA omitted the major source of cost to the industry.

As stated elsewhere, the FAA has largely removed schedule reliability from this rule. The FAA has instead adopted provisions that limit extensions of the FDP and requires reporting of FDP extensions and activities that were not otherwise permitted by the provisions of §117.11, §117.19 and §117.29 in the Final Rule. Under this amendment, costs to airline carriers are limited to reporting exceptional activities. As such, these costs are expected to be relatively minor. By dropping schedule reliability requirement and limiting the associated reporting burden to flight-duty-period (FDP) extension reporting requirements, the cost in dispute by the commenters became a computer programming cost and was estimated to be about one million dollars.

Some commenters stated the appropriate average wage rate should be $297 per hour.

The FAA notes this wage rate significantly contributed to the industry cost estimates. The $297 per hour wage rate as an average is two times the wage rate from Form 41 and four times the wage rate from the 2010 Census Bureau on the airline industry.

Commenters also argued that the FAA underestimates fatigue training cost described in the NPRM.

All carriers already are required to comply with Public Law 111-216 Section 212(b)(2)(B) with respect to the fatigue risk management plan and training (FRMP). In this final rule, the FAA removed the proposed requirement that pilots receive additional fatigue training that is not required by the FRMP. As such, the FAA expects the cost of fatigue education and training to be largely reduced. The final rule does expand the fatigue education and training requirements to dispatchers and certain members of management. The FAA made this change because air carriers operating under 14 CFR part 121 will be in compliance with the statutory pilot training requirement as part of their FRMPs. Since the final rule extends fatigue training to management and dispatchers, it is expected to be added to existing fatigue risk management education and training program.

Numerous commenters stated that the FAA underestimated the cost of rest facilities due to the loss of first class seating and out-of-service time required for infrastructure installation.

The FAA re-analyzed the facility cost based upon the actual numbers and types of facilities that will need to be put in by querying the inspectors for the fleet of airplanes. The FAA assumed the worst case scenario (all class 1 facilities). The FAA recalculated the number of airplanes needing additional upgraded rest facilities. Based on the existing fleet, the FAA estimates 332 airplanes will need class 1 facilities. In addition, the FAA re-estimated compliance costs of optimizing existing equipment and installing first class facilities. We have also estimated downtime and additional fuel burn costs. The final rule rest facility costs include purchase, design and engineering, physical installation of the facilities on the affected aircraft, downtime impact on revenue, and fuel burn cost. Therefore, the cost of rest facilities was estimated to the full extent in the final rule.

The commenters stated that the FAA's cost analysis does not factor in the costs of the cumulative limits. The FAA notes that all known constraints including existing monthly and annual constraints were imbedded in CP optimization.

The commenters submitted that the FAA assumed for the NPRM that the industry's collective bargaining agreements (CBAs) will be renegotiated to permit carriers to adapt to the new rules without any additional costs to the carriers and also assumes that any short term costs that result from conflicts between the new rule and existing CBAs should not be "counted" as part of the NPRM.

The final rule does not require renegotiation of current CBAs. In the final rule the FAA did not calculate potential gains based on the renegotiation of CBAs. The final rule will give two years buffer for carriers to implement all provisions. The FAA still believes that CBA negotiations could result in a change of economic interests between carriers and crewmembers. Any such change is a transfer of benefits and costs between carriers and bargaining units. Such transfers would be negotiated between parties and transfers do not change the total cost and benefits to society.

Many entities conducting supplemental operations stated that the rule would cause the nature of their operations to significantly change, which would result in lost revenue opportunities or much higher cost, or both.

The FAA adopted significant modifications in the final rule to mitigate the impact on supplemental operations. For example, in the final rule, the FAA made compliance with part 117 voluntary for all-cargo operations. With regard to supplemental passenger operations, the FAA increased both the augmented and unaugmented FDP limits from the NPRM. The FAA also increased the split-duty credit and made that credit easier to obtain. In addition, the FAA notes that section 119.55 provides the mechanism to obtain deviation from existing regulations for military missions. Taken together the FAA has provided substantial flexibility for supplemental operations, and as a result, permits most existing revenue opportunities relative to flight safety risks based on past ten years of NTSB accident findings.

The commenters contend that the FAA assumes, without any evidence, that there will be a reduction in absenteeism due to "improved fatigue management," and that reduced absenteeism costs will offset part of the cost of the NPRM.

The FAA believes that the final rule will improve productivity and reduce absenteeism by the enhanced fatigue management system. CDC's research shows that chronic fatigue can cause illness and even death[2]. Comments and data received from Air Line Pilots Association (ALPA), the largest independent pilots' union in the world, devoting more than 20 percent of its dues income to support aviation safety, validated the FAA's estimation of cost saving from reducing flight-crew members fatigue and absenteeism.

Commenters questioned that there is no justification provided that sick leave use will be reduced by 5%. The FAA has verified this number with labor representatives and the supporting document verifying this information can be found in the docket.

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[2] CDC' s MMWR, Weekly, **February 29, 2008 / 57(08);200-203**

Commenters contended that accidents involving two pilots and a flight engineer should be analyzed separately because in the modern era almost all flights are operated without a flight engineer.

This rule does not distinguish between accidents involving a flight engineer and accidents without a flight engineer because it is difficult to attribute specific amounts of fatigue and accident causality to a flight engineer. More specifically, it is difficult to predict in a fatigue-related accident, how the two pilots would have handled the aircraft in question if a flight engineer had not been present. As such, because it is unclear how much flight-engineer fatigue contributed to past accidents and that this rule does not prohibit flight engineers from working on the flight deck, the Regulatory Impact Analysis used for this rule does not distinguish between accidents involving two pilots and those involving a flight engineer.

Some commenters stated that the FAA simply ignores flight cancellation costs despite the fact that the NPRM will result in substantial increases in flight cancellations.

As discussed above, the FAA calculated the scheduling costs of this rule by running the pertinent data through the Cygnus crew scheduling optimization model. The Cygnus model did not indicate that there would be an increase in cancellations as a result of the changes imposed by this rule. This is because certificate holders will be able to use their existing staff members to cover the scheduled flights.

It was argued by commenters that by excluding the cost of schedule buffering required by multiple provisions of the NPRM, the FAA has omitted the major source of cost to the industry.

There are a few major changes related to crew scheduling made in the final rule from NPRM, which significantly reduced the cost to the industry. The pertinent changes from the NPRM are: (1) a flight extension for unexpected circumstances that arise after takeoff, and (2) the removal of the requirement that "circumstances beyond the control of the certificate holder" have to be present in order to utilize the 2-hour FDP extension for certain unforeseen operational circumstances. Using the crew pairing optimizer to simulate operation schedule, costs that attributable to the final rule were estimated to the full extent, including the cost of schedule buffering.

The commenters further stated that the FAA has omitted the cost estimation attributable to the provision of "three consecutive nights" (section 117.27, NPRM), which is more likely to impact cargo carriers partly because they have a substantial concentration of operation during the night time period and flight crew that are accustomed to night time operations.

As an initial matter, the FAA notes that, based on the cost-benefit analysis, all-cargo operations are not required to operate under part 117. However, based on industry comments the FAA has mitigated the burden to cargo operators who may choose to operate under part 117 by reducing (to two hours) the length of "mid-duty rest" that is necessary to schedule five consecutive nighttime FDPs. Moreover, UPS and FedEx stated in their comments that they currently provide their flightcrew members with a mid-duty breaks that are, on average, two hours long. Because the final rule permits five consecutive nights with two-hour breaks, the impact of the consecutive-night provision on all-cargo operators such as UPS and FedEx will be minimal.

The commenters also argued that, under the FAA's cost-benefit methodology, there is no benefit to limiting duty time below 15 hours.

The FAA agrees the risk of accident prevalence in the 15th hour block and beyond is much greater than that associated with duty times short of the 15th hour block. To evaluate this proposition, the FAA computed ratios of accidents to exposure duty hours (dividing accidents in a sequence of flight hour blocks by pilot exposure duty hours), which substantiated the conclusion that accident risk steeply increases in the 15th hour block and beyond. However, the FAA has also determined that FDPs of less than 15 hours can lead to unacceptably high accident risk. For example, the statistic evidence indicates that the ratios of accidents to block hour rises in a fast rate in the 13th to 14th hour block range. Therefore, the regulation of flight duty time being limited under the 15th hour block is necessary and beneficial.

Allied Pilots Association (APA) generally supported the NPRM but stated that the FAA overestimated computer programming cost, fatigue training costs due to overstated training pay and rest facility installation costs. In addition, APA commented that the FAA underestimated the schedule optimization factor and the agility of air carriers when motivated to achieve efficiency.

The computer programing cost is a very small component of airline operation cost. Since the computer programming cost was estimated based on the market pricing, it was adjusted slightly lower or at about the same level as the FAA gained more accurate market data than that used for NPRM through its software providers. Overall, the operation cost in the final rule was revised and turned out to be lower than that of NPRM. Fatigue training costs was revised to be lower than that of NPRM because of the changes made to the proposed fatigue training requirements by the final rule. The revised rest facility installation cost was also lower than that of NPRM. APA's comment on the overestimation of the NPRM cost was based on the assumption that long-term optimization will occur at much faster rate than implicit in the cost analysis, which would result in more savings in the long run than that in the short run. The FAA agrees that long-term optimization of air carriers could be greater than expected. The FAA believes that the crew scheduling optimizer program provides a better estimate to the final rule.

Therefore, the FAA believes that the final rule cost estimates incorporating crew scheduling optimization model accurately reflect the compliance costs.

ATA's Oliver Wyman analysis on September 14, 2011, "Estimated Job Loss Resulting from Flightcrew Member Duty and Rest Requirements" attached to the ATA petition on Flight, Duty and Rest asserted that the proposed rule would cause nearly 17,000 U.S. airline jobs, which would result in total job losses to the economy of 398,000 jobs.

The FAA believes that ATA's analysis of the jobs impact from the proposed Flight, Rest and Duty rule is inaccurate. ATA's jobs impact analysis is based on its estimate, derived from its analysis of the NPRM, that this rule will cost $19.6 billion over a 10-year period. However, many of the major provisions of the final rule have been significantly altered from the NPRM, and, as discussed elsewhere, the FAA estimates that the final rule will cost approximately $390 million over 10 years. This $390 million cost is significantly smaller than the $19.6 billion cost on which ATA based its job impact analysis. CrewPairing's analysis of the final rule results in no change in pilot employment. Therefore, the FAA does not agree with ATA's job impact findings.

With regard to the accidents that were used to calculate the benefits for this rule, some commenters stated that the ATI 2/16/95 flight (RT2) was a part 91 ferry flight, and that the issues leading to that flight's accident have been addressed by other rulemakings. Consequently, the commenters assert, this flight would not be permitted under current rules.

This comment refers to an accident involving ATI in Kansas City during a nighttime Part 91 engine-out ferry flight in a 4-engine DC-8. Prior to takeoff, the Flight Engineer (FE) had improperly determined the minimum control speed on the ground (VMCG), which produced a value that was 9 knots too low. On the first takeoff attempt, the pilot applied power too soon to the "asymmetrical engine" (the serviceable engine on the side with the failed engine) and was unable to maintain directional control during the takeoff roll. He rejected the takeoff and, in preparation for a second takeoff, the pilot agreed to have the FE advance the throttle on the next takeoff attempt. This conflicted with the prescribed procedure.

At 3,215 feet into the takeoff roll, the DC-8 started to veer to the left. At 3.806 feet, the aircraft rotated with a tail strike but the tail remained in contact with the runway for another 820 feet. At 5,250 feet, the aircraft became airborne and climbed to 100 feet, then sank and crashed. All 3 crew members were killed.

NTSB focused on 2 core issues. First, NTSB found that the crew was flying after a shortened rest break, since rest periods were not required for ferry flights. According to the report, the crew was fatigued from lack of rest and lack of sleep, and from disrupted circadian rhythms. Second, NTSB found that the crew did not have adequate, realistic training in techniques or procedures for a 3-engine takeoff. NTSB added that the crew did not adequately understand 3-engine takeoff, and did not adequately understand the significance of VMCG.

In response to an NTSB recommendation related to training crews for a 3-engine takeoff ((A-95-39), FAA issued a Flight Standards Information Bulletin (FSIB). The FSIB directed FAA principal operations inspectors to inform their respective operators to take additional measures to ensure: (1) that aircraft manual requirements for engine-out ferry flights are clear; (2) that crew training segments are clearly outlined for engine-out operations; and (3) that operators use only crews specifically trained and certified for engine-out operations. This has become FAA policy and NTSB found the action acceptable and closed the recommendation.

Consequently, the comment is appropriate to the degree that it addresses the issue of training, which is not part of the proposed rule. However, FAA believes that this flight also illustrates the role and risks associated with fatigue, which the FSIB noted above did not address. With or without training in 3-engine takeoffs, NTSB's findings on fatigue in this accident remain pertinent to this rulemaking.

Benefit/Cost Summary

We have analyzed the benefits and the costs associated with the requirements contained in this final rule and our estimates are summarized in table 1. The FAA has made significant changes to the final rule since the NPRM. The training requirement has been substantially reduced because the FAA has determined that pilots are already receiving the requisite training as part of the statutorily required Fatigue Risk Management Plans. The FAA also has removed all-cargo operations from the applicability section of the new part 117 because their compliance costs significantly exceed the quantified societal benefits.[3] All-cargo carriers may choose to comply with the new part 117 but are not required to do so. Since the carrier would decide voluntarily to comply with the new requirements, those costs are not attributed to the costs of this rule. The costs associated with the rest facilities occur in the two years after the rule is published. The other costs of the rule and the benefits are then estimated over the next ten years.

We provide a range of estimates for our quantitative benefits. Our base case estimate is $376 million ($247 million present value at 7% and $311 million at 3%) and our high case estimate is $716 million ($470 million present value at 7% and $593 million at 3%). The total

[3] The projected cost for all-cargo operations is $306 million ($214 million present value at 7% and $252 million at 3%). The projected benefit of avoiding one fatal all-cargo accident ranges between $20.35 million and $32.55 million, depending on the number of crewmembers on board the aircraft.

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estimated cost of the final rule is $390 million ($297 million present value at 7% and $338 million at 3%).

Table 1: Summary of Benefits and Costs

Total Benefits over 10 Years			
Estimate	Nominal (millions)	PV at 7% (millions)	PV at 3% (millions)
Base	$ 376	$ 247	$ 311
High	$ 716	$ 470	$ 593
Total Costs over 10 Years			
	Nominal (millions)	PV at 7% (millions)	PV at 3% (millions)
Flight Operations	$236	$157	$191
	$138	$129	$134
Training	$16	$11	$13
Total	**$390**	**$297**	**$338**

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Benefit Analysis

This rule is intended to address the problem of fatigued pilots flying in Part 121 commercial service. The nature and extent of the problem is such that the NTSB continues to list pilot fatigue as one of the Most Wanted Transportation Safety Improvements. The NTSB recommendations are based on accident investigations and the NTSB safety study on airline safety. The requirements contained in this final rule address both NTSB recommendations and existing public law. This benefit estimate first examines the nature of fatigue, followed by its causes and how it relates to transportation. Second, we summarize some recent findings on fatigue and occupational performance. Next, we look at the magnitude of crew fatigue in Part 121 passenger operations by briefly examining fatigue reports in the context of this final rule. We then re-analyze the likely effectiveness of the requirements contained in this final rule and the potential to decrease these types of accidents in the future. We project a likely number of preventable events that will occur in absence of this final rule. Finally, we estimate the benefits that will be derived from preventing such events. We provide a base case estimate, and a high case estimate, in addition to a threshold/break even analysis.

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The Nature of Fatigue

Most fatigue studies agree that, "fatigue refers to a subjective desire to rest and an aversion to further work, coupled with an objective decrease in performance."[4]

[4] Jones, et al., "Working hours regulations and fatigue in transportation: A comparative analysis," *Safety Science*, Vol. 43, 2005.

Fatigue is characterized by:

- "increasingly frequent lapses in performance,
- general cognitive slowing, including a lowering of optimum performance,
- memory problems,
- time on task decrements, and
- an increasing inability to maintain the vigilance required to perform the tasks required."[5]

Fatigue has been described as "a nonspecific symptom because it can be indicative of many causes or conditions including physiological states such as sleep deprivation….[s]ome describe fatigue in terms of physiological data or 'objective' observations of…decrements in work or performance….or time-related deterioration in the ability to perform certain mental tasks."[6] While physiological criteria related to fatigue can be readily measureable, subjective feelings of fatigue are not directly observable, and in some instances individuals who are exhibiting diminished performance levels also feel confident in their ability to focus and perform assigned tasks.

Causes of Fatigue

A number of factors increase the risk of fatigue. These include:

- Time of day is very important, because the body follows a rhythm over an approximately 24 hour period, often referred to as a circadian cycle

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[5] Jones, et al., "Working hours regulations and fatigue in transportation: A comparative analysis," *Safety Science*, Vol. 43, 2005.
[6] Torres-Harding, Susan and Leonard A. Jason, "What is Fatigue? History and Epidemiology," *Fatigue as a Window to the Brain*, edited by John DeLuca. The MIT Press, 3-18, 2007.

- The amount of recent sleep that a person has received also affects the level of fatigue risk; most people need an average of eight hours of sleep per 24 hour period.
- The number of continuous hours awake also increases fatigue risk, and for most individuals, once the number of continuous hours awake exceeds 17, fatigue risk increases significantly.
- Sleep debt, the difference between the amount of sleep needed to be fully rested and actual sleep, also contributes to fatigue. Sleep debt accumulates over time, and fatigue risk is higher if sleep debt exceeds eight hours
- Work load and time on task can also affect fatigue risk. If work intensity is high and/or there is a long continuous period of time on task, the risk of fatigue increases.

Fatigue and Transportation

The nature of work in the transportation sector makes that sector especially susceptible to risks to performance, vigilance and response to hazards that are associated with fatigue. Workdays of those responsible for the safety of transportation operations can be characterized by long work periods, often at nighttime or early morning hours. Because transportation workers must sometimes rest or sleep away from home, conditions for rest and sleep quality are also important.

Analysts have examined the links between the specific features of work in the transportation industry, including commercial aviation, and the general features of human physiology and fatigue for decades. For commercial aviation, it has been nearly two decades since the first citation of fatigue as a probable cause for a major aviation accident. This accident, the crash of American International Airways flight 808 at Guantanamo Naval Air Station, Cuba, on August 18, 1993, was investigated by the National Transportation Safety Board. Probable causes of the accident identified by the NTSB included "the impaired judgment, decision making, and flying abilities of the captain and flightcrew due to the effects of fatigue…"

As part of the investigation of that accident, NASA researchers and contractors performed an analysis of the links between aviation risks and the effects of fatigue on human vigilance and performance. This research was reported as part of the NTSB report on the Guantanamo Bay accident[7] and later revised for inclusion in an NTSB report on U.S. Department of Transportation efforts to address fatigue issues in Transportation.[8]

This NTSB research and literature summary provides a thorough and well-documented review of these issues. In the 1999 restatement of the research results in the context of addressing fatigue issues in transportation generally, the following summary is provided:

Fatigue, sleep loss and circadian disruption created by transportation operations can degrade performance, alertness and safety. An extensive scientific literature exists that provides important physiological information about the human operator, which can be used to guide operations and policy. For example, there are human physiological requirements for sleep, predictable effects of sleep loss on performance and alertness and patterns for recovery from sleep loss. Additionally, the circadian clock is a powerful modulator of human performance and alertness, and in transportation operations, it can be disrupted by night work, time zone changes, and day/night duty shifts. Scientific examination of these physiological considerations has

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[7] Rosekind, et.al.,"Appendix E: Analysis of Crew Fatigue Factors," Aircraft Accident Report: Uncontrolled collision with Terrain, American International Airways flight 808, Douglas DC-8-61, N814CK, U.S. Naval Air Station, Guantanamo Bay,Cuba, August 18, 1993. Washington D.C., NTSB Report AAR-94/04, pp. 133-144. http://human-factors.arc.nasa.gov/zteam/PDF_pubs/G_Bay/GuantanamoBay.pdf

[8] Rosekind, et.al., "Appendix C: Summary of Sleep and Circadian Rhythms," *Evaluation of U.S. Department of Transportation Efforts in the 1990s to Address Operator Fatigue.* Washington D.C. NTSB Safety Report NTSB/SR-99/01, May 1999, pp.67-81. http://www3.ntsb.gov/publictn/1999/sr9901.pdf

documented a direct relationship to errors, accidents and safety. This scientific information can provide important input to policy and regulatory considerations.

Recent Findings on Fatigue and Occupational Performance

Fatigue is prevalent in the U.S. workforce, with nearly 38 percent of workers in a study reporting fatigue during a two-week period.[9] The National Sleep Foundation conducted a poll in 2008, which found that 29 percent have fallen asleep or become very sleepy while at work and two percent did not go to work due to sleepiness or a sleep problem.[10] Numerous studies have found that fatigue can significantly reduce productivity. A review of published studies on shift work and productivity found a large decrease in efficiency during the night shift, with the low occurring at 3:00AM. On average, the authors found that productivity was five percent lower at night.[11]

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A large scale study was conducted at 40 companies and institutions in the Netherlands to investigate the relationship between fatigue and future sickness absence. The presence of fatigue was measured using self-reported symptoms, with employers providing absence data. The study controlled for numerous socio demographic and work characteristics. The investigators found that higher levels of fatigue were statistically significant predictors of both short-term and long-term sickness absence.[12]

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[9] Ricci, et al., "Fatigue in the U.S. workforce: prevalence, and implications for lost productive work time," *Occup Environ Med*, Vol. 49(1): 1-10, 2007.
[10] National Sleep Foundation, "2008 Sleep in America Poll: Summary of Findings."
[11] Folkard and Tucker, "Shift work, safety and productivity," *Occupational Medicine*, Vol. 53, 2003.
[12] Janssen, et al., "Fatigue as a predictor of sickness absence: results from the Maastricht cohort study on fatigue at work," *Occup Environ Med*, 2003, 60(Suppl I): i71-i76.

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A study was conducted to estimate fatigue prevalence and associated health-related lost productive time (LPT) in U.S. workers. The investigators found that workers with fatigue were much more likely to report health-related LPT, with a cost of $136.4 billion annually. This amount exceeded health-related LPT reported by workers without fatigue by $101.0 billion.

A study compared the rate of errors made by medical residents working in the ICU on 80 hour weeks versus those on 63 hour weeks. The residents with the shorter work week schedule experienced half the rate of attention failures. The residents with the longer work week schedule made serious medical errors (those causing or having the potential to cause harm to a patient) at a rate 22 percent higher than the residents with the shorter work week schedule.[13]

The railroad industry is at a relatively high risk of fatigue, due to typical 24 hour per day operations. A number of railroads have implemented fatigue countermeasures, which generally reduced absenteeism. For instance, after implementation of fatigue countermeasures for CANALERT, absenteeism decreased from 8.1 to 3.2 percent. After fatigue countermeasures were implemented for the Conrail-Buffalo-Toledo IMPAC project, a statistically significant increase in attendance from 95.21 percent to 98.06 percent was observed.[14] This data demonstrates the potential for fatigue issues, which we will now examine within the specific requirements of this final rule.

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[13] Board on Health Sciences Policy, "Sleep Disorders and Sleep Deprivation: An Unmet Public Health Problem," *The National Academies Press*, 2006.

[14] Sherry, "Fatigue Countermeasures in the Railroad Industry: Past and Current Developments," *Association of American Railroads*, 2000.

ASRS

One can observe fatigue in aviation by examining the Aviation Safety Reporting System (ASRS). The ASRS collects, analyzes, and responds to voluntarily submitted aviation safety incident reports in order to lessen the likelihood of aviation accidents. It is part of a continuing effort by government, industry, and individuals to maintain and improve aviation safety by collecting voluntarily submitted aviation safety incident/situation reports from pilots, controllers, and others**.**

The data in the ASRS is used to:

- Identify deficiencies and discrepancies in the National Aviation System (NAS) so that these can be remedied by appropriate authorities.
- Support policy formulation and planning for, and improvements to, the NAS.
- Strengthen the foundation of aviation human factors safety research. This is particularly important since it is generally conceded that over two-thirds of all aviation accidents and incidents have their roots in human performance errors.

ASRS assures confidentiality and data cannot be traced back to individual operators. So although we cannot claim the rule could prevent specific ASRS events, it is a useful tool in evaluating and validating the presence of fatigue in Part 121 operations. We performed a query for Part 121 ASRS for Fatigue[15]. Since June of 2009, there were a total of 256 reports where fatigue was cited as a factor. We have neither culled the data nor edited any of the data that was reported to ASRS. The top seven results are listed in Table 2.

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[15] We believe that this is a very conservative assumption because other human factors can reveal fatigue, such as confusion and communications breakdown.

Table 2: ASRS Part 121 Fatigue Reports

Result	Total	Relative %
General None Reported / Taken (No action was taken as a result of the fatigue issue reported)	68	26.6%
General Work Refused (Fatigue caused a worker to refuse an assignment)	21	8.2%
General Maintenance Action (Typically a fatigue event related to a maintenance issue—not related to this final rule).	14	5.5%
Flight Crew Became Reoriented (Confusion related to some type of malfunction.)	10	3.9%
Flight Crew Took Evasive Action (Crew took action to avoid an accident or incident)	8	3.1%
Air Traffic Control Issued New Clearance (Substitute clearance given to get back on track)	5	2.0%
Flight Crew Executed Go Around / Missed Approach	5	2.0%

One captain on an international flight described an onerous flight sequence in the Pacific he believed to be unsafe due to cumulative and predictable fatigue:

"This report concerns a trans-Pacific flight assignment including back to back all night pairings (body clock), two un-augmented inter-Asia segments and 36 hours of flight time. We started the sequence with a 12.7 hour actual flight, single augmented with an hour plus delay on the front end. When we arrived we cabbed to downtown for an additional 1.5 hours on the body before rest. The first internal Asia leg is all night, un-augmented. The return leg is daylight-but all night body time-followed by another 1.5 hour cab ride downtown. The [opportunities for] rest were insufficient to maintain any alertness particularly on the last leg. Both the First Officer and I experienced periods of unintended sleep while at the controls. No amount of coffee or mental discipline was sufficient to stay awake!!! This is unsafe and made more unsafe by requiring: 1. Over 12 hours single augmented on the first leg. 2. Two un-augmented legs on the back side of the clock with long preflight awake hours. 3. Over 8 extra hours of "duty time" in CABS!!! Rework this trip before someone gets hurt. No one in the cockpit for the last 6 hours was at their peak to respond to irregular situations. We weren't even able to stay awake the whole time in the seat".

Even if no anomalies occur during a flight, a fatigued crew may be poorer problem solvers than well-rested crews as noted in the research cited above, and thus add a degree of risk to the system. In addition, taking evasive action and missed approaches because of fatigue are serious safety events indicating substantial risk manifesting in the current system.

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Effectiveness

It is usually the case that multiple factors can be identified as causes of specific accidents, and it is seldom the case that a specific rule is 100 percent effective at addressing a variety of accident causal factors. In particular, fatigue is rarely a primary or sole cause of an accident, and therefore this final rule will not likely prevent all future fatigue related accidents. For this final regulatory evaluation, we have established a modified effectiveness ratio to categorize accidents for which fatigue may be a contributing causal factor. This number represents the likelihood the requirements contained in this final rule would have prevented an accident from occurring. It is applied in the calculation of the number of forecasted fatigue accidents, if no action was taken to address the fatigue problem in Part 121 operations.

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In its analysis of the effectiveness of the final rule, the FAA reviewed accidents that could have been prevented or could have been influenced by the requirements contained in this final rule. The effectiveness analysis works by assessing the likely capability of the requirements contained in the final rule to have prevented those accidents. As part of this analysis, the Office of Accident Investigation reviewed the accident reports from NTSB and foreign investigative authorities on all accidents where the NTSB cited fatigue or fatigue was thought to be either a cause or factor. This was done in order to assess the likelihood that the provisions of the final rule would have averted those accidents (including positioning flights operating under Part 91).

A consistent definition was applied to the 20-year history as the requirements of the rule apply to all Part 121 operations. As such, we reviewed the accident history for all operations that would currently operate under Part 121. The final analysis will take into account NTSB findings, FAA's independent assessment, and comments to the docket. Some accidents reviewed scored "zero" because fatigue could not be established as a significant factor or because the final rule would not prevent such an event had the requirements been in place today. These accidents were removed from our effectiveness analysis and forecast. Because this final rule does not mandate compliance with Part 117 for all-cargo operations, we also removed them from our final analysis. Anticipated costs and benefits for these operations, were the rule to apply on a mandatory basis, are provided in footnotes to the relevant discussions in this document.

Each accident was then re-evaluated by conducting a scoring process similar to that conducted by the Commercial Aviation Safety Team (CAST), a well-documented and well understood procedure, similar to the NPRM. The FAA Office of Accident Investigation used the NTSB recommendations along with narratives, probable cause, contributing factors and other pertinent data to score the accidents. When these accidents were not well defined in the probable cause or contributing factors statements of the NTSB reports, Accident Investigation used a Joint Implementation Monitoring Data Analysis Team (JIMDAT)-like method. The JIMDAT-type scoring system is from 0 to 5, and the score is based on the likelihood that a proposed action would have mitigated that accident. The level and percentage of effectiveness criteria are detailed in Table 3.

Table 3: JIMDAT-Type Scoring System

5	90% effectiveness. The proposed requirement directly addresses the NTSB causal factors and would very likely prevent the accident in the future.
4	75% effectiveness. The proposed requirement directly addresses the majority of the NTSB causal factors and would probably prevent or is likely to reduce the risk of the respective accident, given the circumstances that prevailed.
3	50 % effectiveness. The proposed requirement directly addresses one of several NTSB causal factors and is likely to reduce the risk of the respective accident, given the circumstances that prevailed.
2	35% effectiveness. The proposed requirement generally addresses the NTSB causal factors and is likely reduce the risk of the respective accident, given the circumstances that prevailed.
1	15% effectiveness. The proposed requirement is likely to have reduced the risk of the respective accident, given the circumstances that prevailed.
0	0% effectiveness. The proposed requirement would not reduce the risk of this type of accident in the future.

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FAA applied this methodology to each pilot fatigue accident to reach an overall effectiveness ratio for the requirements contained in this final rule. The qualitative assessments ranged from zero (0) to low (1), moderate (3), high (4) and very high (5). The qualitative assessments then were converted to quantitative effectiveness scores as follows: zero; 15%; 35%; 50%; 75%; and 90%.

For this analysis, the FAA presents the quantified benefits and effectiveness analysis for a 10-year period that parallels the cost analysis. Although we only forecast ten years of benefits, we have included a twenty year history of accidents, as these are the circumstances and events which have led to this final rulemaking. Table 4 summarizes the past twenty years of pilot fatigue accidents. The appendices contain a summary of each accident and the corresponding effectiveness analyses.

Table 4: 20 Year Accident History

Date	Location	Service	Carrier	A/C	On Bd	Ftl	Ser	Dam-age	Scenario	Score
07/02/1994	Charlotte, NC	121 Pax	US Air	MD-82	57	37	16	Dest	LOC on Approach; Icing	0.15
02/16/1995	Kansas City, MO	Ferry	ATI	DC-8-63	3	3	0	Dest	LOC in RTO; Engine Out	0.9
12/20/1995	Cali, Colombia	121 Pax	American	B757	164	160	4	Dest	CFIT High	0.35
08/25/1996	JFK, NY	121 Pax	TWA	L1011	262	0	0	Sub	Tail Strike Landing	0.35
01/22/1999	Hyannis, MA	Positioning	Colgan Air (Part 91)	BE-1900	4	0	0	Dest	Hard Landing (BETA)	0.15
05/08/1999	JFK, NY	121 Pax	American Eagle	SF34	30	0	1	Sub	RE Landing	0.5
06/01/1999	Little Rock, AR	121 Pax	American	MD-82	145	11	45	Dest	RE Landing	0.15
07/26/2002	Kirksville, MO	121 Pax	FedEx	BAE-32	3	0	3	Dest	CFIT Low on Approach	0.75
08/27/2006	Lexington, KY	121 Pax	Comair as Delta Connection	CRJ-200	50	49	1	Dest	Wrong Runway T/O	0.35
02/18/2007	Cleveland, OH	121 Pax	Shuttle America as Delta Connection	ERJ-170	74	0	0	Sub	RE Landing	0.5
04/12/2007	Traverse City, MI	121 Pax	Pinnacle as NW Express	CRJ-200	52	0	0	Sub	RE Landing	0.9
06/20/2007	Laramie, WY	121 Pax	Great Lakes	BE-1900	11	0	0	Sub	LOC Bounced Landing	0.15
02/12/2009	Buffalo	121 Pax	Colgan Air	DHC-8-Q400	49	50	0	Dest	LOC In Flight; RE Landing	0.5
Average										52.5%

Quantitative Benefits

James Reason characterizes major accidents and catastrophic system failures as the consequences of multiple, smaller failures that lead up to the actual accident. It is a "Swiss

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cheese" model of human error[16] and also a sequential theory of accident causation. Reason's model describes four levels of human failure, each one influencing the next. O*rganizational influences* lead to instances of *unsafe supervision* which in turn lead to *preconditions for unsafe acts* and ultimately the *unsafe acts of operators*. The unsafe acts of operators are where most accident investigations are focused. It is a useful framework to illustrate how analyses of major accidents and catastrophic systems failures tend to reveal multiple, smaller failures leading up to the actual accident. The chances of the exact same circumstances happening again and causing the "same accident" are virtually nil but the possibility of preventing a similar set of circumstances is real.

This sequential "Swiss cheese" formulation is a very appropriate tool for characterizing the circumstances leading up to accidents. The nature of fatigue is such that actions, reactions and the thought processes of fatigued crews are more susceptible to the types of cascading errors of judgment described in the Reason model of catastrophic failure. The requirements contained in this final rule will decrease pilot fatigue and therefore the accompanying accidents that are associated with fatigue. While it is very difficult to accurately attribute all past accidents to one or more causes indisputably, we have developed the average effectiveness measure to apply to the estimates and recognize that there are additional uncertainties with preventing a future fatigue related event. First, we examine an accident that occurred on October 19, 2004:

At about 1937 central daylight time, Corporate Airlines a BAE Systems BAE-J3201, struck trees on final approach and crashed short of runway 36 at Kirksville Regional Airport, in

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[16] Reason, 1990

Kirksville, Missouri. 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. [17]

Research and accident history indicate that fatigue can cause pilots to make risky, impulsive decisions, to become fixated on one aspect of a situation, and to react slowly to warnings or signs that an approach should be discontinued. Fatigue especially affects decision making, and research shows that people who are fatigued become less able to consider options and are more likely to become fixated on a course of action or a desired outcome. A fatigued pilot might fail to discontinue a flawed approach or might make a risky decision to continue a dangerous approach.

The fatigued crew reported for duty at 0514. The accident was near end of 6th sector on a 'demanding' day. Crew had been on duty 14.5 hours and the PIC is said to have slept poorly night before. The captain was observed resting on a small couch in the company crew room; however, the quality of rest the captain obtained during this time could not be determined. Company pilots stated that the crew room was a noisy meeting area that was not ideal for sleeping.

Additionally, the pilots' high workload during their long day may have increased their fatigue. The accident occurred during the sixth flight segment of the day while the pilots were

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[17] The NTSB evaluated fatigue as a possible factor in this accident and looked at the various circumstances present the day of the accident that might have contributed to the pilots' fatigue. The pilots' available rest time (from about 2100 to 0400) did not correspond favorably with either pilots' reported usual sleeping hours, resulting in much earlier than normal times to go to sleep and awaken. Additionally, the early wakeup call times would have been challenging to both pilots because the human body is normally physiologically primed to sleep between 0300 and 0500.

performing a non-precision approach in low ceilings and reduced visibility. The pilot deficiencies observed in this accident are consistent with fatigue impairment.

Similarly, although the first officer's junior status with the company may have been an issue in his failure to challenge the captain during the approach, he may also have been suffering from fatigue; his failure to monitor and react to the captain's deviations from non-precision approach procedures was consistent with the degrading effects (slowed reactions and/or tunnel vision) of fatigue.

The Safety Board concluded that, on the basis of the less than optimal overnight rest time available, the early reporting time for duty, the length of the duty day, the number of flight legs, the demanding conditions (non-precision instrument approaches flown manually in conditions of low ceilings and reduced visibilities) encountered during the long duty day (and the two previous days), it is likely that fatigue contributed to the pilots' degraded performance and decision-making.

Another fatigue related accident occurred in Traverse City, Michigan on April 12, 2007. The accident occurred well after midnight at the end of a demanding day during which the pilots had flown 8.35 hours, made five landings, had been on duty more than 14 hours, and been awake more than 16 hours. During the accident flight, the CVR recorded numerous yawns and comments that indicate that the pilots were fatigued. Additionally, the captain made references to being tired at 2332:12, 2341:53, and 0018:43, and the first officer stated, "jeez, I'm tired" at 0020:41. Additionally, the pilots' high workload (flying in inclement weather conditions, and in the captain's case, providing operating experience for the first officer) during their long day likely increased their fatigue. The aircraft ran off the departure end of the runway

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during snowy conditions. Although there were no injuries among the 49 passengers, the aircraft was substantially damaged.

As we observe a clear accident history and the accompanying science dealing with fatigue, it is apparent that fatigue threatens aviation safety by increasing the risk of pilot error that could lead to an accident. Fatigue is characterized by a general lack of alertness and degradation in mental and physical performance. Fatigue manifests in the aviation context not only when pilots fall asleep in the cockpit while cruising, but perhaps more importantly, when they are insufficiently alert during take-off and landing. Each flight segment that is flown by a flightcrew member includes a takeoff and a landing, which are the most task and safety-intensive parts of the flight. A flightcrew member whose flight duty period (FDP) consists of a single flight segment only has to perform one takeoff and landing, while a flightcrew member whose FDP consists of six flight segments will have to perform six sets of takeoffs and landings. Because takeoffs and landings are extremely task-intensive, it logically follows that a flightcrew member who has performed six sets of takeoffs and landings will be more fatigued than the flightcrew member who has performed only one takeoff and landing. Reported fatigue-related events have included procedural errors, unstable approaches, lining up with the wrong runway, and landing without clearances. As such, a fatigued crew is dangerous no matter what “type” or segment of operation is examined and the requirements in this final rule will eliminate the distinctions between various operations.

As we have shown, in an airplane accident, there is a series of errors (both causes and factors) that contribute to an accident. Accident scenarios can vary greatly depending on phase of flight, the type of operation, phase of flight and size of the airplane. While pilot fatigue can occur during any stage of flight, takeoff and landing are especially critical times for the crew to exhibit good judgment and sound decision making. The airplane is close to the ground and there is little room for error during these particular phases of flight.

The FAA provides a range of benefit estimates. The base case estimate only looks at the historical events as an exact mirror for the future. The high case estimate assumes that regional carriers will begin flying larger planes. We understand that future accidents, will not be identical to historical accidents but our approach provides a conservative look at the benefits of this rule based on a snapshot of the past.

Here the FAA provides a quantitative benefit estimate of historical-based accidents (base case), and a high case of expected benefits from future averted accidents once this rule is promulgated. Generally our benefit analysis begins using past history as an important reference from which to begin the benefit analysis. We believe the base case benefit estimate, which is based solely on the outcome of past accidents, may be low because today passenger load factors and aircraft size are already greater than they were in the past decade. On the other hand, we also note that this estimate may not fully take into account changes in regulatory requirements that postdate those accidents and that may mitigate the projected risk. As such, our base case estimate represents a snapshot of risk.

Airplane accidents are somewhat random both in terms of airplane size and the number of people on board. For these reasons, projections of future fatalities may be based on future risk exposure, and our projections are typically based on expected distributions around the mean. Our typical scenario incorporates increasing airplane size, expected load factors, and a breakeven analysis. However, our evaluation of the historical accidents showed a disproportionate risk among smaller, regional carriers. Accordingly, as we discuss below, the FAA has decided to base its high case estimate on preventing an accident in a regional jet airplane.

In response to comments, we have reduced the analysis period from the 20 years provided in the proposed regulatory analysis to 10 years here. We received comments disputing the use of a 20 year time frame for accidents stating the accident rate has declined over time. While noting the wide range of operations over the last 20 years, we shortened the accident history to the last ten years. A reduction in the length of the sample period introduces other problems, most importantly with less time there are fewer observations. Observations are important, as the nature of aviation accidents is that while they are rare events, very often these accidents result in severe, high consequences.

The FAA Office of Accident Investigation assessed the effectiveness of this rule to prevent the 6 fatigue-related accidents which occurred on passenger-carrying aircraft in a recent ten year period. This office used the Commercial Aviation Safety Team (CAST) methodology to assign a value to how effective the rule will be at preventing each accident. On average, we expect this rule would have been 52.5 percent effective in preventing the types of accidents had it been in effect over the last 10 years.

Base Case Estimate

Deleted: Our base estimate forecasts only the catastrophic events and the accompanying effectiveness. The high estimate, evaluates historical exposure related to the requirements contained in this final rule, based upon industry segments. The exposure is weighted by the expected number of passengers on each segment type. The high estimate looks at the total number of passengers that we would expect on an airplane and incorporates the historical fatality rates. We do not prevent historical accidents in the future, and we understand that future accidents do not 100% mirror historical accidents. Nevertheless, we provide an estimate based upon this static/historic data. Lastly we provide a threshold analysis and conclude that the benefits of the final rule justify the costs. ¶
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The base case estimate only looks at the historical events as a specific reference point. In this estimate the exact number of fatalities for each past event is multiplied by the relative rule effectiveness score to obtain the historical number of deaths that would have been averted with the requirements contained in this final rule, had this rule been in effect at the time. The base case estimate supposes roughly six deaths will be averted annually. Multiplying six annual averted deaths by the $6.2 million value of statistical life equals $37 million annually. In addition, had the requirements been in place at the time of these historical accidents, $2 million in hull damage for each accident would have been averted, which equals $6 million for ten years or $0.6 million annually. When summed over the ten year period of analysis, the base case estimate is $376 million ($247 million present value at 7% and $311 million present value at 3%).

High Case Estimate

Because airplane accidents are relatively rare they are not necessarily representative of actual risk, especially with regard to airplane size and the number of people on-board. In addition, future conditions will be different than they were when the accident occurred. Thus, the base case represents a snapshot of the risk that fatigue introduces in the overall operating environment. It considers neither the forecasted increase in load factors nor the larger aircraft types. The future preventable events that this rule addresses will not exactly mirror the past events because the airplane types, utilization, and seating capacity have changed.

To quantify the expected benefits in the high case scenario, we narrowed the analysis to three of the six historic accidents which were catastrophic (all on board died). In this case the expected number of preventable catastrophic accidents equals the three accidents multiplied by the 52.5 percent effectiveness rate. Thus over a ten-year time period the expected number of preventable accidents is 1.575. Using the Poisson distribution there is roughly a 20 percent chance for no accident; however, there is also a 50 percent probability of two or more accidents.

While the 20 year accident history has a broader range of catastrophic accidents, in the shorter ten year historical period all the three catastrophic accidents were on regional airplanes. We recognize that as regional airplanes are smaller than the 'typical' passenger jet, assuming all future accidents would be on a regional jet understates the relative risk across the fleet of aircraft affected by this rule. It does, however, represent historical accidents and may be somewhat representative actual future risk, since the mainline carriers typically have collective bargaining agreements that are already largely reflective of the requirements of this rule.[18]

The average size airplane in the forecast period is a B737/A320 with an expected number of passengers and crew of 123 given a forecasted 142 seat airplane and a load factor of 83 percent.[19] Even though there was a (relatively large) B757 passenger airplane accident in the 20 year history, if one looks at the past 10 years as truly representative of risk, the preventable accident would likely be on a regional airplane.

For the high case the FAA backed away from a benefit outcome based on mean fleet, flight hours, and occupant numbers because ultimately we were persuaded there was information which could not be ignored by the three regional passenger accidents occurring without a mainline passenger accident. For this reason, we selected an 88 seat regional jet (like an ERJ-175) to be the representative airplane for the high case. This size airplane is also consistent with the fact that regional operators are expected to fly somewhat larger airplanes in the future.

The expected benefit from this high case follows a simple methodology for estimating and then valuing the expected number of occupants in a prevented accident. With a total of 0.3 accidents per year over the ten year period multiplied by the 52.5 percent effectiveness rate, the analysis assumes 0.1575 average accidents per year. The estimated occupant value for each averted accident equals the average number of seats (88) multiplied by the load factor of 77% plus 4 crew members for a total of 72 averted fatalities. Each of these prevented fatalities is

[18] It is unusual that collective bargaining agreements would closely mirror regulatory requirements. However, flight and duty limitations are unique because they address both safety considerations, which are regulatory in nature, and lifestyle considerations, which are properly addressed in collective bargaining agreements. Because of the impact of collective bargaining agreements on the number of hours that pilots work, those agreements were considered by the FAA in calculating both the costs and benefits of this rule.

[19] Table 6, FAA Aerospace Forecasts Fiscal Years 2011

multiplied by a $6.2 million value of statistical life. The expected value of a preventable accident equals the sum of the averted fatalities at $446.4 million added to the value of the airplane hull loss ($8.15 million replacement value), for a prevented accident benefit of $454.6 million.[20] Over a ten year period the value of preventing the expected 1.575 accidents equals approximately $716 million ($470 million present value at 7% and $593 million present value at 3%).

[20] In contrast, the value of an averted all-cargo fatal accident would range between $20.35 million (loss of hull and 2 crewmembers) and $32.55 million (loss of hull and 4 crewmembers).

Benefit Summary

The new requirements in this final rule will eliminate the current rest and duty distinctions between domestic, flag and supplemental operations as the requirements apply universally to all Part 121 certificate holders conducting passenger operations. The sleep science, while still evolving and subject to individual inclinations, is clear in a few important respects: most people need eight hours of sleep to function effectively, most people find it more difficult to sleep during the day than during the night, resulting in greater fatigue if working at night; the longer one has been awake and the longer one spends on task, the greater the likelihood of fatigue; and fatigue leads to an increased risk of making a mistake. The requirements contained in this final rule and the accompanying analysis are designed reduce the factors that lead to fatigue in most individuals and for all flight crew.

Deleted: For our base case estimate, we conservatively look only at the subset of fatigue related accidents where hull losses and passenger deaths occurred. This base case estimate does not examine the future exposure to pilot fatigue but rather it is based upon the history of accidents. Of the seven events in the most recent ten years, historically only three were "catastrophic" in nature where virtually everyone on the airplane was killed. We use those three catastrophic accidents as the minimum expected number of accidents for our period of analysis, and incorporate the expected average effectiveness of 58%. ¶

For the estimate of the number of individuals per airplane, we project an aircraft roughly the size of a regional aircraft with 66 people on each airplane. [21] This number represents the most likely number of people on an airplane and current state of aviation and the types of the airplanes that are operated in the market today. We multiply the expected 66 people by the value of averting fatalities ($6.2 million) to estimate $409 million in benefits from averting fatalities. This benefit is added to the weighted average airplane value that would be involved in a preventable accident ($8.15 million). As such, the base case estimate from averting an event in the base case scenario is roughly $417 million. ¶

With a total of 0.3 events annually over the ten year period of analysis, and the corresponding 58% average effectiveness, 0.174 average annual events would be averted for our base case estimate. When we multiply the average annual events that will be averted in our lower bound estimate (0.174) by the estimated benefit from averting an event, $404 (weighted average) million, the annual benefits are approximately $73 million. When summed over the period of analysis, the total estimated lower bound benefits are approximately $726 million ($477 million present value). ¶

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High Estimate¶

As discussed earlier, over the past 10-years, there were a total of 7 events where the requirements contained in this final rule would have been on average 58% effective, if the requirements had in place at the time of the accidents for this high estimate. We assume equal risk for every year of the analysis period, and an accompanying forecasted ten-year benefit period that mirrors the costs. The corresponding annual equivalent of seven events over the period of analysis equals 0.7 events per year. When multiplied by the effectiveness of 58%, the total estimated annual preventable events are 0.406. ¶

For our high estimate, we consider a number of potential occupants in ... [95]

The actual benefits of the final rule will depend upon the type and size of accident that the rule averts. Because we recognize the potential variability in the quantified benefits of this final rule, we provide a base case estimate, and a high case estimate. We also note that preventing a single catastrophic accident in a 10-year period with 61 people on board would cause this rule to be cost beneficial. Our base case estimate is $376 million ($247 million present value at 7% and $311 million at 3%) and our high case estimate is $716 million ($470 million present value at 7% and $593 million at 3%).

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Cost Analysis

The cost of the final rule to Part 121 passenger air carriers can be categorized into three main cost components: flight operations, training, and rest facilities. Flight operations cost consists of three main sub-components: crew scheduling cost, computer programming of crew management systems cost, and cost saving associated with the need for fewer reserve flightcrew members. Training cost consists of two main sub-components: dispatchers and management fatigue training cost, and curriculum development cost. Rest facilities cost consists of four main sub-components: engineering cost, installation cost, aircraft downtime cost, and increased fuel usage cost. The final rule costs were calculated using industry-provided data whenever possible, along with expert analysis.

The total estimated cost of the final rule is $390 million for the ten year period from 2013 to 2022. The present value is $297 million and $338 million using a seven percent and a three percent discount rate, respectively. The 2013 effective date of the final rule allows two years for carriers to become compliant with the final rule. The FAA classified costs into three main components and estimated the accompanying costs. Data was obtained from various industry sources; the sources of the data used in cost estimation are explained in each section. Table 6 identifies the three main cost components. Flight operations cost accounts for approximately53 percent of the total present value cost of the rule. Rest facilities account for approximately 43 percent of the total present value cost of the rule. Roughly four percent of the costs contained in this analysis are attributable to training. Each of the main cost components are explained in-depth in the following sections of this document.

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Table 6: Cost Summary

Cost Component	Nominal Cost (millions)	PV at 7% (millions)	PV at 3% (millions)
Flight Operations	$236	$157	$191
Rest Facilities	$138	$129	$134
Training	$16	$11	$13
Total	**$390**	**$297**	**$338**

Flight Operations Cost

The flight operations cost component of the final rule is composed of three sub-components: crew scheduling costs, crew management system computer programming costs, and cost savings of reduced reserves due to reducing fatigue. Table 7 provides a summary of the three sub-components of the flight operations cost. The derivations of sub-component costs are explained in-depth in the following sections of the document.[24]

[24] Operators might be able to reduce their flight operations costs by developing and implementing a fatigue risk management system (FRMS). The FAA is not imposing an FRMS program requirement on Part 121 carriers, but does allow carriers the FRMS option. Carriers might develop an FRMS program as an alternative to the final rule flightcrew member duty and rest requirements when the crew scheduling cost savings equal or exceed the costs of the FRMS program. Carriers might do this for ultra-long flights, which have flight times over 16 hours. FRMS is optional and would only be implemented by an operator if their compliance costs could be reduced as FRMS only provides cost relief. We did not estimate this potential savings as we do not know how many operators would use FRMS and the cost of FRMS has a wide range.

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Table 7: Summary of Flight Operations Costs

Flight Operations Cost Sub-Component	Nominal Cost (millions)	PV Cost (millions)
Crew Scheduling	$ 440	$ 289
Computer Programming	$ 8	$ 7
Reducing Fatigue Saving	($ 211)	($ 138)
Total Flight Operations	**$ 236**	**$ 157**

Note: Numbers may not sum to total due to rounding-off error.

Crew Scheduling

Overview

Numerous commenters objected to FAA's assumptions regarding the 25 percent cost-savings resulting from long-term scheduling optimization in the NPRM. To address these concerns, the FAA estimated the scheduling compliance costs using a commercial crew scheduling program. The final rule's impact on crew scheduling costs was evaluated using Cygnus, a pairing and bid line optimizer developed by CrewPairings, Inc.[25] Part 121 passenger air carriers provided actual crew schedule data to the FAA for assistance in the cost analysis of the Flightcrew Member Duty and Rest Requirements Rulemaking. Each carrier provided data for one or more "cases". A case is defined as a carrier fleet, which usually consists of one aircraft type. In some of the cases, the carrier schedules multiple aircraft types using the same

[25] Cygnus has been used by more than 30 major airlines worldwide over the past 40 years.

[27] Most regional carriers operate code-share flights for a number of mainline partners; crew scheduling is usually performed separately for each mainline partner. This analysis was conducted using the same process as the actual carrier, so each regional carrier case represents a sub-fleet.

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pool of flightcrew members; the methodology in this regulatory impact analysis mirrors actual carrier practice.

In total, carriers provided data for eight cases. We believe these are representative of the Part 121 air transportation industry. Mainline passenger carriers were represented with two short-haul, narrow-body aircraft cases and two long-haul, wide-body aircraft cases. Regional passenger carriers were represented with two cases.[27] Cargo carriers were represented with one short-haul, narrow-body aircraft case and one long-haul, wide-body aircraft case.

In addition to the eight cases based on actual carrier fleets, a synthetic supplemental carrier case was created because no supplemental carriers provided crew schedule data. Creation of the synthetic supplemental carrier involved modification of the cargo wide-body case. The flight schedules and crew bases of the cargo wide-body case were retained because cargo carriers consist of the major share of supplemental carriers. The cargo carrier collective bargaining agreement (CBA) rules were replaced with those reflecting a representative supplemental carrier CBA. The representative supplemental carrier CBA reflected rules from a number of actual supplemental carrier CBAs. These changes reflect the impacts of this final rule on actual supplemental passenger carriers operating wide-body aircraft with route structures similar to the cargo carrier wide-body aircraft case.

The crew schedule data consisted of one scheduling period (month) per case. The specific periods varied by carrier, based on data availability. The data included full bid line and pairing information for each flightcrew member, and included both lineholder and reserve flightcrew members.

The use of a pairing and bid line optimizer enabled the FAA to more accurately model the impacts of the final rule on industry crew scheduling costs than was possible during NPRM cost analysis. The pairing and bid line optimizer has been used worldwide by all types of airlines for their own crew scheduling needs and addresses the optimizer and scheduling limitations in the NPRM cost analysis. Due to this extensive real-world experience, results for these eight cases can be expected to accurately portray the impacts of the final rule on crew scheduling costs for the cases studied, without making assumptions about potential optimization by carriers.

Crew Scheduling Analysis

Accurately analyzing the final rule's impact on crew scheduling costs for the eight cases required isolating the final rule's impact from the impacts of various contractual, management, and discretionary crew scheduling practices. The pairing and bid line optimizer was first calibrated to ensure that it was capable of creating crew schedules identical to the crew schedules provided by the carriers. After calibration, existing federal regulations relevant to flightcrew member scheduling were removed from the optimizer and replaced with the final rule requirement. Changes in crew scheduling cost could then be attributed solely to the final rule.

The first step in optimizer calibration was receiving and formatting the input data from carriers for use in the optimizer. The input data included flight schedules, aircraft flow information, production pairings, regulations, and the carrier's rule set (contractual, management, and discretionary rules) from the carriers' crew management systems. Carrier rule sets included parameters for crew bases, maximum/minimum flight time, rest time, duty time, and ground time to allow aircraft changes. The bid lines and pairings that were received directly from the carriers in this first step are referred to as the "production solution." Since no modifications were made to the production solution by the FAA or the optimizer, the production solution accurately represents the current crew scheduling environment, including all regulatory, contractual, management, and discretionary rules.

Once the production solution was established, the bid lines and pairings were set aside. The optimizer was run using only the flight schedules, aircraft flow information, federal aviation regulations and the carrier's rule set. The optimizer then created its own bid lines and pairings, which are referred to as the "Baseline solution." The Baseline solution was compared to the production solution using a number of metrics, such as the amount of credit hours, duty periods, hotel room nights required, distribution of time among crew bases, number of aircraft swaps, etc. Once the Baseline solution was identical or virtually identical to the production solution, the optimizer was deemed calibrated for each of the cases.

Calibration of the optimizer verified that the optimizer could accurately reproduce the crew scheduling process at each of the carriers. The Baseline solution could be substituted for the production solution at each carrier with no change in crew scheduling cost.

To determine the impact of the final rule, the regulations in the Baseline solution were replaced with the final rule. All provisions of the final rule were implemented in this analysis, including maximum flight time, maximum flight duty time, minimum rest time, and cumulative limits. All other, non-regulatory rules from the Baseline solution were retained. Using these inputs, the optimizer created bid lines and pairings referred to as the "final rule solution."

Since the only difference between the Baseline solution and the final rule solution was the substitution of the final rule for the existing regulations, the change in cost between the solutions is solely attributable to the final rule. Eight industry groups were created for the final rule cost analysis. Three cargo groups were dropped from final rule cost estimates. The two short-haul passenger cases were combined for the passenger narrow-body group. The two long-haul passenger cases were combined for the passenger wide-body group. The two short-haul passenger and two long-haul passenger cases were combined for the passenger integrated group.

The two regional cases were combined for the regional group. The synthetic supplemental case was renamed the supplemental group. Table 8 lists the number of flightcrew members per industry group used in the crew pairing analysis, in the determination of the compliance cost for the final rule.

Table 8: Flightcrew Members per Industry Group

Industry Group	Flightcrew Members
Passenger Integrated	4,173
Passenger Narrow-body	2,622
Passenger Wide-body	1,551
Regional	540
Supplemental	806

For each industry group, the change in cost between the Baseline and final rule solutions was divided by the number of flightcrew members in the Baseline solution to determine the monthly final rule crew scheduling cost per flightcrew member for that group. The final rule crew scheduling cost is valued by summing the change in credit hour cost, per diem cost, and hotel cost from the Baseline solution to the final rule solution. The annual final rule crew scheduling cost per flightcrew member was calculated by multiplying the monthly cost by 12. Table 9 presents the monthly and annual final rule cost per flightcrew member for each group.

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Table 9: Final Rule Crew Scheduling Cost per Flightcrew Member

Industry Group	Final Rule Monthly Cost per Flightcrew Member	Final Rule Annual Cost per Flightcrew Member
Passenger Integrated	$22	$264
Passenger Narrow-body	$98	$1,176
Passenger Wide-body	-$107	-$1,284
Regional	$84	$1,008
Supplemental	$1,261	$15,133

The final rule crew scheduling cost per flightcrew member in Table 9 includes crew salary, per diem, and hotel costs. Crew salary is calculated by multiplying the change in credit hours from the Baseline solution to the final rule solution by the estimated average credit hour cost per flightcrew member. Estimated average credit hour cost per flightcrew member was calculated using Bureau of Transportation Statistics Form 41 data[28] and other industry data.

Item 51230, Pilots and Copilots, from Schedule P-5.2 was used to determine the total flightcrew cost by carrier and by aircraft type. Block hours by carrier and by aircraft type were taken from the AirHoursRamp item in the Air Carrier Summary Data, T2: U.S. Air Carrier Traffic and Capacity Statistics by Aircraft Type report. Total flightcrew cost data and aircraft block hour data were both summed for each of the five industry groups. The industry group sum of total flightcrew cost was divided by the industry group sum of aircraft block hours for each of the five industry groups. These calculations resulted in the average total flightcrew cost per aircraft block hour.

[28] Data is from 1Q 2010 through 3Q2010, the most recent data available as of April 2011.

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To determine the average cost per block hour for an individual flightcrew member, it was necessary to divide the average total flightcrew cost per aircraft block hour by the average number of flightcrew members per flight. The average number of flightcrew members per flight was estimated using data provided to the FAA by a number of carriers.

Several steps were necessary to convert from the average cost per block hour per flightcrew member to the average credit hour cost per flightcrew member. First, estimated credit hours per flightcrew member per month by industry group were derived from analysis of AIR Inc. Salary Survey data. The AIR Inc. Salary Survey provided estimated credit hours per flightcrew member per month for 29 carriers. Each of these carriers was assigned to one of the industry groups. Weighted average estimated credit hours were calculated using carrier block hour data from Schedule T2: U.S. Air Carrier Traffic and Capacity Statistics by Aircraft Type carrier block hours from the Air Carrier Summary Data database. Next, actual crew scheduling data provided by a number of carriers to the FAA was analyzed to determine the average flightcrew member number of block hours per month for each of the industry groups. Dividing the average flightcrew member block hours per month by the average flightcrew member credit hours per month resulted in a ratio of block hours per month to credit hours per month, for each of the industry groups. The average cost per block hour per flightcrew member was multiplied by the ratio of block hours per month to credit hours per month to result in the average credit hour cost per flightcrew member for each of the industry groups.

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The approach to calculating the average credit hour cost per flightcrew member presented in Table 10 addresses NPRM comments made by several commenters. Commenters stated that the salary data used in the NPRM RIA "does not approximate current, real world flight crew unit costs…"[29] ATA suggested that the FAA use DOT Form 41 data for calculation of crew salary costs. The approach to crew salary costs presented in Table 10 responds to this comment by using the most recent 2010 DOT Form 41 data available as of April 2011 for the calculation of average credit hour costs per flightcrew member. This approach does not include payroll taxes because these represent a transfer cost. This approach also does not include pension and benefit costs, because these costs will not be affected by the marginal change in credit hours attributable to the final rule.

Table 10: Average Flightcrew Member Cost per Credit Hour

Industry Group	Average Flightcrew Cost per Block Hour	Average Flightcrew Members per Flight	Average Flightcrew Member Cost per Block Hour	Weighted Average Estimated Credit Hrs/Month	Average Flightcrew Member Block Hrs/Month	Ratio of Credit Hrs/Month to Block Hrs/Month	Average Credit Hour Cost per Flightcrew Member
Passenger Integrated	$481	2.24	$214	78	59	0.76	**$163**
Passenger Narrow-body	$417	2.00	$209	82	60	0.73	**$153**
Passenger Wide-body	$629	2.67	$236	60	59	0.98	**$231**
Regional	$179	2.00	$89	82	48	0.59	**$53**
Supplemental	$712	2.16	$329	71	44	0.61	**$201**

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Table 10 summarizes the steps used to calculate the average monthly credit cost per flightcrew member. First, the number of flightcrew members in the Baseline solution of each case was summarized by industry group. Next, the change in credit hours from the Baseline solution to the final rule solution was calculated. The result was multiplied by the average

[29] Comments of the Air Transport Association of America, Inc. in the matter of Notice of Proposed Rulemaking for Flightcrew Member Duty and Rest Requirements, Docket No. FAA-2009-1093, November 15, 2010.

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flightcrew member cost per credit hour[30] to calculate the final rule credit hour cost. The final rule credit hour cost per flightcrew member was necessary to have for extrapolation of the crew scheduling cost to the industry; this was calculated by dividing the final rule credit hour cost by the number of flightcrew members in the Baseline solution and is shown in Table 11.

Table 11: Average Monthly Credit Hour Cost per Flightcrew Member Calculation

Industry Group	Baseline Solution Flightcrew Members	Change in Credit Hours from Baseline Solution to Final Rule Solution	Average Flightcrew Member Cost per Credit Hour	Final Rule Credit Hour Cost	Final Rule Credit Hour Cost per Flightcrew Member
Passenger Integrated	*4,173*	*723*	*N/A*	*$29,854*	***$7***
Passenger Narrow-body	2,622	1,758	$153	$268,664	**$102**
Passenger Wide-body	1,551	-1,035	$231	-$238,809	**-$154**
Regional	540	94	$53	$4,953	**$9**
Supplemental	806	4,642	$201	$930,922	**$1,155**

Note: The passenger integrated group is the combined passenger narrow-body and passenger wide-body groups.

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Per-diem costs were calculated by multiplying the change in time away from base (TAFB) from the Baseline solution to the final rule solution by the appropriate per diem rate. Because flightcrew members at some carriers receive different per diem rates based on whether TAFB is domestic or international, the pairings summary in each of the solutions provided domestic and international TAFB separately. The per diem rates used in this analysis were a weighted average of carriers reporting per diem rates in the 2006-07 AIR, Inc. Salary Survey. The data was categorized by operator type (freight, passenger, and regional) since per diem rates

[30] Average flightcrew member cost per credit hour calculation is shown in Table 10.

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do not differ by aircraft type operated. Weighted averages were calculated using T2: U.S. Air Carrier Traffic and Capacity Statistics by Aircraft Type carrier block hours from the Air Carrier Summary Data database. Table 12 shows the weighted average hourly per diem rates by operator type used in this analysis.

Table 12: Hourly Per Diem Rates by Operator Type

Operator Type	Weighted Average Domestic Per Diem Rate	Weighted Average International Per Diem Rate
Passenger	$1.94	$2.28
Regional	$1.60	$1.99
Supplemental	$2.06	$2.28

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Table 13 summarizes the steps used to calculate the average monthly domestic per diem cost per flightcrew member. First, the number of flightcrew members in the Baseline solution of each case was summarized by industry group. Next, the change in domestic TAFB hours from the Baseline solution to the final rule solution was calculated. The result was multiplied by the weighted average domestic per diem rate to calculate the final rule domestic per diem cost. The final rule domestic per diem cost per flightcrew member was necessary to have for extrapolation of the crew scheduling cost to the industry; this was calculated by dividing the final rule domestic per diem cost by the number of flightcrew members in the Baseline solution.

Table 13: Average Monthly Domestic Per Diem Cost per Flightcrew Member Calculation

Industry Group	Baseline Solution Flightcrew Members	Change in Domestic TAFB Hours from Baseline Solution to Final Rule Solution	Weighted Average Domestic Per Diem Rate per Hour	Final Rule Domestic Per Diem Cost	Final Rule Domestic Per Diem Cost per Flightcrew Member
Passenger Integrated	4,173	7,488	$1.94	$14,557	**$3**
Passenger Narrow-body	2,622	3,625	$1.94	$7,048	**$3**
Passenger Wide-body	1,551	3,863	$1.94	$7,510	**$5**
Regional	540	9,960	$1.60	$15,972	**$30**
Supplemental	806	3,159	$2.06	$6,509	**$8**

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Table 14 summarizes the steps used to calculate the average monthly international per diem cost per flightcrew member. First, the number of flightcrew members in the Baseline solution of each case was summarized by industry group. Next, the change in international TAFB hours from the Baseline solution to the final rule solution was calculated. The result was multiplied by the weighted average international per diem rate to calculate the final rule international per diem cost. The final rule international per diem cost per flightcrew member was necessary to have for extrapolation of the crew scheduling cost to the industry; this was calculated by dividing the final rule international per diem cost by the number of flightcrew members in the Baseline solution.

Table 14: Average Monthly International Per Diem Cost per Flightcrew Member Calculation

Industry Group	Baseline Solution Flightcrew Members	Change in International TAFB Hours from Baseline Solution to Final Rule Solution	Weighted Average International Per Diem Rate per Hour	Final Rule International Per Diem Cost	Final Rule International Per Diem Cost per Flightcrew Member
Passenger Integrated	4,173	6,637	$2.28	$15,120	**$4**
Passenger Narrow-body	2,622	1,030	$2.28	$2,346	**$1**
Passenger Wide-body	1,551	5,607	$2.28	$12,774	**$8**
Regional	540	-16	$1.99	-$31	**$0**
Supplemental	806	9,759	$2.28	$22,270	**$28**

The final rule domestic per diem cost per flightcrew member column from Table 13 and the final rule international per diem cost per flightcrew member column from Table 14 were summed to calculate the final rule per diem cost per flightcrew member. The results are shown in Table 15.

Table 15: Average Monthly Per Diem Cost per Flightcrew Member

Industry Group	Final Rule Domestic Per Diem Cost per Flightcrew Member	Final Rule International Per Diem Cost per Flightcrew Member	Final Rule Per Diem Cost per Flightcrew Member
Passenger Integrated	$3	$4	**$7**
Passenger Narrow-body	$3	$1	**$4**
Passenger Wide-body	$5	$8	**$13**
Regional	$30	$0	**$30**
Supplemental	$8	$28	**$36**

Hotel costs were calculated by multiplying the change in required hotel room nights from the Baseline solution to the final rule solution by the average hotel room cost. The hotel room

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costs used in this analysis were included in data provided to the FAA and differ by carrier. Table 16 summarizes the final rule monthly hotel cost per flightcrew member by industry group.

Table 16: Cost Components of Monthly Final Rule Cost per Flightcrew Member

Industry Group	Final Rule Monthly Credit Cost per Flightcrew Member	Final Rule Monthly Per Diem Cost per Flightcrew Member	Final Rule Monthly Hotel Cost per Flightcrew Member	Final Rule Monthly Cost per Flightcrew Member
Passenger Integrated	$7	$7	$8	**$22**
Passenger Narrow-body	$102	$4	-$8	**$98**
Passenger Wide-body	-$154	$13	$34	**-$107**
Regional	$9	$30	$46	**$84**
Supplemental	$1,155	$36	$70	**$1,261**

Extrapolation of Crew Scheduling Analysis

All Part 121 passenger air carriers in the U.S. air transport industry were categorized into one of the five industry groups based on how closely the carrier resembled one of the five industry groups. A number of metrics such as operating authority, aircraft fleet, aircraft utilization, markets served, collective bargaining agreements, etc. were examined to determine which of the five industry groups each carrier most closely resembled. Table 17 lists the number of air carriers in each group and the number of flightcrew members in each group.

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Table 17: Final Rule Cost Analysis Industry Groups

Industry Group	Part 121 Carriers	Flightcrew Members
Passenger Integrated	7	36,013
Passenger Narrow-body	16	12,128
Passenger Wide-body	1	150
Regional	40	20,668
Supplemental	3	1,267
Total	**67**	**70,226**

Source: Adapted from FAA VIS, December 2010

The number of flightcrew members presented in Table 17 reflects the number of flightcrew members listed on each Part 121 carrier's operating certificate in the FAA's Vital Information Subsystem (VIS) as of December 2010. The total industry final rule cost would be overstated if extrapolation was based on the number of VIS flightcrew members because not all of these flightcrew members are lineholders. Each carrier employs a significant number of reserve flightcrew members. The FAA estimated that reserves comprise 15 percent of flightcrew members for the average Part 121 passenger air carrier based on APA published information[31]. Thus, the extrapolation of the crew scheduling analysis to the Part 121 passenger air transportation industry used the number of flightcrew members (lineholders) shown in Table 18 to determine the final rule crew scheduling cost.

[31] "The Reserve System – A Quality of Life Nightmare," page 16, Flightline, Allied Pilots Association, December 2010/January 2011.

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Table 18: Reserve-Adjusted Flightcrew Members by Industry Group

Industry Group	Flightcrew Members Adjusted for Reserves
Passenger Integrated	30,611
Passenger Narrow-body	10,309
Passenger Wide-body	128
Regional	17,568
Supplemental	1,077
Total	**59,692**

Note: Numbers may not sum to total due to rounding-off error.

The number of flightcrew members in each industry group shown in Table 18 was multiplied by the appropriate annual cost per flightcrew member (Table 16) to extrapolate the estimated cost to the Part 121 passenger air transportation industry, as shown in the "Preliminary Annual Crew Scheduling Cost" column in Table 19. In 2010, there were eight Part 121 carriers that conducted both all-cargo and passenger operations. For those carriers, the number of passenger revenue departures as a share of total revenue departures in 2010 as reported in Database T1: U.S. Air Carrier Traffic and Capacity Summary by Service Class from the Bureau of Transportation Statistics was used as the share of crew scheduling costs attributable to the final rule. The "Final Annual Crew Scheduling Cost: Adjusted for Passenger Flights Only" column in Table 19 presents the annual, nominal crew scheduling costs by industry group.

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Table 19: Annual Crew Scheduling Costs

Industry Group	Final Rule Annual Cost per Flightcrew Member	Reserve-Adjusted Flightcrew Members	Preliminary Annual Crew Scheduling Cost (millions)	Final Annual Crew Scheduling Cost Adjusted for Passenger Flights Only (millions)
Passenger Integrated	$264	30,611	$8	$8
Passenger Narrow-body	$1,176	10,309	$12	$12
Passenger Wide-body*	-$1,284	128	$0	$0
Regional	$1,008	17,568	$18	$18
Supplemental	$15,133	1,077	$16	$7
Total	**N/A**	**59,692**	**$54**	**$44**

* Some flights that currently require four flightcrew members could be completed with three flightcrew members under the final rule.

Note: Numbers may not sum to total due to rounding-off error.

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Table 20 presents the nominal and present value (at seven percent discount rate) crew scheduling cost for the entire passenger-carrying portion of the industry for each year of the ten year period of analysis[32]. Each table contains all crew scheduling cost components, including crew salary, per diem, and hotel costs.

[32] The projected cost for all-cargo operators associated with crew scheduling was $286 million over 10 years in nominal costs and $188 million in present value costs.

Table 20: Ten Year Crew Scheduling Costs

Year	Nominal Cost (millions)	PV Cost (millions)
2014	$ 44	$ 38
2015	$ 44	$ 36
2016	$ 44	$ 34
2017	$ 44	$ 31
2018	$ 44	$ 29
2019	$ 44	$ 27
2020	$ 44	$ 26
2021	$ 44	$ 24
2022	$ 44	$ 22
2023	$ 44	$ 21
Total	**$ 440**	**$ 289**

Note: Numbers may not sum to total due to rounding-off error.

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Limitations of Crew Scheduling Analysis

The FAA believes that carriers will be able to reduce much of the cost shown in Table 20. Carriers will engage in additional network optimization to reduce crew scheduling costs, which the FAA is unable to quantify at this point. In the long run, this may involve re-timing flights, changing schedule frequency, and entering or leaving markets. However, there may also be costs associated with these actions such as changes in aircraft utilization and revenue losses. At this time, the FAA has not estimated potential long-run optimization of crew scheduling costs.

The final rule economic costs are best measured as society's willingness to be compensated for consumption opportunities forgone as a result of resources being diverted to the production of improved aviation safety. Because these opportunity costs are difficult to estimate, our estimates of crew scheduling costs reflect, for the most part, financial costs that will be incurred by affected air carriers. These financial costs are likely to overstate the economic costs of the proposed rule.

A large part of estimated crew scheduling costs is increased compensation to flightcrew members for the additional time spent in avoiding pilot fatigue. These compensation costs will reflect economic costs only if flightcrew wage rates are accurate measures of the forgone value of goods and services that could otherwise be produced. However, it is likely that flightcrew members will be able to use some of the time spent avoiding fatigue in productive activities, including the production of leisure activities. Our cost estimates do not include offsets for the value of these activities.

Increased per diem cost estimates do not include offsets that are likely to occur. For example, meals consumed on the road by flight crew members are substitutes for meals that would otherwise be consumed at home. Resource savings (the value of labor and food used to produce meals at home in this example) are not reflected in our cost estimates. Similarly, the costs associated with increased hotel expenses do not include offsets for at-home savings that will likely occur—e.g., reduced energy and water consumption and avoided cleaning costs.

Computer Programming

Carriers will incur computer programming costs as they will need to update their crew management systems and their schedule optimization systems with the constraints imposed by the final rule.

Deleted: The flight-duty-period (FDP) extension requirements are deemed to be a part of computer programming and imposed by the final rule, which requires carriers to report activities that were not otherwise permitted by the provisions of §117.11, §117.19 and §117.29 in the final rule.

A one-time cost will be incurred in 2013 as carriers update their crew management systems. Crew management system update costs were estimated for each individual carrier, based on the number of flightcrew members listed on the carrier's operating certificate.

Carriers were assigned to one of three groups based on the number of flightcrew members. Costs vary with size of carriers, estimated by the number of person-days and staff costs. Person-days required to perform the system update were estimated about 400, 160 and 80 days for large (more than 1,000 flightcrew members), average (250 to 1,000 flightcrew members) and small (less than 250 flightcrew members) carriers, respectively. A daily professional staff cost was estimated approximately $625. Table 21 presents the nominal and present value of crew management system update costs[34].

Table 21: Crew Management System Update Costs

Year	Flightcrew Members	Carriers	Cost per Carrier	Nominal Cost (millions)	PV Cost (millions)
2014	>1,000	16	$250,000	$ 4	$ 3
	250-1,000	21	$100,000	$ 2	$ 2
	<250	30	$50,000	$ 2	$ 1
Total		67		$ 8	$ 7

Note: Numbers may not sum to total due to rounding-off error

[34] The projected cost for all-cargo operations associated with computer programming was $2 million in nominal cost and $1 million in present value cost.

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Cost Savings from Reducing Flightcrew Members Fatigue

The final rule is designed to reduce the risk of fatigued flightcrew members by limiting the maximum number of hours they are permitted to be on duty, the number of hours they actually fly during duty periods, and by ensuring that they receive adequate rest periods before reporting for duty. According to CDC, "chronic sleep loss is an under-recognized public health problem that has a cumulative effect on physical and mental health. Sleep loss and sleep disorders can reduce quality of life and productivity, increase use of health-care services, and result in injuries, illness, or deaths."[35] It is expected that the final rule will result in better-rested flightcrew members, and reduce wage loss. The final rule will reduce flight crew member fatigue, thus reducing the use of sick time. When a flightcrew member is scheduled for duty and calls in sick or fatigued, the carrier must use a reserve flightcrew member to complete the scheduled duty. The final rule will reduce the use of reserve flightcrew members to cover fatigue-induced sick call-ins by flight crew members, which will reduce the flight operations cost associated with fatigue issues for carriers.

While the precise share of current sick time attributable to fatigue is unknown, it is most likely greater than zero. Similarly, while the precise amount by which the final rule will reduce sick time is unknown, it is also most likely greater than zero. Labor representatives have informed the FAA that the estimated sick time that is used due to fatigue is approximately five percent. In light of this information, the FAA assumes, for the purposes of this analysis, that sick time accounts for five percent of total industry flightcrew member pay. Total industry flightcrew member pay was calculated by multiplying the average flightcrew member cost per credit hour

[35] CDC's MMWR, Weekly, February 29, 2008 / 57(08);200-203.

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from Table 10 by the estimated number of credit hours per month[36] and multiplied by 12 for each carrier to calculate total annual industry flightcrew member pay.

In 2010, there were eight Part 121 carriers that conducted both all-cargo and passenger operations. For those carriers, the number of passenger revenue departures as a share of total revenue departures in 2010 as reported in Database T1: U.S. Air Carrier Traffic and Capacity Summary by Service Class from the Bureau of Transportation Statistics was used as the share of cost savings attributable to the final rule.

The final rule is expected to reduce the use of sick time by five percent. The nominal value of the cost savings is approximately $211 million ($138 million present value) over the ten-year period of analysis.[37] Table 22 presents the annual cost savings.

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[36] Estimated number of credit hours per month by carrier was taken from the 2006-07 U.S. Airlines/Corporate Salary Survey published in AIR Inc.

[37] The projected cost savings to all-cargo operators was estimated at $48 million nominal value over 10 years and $32 million in present value.

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Table 22: Reducing Flightcrew Members Fatigue Cost Savings

Year	Nominal Cost Savings (millions)	PV Cost Savings (millions)
2014	$ 21	$ 18
2015	$ 21	$ 17
2016	$ 21	$ 16
2017	$ 21	$ 15
2018	$ 21	$ 14
2019	$ 21	$ 13
2020	$ 21	$ 12
2021	$ 21	$ 11
2022	$ 21	$ 11
2023	$ 21	$ 10
Total	**$ 211**	**$ 138**

Note: Numbers may not sum to total due to rounding-off error

Flight Operations Cost Summary

The total flight operations cost is composed of the additional crew scheduling costs (flightcrew member salary, hotel, and per diem), plus the computer programming costs, and less the cost savings from reducing flightcrew members fatigue. The net nominal value of the total flight operations cost for the period of analysis is approximately $236 million, with a present value of $157 million[38]. Table 23 presents the annual nominal and present value total flight operations cost.

[38] The projected cost to all-cargo operators associated with flight operations is $240 million in nominal cost over 10 years and $158 million in present value.

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Table 23: Total Flight Operations Cost

Year	Nominal Cost (millions)	PV Cost (millions)
2014	$ 30	$ 27
2015	$ 23	$ 19
2016	$ 23	$ 17
2017	$ 23	$ 16
2018	$ 23	$ 15
2019	$ 23	$ 14
2020	$ 23	$ 13
2021	$ 23	$ 12
2022	$ 23	$ 12
2023	$ 23	$ 11
Total	**$ 236**	**$ 157**

Note: Numbers may not sum to total due to rounding-off error.

Rest Facilities

The final rule establishes maximum flight-duty period limits for augmented operations that are dependent on the start time of the flight duty period, the number of flightcrew members assigned to the flight, and the class of rest facility installed on the aircraft. The final rule establishes detailed specifications for each of the three classes of rest facilities. Class 1 rest facilities are most conducive to reducing the risk of fatigue in augmented operations; accordingly, the maximum flight duty time permitted for augmented operations conducted with Class 1 rest facility-equipped aircraft is greater than the maximum flight duty time permitted for augmented operations conducted with either Class 2 or 3 rest facility-equipped aircraft. The definitions of the rest facilities are as follows:

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- A Class 1 rest facility is a bunk or other surface that allows for a flat sleeping position and is located separate from both the flight deck and passenger cabin in an area that is temperature-controlled, allows the crewmember to control light, and provides isolation from noise and disturbance.
- A Class 2 rest facility is a seat in an aircraft cabin that allows for a flat or near flat sleeping position; is separated from passengers by a minimum of a curtain to provide darkness and some sound mitigation; and is reasonably free from disturbance by passengers or crewmembers.
- A Class 3 rest facility is a seat in an aircraft cabin or flight deck that reclines at least 40 degrees and provides leg and foot support.

There are four sub-components of the rest facility cost component of the final rule. The first sub-component consists of the rest facility design and engineering costs. The second sub-component consists of the cost resulting from the physical installation of the facilities on the affected aircraft. The third sub-component is the value of the aircraft downtime required to install the rest facilities. The final sub-component is additional aircraft fuel consumption cost due to the weight of the rest facilities. The following paragraphs discuss how the FAA estimated each of the rest facility cost sub-components, and Table 24 details the final cost of each of these sub-components. The total rest-facility cost is approximately $138 million ($129 million present value[39].)

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[39] We assumed costs of engineering, installation and downtime incur in two years prior to the compliance of the final rule and fuel cost incurs for a 10-year period.

Table 24: Rest Facility Cost Overview

Rest Facilities Cost Sub-Component	Nominal Cost (millions)	PV Cost (millions)
Engineering	$ 12	$ 11.5
Installation	$ 99	$ 96
Downtime	$ 12	$ 11.5
Fuel	$ 15	$ 10
Total Rest Facilities	**$ 138**	**$ 129**

Engineering

During NPRM cost analysis, the FAA obtained detailed cost estimates from two supplemental type certificate (STC) holders. For this final regulatory evaluation we have delineated between engineering and kit/installation costs, as the engineering cost per operator would be a one-time, non-recurring cost for each type (make and model) of aircraft. We continue using the data provided by the STC holders as the basis for engineering and installation. The engineering costs are non-recurring, design costs. These consist of system, development, engineering, analysis, and certification costs. We conservatively use the engineering cost of $0.5 million per make/model as estimated by the STC holders. Accordingly, there will be roughly 24 different designs at $0.5 million per design (make/model). The actual engineering cost will not be incurred until 2014, one year after the implementation of the rule (2013) because the final payment will not occur until successful demonstration of the STC on all of the aircraft. As such, the estimated engineering cost is approximately $12 million ($0.5 million x 24), or $11.5 million present value at 7% discount rate.

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Installation

Based upon public comments in response to the NPRM, the FAA has refined the estimate of the number of aircraft that will require rest facility installation. The FAA now estimates, based on data collected from FAA inspectors, that 223 aircraft will need crew rest modifications to comply with the final rule.[40] This is an increase from the estimate of 104 aircraft in the NPRM cost analysis. However, it is lower than the estimates of some NPRM commenters. The FAA believes that the final rule estimate of 223 aircraft represents the worst case scenario because aircraft will be re-optimized based upon current configurations. The FAA estimates that, any additional aircraft, beyond the approximate 223 aircraft used in this analysis, will already have adequate rest facilities. Once the additional 223 aircraft have rest facilities installed, each fleet will be re-optimized for the most efficient use. As such, we conservatively assume all of these 223 aircraft will have a Class 1 facility installed for an upper-bound estimation.

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We continue to use the equipment and labor cost provided by an STC holder for our estimate of installation costs to the carriers. The kit and the installation for each of the individual airplanes will cost roughly $350,000 and $95,000, respectively. As such, the total cost of each installation will be roughly $445,000 ($350,000 + $95,000). When multiplied by the affected fleet of 223 aircraft, the total facility installation cost will be approximately $99 million ($445,000 x 223), or $96 million present value at 7% discount rate.

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[40] All aircraft used in augmented operations by carriers conducting both all-cargo and passenger operations are included in this analysis, since it is not possible to identify whether aircraft are used exclusively in all-cargo operations.

Downtime

Commenters indicated that an aircraft could be out of service for two weeks during rest facility installation. The FAA estimates the cost to Part 121 operators for this potential additional planned time out of service, or *downtime,* to install the rest facilities. STC designers have indicated that with proper planning, a modifier can install rest facilities in two to four days. We conservatively use a four-day estimate for the calculation of the downtime cost. The FAA conservatively assumes that if an aircraft was to be out of service for any part of a day, that airplane would be out of service for the entire day.

For this analysis, the FAA uses the opportunity cost of capital to approximate the planned downtime cost to the operators. Using guidelines prescribed by the Office of Management and Budget, the FAA uses seven percent as a proxy for average annual rate of return on capital. The FAA uses $69 million as the estimated market value of an aircraft[41] for downtime in this analysis. The yearly opportunity cost of capital per aircraft would be $4.83 million, roughly $13,233 per day. When multiplied by the affected fleet (223 aircraft) and the days out of service (4 days), the downtime cost for the fleet is $12 million (223 x 4 x $13,233), or $10 million present value.

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Fuel Consumption Costs

We have analyzed the costs associated with the design and installation of Class 1 rest facilities. We assume the rest facilities will be installed in the most efficient manner possible, with no impact on passenger seats or the revenue that they generate. As such, we do not estimate

[41] November, 2010 The Airline Monitor. This number represents the appraised value of a 767-300. p.33

loss of revenue from a Class 1 rest facility, because as defined by the rule, the facilities will be located separate from both the flight deck and passenger cabin, and will not necessarily require the removal of passenger seats. For example, a Class 1 rest facility can be located in aircraft belly or overhead area, neither of which requires the removal of passenger seats. Although there will be no revenue impact, there will be an additional cost that will add to the aircraft operating costs due to the estimated additional impact of weight changes on each aircraft. Estimates for the additional incremental weight impact are used to calculate the additional fuel consumption for the affected fleet.

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The estimated cost of fuel reflects the most recent forecast using data from the 2011 FAA Aerospace Forecast. We use the fuel consumption methodology as derived from the FAA's guidance, Economic Values for the FAA Investment and Regulatory Decisions along with the estimated average fuel cost of approximately $2.85 per gallon. To calculate the additional annual cost of fuel per aircraft, we multiply the 300 additional pounds by the fuel consumption factor of .005 gallons per hour per pound (consistent with a two-engine, wide-body aircraft) and arrive at 1.5 gallons per hour per aircraft. This product is then multiplied by the average annual flight hours per aircraft of 2,380[42] and finally by the cost of fuel ($2.85) to arrive at the total annual estimated additional cost of fuel per aircraft of $6,763. When multiplied by the affected annual fleet (223 aircraft), the annual incremental fuel consumption cost is approximately $1.5 million. When summed over the period of analysis, the total estimated cost for fuel is approximately $15 million (1.5 x 2,380 x 223 x $2.85 x 10) or $10 million present value.

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Fatigue Training

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In accordance with the Airline Safety and Federal Aviation Administration Extension Act of 2010, Section 212, each air carrier conducting operations under 14 CFR part 121 must have submitted a fatigue risk management plan (FRMP) to the Administrator for review and acceptance. A FRMP is an air carrier's management plan outlining policies and procedures for reducing the risks of flightcrew member fatigue and improving flightcrew member alertness. In this final rule the FAA kept the requirement for pilots to receive fatigue training, but eliminated the incremental cost of compliance because the operators are already in compliance with FRMP. The final keeps the requirement for management and dispatchers to have fatigue training and the requirement for curriculum development and keeps the costs for these requirements. Again, the FAA made this change as air carriers under 14 CFR part 121 will be in compliance with the statutory pilot training requirement as part of the FRMP's. This rule change reduces the nominal training cost requirement to $16 million.

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The final rule requires that dispatchers and upper management having operational control over flightcrew members be given fatigue training. The number of dispatchers in the U.S. air transportation industry is equal to approximately three percent of the number of pilots. The number of management personnel (immediate supervisors and schedulers) is estimated to be about nine percent of flightcrew members. Therefore, the total number of dispatchers and management personnel required to receive fatigue training is estimated to be approximately 12 percent of total flightcrew members.

The estimated total cost of the proposed fatigue training requirements for dispatchers and management personnel over the ten year period from 2013 to 2022 is $16 million or $11 million in present value.

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In addition carriers will incur a one-time cost to develop fatigue training curriculum. According to industry standard, curriculum development takes three hours for each hour of course required. Therefore, the time needed to develop the initial training curriculum will be fifteen hours and the time needed to develop the recurrent training curriculum will be six hours. The FAA assumes that the wage rate of the curriculum developer is approximately $100 per hour. Each of the 67 Part 121 passenger air carriers will need to develop its own curriculum. The total cost of curriculum training is $140 thousand or $120 thousand in present value.

Thus the training cost requirement for management and dispatchers plus curriculum development cost equals $16 million and $11 million in present value.

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Cost Analysis Summary

The present value cost of the final rule to Part 121 passenger air carriers over the ten-year period of analysis is $390 million ($284 million present value). Flight operations account for approximately 53 percent of the nominal total cost; crew scheduling cost is the largest sub-component of flight operations cost. Rest facilities account for roughly 43 percent of the nominal total cost; rest facility installation is the largest sub-component of rest facilities cost. Roughly 4 percent of the nominal cost of the final rule is attributable to training. All final rule cost components were calculated using industry-provided data whenever possible, along with expert analysis.

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Table 25: Cost Summary

Cost Component	Nominal Cost (millions)	PV at 7% (millions)	PV at 3% (millions)
Flight Operations	$236	$157	$191
Rest Facilities	$138	$129	$134
Training	$16	$11	$13
Total	$390	$297	$338

Note: Numbers may not sum to total due to rounding-off error.

Cost-Benefit Summary

The total estimated cost of the final rule over 10 years is $390 million ($297 million present value at 7% and $338 million at 3%).[43] We provide a range of estimates for our quantitative benefits over the same period. Our base case estimate is $376 million ($247 million present value at 7% and $311 million at 3%) and our high case estimate is $716 million ($470 million present value at 7% and $593 million at 3%). We also note that preventing a single catastrophic accident in a 10-year period with 61 people on board would cause this rule to be cost beneficial.

[43] The projected cost for all-cargo operations is $306 million ($214 million present value at 7% and $252 million at 3%). The projected benefit of avoiding one fatal all-cargo accident ranges between $20.35 million and $32.55 million, depending on the number of crewmembers on board the aircraft.

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Make Model Name : B767-300 and 300 ER
Crew Size.Number Of Crew : 3
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Flight Plan : IFR
Mission : Passenger
Flight Phase : Parked
Person : 1
Reference : 1
Location Of Person.Aircraft : X
Location In Aircraft : Flight Deck
Reporter Organization : Air Carrier
Function.Flight Crew : Pilot Flying
Function.Flight Crew : Captain
Qualification.Flight Crew : Air Transport Pilot (ATP)
ASRS Report Number.Accession Number : 921052
Human Factors : Workload
Human Factors : Troubleshooting
Human Factors : Time Pressure
Human Factors : Situational Awareness
Human Factors : Fatigue
Human Factors : Distraction
Human Factors : Communication Breakdown
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Communication Breakdown.Party1 : Flight Crew
Communication Breakdown.Party2 : Dispatch
Communication Breakdown.Party2 : Other
Person : 2
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Location Of Person.Aircraft : X
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Reporter Organization : Air Carrier
Function.Flight Crew : First Officer
Function.Flight Crew : Pilot Flying
Qualification.Flight Crew : Air Transport Pilot (ATP)
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Human Factors : Workload
Human Factors : Fatigue
Human Factors : Distraction
Human Factors : Time Pressure
Events
Anomaly.Deviation - Procedural : FAR
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Anomaly.Inflight Event / Encounter : Weather / Turbulence
Detector.Person : Flight Crew
When Detected : Pre-flight
Result.General : None Reported / Taken
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Accident Appendix

1. Accident DCA94MA065

Date: 7/2/1994

July 2, 1994 in Charlotte, NC

A/C: MD-82, N954VJInjuries: 37 Fatal, 16 Serious

Accident Summary: Aircraft collided with trees and a private residence near the Charlotte/Douglas International Airport, Charlotte, North Carolina (CLT), shortly after the flightcrew executed a missed approach from the instrument landing system (ILS) approach to runway

Probable Cause: Probable cause was determined to be the flightcrew's decision to continue an approach into severe convective activity that was conducive to a microburst: 2) the flightcrew's failure to recognize a windshear situation in a timely manner, 3) the flightcrew's failure to establish and maintain the proper airplane attitude and thrust setting necessary to escape the windshear; and 4) the lack of real-time adverse weather and windshear hazard information dissemination from air traffic control, all of which led to an encounter with and failure to escape from a microburst-induced windshear that was produced by a rapidly developing thunderstorm located at the approach end of runway.

Flight Crew/Fatigue Related Information: The captain was off duty for 3 days before the beginning of the accident trip. On the morning of June 28, 1994, he flew with his National Guard squadron, which is based at Wright Patterson Air Force Base Ohio, near his home. On the day of the accident he awoke about 0455 drove to the airport in Dayton Ohio, and departed on a flight to Pittsturgh at around 0745. The reporting time for the trip that included the accident flight was 0945, and the departure time for LGA was at 1045. The first officer flew a 4-day trip that ended

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A/C: DC-9-15, registration: N565PC . Injuries: 2 Fatal¶
Date: 2/17/1991¶
Accident Summary: After takeoff, aircraft rolled to the right, then severely to the left past (90 degrees) and crashed. An ATC and some witnesses saw a fireball come out of the rear of the plane.¶
Probable Cause: Probable cause was determined to be failure of the flight crew to detect and remove ice from the aircrafts wings which was largely a result of lack of appropriate response by the FAA, Douglass aircraft company, and Ryan International airlines to the known critical effect that a minute amount of contamination has on the stall characteristics of the DC-9 series 10 airplane. NTSB considered possibility that fatigue influenced pilots' judgment & decision not to conduct exterior preflight inspection of A/C. Crew had flown same night-time schedule for 6 days, & PIC for 12 of 13 days, averaging 3.8 flight hours & 5 landings each night. His schedule had recently increased from flying for 5 days, then 9 days off at home in CA. Though his family said he was used to night flying, recent increase in duty & flight time could have induced fatigue. But BTSB was divided on exact role of fatigue; some wanted fatigue as a cause, others did not. But fatigue's presence was not disputed. In the end, however, the Board could not reach a firm conclusion & excluded fatigue as a cause or factor.¶
Flight Crew/Fatigue Related Information: The captain flew six successive night flights the week before the incident, and flew another six successive night flights with the same first officer each night, including the night of the event. The total flight time for the six successive night flights, which included the night of the incident was 19.6 hrs. The first officer's total flight time in the 7 days prior to the incident was 19.6 hrs, accumulated all during six successive night flights with the same captain.¶
On the six successive night flights, the captain and first officer came on duty around 2145. On the day before the accident, a van driver for the hotel overheard the pilots talking about how little sleep they get. On the day of the incident, an airline mechanic described the pilots as normal and rested. On the day of the accident, the operations supervisor stated the crew remained in the cockpit; normal crewmembers leave the airplane for a walk around. Supervisor described the captain as quiet and expressionless.¶
The captain was used to flying nights as a result of his military flying. Normal schedule was 5 nights on, 9 nights off. But a few weeks before accident, duty schedule changed as a result of airline contract to carry mail for US P... [233]

around 0930 on July 2. On the day of the accident, he arose about 06 I5 and flew the leg to Pittsburgh that departed St. Louis at 0810. He arrived in Pittsburgh at 0030.

SCORE: 0.35 Fatigue could have affected FO's performance (PF). PIC, who was off-duty preceding 3 days, was much less vulnerable to fatigue, but he too had already had a long day. Accident occurred 14 hours into PIC's day. He awoke at 0455, drove to Dayton from home, then flew to PIT to begin duty day. Accident occurred at 1843, at end of third of 4 scheduled legs. His long day may have contributed to his failure to make 2 standard call-outs on approach at 1000 AGL & 100 AGL. As NTSB notes, failure to make these call-outs contributed to PIC's loss of situational awareness, his directing FO to go-around "to the right" instead of following runway heading as directed, & directing FO to "push down" after FO had initiated 15-degree nose-up & right banking turn.

FO was more vulnerable to fatigue. His duty day ended June 30 at 2230 at Blountsville, TN. NTSB report does not say when that duty day began, nor when FO awoke that day. At Blountville, he went to bed at 0130 & awoke at 0900. His next duty day ended at STL at 2040 EDT. He went to bed at 2230 & awoke at 0615 on accident day. He then flew to PIT & began pairing with accident PIC. Like PIC, FO was nearly 14 hours into his day when accident occurred. He was PF on PIT-LGA leg & on accident leg from CAE. Fatigue could have contributed to incomplete pre-flight brief, failure to maintain sterile cockpit below 10,000 feet, approach briefing in which he omitted field elevation, FAF altitude, DH, & MAP altitudes, all of which NTSB noted had contributed to lack of situational awareness by both pilots. Finally, all the above contributed to crew's choice to initiate non-standard go-around. Other factors were important, including ATC performance, A/C's inadequate windshear algorithm, & abnormally severe windshear. In short, hard to justify a high score, but equally hard to argue that fatigue was irrelevant.

2. Accident DCA95MA020

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Date: 2/16/1995

NTSB Identification: DCA95MA020, Air Transport International

February 16, 1995 in Kansas City, MO

A/C: DC-8-63, N782AL Injuries: 3 Fatal

Accident Summary: Aircraft was destroyed by ground impact and fire during attempted takeoff.

Probable Cause: Probable cause was determined to be loss of directional control by pilot in command during the takeoff roll, flightcrews lack of understanding of the three-engine takeoff procedures and their decision to modify these procedures and the failure of the company to ensure that the flight crew had adequate experience, training and rest to conduct the non-routine flight

Flight Crew/Fatigue Related Information: Safety board believes the captain and other crew members were experiencing fatigue at the time of the accident. The captain's performance in the accident reveals many areas of degradation in which fatigue is probably a factor. Accident report notes a demanding Delaware -Germany overnight round trip flight (6 time zones crossed) and a daytime rest period which caused disruptions in circadian rhythms. Additionally, the captains last rest period was repeatedly interrupted by the company. Report also notes that since flight was non-revenue flight, it was under different duty rules and the same flight, were it a revenue flight, would have been illegal given the rest periods the crew had.

SCORE: 0.9 Fatigue was a significant problem in this accident. With or without crew's inadequate training & knowledge of 3-engine T/O, NPRM would preclude this crew from this ferry trip. Also, all 3 crew performed poorly & all 3 likely were fatigued, per NTSB, & all 3 exhibited "performance degradation" symptomatic of fatigue (difficulties in setting proper priorities & continuation of T/O attempt despite disagreement & confusion on important issues).

3. Date: 12/20/1995

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NTSB Identification: DCA96RA020, American Airlines

December 20, 1995 in Cali, Colombia

A/C: B757-200, N651AA Injuries: 160 Fatal, 4 Serious

Accident Summary: Aircraft crashed 38 miles north of Cali, Columbia into mountainous terrain during a descent under instrument flight rules

Probable Cause: Probable causes were determined to be the flight crew's failure to adequately plan and execute the approach to runway 19 at SKCL and their inadequate use of automation; Failure of the flightcrew to discontinue the approach into Cali, despite numerous cues alerting them of the inadvisability of continuing the approach; The lack of situational awareness of the flightcrew regarding vertical navigation, proximity to terrain, and the relative location of critical radio aids; Failure of the flightcrew to revert to basic radio navigation at the time when the FMS-assisted navigation became confusing and demanded an excessive workload in a critical phase of the flight.

Flight Crew/Fatigue Related Information:

At 2138 CFIT at 9000; peak at 9190. Night VOR/DME approach from MIA; 2 hrs late. PIC concerned to get cabin crew on ground to meet AAL rules on cabin crew rest (for next day return flight). Cali in long N/S valley; high terrain west & east. Cleared to Cali VOR; readback "cleared direct," entered "direct;" way points go off display. Later cleared to interim Tulua VOR. Expecting “direct,” crew became unsure of location. CVR shows crew fumbled with charts & Tulua ID, but already past Tulua. When crew finally entered Tulua, A/C began turning back to Tulua; PIC overrode. Then ATC offered direct approach from north (was 01; now 19). Crew rushed to get down. Put in single-letter ID for ROSO, but Colombia has 2 navaids with single-letter "R." Per ICAO, software defaults to "R" with more traffic (well north at Romeo VOR--Bogota); had to punch in all 4 letters for ROSO. Again A/C began turning back. Crew now very confused & they knew it. FO (PF): "where are we?" PIC says go S/SE – now east of valley, 13 miles off course & below terrain between A/C & Cali. Now more confused; reading DME to ROMEO, thinking it was ROSO. Stepped down early, configured to land as GPWS sounded. Pulled up but did not retract spoilers; slow climb (184 knots at impact). Hit east slope nose up, skidded over top & down west side. Both pilots, 6 FA & 152 pax fatal; 4 pax serious.

CAUSE per Colombian CAA: 1. crew's failure to adequately plan & execute approach to runway 19 & inadequate use of automation; 2. Failure to discontinue approach, despite numerous cues; 3. lack of situational awareness regarding vertical navigation, proximity to terrain, & relative location of critical radio aids; 4. Failure to revert to basic radio nav when FMS-nav became confusing & demanded excessive workload. Factors: 1. crew's ongoing efforts to expedite approach & landing to avoid potential delays from exceeding company duty time limits; 2. execution of GPWS escape maneuver with speed brakes deployed; 3. FMS logic that dropped all intermediate fixes from display(s) upon execution of direct routing; 4. FMS-generated nav information that used different naming convention from that published in nav charts."

SCORE: 0.35 Crew certainly would have been tired, despite being first of their duty tour. PIC had been awake close to 17 hours & FO had been awake at least 15 hours (14 & 17 hours are key thresholds in fatigue). Yet even if each had been operating earlier in their day, they likely would not have sorted out confusion created by single-letter identifier for Rozo & Romeo. Yet more rested crew may have avoided readback-hearback error related to "direct" with interim way points. Crew clearly knew they were very confused & that they were uncertain of their position in rugged terrain. More alert crew might have responded more appropriately, either by climbing above terrain to sort things out, or by reverting to radio nav until they re-established their position, or may have recognized that over-ride of northbound turn had pushed them across ridge line, east of valley. Though crew certainly would be tired, fatigue was less than a show-stopper. Key factors would have remained with or without alert crew: non-radar environment; confusion from multiple identifiers; self-induced pressure; unexpected change to unfamiliar step-down approach at night in mountainous terrain; & significantly delayed flight. The requirements might have led to avoiding confusion or to more appropriate response to confusion.

4. NTSB Identification: NYC96FA174, TWA

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August 25, 1996 in JFK, NY

A/C: L-1011, N31031 Injuries: None

Date: 8/25/1996

Accident Summary: Aircraft was substantially damaged when the tail struck the runway, while landing at John F. Kennedy International Airport, Jamaica, New York (JFK).

On arrival in JFK area, wx was ¼-mile in fog, scattered at 200, & temp/dew of 66/66F. Crew expected 4R, but before reaching FAF, 4R went below minimum & ATC offered 4L (still above minimum). PIC accepted & FO (PF) transitioned to 4L. Inspection methods from Lockheed & adopted by TWA did not adequately specify how to check slat drive system for slack.

But crew failed to reset altimeter bug for new runway (100 feet higher than 4R). PIC also missed several required call-outs on approach & no charts for 4L were on board. When PF asked for charts, PIC said "just fly the approach." A/C was slow & unstable throughout approach & when altimeter read 50 feet (in fact 150 feet), A/C began to flare. FO recognized they were high & pushed nose over. On landing, A/C had tail strike & substantial damage. Failure to reset altimeter & absence of charts were fundamental in this accident.

Probable Cause: Probable cause was determined to be the failure of the flight crew to complete the published checklist and to adequately cross-check the actions of each other, which resulted in their failure to detect that the leading edge slats had not extended and led to the aircraft's tail contacting the runway during the computer-driven, auto-land flare for landing.

Flight Crew/Fatigue Related Information: The captain reported that he had difficulty adjusting to disruptions in his sleeping schedule, and for this reason did not bid to fly international routes. According to his sleep schedule, he had been awake about 24 hours at the time of the accident and reported that he that he felt, ""awful, just tired and exhausted."" The first officer said that the captain attempted to rest during the cruise portion of the flight to JFK, with his head back in the seat, but that there were visiting crewmembers in the cockpit and the captain might not have received good rest. In addition, the captain commented that he had not slept well in the hotel.

The first officer reported that he had flown the LAS layover trip several times during July, and had learned the importance of good sleep for flying it. He reported that he had in excess of 14

hours of rest in the scheduled 24 hours of off duty, which was split over two periods. At the time of the accident he had been awake for over 9 hours following a rest in excess of 5 1/2 hours.
The flight engineer reported that she had not slept well in the hotel on the layover. Additionally, she reported that she felt rested when the accident trip began; however, at the time of the landing she was getting tired

SCORE: 0.35 Had crew been better rested, they may not have missed altimeter reset, may have recognized or acted upon unstable approach, or may have gone around, as required by company procedures when not stable at 500 feet. NPRM's treatment of night operations may have affected this flight. Conversely, crews have made similar errors when well rested & flying at mid-day. FAA believes that avoidable fatigue contributed to crew's failures on approach.

5. NTSB Identification: NYC99LA052, Colgan Air

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January 22, 1999 in Hyannis, MA

A/C: BE-1900, N215CJ Injuries: None

At 1719 (dusk), Beech 1900D by Colgan substantially damaged on landing at HYA. No injury to PIC, FO & 2 employees as pax on positioning flight from BOS to HYA in IMC. Started taxi at BOS at 1600. T/O & en route uneventful. But RVR at HYA went below minimum while en route. Wx was 100-foot ceiling in fog, with variable winds at 3 knots.
On arrival at HYA, PIC performed 2 missed approaches. Before trying 3rd approach, he advised tower & pax that this was last shot, or they return to BOS. On third approach, both PIC & FO visually acquired runway. FO said PIC lined up with centerline & requested flaps. FO said A/C "floated at 20 feet over runway at normal transition when I heard PIC taking power levers over

flight idle gate by sound of engine/props.' This placed prop in 'BETA' range. A/C then started to sink, & PIC pulled back on control yoke.

Main gear struck ground & fractured during +2.9G touchdown, which occurred 2500 feet beyond approach end of 5,252 foot runway. Ran off right side of runway, 4700 feet beyond approach end & stopped. To place throttles in BETA, it was necessary to lift power levers over flight idle stop. Flight manual included warning: 'Do not lift power levers in flight.'

On accident day, PIC reported for duty at 0535, with first departure from HYA at 0620. He returned to HYA at 0920, after 3 flights & 2:31 flight time. Then with different FO, PIC T/O for Boston at 1100. They flew 5 more flights for 3:53 flight hours, then returned to BOS at 1540.

Probable CAUSE: PIC's improper placement of power levers in BETA position while in flight. Factors: fog & dusk conditions.

SCORE: 0.15 Accident report summarizes only Captain's flight day, not his preceding 72 hours. Clearly had a long day & difficulty getting into HYA did not help. Started taxi at BOS 12.5 hours into duty day for flight to HYA, so he needed to be on ground at HYA within half-hour to beat new NPRM max duty day. May have precuded this PIC from this flight (or not – close call). Also, though better rested PIC may have handled flare better, others have pulled throttle & props into beta. Fatigue might help explain PIC's decision to take 3 shots at landing below mimium,

6. NTSB Identification: NYC99FA110, American Eagle

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May 8, 1999 in JFK, NY

A/C: SF34, N232AE Injuries: 1 Serious

Accident NYC99FA110

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Accident Summary: Aircraft sustained substantial damage during landing at John F. Kennedy International Airport (JFK)

Probable Cause: Probable cause was determined to be the pilot-in-command's failure to perform a missed approach as required by his company procedures. Factors were the pilot-in-command's improper in-flight decisions, the pilot-in-command's failure to comply with FAA regulations and company procedures, inadequate crew coordination, and fatigue

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Flight Crew/Fatigue Related Information: On May 6, 1999, the captain went off duty about 2030, drove home, and was asleep about 2300. On May 7, 1999, he awoke about 0700. He attempted to nap about 1200, but was unsuccessful. He reported for duty about 2200. The first officer was off duty on May 6, 1999. He departed Las Vegas, Nevada (commuting on a jumpseat) at 1230, and arrived at JFK about 1730. He ate, then rested in the pilot's crew room, but did not sleep. There was a 3 hour time difference between Las Vegas and JFK. The trip sequence scheduled the pilots to depart JFK at 2246, arrive at BWI at 2359, on May 7, 1999; and depart BWI for JFK at 0610 on May 8, 1999. They were provided with individual rooms at a local hotel, approximately 10 minutes from the airport. Due to a takeoff delay at JFK, the flightcrew did not arrive at BWI until 0025. They arrived at the hotel about 0100. The captain stated that he was asleep by 0130. He awoke at 0445 for the scheduled 0530 van ide back to the airport. The first officer stated that he was asleep between 0130 and 0200. He received a wake-up call at 0445. During post-accident interviews, both pilots stated that they were fatigued.

At 0702, SF34 by American Eagle substantially damaged on landing at JFK; 1 pax serious; no injury to 26 pax, FA & 2 pilots. En route from BWI uneventful. On arrival in NY area, crew completed checklists & briefings for runway 04 when ATC advised crew that RVR for 04 was 1,600. Crew needed 1800 so ATC cleared them to holding fix at 4,000. While flying toward holding fix, RVR increased. ATC offered crew ILS approach, but advised that they might be too high. PIC accepted clearance nevertheless. Controller asked if crew could make approach from their position. PIC said yes & continued entire approach with excessive altitude, airspeed, & rate of descent, while remaining above glide slope. This violated company procedures & FAR 91.175. Crew then failed to respond to 4 audible GPWS warnings. During approach, FO failed to make required callouts, including missed approach callout. Landed 7,000 feet beyond approach end, at 157 knots, & overran.

During interviews, both pilots said they were fatigued. Crew was working continuous duty overnight schedule. Continuous duty overnights (CDO) at American Eagle identifies trip sequence that is flown during late night hours, extending into early morning hours, with significant elapsed time period between one arrival & next departure. Since break between flights is not sufficient to qualify as free from duty rest period, crew remains continuously on duty, though carrier may have provide hotel room for rest.

On May 6, PIC went off duty at 2030, drove home, & was asleep at 2300. On May 7, he awoke at 0700. He tried to nap about noon but was unsuccessful. He reported for duty at 2200. FO was off duty on May 6. He departed LAS (commuting on jumpseat) at 0930 local time on May 7 (1230 EDT) & arrived at JFK at 1730. He ate then rested in crew room, but did not sleep. Trip sequence scheduled crew to depart JFK at 2246, arrive BWI at 2359, & then depart BWI for JFK at 0610 on 5/8. They were provided with individual rooms at hotel 10 minutes from airport. But, due to delays at JFK, crew did not arrive at BWI until 0025. They arrived at hotel at 0100 & PIC was asleep by 0130. He awoke at 0445 for scheduled 0530 van ride back to airport. FO said he was asleep between 0130 and 0200. He received wake-up call at 0445.

CAUSE: PIC's failure to perform missed approach as required by company procedures. Factors:

PIC's improper in-flight decisions, failure to comply with FARs & company procedures, inadequate crew coordination, & fatigue.

SCORE: 0.5 Crew likely was tired, & helps to explain why crew did little right on or before the approach. Yet, the requirements would not reach the practice of "Continuous Duty Overnight, but it would have reached the FO's continuous day starting with his commute. This would not have helped PI, but it might have ensured at least one alert crewmember.

7. NTSB Identification: DCA99MA060, American

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June 1, 1999 in Little Rock, AR

A/C: MD-82, N215AA Injuries: 11 Fatal, 45 Serious

Accident DCA99MA060

Accident Summary: Aircraft crashed after it overran the end of runway

Flight Crew/Fatigue Related Information: The captain went to sleep about 2200 the night before the accident and slept until between 0700 and 0730. On nonflying days, he would typically go to sleep between 2130 and 2200, wake up about 0515, and leave for work about 0600. On May 30, 1999, the first officer traveled from his home outside Los Angeles, California, to Chicago. The first officer indicated that he had been commuting from his home to the Chicago-O'Hare base for about 3 months and that, as a result, he was adjusted to the central time zone. The first officer indicated that he was involved in routine activities while in the Chicago area. He went to bed between 2000 and 2200 the night before the accident and woke up about 0730.

The board found that at the time of the accident (2350:44), the captain and the first officer had been continuously awake for at least 16 hours. Also the accident time was nearly 2 hours after the time that both pilots went to bed the night before the accident and the captain's routine bedtime (between 2130 and 2200), meaning their circadian systems were not actively promoting alertness. The Safety Board concludes that the flight crew's degraded performance was consistent with known effects of fatigue.

CAUSE: failure to discontinue approach when severe thunderstorms & associated hazards to flight operations had moved into airport area, & crew's failure to ensure that spoilers had extended after touchdown. Factors: flight crew's (1) impaired performance resulting from fatigue & situational stress associated with intent to land under the circumstances, (2) continuation of approach when company's max crosswind component was exceeded, & (3) use of reverse thrust greater than 1.3 engine pressure ratio after landing.

SCORE: 0.15 FO was 5 months into 1-year probation & paired with Chief Pilot from ORD base. But FO later testified of good working relationship with PIC & said rank of Chief Pilot was no barrier. Accident occurred 14 hours into duty day & nearly 17 hours after awakening. Long day & disrupted flight into & from DFW. FO showed signs on CVR of recognizing that landing was not a good idea, but PIC focused on landing. Was this fatigue or task fixation? Would more rest have made recently hired FO more willing to speak up to PIC-Chief Pilot? Call-outs were made & SOPs indicate crew was engaged. Perhaps a less worn-out PIC would have considered diverting (or not), or may at least have responded to implied warnings from tower. Would have exceeded the requirements contained in this final rule by 12 minutes at impact; may have changed sequence before T/O (had to be released by 2316 - - 2304 might have made a difference).

8. NTSB Identification: DCA05MA004, Corporate Airlines as American Connection

October 19, 2004 in Kirksville, MO

Deleted: 10. NTSB Identification: DCA02MA054, Federal Express¶
July 26, 2002 in Tallahassee, FL¶
A/C: B737-300, N487FE . Injuries: 3 Serious¶
Accident AAR0402¶
Date: 7/26/2002¶
Accident Summary: Aircraft struck trees on short final approach and crashed short of runway 9 at airport.¶
At 0537 (night), A/C destroyed by impact & post impact fire when it undershot on visual approach to 09, striking trees along extended centerline 3,650 feet short into black hole. FO flying. Wx: calm, visibility

Deleted: , clouds few at 100 & scattered at 2500. On arrival at TLH, FO briefed for visual to 27. Minute later he asked PIC if they should use 09 instead. Some discussion followed but no decision. Ten 10 minutes later, SO asked pilots if they wanted to run approach checklist. FO again raised question of 09 vs 27 & crew decided on 09. Turned onto final 2.5 NM out. ¶
At this point PAPI would have indicated 1 white & 3 red (low). But A/C continued to descend below glide slope & was at 200 AGL at 0.9 miles out. PAPI would have shown 4 red. CVR shows no discussion about PAPI or altitude other than comment by FO that '(I'm) gonna have to stay just little bit higher... I'm gonna lose end of runway', to which PIC replied 'yeah... yeah, okay.' About 18 seconds later PIC commented 'it's startin' to disappear in there little bit (isn't) it? Think we'll be alright, yeah.' Then hit trees 11 seconds later. ¶
Crew believed they were on glide slope & showed no concern of undershooting. FO later said that 'from time I rolled out (on final), I saw that I was on glide slope... & it never changed.' Approach to 09 is over forest with no ground lights or other visual references (black hole), which can lead pilots to believe they are higher than they really are. NTSB notes that PAPI should have prevented this trap but FO's first class medical noted he had color vision defect. After accident, he failed 7 red/green vision tests. Specialists' report found that he had severe congenital deuteranomaly that could result in 'difficulties interpreting red/green & white signal lights.' Report added that '... he would definitely have had problems discriminating PAPIs... because red lights would appear not to be red at all, ... more indistinguishable from white than red... it would be extremely unlikely that he would be capable of seeing even color pink on PAPI... more likely combination of whites & yellows & perhaps, not even that difference.' ¶
Probable Cause: Probable cause was determined to be the captain's and first officer's failure to establish and ... [234]

A/C: BAE-32, N875JX Injuries: 13 fatal, 2 Serious

Accident AAR0601

Accident Summary: Aircraft struck trees on final approach and crashed short of runway.

At 1937 on LOC/DME final at Kirksville in IMC, hit trees at 33 feet QFE on center line 1.3 NM out. WX: wind 020 at 6, visibility 4, mist & 300 overcast. On final, PIC (PF) maintained constant descent of 1200 FPM until impact (met company SOP but exceeded that recommended by FAA for descent below 1000 AGL). At MDA, PIC said 'I can see ground there' (as PF, he should have been on instruments). Continued through MDA & asked FO 'what do you think?' FO: 'I can't see (expletive).' Seconds later PIC said 'yeah, there it is. Approach lights in sight' just as GPWS called "200" & FO announced 'in sight, continue'. (Both looking out window; nobody on instruments). Never recognized low altitude until seeing trees 2 seconds before impact. Wx complicated approach but crew never seemed too concerned about wx. Flew approach in casual fashion & lack of professionalism: no sterile cockpit (casual conversation); non-standard phraseology; humming; etc. PIC known for sense of humor & was said to 'emphasize fun in the cockpit'.

Crew was fatigued: reported for duty at 0514. Accident was near end of 6th sector on 'demanding' day in IMC. Crew had been on duty 14.5 hours & PIC is said to have slept poorly night before. PIC commuted from home in NJ to STL & FO commuted from Ohio. Reported for duty at 1345 on 10/17 (2 days before accident). Flew 3 flights in 8-hour duty day & arrived at over-night destination (Quincy) at 2125. On 10/18, departed Quincy at 1415 after more than 15 hours off. Flew 3 flights & 6:20 duty day. Arrived at over-night destination in Burlington at 1945. On 10/19, duty day began at 0514 after 9 hours off. Departed BRL at 0544 to STL &

arrived 0644. Next 2 flights cancelled due to wx. T/O for round-trip from STL-Kirksville (IRK) at 1236. Landed STL at 1745.

Probable Cause: failure to follow procedures & improper non-precision instrument approach at night in IMC, including descent below MDA before acquiring runway environment. Factors: non-standard callouts; unprofessional demeanor; & crew fatigue.

Probable cause was determined to be 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

Flight Crew/Fatigue Related Information: Captain reportedly did not sleep well the night before the accident but did not report feeling tired. He was later observed resting on a couch the morning of the accident. First officer reportedly did not have any trouble sleeping the night before the accident and the day of the accident seemed alert and happy.

However, the flight crews rest time (2100-0400) did not correspond favorably with either ones sleeping patterns and at the time of the accident, they had been on duty 14.5 hrs and it had been 15 hrs since their last rest period. The board suggests that the pilot deficiencies observed could be consistent with fatigue impairment

SCORE: 0.9 Accident flight T/O STL at 1842 for IRK on 6th flight of day after 6:14 flight time & 14.5-hour day already. Long, brutal day in IMC that started with limited rest period. Crew was familiar with each other & with IRK. WX & PIC's established practice of "fun in the cockpit" also were factors. Fatigue had to be a big player, though PIC's history of "fun in cockpit implies other issues. The requirements in this final rule would have precluded this crew from taking this flight.

9. NTSB Identification: DCA06MA064, Comair as

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August 27, 2006, Lexington, KY

A/C: CRJ-200, N431CA Injuries: 49 Fatal, 1 Serious

Accident AAR0705

Date: 8/27/2007

Accident Summary: Aircraft crashed during takeoff from Blue Grass Airport, Lexington, Kentucky.

At 0607 Comair 5191 crashed on T/O from Blue Grass Airport (LEX) for ATL. A/C ran off end of Runway 26 & was destroyed by impact forces & post crash fire. T/O wrong runway; had been cleared to T/O on Runway 22. PIC, FA & all 47 pax fatal; FO serious. Threshold for 22 & 26 are close & common taxiway had construction near thresholds, possibly inviting confusion in darkness after short taxi from nearby terminal. Also, sole controller in tower turned away after clearing A/C for T/O (A/C was the only active A/C on the airport).

Runway 22 had minor construction work underway preceding week with NOTAM for "some" lights out. Crew also appeared behind the curve early: approached wrong RJ on ramp (corrected by ramp staff); called Toledo tower rather than LEX (corrected by tower); called wrong flight number (corrected by tower); & vocally ran through checklist on taxi so quickly NTSB had to slow CVR read-out to understand it. Crew then taxied onto darkened, closed short runway (26). Initiated rolling T/O, further reducing chance to recognize wrong runway, crossed intersection with active runway, lighted 7,000-foot Runway 22, 500 feet from start of rolling T/O on 26, continued & rotated just as they ran out of pavement. Ran onto grass & nose lifted slightly (with main gear tracks deepening in grass) just as A/C struck perimeter fence, then rolled at high speed into trees & burned out. PIC, FA & 47 pax fatal; FO serious. CAUSE: crew's failure to use available cues & aids to identify A/C's location on airport surface during taxi & their failure to cross-check & verify that A/C was on correct runway before T/O. Factors: crew's non-pertinent conversation during taxi, which resulted in loss of positional awareness, & FAA's failure to require that all runway crossings be authorized only by specific ATC clearances.

Probable Cause: Probable cause was determined to be s 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

Flight Crew/Fatigue Related Information: The captain and the first officer received more than the minimum required rest periods during their respective trips in the days before the accident, and their flight and duty times in the week and month before the accident would not have precluded them from obtaining adequate sleep. Also, both pilots had only been awake for about 2 hours at the time of the accident. Two factors in the pilots' schedules just before the accident could have been associated with the potential development of a fatigued state: acute sleep loss and circadian disruption - The captain and the first officer also awakened on the day of the accident at a time when they would normally be asleep.

Overall, The Safety Board concludes that, even though the flight crewmembers made some errors during their preflight activities and the taxi to the runway, there was insufficient evidence to determine whether fatigue affected their performance

SCORE: 0.35 Fatigue likely was not an issue for PIC (PNF) but it may have affected FO's performance (PF). FO began his duty tour on 8/25 at JFK. He drove that morning to FLL near his home for flight to JFK. Departed FLL at 0559 & arrived JFK at 0832. NTB does not note when FO awoke, but it likely would have been around 0400 to reach his 0559 departure at FLL. His duty day then began with flight from JFK to ROC at 1305. Return flight to JFK T/O at 1600 but crew had to divert to BDL for fuel & did not land at JFK until nearly 2000. Due to late arrival, crew was asked to reposition A/C to LEX. Departed gate at 2130 but were not able to T/O until 2300; arrived at LEX at 0140. FO reached his hotel at 0210 on 8/26. By the time he got to bed, FO would have had nearly a 23-hour day. On 8/26, FO had day off. He told his wife that morning by phone that he had "slept in" & planned to go to bed early that night. Phone records, hotel key cards, & credit card records indicate normal day of activity through at least 1830 on his rest day, when FO paid for meal in hotel restaurant (probably asleep no earlier than 2000). On 8/27 he & PIC reported for duty at 0515. FO likely had same wake-up call as PIC (0415).

Though FO had free day before accident, 8/25 was 23-hour day, with very late time to bed, followed on 8/27 by very early start to his day. Despite "sleeping in" on 8/26, FO would have been coping with sleep deficit. This could partly explain his confusion or inattention prior to departing gate. It also could have made him more vulnerable to visual confusion caused by minor construction & related barriers, & his failure to respond to visual cues of unlighted runway & crossing active runway that was fully lighted. Yet other factors also may explain these failures. For example, FO had flown into LEX 2 nights before when "lights were out all over the place." That was at end of his 23-hour day; neither he nor that Captain apparently recognized that outages had been NOTAMed on 8/25. On morning of accident, runway end identifier lights were out of service. Closeness of 2 runway ends with single taxiway also increases risk of wrong runway T/Os. Finally, with terminal close to runway ends, taxi time was short, increasing percentage of head-down time, at least for PNF. The requirements would have precluded FO from taking positioning flight & extending very long duty day on first day. This may have averted the entire scenario.

10. NTSB Identification: DCA07MA072, Shuttle America

Deleted: 13.

February 18, 2007, Cleveland, OH

A/C: ERJ-170, N862RW Injuries: None

Accident AAR0801

Accident Summary: Aircraft overran the end of the runway during a landing in snowy conditions and stuck an ILS antenna and fence, and the nose gear collapsed.

Flight Crew/Fatigue Related Information: The day of the accident, the captain had been awake for all but about 1 hour of the previous 32 hours; he stated that his lack of sleep affected his ability to concentrate and process information to make decisions and, as a result, was not "at the best of [his] game." The captain also reported that he had insomnia, which began 9 months to 1 year before the accident and lasted for several days at a time. From Feb 11-14 the first officer flew a total of 18hrs 27 mins. On Feb, he started a 3-day 6-leg trip and by the 18th, his total flight time was 11 hrs 50 mins. At the time of the accident, the first officer had been on duty about 9 hrs 15 mins with a total flight time of 5 hrs 30 mins. The first officer agreed to be the flying pilot because of the captain's references to fatigue and lack of sleep the night before.

A contributing factor to the accident was the pilot's fatigue which affected his ability to effectively plan and monitor the approach and landing. The Safety Board concludes that the captain was fatigued, which degraded his performance during the accident flight.

CAUSE: failure to execute a missed approach when visual cues for runway were not distinct & identifiable. Factors: (1) crew's decision to descend to ILS DH instead of localizer (glideslope out) MDA; (2) FO's long landing on short, contaminated runway & crew's failure to use reverse thrust & braking to max effectiveness; (3) PIC's fatigue, which affected his ability to effectively plan for & monitor approach; & (4) carrier's failure to administer attendance policy that permitted crew to call in as fatigued without fear of reprisals.

SCORE: 0.5 A better rested PIC likely would have flown this leg, & likely would have increased chances of going around. However, it but probably would not have changed confusion over glideslope & ILS DH versus localizer MDA. Either way, the requirements would have enabled PIC to opt out of flight.

11. NTSB Identification: DCA07FA037, Pinnacle as Northwest Express

Deleted: 14.

April 12, 2007, Traverse City, MI

A/C: CRJ-200, N8905F Injuries: None

Accident AAR-0802

Date: 4/12/2007

Accident Summary: Aircraft ran off the departure end of the runway during snowy conditions.

Probable Cause: Probably cause was determined to be the pilots' decision to land at TVC without performing a landing distance assessment, which was required by company policy because of runway contamination initially reported by TVC ground operations personnel and continuing reports of deteriorating weather and runway conditions during the approach. This poor decision making likely reflected the effects of fatigue produced by a long, demanding duty day, and, for the captain, the duties associated with check airman functions

Flight Crew/Fatigue Related Information: The accident occurred well after midnight at the end of a demanding day during which the pilots had flown 8.35 hours, made five landings, been on duty more than 14 hours, and been awake more than 16 hours. During the accident flight, the CVR recorded numerous yawns and comments that indicate that the pilots were fatigued. Additionally, the captain made references to being tired at 2332:12, 2341:53, and 0018:43, and the first officer stated, "jeez, I'm tired" at 0020:41. Additionally, the pilots' high workload (flying in inclement weather conditions, and in the captain's case, providing operating experience for the first officer) during their long day likely increased their fatigue.

SCORE: 0.9 Crew was clearly tired & had been on duty 15 hours as of accident time & 12:44 hours at pushback; The requirements would have precluded this crew from taking this flight.

12. NTSB Identification: DEN07LA101, Great Lakes Airlines

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June 20, 2007, Laramie, WY

A/C: BE-1900D, N253GL Injuries: None

Accident DEN07LA101

Date: 6/20/2007

Accident Summary: The airplane landed long, bounced, and touched down again. The captain tried to slow down and turn the airplane off the runway on to a taxiway at high speed. During the turn attempt, the airplane departed the runway and the airplane's right propeller struck the top of an electrical box that powered the runway approach lighting system.

Probable Cause: Probable cause was determined to be The pilot's improper decision, his misjudgment of his speed and distance, and his failure to perform a go-around resulting in the airplane overrunning the runway and striking an electrical box. Factors contributing to the accident were the failure of the crew to perform proper crew resource management, the first officer's failure to intervene before the accident occurred, and the electrical box.

Flight Crew/Fatigue Related Information: Only mention of flight crew schedule is the crew was on the third day of a three-day trip, which had started in Cortez, Colorado, that morning at 0520. The crew had flown from Cortez to Denver, Colorado, to Farmington, New, Mexico, back to Denver, then to Laramie, and then to Worland.

SCORE: 0.15 Given number of days & segments flown, the accident occurred precisely at NPRM's proposed limit of 11-hour duty day. The requirements might have made a difference.

13. NTSB Identification: DCA09MA027, Colgan Air as Continental Connection

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February 12, 2009, Clarence Center, NY

A/C: DHC-8-400Q, N200WQ Injuries: 50 Fatal

Accident DCA09MA027

Accident Summary: Aircraft crashed into residence 5 nautical miles northeast of the airport and was destroyed by impact and post-crash fires.

At 2217 Dash 8-Q400 by Colgan Air as Continental Connection crashed on ILS approach to runway 23 at BUF 5 NM NE of airport in Clarence Center. FO arrived EWR on red-eye from West Coast via MEM at 0623. First flight @ 1300 cancelled. Accident flight delayed; T/O EWR at 2120. Newly upgraded PIC (110 hours in M/M); FO (PF) had 700 hours in type. Steady, non-pertinent chatter enroute & throughout approach. FO notes little knowledge of icing. Other pilots describe light-moderate rime icing b/ 6,500 & 3,500 but none at 2,300. Accident A/C was in icing 9 minutes. De-icing system was "on" (which increases speed at which crews get low-speed cue, but does not affect actual stall speed).

At 22:15:14 BUF Approach cleared flight for ILS approach to runway 23 (acknowledged). At 22:16:02, engine power levers were reduced to flight idle & Approach instructed crew to contact Tower. Crew extended gear & auto flight system captured ILS 23 localizer. PIC then moved engine conditions levers forward to max RPM position as FO acknowledged instructions to Tower. At 22:16:28 FO moved flaps to 10°, & 2 seconds later stick shaker activated (warning of impending stall) & autopilot disconnected, with ”disconnect” horn sounding until impact. Stickpusher then activated (to correct actual stall). Crew added power to 75% torque. At 2216:37, FO told PIC that she had put flaps up; airspeed now 100 knots, & roll angle reached 105 degrees right wing down before A/C began to roll back to left & stick pusher activated second time (about 2216:40). Roll angle then reached 35 degrees left wing down before A/C began to roll again to right. FO then asked whether she should put gear up; PIC responded “gear up” with expletive. Pitch & roll had reached 25 degrees nose down & 100 degrees right wing down, when A/C entered steep descent. Stick pusher activated third time (at 2216:50), followed by impact. All 4 crew & 45 pax fatal; 1 ground fatal. (Not an icing accident.)

Both pilots likely were significantly fatigued. Both pilots were based at EWR. PIC lived near Tampa & FO lived near Seattle. Neither had “crash pad” at EWR & both regularly used crew room to sleep. PIC tried to bid trips that ensured some nights in hotels at out-stations. At EWR he usually slept in crew room. FO always slept in crew room at EWR & was open about it.

PIC, recently upgraded, commuted to EWR on 2/9 from TPA; arrived EWR at 2005 & spent night in crew room. Phone records & log-ins to crew tracking system indicate he got little sleep. Reported for duty at 0530 on 2/10, flew 3 flights & arrived at BUF at 1300& had hotel room. Left hotel at 0515 on 2/11 to report at 0615. Again flew 3 flights & returned to EWR at 1544; spent rest of day & night in crew room. Again, phone, tracking system & contact with others indicate very little sleep.

FO commuted to EWR from SEA. She awoke on 2/11/ at 0900, arrived at PDX at 1730 for FedEx flight to MEM; arrived MEM at 0230 EST (2230 PST); had about 90 minutes of sleep on flight. She then T/O MEM at 0418 & arrived EWR at 0623, sleeping for "much of" 2-hour flight. At EWR, she spent day in crew room & napped, but phone, tracking system & conversations show she got little sleep.

On 2/12, crew was scheduled for 3 flights: EWR-ROC; ROC-EWR; & EWR-BUF. First 2 cancelled due to winds at EWR & ground delays. Dispatch estimated 1910 departure for accident flight. Multiple delays; pushed back at 1945 & finally T/O 2120 for BUF. FO noted multiple times that she was not feeling well & before T/O said she was "ready to be at hotel" at BUF.

CAUSE: Captain's inappropriate response to activation of stick shaker, which led to stall from which A/C did not recover. Factors: (1) crew's failure to monitor airspeed in relation to rising position of low-speed cue, (2) crew's failure to adhere to sterile cockpit procedures, (3) PIC's failure to effectively manage flight, & (4) Colgan's inadequate procedures for airspeed selection & management during approaches in icing conditions. NOTE: NTSB Cited fatigue in findings, but not in causal statement because NTSB said it could not determine "the extent of their impairment & degree to which it contributed to performance deficiencies." But clearly suggests it did contribute. NOTE: NTSB was divided on the issue, with some arguing that the overwhelming issue was skills-based: pulling up to 30 degrees, not pushing power up all the way even well into the stall, and thereby missing several opportunities to allow the aircraft to fly out of the stall. In short, debate is this: though the crew clearly was fatigued, would the outcome have been any different if the same crew were better rested?

Flight Crew/Fatigue Related Information: On the day of the accident, the captain was scheduled to report to EWR at 1330. Because his duty period on February 11, 2009, had ended about 1544, he had a 21-hour, 16-minute scheduled rest period before his report time. However, at 0310 on February 12, the captain logged into Colgan's CrewTrac computer system. This activity would have meant that he had, at a minimum, a 5-hour opportunity for sleep followed by another sleep opportunity of about 4 hours. During the 24 hours that preceded the accident, the first officer was reported to have slept 3.5 hours on flights and 5.5 hours in the crew room.

At the time of the accident, the captain would have been awake for at least 15 hours if he had awakened about 0700 and for a longer period if he had awakened earlier. The accident occurred about the same time that the captain's sleep opportunities during the previous days had begun and the time at which he normally went to sleep. The first officer had been awake for about 9 hours at the time of the accident, which was about 3 hours before her normal bedtime. The captain had experienced chronic sleep loss, and both he and the first officer had experienced interrupted and poor-quality sleep during the 24 hours before the accident

The pilots' failure to detect the impending onset of the stick shaker and their improper response to the stick shaker could be consistent with the known effects of fatigue. The NTSB concludes that the pilots' performance was likely impaired because of fatigue, but the extent of their impairment and the degree to which it contributed to the performance deficiencies that occurred during the flight cannot be conclusively determined

SCORE: 0.5 Accident had many issues, but fatigue clearly was one of them. Both pilots had to be exhausted when they initiated approach to BUF. PIC was completing 4th day since awakening on 2/ 9. He had opportunity for quality sleep only on night of 2/10, & that was cut short with departure from hotel at 0515 on 2/11. Both pilots essentially stayed up all night on 2/11, with no opportunities for deep sleep, then found themselves operating late-night flight after day-long cancellations & delays. At one level, any rule that might have diminished this crew's fatigue could have been a show-stopper with a high score. However, crew had other basic problems. PIC clearly was not well versed in stall recognition nor response to stall (never went to full power, which likely would have enabled the aircraft to fly out of the stall in at least 2 points during the sequence). Same lack of recognition & knowledge appears true of FO; she raised flaps during a stall. Being well rested would not have provided this crew with any more skill than they already had, it would not necessarily have averted the chatter sustained throughout flight, nor would it necessarily have led crew to enter proper ref speeds for conditions. BUT more rest may have at least kept them tuned in enough to monitor airspeed. That alone could have averted the entire scenario. However, too many other fundamental issues to score above 50%.

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(millions)

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PV at 3%
(millions)

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ComponentHigh Estimate	$ 1,330	$873	$1,102

Static/Historical Estimate	**Nominal (millions)**$ 380	**PV at 7% (millions)**$ 249	**PV at 3% (millions)**$ 315

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Rest FacilitiesCost Component			
Flight Operations	$138 627	$129 414	$134 521

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02/17/1991	Cleveland, OH	121 Cargo	Ryan International	DC-9-15	2	2	0	Dest	LOC Climb-out; Icing	0.5
08/18/1993	GTMO, Cuba	121 Cargo	Konnie Kallita	DC-8	3	0	3	Dest	Landed Short	0.9

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10/19/2004	Kirksville, MO	121 Pax	Corporate Airlines as American Connexion	BAE-32	15	13	2	Dest	CFIT Low on Approach	0.9

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For our base case estimate, we conservatively look only at the subset of fatigue related accidents where hull losses and passenger deaths occurred. This base case estimate does not examine the future exposure to pilot fatigue but rather it is based upon the history of accidents. Of the seven events in the most recent ten years, historically only three were "catastrophic" in nature where virtually everyone on the airplane was killed. We use those three catastrophic accidents as the minimum expected number of accidents for our period of analysis, and incorporate the expected average effectiveness of 58%.

For the estimate of the number of individuals per airplane, we project an aircraft roughly the size of a regional aircraft with 66 people on each airplane. [1] This number represents the most likely number of people on an airplane and current state of aviation and the types of the airplanes that are operated in the market today. We multiply the expected 66 people by the value of averting fatalities ($6.2 million) to estimate $409 million in benefits from averting fatalities. This benefit is added to the weighted average airplane value that would be involved in a preventable accident ($8.15 million). As such, the base case estimate from averting an event in the base case scenario is roughly $417 million.

With a total of 0.3 events annually over the ten year period of analysis, and the corresponding 58% average effectiveness, 0.174 average annual events would be averted for our base case estimate. When we multiply the average annual events that will be averted in our lower bound estimate (0.174) by the estimated benefit from averting an event, $404 (weighted average) million, the annual benefits are approximately $73 million. When summed over the period of analysis, the total estimated lower bound benefits are approximately $726 million ($477 million present value).

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[1] FAA Aerospace Forecasts Fiscal Years 2011 & Form 41- This number also coincides with the historical accident proportions by industry segment.

High Estimate

As discussed earlier, over the past 10-years, there were a total of 7 events where the requirements contained in this final rule would have been on average 58% effective, if the requirements had in place at the time of the accidents for this high estimate. We assume equal risk for every year of the analysis period, and an accompanying forecasted ten-year benefit period that mirrors the costs. The corresponding annual equivalent of seven events over the period of analysis equals 0.7 events per year. When multiplied by the effectiveness of 58%, the total estimated annual preventable events are 0.406.

For our high estimate, we consider a number of potential occupants in a part 121 operation. The most likely number of preventable fatalities would occur on an airplane which has an estimate of 142 forecasted seats[2] with a load factor of 83 percent[3] to arrive at 118 passengers per airplane. In addition to the 118 passengers, a there would also be a pilot, copilot, and three flight attendants, which would total 123 people on board. This high estimated does not assume that all events will result in catastrophic events; rather we use the average historical "fatality rate" for the number of people that we estimate will be on an airplane. This ten-year average historical fatality rate of 41% multiplied by the 123 people on board equals 50 people. This is the estimated number of preventable deaths that would occur in a fatigue related event in our high scenario. As shown in Table 5, the number of averted deaths multiplied by the $6.2 million (benefit from averting a fatality) and added to the value of an airplane ($17.6 million) to equals a total benefit of $328 million per accident. This number represents the median size airplane operated in part

[2] Table 9 FAA Aerospace Forecasts Fiscal Years 2011.
[3] Table 6 FAA Aerospace Forecasts Fiscal Years 2011.

121 service. This high estimate takes the median airplane into account and does not take into account the average numbers to include supplemental and cargo operations.

Table 5: High Scenario

Total People		123
41% Fatality Rate		50
Fatality Benefits @ $6.2 Million.	$	310,000,000
Airplane Value	$	17,600,000
Total	$	327,600,000

To calculate the annual benefits, we multiply the total estimated annual preventable events (0.406) by $328 million to arrive at roughly $133 million. When summed over the period of analysis, the total benefits are approximately $1.33 billion ($873 million present value).

Static/Historical Estimate

The static estimate only looks at the historical events. As such, this case forecasts roughly eight accidents with roughly 4 averted. The future preventable events will not exactly mirror the past events because the airplane types, utilization, seating capacity have changed. This scenario takes neither the forecasted increase in seats nor the aircraft types into account and as such is an unlikely future scenario.

In this static estimate the exact number of fatalities for each past event is multiplied by the relative rule effectiveness score to obtain the historical number of deaths that would have been averted with the requirements contained in this final rule. An estimate of past deaths in pilot fatigue accidents is not representative of the current or forecasted number of people on an airplane. Passenger seats and accompanying load factors are totally independent of pilot fatigue and would be an inaccurate (very low) predictor of future accidents and their accompanying passenger loads.

Nevertheless, the static estimate will result in roughly 6 annual averted deaths. Multiplying 6 annual averted deaths by the $6.2 million value equals $37 million annually. In addition, had the requirements been in place at the time of these historical accidents, $2 million in damages for each accident would also have been averted, which equals $8 million for ten years or $0.8 million annually. When summed over the ten year period of analysis, the historical static estimate is $380 million ($249 million present value).

Break Even

A threshold or "break-even" analysis answers the question how small could the value of the benefits be before the rule would yield zero net benefits. Based upon the break-even threshold, the benefits of this final rule will justify the costs if the requirements of this final rule prevent only one accident halfway through the analysis period, with 141 passengers on board. A B-737 can have this number of people on board. While we cannot precisely calculate the likelihood of such an accident, we have analyzed the airborne hours in conjunction with the aircraft size. Based upon these exposure variables, there is roughly a 47% chance that an aircraft will have more than 140 seats.

Preventing such an accident would justify the costs of this final rule and because the base case forecasts more than one accident over the period of analysis, the benefits of this rule justify the costs.

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Freight Integrated	1,383
Freight Narrow-body	330
Freight Wide-body	1,053

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Freight Integrated	$312	$3,744
Freight Narrow-body	$286	$3,432
Freight Wide-body	$320	$3,840

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Freight Integrated	$1,220	2.87	$425	87	44	0.50	**$214**
Freight Narrow-body	$532	2.00	$266	62	34	0.55	**$146**
Freight Wide-body	$1,373	3.00	$458	66	45	0.67	**$309**

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Freight Integrated	*1,383*	*1,544*	*N/A*	*$385,523*	***$279***
Freight Narrow-body	330	560	$146	$81,599	**$247**
Freight Wide-body	1,053	984	$309	$303,924	**$289**

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Freight	$1.98	$2.85

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Freight Integrated	1,383	7,087	$1.98	$14,066	**$10**
Freight Narrow-body	330	890	$1.98	$1,767	**$5**
Freight Wide-body	1,053	6,197	$1.98	$12,299	**$12**

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Freight Integrated	1,383	3,252	$2.85	$9,284	**$7**
Freight Narrow-body	330	2,390	$2.85	$6,824	**$21**
Freight Wide-body	1,053	862	$2.85	$2,460	**$2**

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Freight Integrated	$10	$7	**$17**
Freight Narrow-body	$5	$21	**$26**
Freight Wide-body	$12	$2	**$14**

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Freight Integrated	$279	$17	$16	**$312**
Freight Narrow-body	$247	$26	$12	**$286**
Freight Wide-body	$289	$14	$17	**$320**

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Freight Integrated	3	7,230
Freight Narrow-body	16	846
Freight Wide-body	3	914

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Freight Integrated	6,146
Freight Narrow-body	719
Freight Wide-body	777

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Industry Group	Final Rule Annual Cost per Flightcrew Member	Reserve-Adjusted Flightcrew Members	Annual Crew Scheduling Cost
Freight Integrated	$3,744	6,146	**$23.0**
Freight Narrow-body	$3,432	719	**$2.5**
Freight Wide-body	$3,840	777	**$3.0**
Passenger Integrated	$264	30,611	**$8.1**
Passenger Narrow-body	$1,176	10,091	**$11.9**
*Passenger Wide-body	-$1,284	128	**-$0.2**
Regional	$1,008	17,434	**$17.6**
Supplemental	$15,132	1,446	**$21.9**
Total	**N/A**	**67,351**	**$87.4**

*Based upon the provisions in this final rule, some flights currently require four pilots which could be completed with three pilots under the requirements of this final rule.

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For the final rule, the FAA did not adopt the requirement from NPRM for Part 121 carriers to periodically report schedule reliability data to the FAA. There will be minor recurring costs to carriers when they need to report exceptional activities. The FAA estimated that the final annual paperwork burden for three provisions (§117.11, §117.19 and §117.29) is $92,250; the ten year nominal cost is $0.9 million and the present value cost is $0.6 million (see paper reduction analysis for more details). Table 22 presents the annual nominal and present value of FDP extension reporting costs.

Table 22: FDP Extension Reporting Costs

Year	Nominal Cost (millions)	PV Cost (millions)
2013	$ 0.1	$ 0.1
2014	$ 0.1	$ 0.1
2015	$ 0.1	$ 0.1
2016	$ 0.1	$ 0.1
2017	$ 0.1	$ 0.1
2018	$ 0.1	$ 0.1
2019	$ 0.1	$ 0.1
2020	$ 0.1	$ 0.1
2021	$ 0.1	$ 0.0
2022	$ 0.1	$ 0.0
Total	**$ 0.9**	**$ 0.6**

Total final rule computer programming cost is the sum of crew management system update costs and schedule reliability reporting costs. The total nominal computer programming cost over the ten year period of analysis is $10.2 million ($8.7 million present value), as presented in Table 23.

Table 23: Total Computer Programming Costs

Year	Nominal Cost (millions)	PV Cost (millions)
2013	$ 9.3	$ 8.2
2014	$ 0.1	$ 0.1
2015	$ 0.1	$ 0.1
2016	$ 0.1	$ 0.1
2017	$ 0.1	$ 0.1
2018	$ 0.1	$ 0.1
2019	$ 0.1	$ 0.1
2020	$ 0.1	$ 0.1
2021	$ 0.1	$ 0.0
2022	$ 0.1	$ 0.0
Total	**$ 10**	**$ 9**

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ACN: 921052 *(1 of 256)*

Time / Day

Date : 201011
Local Time Of Day : 0601-1200

Place

Locale Reference.Airport : ZZZZ.Airport
State Reference : FO

Environment

Light : Night

Aircraft

Reference : X
Aircraft Operator : Air Carrier
Make Model Name : B767-300 and 300 ER
Crew Size.Number Of Crew : 3
Operating Under FAR Part : Part 121
Flight Plan : IFR
Mission : Passenger
Flight Phase : Parked

Person : 1

Reference : 1
Location Of Person.Aircraft : X
Location In Aircraft : Flight Deck
Reporter Organization : Air Carrier
Function.Flight Crew : Pilot Flying
Function.Flight Crew : Captain
Qualification.Flight Crew : Air Transport Pilot (ATP)
ASRS Report Number.Accession Number : 921052
Human Factors : Workload
Human Factors : Troubleshooting
Human Factors : Time Pressure
Human Factors : Situational Awareness
Human Factors : Fatigue
Human Factors : Distraction
Human Factors : Communication Breakdown
Human Factors : Physiological - Other
Communication Breakdown.Party1 : Flight Crew
Communication Breakdown.Party2 : Dispatch
Communication Breakdown.Party2 : Other

Person : 2

Reference : 2
Location Of Person.Aircraft : X
Location In Aircraft : Flight Deck
Reporter Organization : Air Carrier
Function.Flight Crew : First Officer
Function.Flight Crew : Pilot Flying
Qualification.Flight Crew : Air Transport Pilot (ATP)
ASRS Report Number.Accession Number : 921392
Human Factors : Workload
Human Factors : Fatigue
Human Factors : Distraction
Human Factors : Time Pressure

Events

Anomaly.Deviation - Procedural : FAR
Anomaly.Deviation - Procedural : Published Material / Policy
Anomaly.Inflight Event / Encounter : Weather / Turbulence
Detector.Person : Flight Crew
When Detected : Pre-flight
Result.General : None Reported / Taken

Assessments

Contributing Factors / Situations : Company Policy
Contributing Factors / Situations : Weather
Primary Problem : Company Policy

Narrative: 1

Upon receiving/reviewing flight paperwork 1:30 prior to departure, noted a non-normal flight route, and abnormally long FLIGHT time (6+09). Pairing is normally schedule for 5+40 BLOCK time. Contacted Dispatch to receive a flight briefing; they reiterated the lengthy routing was due to enroute WX as well as ETOPS alternate airport weather consideration. At that time, I asked IF dispatch was planning on using the same route to return, as that may infringe upon federal aviation regulation 121.483a (two-pilots plus an additional crewmember limited to 12 hours of flying in a 24 consecutive hour period). Dispatch stated they weren't sure (as they were trying to coordinate 'other' flight delay problems at the same time as my briefing). Dispatch said they didn't think about that, and that they appreciated the 'heads up'. I then called Crew Scheduler right away and made him aware of the possibility of a 12/24 problem. He responded by saying it hadn't been loaded into CrewTrac yet and that he would check it out and keeps an eye on it. Due to enroute turbulence, aircraft speed was limited to M.78 (flight planned at M.80) over roughly 40% of the flight, therefore increasing the overall block time to 6+39 at block in at the destination. Preparing for a quick turnaround, the Captain reviewed the return flight planning paperwork, finding the reverse course on the abnormally long route with a flight time projected at 6+03. Discussions between the flight crew ensued between the flight crew regarding the federal aviation regulation 12 hour limitation. I contacted Crew Scheduling right away and let him know that we were not willing to accept this assignment, as it would exceed the FAR. He stated that the regulation was based on "Planned" block (via the pairings), not actual block time for the day. I asked to speak with his supervisor. He responded by accepting my request to speak to the Supervisor, as he would "get him on the phone". I was placed on hold for approximately 3 mins, at which time the scheduler relayed, "...the supervisor says there are provisions in the CONTRACT to allow a 3 pilot crew to take the flight, therefore he is ordering us to take the return flight to our home base". (Note: the CONTRACT deals only with DUTY-TIME, not FAR's; I was a bit confused) I subsequently called Chief Pilot on his cell phone and got vx mail; I did not leave a message - the greeting was generic and I wasn't sure I had the correct number. Shortly thereafter, on the local agent's duty cell, the Chief Pilot called and we briefly spoke of the situation. He understood the situation and that the Scheduling Supervisor had ordered us to take the flight; The Chief Pilot ordered us to take the return flight. Seeing as there is only 1 flight/week on this route and that it would cause undue delay to the passengers and crew, and costs involved in passenger and crew accommodation and/or rebooking, it is understandable that Management would want the aircraft to return as planned. As this is already a diurnal turn for a heavy crew, the workload is high enough; especially on the return leg with the middle of the night departure, and local/enroute weather conditions. It is RARE that due to such extreme weather that the flight/crew are planned for the abnormal route and flight time. I feel that in such case(s), the burden should NOT be placed upon the crew to complete the mission for purely financial gain on the part of the company, by keeping the schedule, regardless of what conditions the crew may face. Taking 'strained' interpretations of the FAR's, and making the crew FLY NOW/GRIEVE LATER is unacceptable. The Company was given a "heads up" prior to departure (Dispatch; Crew Scheduling). Company (Crew Scheduler; Senior Director Crew Scheduling; Chief Pilot) was AGAIN notified of the impending FAR violation amid the pairing, and the crews' wishes to not continue the flight. Understanding that there are cases where an 'operational issue' amid a flight day/pairing causes either a 2 or 3 pilot crew to exceed the 8 or 12 in 24 hour rule(s), this was STRETCHING IT, as the company was WELL AWARE of WEATHER, ROUTE, FLIGHT/BLOCK TIME(s), and FAR's....PRIOR TO DEPARTURE...yet chose to put ON-TIME PERFORMANCE and REVENUE GENERATION before SAFETY. Diurnal operation; augmented crew; abnormal routing; extended flight time; enroute/ETOPS alternate and destination weather issues. I, as the Captain, made the company VERY AWARE of the issue we were up against. The crew was NOT SUPPORTED in this operation. Luckily, all were well rested prior to initially reporting for the flight.

Synopsis

Three B767-300 pilots were ordered to fly a return leg on an international trip which would put the crew over 12 flight hours in 24. The Company knew prior to departure that the problem would exist.

--Page Break--

ACN: 920653 *(2 of 256)*

Time / Day

Date : 201011
Local Time Of Day : 0601-1200

Place

Locale Reference.Airport : BOS.Airport
State Reference : MA
Altitude.AGL.Single Value : 0

Environment

Flight Conditions : VMC
Light : Dawn

Aircraft

Reference : X
ATC / Advisory.TRACON : A90
Aircraft Operator : Air Carrier
Make Model Name : A320
Crew Size.Number Of Crew : 2
Operating Under FAR Part : Part 121
Flight Plan : IFR
Mission : Passenger
Flight Phase : Takeoff
Flight Phase : Taxi
Airspace.Class B : BOS

Component

Aircraft Component : Pneumatic Valve/Bleed Valve
Aircraft Reference : X
Problem : Improperly Operated

Person

Reference : 1
Location Of Person.Aircraft : X
Location In Aircraft : Flight Deck
Reporter Organization : Air Carrier
Function.Flight Crew : Captain
Function.Flight Crew : Pilot Not Flying
Qualification.Flight Crew : Air Transport Pilot (ATP)
Experience.Flight Crew.Total : 13305
Experience.Flight Crew.Last 90 Days : 174
Experience.Flight Crew.Type : 5472
ASRS Report Number.Accession Number : 920653
Human Factors : Workload
Human Factors : Distraction
Human Factors : Confusion
Human Factors : Fatigue

Events

Anomaly.Deviation - Procedural : Published Material / Policy
Detector.Person : Flight Crew
When Detected : In-flight
Result.Flight Crew : Became Reoriented

Assessments

Contributing Factors / Situations : Airport
Contributing Factors / Situations : Human Factors

Contributing Factors / Situations : Procedure
Primary Problem : Human Factors

Narrative: 1

We briefed a Flaps 2, TOGA, BLEEDS OFF take off from Runway 27. After takeoff, we noticed that we had forgotten to select the engine bleeds off. I believe two items contributed to our omitting to select the engine bleeds off as we had briefed. 1. As BOS was using Runway 27 for takeoff, I elected to do a single engine taxi to conserve fuel. Taxiing from our gate to Runway 27 involved crossing 3 runways and a taxi route that I was not very familiar with. While we remained focused on the taxi route and coordinating clearance to cross the 3 runways enroute to Runway 27, we also became distracted from our bleeds off SOP set up. As an additional distraction, the First Officer was also tasked with starting the number 2 engine while backing me up with the taxi route. 2. I also believe that fatigue was a contributing factor in our SOP omission. This was day three of a trip with a wake pattern of early, early, and earliest. Day one involved a XD:00 domicile time wake up. Day two was XD:15 and day three was a XA:45 domicile time wake up. While I felt fit to fly, I also felt tired from the very early wake up on day three. I will try to be more careful and deliberate with SOP compliance and give more consideration to minimizing distractions, especially when fatigued in the future.

Synopsis

An A320 Captain reported that the crew failed to select the engine bleeds off for a BLEEDS OFF takeoff because the First Officer was starting an engine, they were dealing with complex BOS taxi requirements, and experiencing fatigue.

Page Break

ACN: 920543 *(3 of 256)*

Time / Day

Date : 201011
Local Time Of Day : 1201-1800

Place

Locale Reference.Airport : ATL.Airport
State Reference : GA
Altitude.AGL.Single Value : 15000

Environment

Flight Conditions : VMC
Weather Elements / Visibility.Other
Light : Daylight

Aircraft

Reference : X
ATC / Advisory.TRACON : A80
Aircraft Operator : Air Carrier
Make Model Name : Light Transport, Low Wing, 2 Turbojet Eng
Crew Size.Number Of Crew : 2
Operating Under FAR Part : Part 121
Flight Plan : IFR
Mission : Passenger

Flight Phase : Climb
Route In Use.SID : NUGGT4
Airspace.Class B : ATL

Component

Aircraft Component : FMS/FMC
Aircraft Reference : X
Problem : Improperly Operated

Person

Reference : 1
Location Of Person.Aircraft : X
Location In Aircraft : Flight Deck
Reporter Organization : Air Carrier
Function.Flight Crew : First Officer
Function.Flight Crew : Pilot Not Flying
Qualification.Flight Crew : Air Transport Pilot (ATP)
Qualification.Flight Crew : Multiengine
Experience.Flight Crew.Total : 5000
Experience.Flight Crew.Last 90 Days : 130
Experience.Flight Crew.Type : 700
ASRS Report Number.Accession Number : 920543
Human Factors : Workload
Human Factors : Human-Machine Interface
Human Factors : Fatigue
Human Factors : Confusion
Human Factors : Time Pressure

Events

Anomaly.Deviation - Track / Heading : All Types
Anomaly.Deviation - Procedural : Clearance
Anomaly.Deviation - Procedural : Published Material / Policy
Detector.Person : Air Traffic Control
When Detected : In-flight
Result.Flight Crew : Became Reoriented
Result.Air Traffic Control : Issued Advisory / Alert

Assessments

Contributing Factors / Situations : Chart Or Publication
Contributing Factors / Situations : Human Factors
Primary Problem : Human Factors

Narrative: 1

After I loaded the flight plan into the FMS with the SUMMIT FOUR RNAV departure approximately 1 hour prior to departure and I requested the PDC 30 minutes prior to departure via ACARS (PDC). Our departure (SID) was changed by ATC from a SUMMT FOUR to a NUGGT4, we should have caught it, but we did not. The change on the routing comes in between the dashes, (EX:-summt4.summt-), but since the first two way points in both departure (SID) departing RUNWAY 26L were identical. The Captain and I overlooked it, we figured out the problem after the ATC told us to call ATC after passing SUMMT waypoint approx at 15000 feet. We did not have any conflict with another aircraft. At that point we re-checked the paper work and figured out the problem. I do believe that [fatigue] from the prior 14 hour duty day followed by an early duty-in, and the same initial waypoint in those SIDS are contributing factors. If the first waypoint in every SID were different it could raise a flag on the take off clearance, since when you are replying back the clearance you are looking at that waypoint on the screen.

Synopsis

An aircraft departed ATL after receiving a revised PDC SID which included the NUGGT FOUR. The crew failed to remove the SUMMT FOUR from the FMC and so had a track deviation on departure.

Page Break

ACN: 920371 *(4 of 256)*

Time / Day

Date : 201011
Local Time Of Day : 1801-2400

Place

Locale Reference.Airport : EWR.Airport
State Reference : NJ
Relative Position.Angle.Radial : 095
Relative Position.Distance.Nautical Miles : 10
Altitude.MSL.Single Value : 11000

Environment

Flight Conditions : VMC
Light : Night

Aircraft

Reference : X
ATC / Advisory.TRACON : N90
Aircraft Operator : Air Carrier
Make Model Name : A300
Crew Size.Number Of Crew : 2
Operating Under FAR Part : Part 121
Flight Plan : IFR
Mission : Cargo / Freight
Flight Phase : Takeoff
Airspace.Class B : EWR

Component

Aircraft Component : PFD
Aircraft Reference : X
Problem : Malfunctioning

Person : 1

Reference : 1
Location Of Person.Aircraft : X
Location In Aircraft : Flight Deck
Reporter Organization : Air Carrier
Function.Flight Crew : Pilot Flying
Function.Flight Crew : First Officer
Experience.Flight Crew.Total : 19450
Experience.Flight Crew.Last 90 Days : 75

Experience.Flight Crew.Type : 225
ASRS Report Number.Accession Number : 920371
Human Factors : Distraction
Human Factors : Communication Breakdown
Human Factors : Human-Machine Interface
Communication Breakdown.Party1 : Flight Crew
Communication Breakdown.Party2 : Flight Crew

Person : 2

Reference : 2
Location Of Person.Aircraft : X
Location In Aircraft : Flight Deck
Reporter Organization : Air Carrier
Function.Flight Crew : Pilot Not Flying
Function.Flight Crew : Captain
Qualification.Flight Crew : Air Transport Pilot (ATP)
Experience.Flight Crew.Total : 11922
Experience.Flight Crew.Last 90 Days : 82
Experience.Flight Crew.Type : 909
ASRS Report Number.Accession Number : 920367
Human Factors : Distraction
Human Factors : Communication Breakdown
Human Factors : Fatigue
Communication Breakdown.Party1 : Flight Crew
Communication Breakdown.Party2 : ATC
Communication Breakdown.Party2 : Flight Crew

Events

Anomaly.Aircraft Equipment Problem : Less Severe
Anomaly.Deviation - Altitude : Overshoot
Anomaly.Deviation - Procedural : Clearance
Detector.Person : Flight Crew
Were Passengers Involved In Event : N
When Detected : In-flight
Result.Flight Crew : Became Reoriented
Result.Flight Crew : Returned To Clearance
Result.Aircraft : Equipment Problem Dissipated

Assessments

Contributing Factors / Situations : Aircraft
Contributing Factors / Situations : Human Factors
Primary Problem : Human Factors

Narrative: 1

After departing EWR we were assigned to climb to 11,000 FT after contacting Departure Control. I was manually flying the aircraft at the time. Departure cleared us direct to a waypoint that was not in our filed route of flight. We were also given a frequency change at the same time. As we were climbing through 9,500 FT the ND/PFD on my side blinked off then back on. This distraction,along with the newly assigned routing caused me to overshoot our assigned altitude by 500 FT. As I started to descend back to 11,000 we were then cleared to climb to FL230. After reaching cruise altitude we briefly discussed the issue and then again after landing in a crew room. It was agreed that in a busy terminal area we should utilize automation to maintain lateral and vertical flight.

Narrative: 2

I acknowledged the routing and frequency change and flipped the comm switch to the new frequency, then entered direct to "SJB" in the FMC. The FMC responded with "not in data base" because I had reversed the last two letters of the VOR identifier. The Controller did not mention the altitude deviation. The rest of the flight was uneventful. The First Officer and I later discussed what happened and why. I learned that when the aircraft was approaching 11,000 FT both the First Officer's primary and secondary flight displays blanked out and that he had to reference my displays until his resumed normal operations. Blanking of flight displays is a known anomaly on the A300. This leg was the first leg of the pairing. We positioned to EWR the previous day and laid over in the hotel. I stayed up late watching football and slept until XA:00 the next morning. I was busy all day and went back to bed at XS:00 attempting to take a nap. I was unsuccessful and never did fall asleep. Our scheduled departure time was XO:00 local time.

Synopsis

On climbout an A300 Flight Crew failed to level at their cleared altitude when the pilot flying momentarily lost his nav displays and the pilot not flying was heads down correcting a CDU nav entry error.

--Page Break--

ACN: 920227 *(5 of 256)*

Time / Day

Date : 201011
Local Time Of Day : 1801-2400

Place

Locale Reference.Airport : AVL.Airport
State Reference : NC
Altitude.MSL.Single Value : 5500

Environment

Flight Conditions : VMC
Light : Night

Aircraft

Reference : X
ATC / Advisory.Tower : AVL
Aircraft Operator : Air Carrier
Make Model Name : Regional Jet 200 ER/LR (CRJ200)
Crew Size.Number Of Crew : 2
Operating Under FAR Part : Part 121
Flight Plan : IFR
Flight Phase : Initial Approach
Airspace.Class C : AVL

Person : 1

Reference : 1
Location Of Person.Aircraft : X
Location In Aircraft : Flight Deck
Reporter Organization : Air Carrier
Function.Flight Crew : First Officer
Function.Flight Crew : Pilot Not Flying
Qualification.Flight Crew : Commercial
ASRS Report Number.Accession Number : 920227

Human Factors : Situational Awareness
Human Factors : Communication Breakdown
Human Factors : Fatigue
Communication Breakdown.Party1 : Flight Crew
Communication Breakdown.Party2 : Flight Crew

Person : 2

Reference : 2
Location Of Person.Aircraft : X
Location In Aircraft : Flight Deck
Reporter Organization : Air Carrier
Function.Flight Crew : Captain
Function.Flight Crew : Pilot Flying
Qualification.Flight Crew : Air Transport Pilot (ATP)
ASRS Report Number.Accession Number : 920225

Events

Anomaly.Deviation - Procedural : Published Material / Policy
Anomaly.Inflight Event / Encounter : CFTT / CFIT
Detector.Automation : Aircraft Terrain Warning
Were Passengers Involved In Event : N
When Detected : In-flight
Result.Flight Crew : Took Evasive Action
Result.Flight Crew : FLC complied w / Automation / Advisory
Result.Flight Crew : Became Reoriented

Assessments

Contributing Factors / Situations : Airport
Contributing Factors / Situations : Company Policy
Contributing Factors / Situations : Human Factors
Contributing Factors / Situations : Procedure
Primary Problem : Airport

Narrative: 1

Prior to departure, we covered the terrain considerations and special procedures for AVL arrivals. We were cleared down to 5,500 FT with AVL approach. We were asked if we saw the airport by ATC, we responded yes. We unwisely accepted a clearance for a visual to 16. Still at 5,500 FT, I stated to the pilot flying that we should remain there until intercepting. While I was looking at the runway outside the side window the Captain asked me "Does it look OK to you?" To which I responded "yes." We had just started down from 5,500 FT when we received an EGPWS caution message. We immediately initiated the escape maneuver and were clear before we had time to complete it. We then proceeded to join the ILS localizer and glideslope and made a normal landing. We made the mistake of accepting a visual approach even though we covered the airport specific procedures in our manuals, including the company pages during the departure briefing. It was the 6th and final leg of a 13 and a half hour duty day, and I was used to flying in daylight there and accepting visual approaches. More assertiveness training for the first officer might be called for. My suggestion should have been phrased clearer and with more advocacy. The long duty day could have been a contributing factor.

Narrative: 2

We briefed the arrival and approach as a night visual and that we would need to stay high and be on the ILS before making the approach. We also briefed the suggestion that we configure early (which we did perform) and that we maintain situational awareness using the EGPWS terrain display on the MFDs (which we also did). Initially, the First Officer did express that we should stay high until further along in the downwind, but I queried again to see if he thought it was okay once abeam the threshold. He said "yes", and I commenced a descent maneuvering for the approach. I think we could have been tired and overworked (a contributing factor). More vigilance to maintain SA on the night approaches and in terrain. Asking for the ILS approach into AVL and others like it on the Special Airports list. Better communication between the pilot flying to the pilot not flying.

Synopsis

A tired CRJ Flight Crew accepted a night visual approach into AVL with surrounding high terrain despite having agreed to not do so during a pre-departure briefing. Upon beginning descent while on downwind they received an EGPWS terrain warning, climbed back to altitude and continued downwind to an appropriate spot from which to follow ILS guidance.

---Page Break---

ACN: 920078 *(6 of 256)*

Time / Day

Date : 201011
Local Time Of Day : 0001-0600

Place

Locale Reference.Airport : SWF.Airport
State Reference : NY
Relative Position.Angle.Radial : 100
Altitude.MSL.Single Value : 21000

Environment

Flight Conditions : VMC
Weather Elements / Visibility.Visibility : 10
Light : Dawn
Ceiling.Single Value : 25000
RVR.Single Value : 6000

Aircraft

Reference : X
ATC / Advisory.Center : ZNY
Aircraft Operator : Air Carrier
Make Model Name : B727 Undifferentiated or Other Model
Crew Size.Number Of Crew : 3
Operating Under FAR Part : Part 121
Flight Plan : IFR
Mission : Cargo / Freight
Flight Phase : Descent
Route In Use : Direct
Airspace.Class A : ZNY

Component

Aircraft Component : Electronic Flt Bag (EFB)
Aircraft Reference : X
Problem : Design

Person : 1

Reference : 1
Location Of Person.Aircraft : X
Location In Aircraft : Flight Deck

Reporter Organization : Air Carrier
Function.Flight Crew : Pilot Flying
Function.Flight Crew : First Officer
Qualification.Flight Crew : Air Transport Pilot (ATP)
Qualification.Flight Crew : Flight Engineer
Qualification.Flight Crew : Instrument
Qualification.Flight Crew : Flight Instructor
Qualification.Flight Crew : Multiengine
Experience.Flight Crew.Total : 4000
Experience.Flight Crew.Last 90 Days : 60
Experience.Flight Crew.Type : 400
ASRS Report Number.Accession Number : 920078
Human Factors : Training / Qualification
Human Factors : Time Pressure
Human Factors : Situational Awareness
Human Factors : Fatigue
Human Factors : Confusion
Human Factors : Communication Breakdown
Human Factors : Human-Machine Interface
Communication Breakdown.Party1 : Flight Crew
Communication Breakdown.Party2 : ATC

Person : 2

Reference : 2
Location Of Person.Aircraft : X
Location In Aircraft : Flight Deck
Reporter Organization : Air Carrier
Function.Flight Crew : Flight Engineer / Second Officer
Qualification.Flight Crew : Flight Instructor
Qualification.Flight Crew : Air Transport Pilot (ATP)
Qualification.Flight Crew : Commercial
Qualification.Flight Crew : Instrument
Qualification.Flight Crew : Multiengine
Qualification.Flight Crew : Flight Engineer
Experience.Flight Crew.Total : 5300
ASRS Report Number.Accession Number : 920878
Human Factors : Time Pressure
Human Factors : Situational Awareness
Human Factors : Fatigue
Human Factors : Confusion
Human Factors : Communication Breakdown
Human Factors : Training / Qualification

Events

Anomaly.Aircraft Equipment Problem : Less Severe
Anomaly.Deviation - Altitude : Crossing Restriction Not Met
Anomaly.Deviation - Procedural : Clearance
Detector.Person : Air Traffic Control
Detector.Person : Flight Crew
Were Passengers Involved In Event : N
When Detected : In-flight
Result.General : None Reported / Taken

Assessments

Contributing Factors / Situations : Aircraft
Contributing Factors / Situations : Human Factors
Primary Problem : Human Factors

Narrative: 1

Inbound to SWF we received a route change and a crossing restriction simultaneously. The crossing restriction was to cross 35 NM southwest of the LHY VOR at FL180. We were using newly installed EFBs which required extra time and effort to properly tune, identify, and navigate to the re-route that was issued. Once LHY was tuned and identified we discovered that the DME was erratic and indicating that we were flying away from a VOR, not toward the LHY VOR (indicating approximately 166 NM outside of the VOR). Shortly after that the DME became inoperative on both DME receivers. As we were attempting to determine our distance to LHY, New York Center asked us what our rate of descent was. We replied that we had a descent rate of 4,000 FPM. New York asked us again what our rate of descent was as we descended through approximately FL200. As we descended through FL190 we were given "descend and maintain 13,000". Then New York Center gave us a frequency change, at which point the pilot not flying said we were still not receiving DME from LHY and asked the ATC Controller how far from LHY we were. The Controller replied 14 NM. Although there was never verbal mention of missing the crossing restriction, it was apparent that the restriction was not complied with when given the information on our distance by the Controller as we switched frequencies. Human Performance Considerations: 1. Fatigue of the pilot flying after flying all night. 2. Unfamiliarity with the northeast navaids and using new EFB equipment in the aircraft. 3. Failure to obtain distance from the VOR in a timely manner. 4. Failure to increase the rate of descent because of a loss of situational awareness due to erroneous and/or inoperative DME on the LHY VOR.

Synopsis

Fatigue, lack of familiarity with the area, and the newly installed EFB contributed to the failure of a B727 flight crew to comply with an ATC crossing restriction on descent.

Page Break

ACN: 919861 *(7 of 256)*

Time / Day

Date : 201011
Local Time Of Day : 0001-0600

Place

Locale Reference.Airport : ZZZ.Airport
State Reference : US
Altitude.AGL.Single Value : 0

Environment

Light : Night

Aircraft

Reference : X
Aircraft Operator : Air Carrier
Make Model Name : Dash 8-100
Operating Under FAR Part : Part 121
Mission : Passenger
Flight Phase : Parked
Maintenance Status.Records Complete : N
Maintenance Status.Released For Service : Y

Maintenance Status.Maintenance Type : Scheduled Maintenance
Maintenance Status.Maintenance Items Involved : Testing
Maintenance Status.Maintenance Items Involved : Inspection
Maintenance Status.Maintenance Items Involved : Work Cards

Component

Aircraft Component : Chip Detector
Manufacturer : Pratt-Whitney
Aircraft Reference : X

Person

Reference : 1
Location Of Person : Gate / Ramp / Line
Reporter Organization : Air Carrier
Function.Maintenance : Lead Technician
Qualification.Maintenance : Airframe
Qualification.Maintenance : Powerplant
ASRS Report Number.Accession Number : 919861
Human Factors : Workload
Human Factors : Training / Qualification
Human Factors : Time Pressure
Human Factors : Fatigue
Human Factors : Distraction
Human Factors : Communication Breakdown
Human Factors : Situational Awareness
Communication Breakdown.Party1 : Other
Communication Breakdown.Party1 : Maintenance
Communication Breakdown.Party2 : Maintenance

Events

Anomaly.Aircraft Equipment Problem : Critical
Anomaly.Deviation - Procedural : Maintenance
Anomaly.Deviation - Procedural : Published Material / Policy
Detector.Person : Maintenance
Were Passengers Involved In Event : N
When Detected : In-flight
Result.General : Maintenance Action
Result.Flight Crew : Diverted

Assessments

Contributing Factors / Situations : Aircraft
Contributing Factors / Situations : Chart Or Publication
Contributing Factors / Situations : Company Policy
Contributing Factors / Situations : Environment - Non Weather Related
Contributing Factors / Situations : Human Factors
Contributing Factors / Situations : Manuals
Contributing Factors / Situations : Procedure
Contributing Factors / Situations : Staffing
Primary Problem : Human Factors

Narrative: 1

Three aircraft stayed overnight. I was Lead Mechanic in charge of two of the three aircraft. I was a 'working' Lead that night because manpower was short and there was a heavy workload to accomplish. The aircraft was scheduled for a Line Check that night amongst other things. I cleared a couple task cards on my other aircraft and came over to a DHC-8-100 to do a paperwork scan and noticed that there were a stack of write-ups made from the Line Check. I assessed the priority of the work. There was one write-up that took priority over all the others and it was the #2 Engine Main Oil Tank Chip Detector was flagged. I proceeded to get my tools and take out the chip detector. Knowing that this was an inspection necessary task, I showed it to the (Quality Control) QC Representative. He assessed the debris which was a little tiny sliver of metal that bridged the gap between the magnetic poles. He categorized it to be allowable fuzz and instructed me to go ahead and reinstall the chip detector, torque and safety as required. He watched me install the chip detector, made sure it was torqued to the right value and inspected my safety wire. After all other maintenance was complied with, I ran the engine and we did a Leak Check. After the Leak Check, I checked the Engine Condition Panel to see if the chip detector had flagged a second time. It had not. The Quality Control Representative wrote the wording in the Corrective Action block of the write-up and I signed for the work done since I was the one who performed it. I trusted that he looked everything up and had the knowledge to know if anything else had to be documented. I was thinking that the Quality Control Department would know the proper action to take. It came time to finalize all the paperwork to release the plane and I didn't think twice that there was suppose to be any other action taken for the chip detector. When I came into work three nights later, I was alerted that the proper maintenance actions were not taken. We were supposed to perform Workcard 79-79-XX which is for Chip Detector Debris Collection and Inspection. That workcard refers to another workcard if any debris is found. The other workcard is 79-79-XY which tells you to perform a patch check of the oil filters and collect debris to send to the lab for analysis. I was told that the aircraft was diverted into ZZZ for the proper maintenance actions. I was notified by my Supervisor that the proper maintenance procedures were not followed. He said that a Dayshift Quality Control Inspector was auditing the paperwork package and noticed that there should have been other workcards issued typically when this instance happens. Once the problem was identified, the aircraft was diverted for proper maintenance which included draining the main oil tank, cleaning and inspecting the main oil filter and strainer and leak checking the components that were disturbed. A way for this situation to be avoided on my part is to always double check what the Quality Control Department says and look at the procedures for myself, to determine the proper course of action. I should not have taken his word for it on what was supposed to be done.

Synopsis

A Lead Line Mechanic describes how assumptions, workload, and lack of communications in the work environment contributed to a DHC-8-100 aircraft being diverted due to proper maintenance procedures not being followed after metal had been found on the #2 engine chip detector.

ACN: 919714 *(8 of 256)*

Time / Day

Date : 201011
Local Time Of Day : 0601-1200

Place

Locale Reference.Airport: ZZZ.Airport
State Reference : US
Altitude.AGL.Single Value : 0

Environment

Flight Conditions: VMC

Aircraft

Reference : X
Aircraft Operator : Air Carrier
Make Model Name : A320
Crew Size.Number Of Crew : 2
Operating Under FAR: Part 121
Flight Plan : IFR

Mission : Passenger
Flight Phase : Parked

Person

Reference : 1
Location Of Person.Aircraft: X
Location In Aircraft : Flight Deck
Reporter Organization : Air Carrier
Function.Flight Crew : Pilot Flying
Experience.Flight Crew.Total : 7500
Experience.Flight Crew.Last 90 Days : 90
Experience.Flight Crew.Type : 175
ASRS Report Number.Accession Number : 919714
Human Factors : Fatigue

Events

Anomaly.Deviation - Procedural: FAR
Anomaly.Deviation - Procedural : Published Material / Policy
Detector.Person : Flight Crew
When Detected : Pre-flight
Result.General : Work Refused

Assessments

Contributing Factors / Situations : Company Policy
Contributing Factors / Situations : Human Factors
Primary Problem : Ambiguous

Narrative: 1

This is a fatigue report. I had awakened at very early [hour] and commuted down to my base to be in position for my morning short call assignment. I had been at the airport all day long and had been fighting a cold. In the evening, I received a phone call from the crew desk saying they had a late night departure that I was legal for. I was already exhausted from being at the airport all day and did not expect to be called that late into my duty period, that anything after that should have gone to the afternoon short call pilot. I told him I was not fit to fly that late after being on duty for that long and the fatigue I was experiencing. I would have been departing 12 hours and 41 minutes after I started on duty.

Synopsis

An A320 pilot on reserve duty in the morning was called for a trip departing late in the evening and because of illness and fatigue refused the trip.

--Page Break--

ACN: 919528 *(9 of 256)*

Time / Day

Date : 201011
Local Time Of Day : 1201-1800

Place

Locale Reference.Airport : SLLP.Airport
State Reference : FO
Relative Position.Angle.Radial : 305
Relative Position.Distance.Nautical Miles : 4
Altitude.MSL.Single Value : 15500

Environment

Flight Conditions : VMC
Ceiling : CLR

Aircraft : 1

Reference : X
ATC / Advisory.Tower : SLLP
Aircraft Operator : Air Carrier
Make Model Name : Commercial Fixed Wing
Crew Size.Number Of Crew : 3
Operating Under FAR Part : Part 121
Flight Plan : IFR
Mission : Passenger
Flight Phase : Initial Approach

Aircraft : 2

Reference : Y
ATC / Advisory.Tower : SLLP
Make Model Name : Any Unknown or Unlisted Aircraft Manufacturer

Person : 1

Reference : 1
Location Of Person.Aircraft : X
Location In Aircraft : Flight Deck
Reporter Organization : Air Carrier
Function.Flight Crew : Captain
Function.Flight Crew : Pilot Flying
Qualification.Flight Crew : Air Transport Pilot (ATP)
ASRS Report Number.Accession Number : 919528
Human Factors : Training / Qualification
Human Factors : Communication Breakdown
Human Factors : Confusion
Communication Breakdown.Party1 : Flight Crew
Communication Breakdown.Party2 : ATC

Person : 2

Reference : 2
Location Of Person.Aircraft : X
Location In Aircraft : Flight Deck
Reporter Organization : Air Carrier
Function.Flight Crew : Relief Pilot
Function.Flight Crew : Pilot Not Flying
Qualification.Flight Crew : Air Transport Pilot (ATP)
ASRS Report Number.Accession Number : 919726
Human Factors : Fatigue
Human Factors : Confusion
Human Factors : Situational Awareness

Person : 3

Reference : 3
Location Of Person.Aircraft : X
Location In Aircraft : Flight Deck
Reporter Organization : Air Carrier
Function.Flight Crew : First Officer
Function.Flight Crew : Pilot Not Flying
Qualification.Flight Crew : Air Transport Pilot (ATP)
ASRS Report Number.Accession Number : 919722
Human Factors : Situational Awareness
Human Factors : Communication Breakdown
Human Factors : Confusion
Communication Breakdown.Party1 : ATC
Communication Breakdown.Party2 : Flight Crew

Events

Anomaly.ATC Issue : All Types
Anomaly.Conflict : NMAC
Detector.Automation : Aircraft RA
Detector.Person : Flight Crew
When Detected : In-flight
Result.Flight Crew : Took Evasive Action

Assessments

Contributing Factors / Situations : Human Factors
Contributing Factors / Situations : Procedure
Primary Problem : Human Factors

Narrative: 1

We were cleared for the ILS Z approach to Runway 10, as we passed the PAZ VOR outbound we began our descent from the initial approach altitude of 18,000 FT to 15,000 FT. At approximately 4 miles from the VOR, on the outbound leg, traffic popped up and was observed on TCAS by the First Officer. We weren't able to get a visual since the aircraft was almost directly below us. We were descending at approx. 800 to 1,000 FT per minute. I started to level our aircraft at approximately 15,500 FT. At this point the other aircraft started a rapid climb in our direction. Within a couple of seconds we got an R/A from our TCAS commanding a climb. I immediately disconnected the auto pilot and auto throttles and pitched up so as to keep the aircraft in the green on the vertical speed indicator. There were 2 green dots at the top of the indicator, the rest was red. I used max power and had to peg the VSI (6,000 FPM) to out climb the threat. The aircraft was still converging at [such] a rate that we all were anticipating contact. The aircraft came within 200 FT of our underbelly. Once we determined the aircraft was no longer a threat I leveled our aircraft at approximately 19,500 FT, performed a descending 360 degree turn to get back to the initial approach altitude, then completed the ILS approach. We never saw the other aircraft.

Narrative: 2

On initial approach we received a TCAS resolution advisory to climb for conflicting traffic. We were cleared the ILS Z Runway 10 approach. We received advisory on outbound leg passing PAX VOR while descending from 18,000 FT to 15,000 FT at approximately 16,000 FT. Autopilot/auto throttles were both disengaged and we performed a max angle/power climb to green VVI indicator range to clear the threat. We climbed to approximately 19,500 FT to clear the conflict aircraft. We were in VMC conditions and the conflict aircraft came within 200 FT of our aircraft, however, it was never spotted. We were never advised of any other aircraft in the area. Additionally, ATC communications was intermittent. Approach was re-initiated and completed successfully without any further conflicts.

Narrative: 3

After an all night flight to La Paz, Bolivia, we found ourselves in the Andes mountain range (pilots on oxygen) cleared for the ILS ZULU Runway 10. CAVOK. Radio communication with ATC (Approach and Tower) was very spotty, in fact 10 minutes prior to the incident, while descending over the highest terrain, the crew found themselves [out of] communication with ATC for about 5 minutes on all frequencies. Initial descent was given to FL200, usually an initial descent to 18,000 is given. Flight was NOT advised of any traffic in the area, by Approach or Tower. We were given a step down from FL200 to 18,000 and on a procedure turn outbound cleared for the approach by Tower. We were passing through about 16,300 FT at 160 KTS when I noticed traffic on the TCAS coming from behind. I went from the 20 mile scale to the 5 mile scale on the TCAS. Around 15,700 FT the traffic went form a white to yellow annunciation (Traffic/Traffic Annunciation was heard) and the aircraft appeared directly beneath us. At 15,500 FT, the traffic went from yellow to red and an R/A to climb/climb accompanied with several expletives from the flight crew. Captain initiated an immediate/non-hesitant, maximum power climb following the command of the R/A. I also communicated with ATC that we were in the climb responding to an R/A. ATC had no response. The response to the R/A had little effect, in fact the infringing aircraft was now 200 FT directly underneath us. IT SEEMED AS IF THE APPROACHING AIRCRAFT WAS ATTEMPTING TO RAM US! Following the climb directive by the TCAS system was NOT going to avoid a collision as the intruding aircraft was under us and climbing faster then we were. The Captain, doing what he had to do to avoid a collision, in a maximum power climb, on oxygen, after flying all night, at 150 KTS executed a right turn in an attempt to get away from the aircraft under us. The Relief Pilot, who was initially in his seat, seat belt on, on oxygen, came out of his seat, and off oxygen to look out of the left rear cockpit window to try to assist in the avoidance of the intruding aircraft. Passing through approximately 19,500 FT, we were clear of conflict. Now came time for the Captain to regain control and airspeed of the aircraft, as well as situational awareness of the mountainous terrain around us. I told ATC that we had experienced a near mid-air collision (ATC seemed to understand these words). The ATC Controller immediately began communication with the intruding aircraft asking their position and DME. She also asked if they had seen us. I am fluent in Spanish, and overheard the conversation. It became apparent that the Controller had no idea where the intruding aircraft was and the pilot of the intruding aircraft claimed that he had us in sight (His gun-sights/pipper MAYBE!). It took us approximately 4,000 FT of maneuvering to avoid a collision. We were again cleared for the approach, we made a 360 degree circling turn to lose altitude gained during the escape maneuver, configured the aircraft into a stable approach scenario and landed at a 13,313 FT elevation airport as if it was another day at the office. Upon landing in SLLP we informed ATC via radio that we had experience a NMAC. The Controller was trying to convince us that we had not since the departing aircraft had us in sight. The Controller seemed surprised when I asked for the tail number and aircraft type for the near miss report we were going to file. The ATC Controller said she did not have that information and wanted to know our altitude and DME from the PAZ VOR when the incident occurred. We elected NOT to give the Bolivian ATC any information via the radio, rather to provide them information via the company in the reporting process. We left SLLP for the next leg and upon parking the aircraft the flight crew noticed a Bolivian Government Aircraft, with Government of Bolivia markings (large corporate type jet) parked next to us. The pilot was standing in front of the aircraft talking to some folks in suits. This jet was surrounded, in a circle, with at least 20 armed soldiers of the Bolivian Army. We were told by an unnamed local source that they thought this was the aircraft we had the near miss with.

Synopsis

Flight crew arriving SLLP and cleared for the ILS Z Runway 10 approach reports TCAS RA and NMAC with aircraft climbing under them on the PAZ 305 radial. A maximum rate climb and maneuvering eventually results in a clear of conflict TCAS announcement.

---Page Break---

ACN: 919170 *(10 of 256)*

Time / Day

Date : 201011
Local Time Of Day : 0001-0600

Place

Locale Reference.Airport : DFW.Airport
State Reference : TX

Environment

Flight Conditions : VMC

Aircraft

Reference : X
ATC / Advisory.Tower : DFW
Aircraft Operator : Air Carrier
Make Model Name : B737-700
Crew Size.Number Of Crew : 2
Operating Under FAR Part : Part 121
Flight Plan : IFR
Mission : Passenger
Flight Phase : Initial Approach
Airspace.Class B : DFW

Person

Reference : 1
Location Of Person.Aircraft : X
Location In Aircraft : Flight Deck
Reporter Organization : Air Carrier
Function.Flight Crew : Captain
Function.Flight Crew : Pilot Flying
Qualification.Flight Crew : Air Transport Pilot (ATP)
ASRS Report Number.Accession Number : 919170
Human Factors : Troubleshooting
Human Factors : Fatigue
Human Factors : Confusion
Human Factors : Physiological - Other

Events

Anomaly.Deviation - Track / Heading : All Types
Anomaly.Deviation - Procedural : Clearance
Detector.Person : Flight Crew
Were Passengers Involved In Event : N
When Detected : In-flight
Result.Flight Crew : Executed Go Around / Missed Approach
Result.Flight Crew : Became Reoriented

Assessments

Contributing Factors / Situations : Airport
Contributing Factors / Situations : Human Factors
Contributing Factors / Situations : Procedure
Primary Problem : Human Factors

Narrative: 1

I was flying the approach into DFW. ATC assigned us 17R which was a change from the expected runway, so we loaded the ILS to 17R in LNAV and changed to the 17R ILS frequencies. ATC called traffic to us at 11:00 clock (we were on an angling right base). Looked but couldn't see it. ATC asked if we could see the airport (we could) and issued a visual approach clearance. ATC instructed us to keep our speed up to the final approach fix. Autopilot was on and connected to LNAV. We kept looking to the left for the traffic and when I looked to the right I saw the left and right runway and disconnected the autopilot to turn final. As I turned final, we both noticed that we were right of the LNAV track. We checked the ILS raw data and it also showed us right of course. We checked for proper LNAV points, ILS frequencies and identifiers which were all correct. Next we asked the Tower to verify the ILS was operating and were told it checked OK. Tower also verified the ILS frequency and assigned runway. Now we are about 3 miles from landing and my eyes were telling me to land on the right runway while my instruments are telling me to land on the left. This doesn't make sense and I do a go-around to give us time to discover the problem. As we go around, I look out the left window and see the passenger terminal. This is not where it should be and after cleaning up and doing checklists, I look at the airport diagram again and it dawns on me that I have lined up on the 18R/L side of the airport which explains the conflicting information. On downwind, we reload the LNAV and re-verify everything. On approach, we carefully follow the instruments to final and make an uneventful landing in 17R. This event occurred primarily because I followed my visual input first and didn't rely on my navigation aids enough. Other factors included: The airport is brightly lit on both sides of the 18 complex which made me think the terminal was to my right. It is fairly dark to the east of the 17s. The runway lights are difficult to see until almost lined up on final. This was obvious on our second approach as we crossed the 18 centerlines but still couldn't see the 17s. The traffic call and the requirement to keep our speed up added distraction. End of the day fatigue and VMC weather lead to less vigilance. As years of training have taught me, always use the instruments to verify where the aircraft is. While this saved me from landing on the wrong runway, I could have used it much more effectively (and sooner) to avoid lining up on the wrong runway. At airports where there are runways separated by large areas, I will review how many runways will be crossed prior to turning final. This is especially important on VMC arrivals with visual approaches.

Synopsis

Following a late runway change at DFW the flight crew of a B737-700 lined up visually with the wrong runway. The discrepancy between their visual picture and the ILS/NAV displays alerted them to make a go around and reorient themselves.

Page Break

ACN: 918741 *(11 of 256)*

Time / Day

Date : 201011

Place

Locale Reference.Airport : ZZZ.Airport
State Reference : US
Altitude.AGL.Single Value : 0

Aircraft

Reference : X
Aircraft Operator : Air Carrier
Make Model Name : B757-200
Crew Size.Number Of Crew : 2
Operating Under FAR Part : Part 121
Flight Plan : IFR
Mission : Passenger

Person

Reference : 1
Location Of Person.Aircraft : X
Location In Aircraft : General Seating Area
Cabin Activity : Safety Related Duties
Reporter Organization : Air Carrier
Function.Flight Attendant : Flight Attendant (On Duty)
ASRS Report Number.Accession Number : 918741
Human Factors : Fatigue

Events

Anomaly.Other
Detector.Person : Flight Attendant
When Detected : In-flight
Result.General : None Reported / Taken

Assessments

Contributing Factors / Situations : Company Policy
Contributing Factors / Situations : Human Factors
Primary Problem : Ambiguous

Narrative: 1

The trips that have a tag leg prior to working a red eye are causing extreme fatigue for myself and others. Our bodies just cannot take a nap prior to working the tag flight. We wake up that morning around XA00 and then we have to leave the hotel around XK15 or XK30 and then continuously work until XA00 the following morning. It is not the hours on duty that are causing the fatigue...it is the fact that we are not able to nap prior to working all night long. We start our day around XJ00. (getting ready to leave hotel) and do not finish until XA00 the following morning. I do not mind a productive trip but these tags should not be prior to working a red eye. On top of it all we have 2 hours and 25 minutes on the ground in between the tag and the red eye...it is just absurd!

Synopsis

B757 Flight Attendant describes fatiguing trips created by her company that require an early evening check in for a short flight segment, then a 2 hour and 25 minute break beforwe departing on a red eye.

ACN: 918702 *(12 of 256)*

Time / Day

Date : 201011

Environment

Weather Elements / Visibility : Turbulence

Aircraft

Reference : X
Aircraft Operator : Air Carrier
Make Model Name : Commercial Fixed Wing
Crew Size.Number Of Crew : 2
Operating Under FAR Part : Part 121
Flight Plan : IFR
Mission : Passenger

Person

Reference : 1
Location Of Person.Aircraft : X
Location In Aircraft : Flight Deck
Reporter Organization : Air Carrier
Function.Flight Crew : Captain
Function.Flight Crew : Pilot Flying
Qualification.Flight Crew : Air Transport Pilot (ATP)
Experience.Flight Crew.Total : 25000
ASRS Report Number.Accession Number : 918702
Human Factors : Fatigue
Human Factors : Situational Awareness

Events

Anomaly.Other
Detector.Person : Flight Crew
Were Passengers Involved In Event : N
When Detected.Other
Result.General : None Reported / Taken

Assessments

Contributing Factors / Situations : Human Factors
Primary Problem : Human Factors

Narrative: 1

This report concerns a trans-Pacific flight assignment including back to back all night pairings (body clock), two un-augmented inter-Asia segments and 36 hours of flight time. We started the sequence with a 12.7 hour actual flight, single augmented with an hour plus delay on the front end. When we arrived we cabbed to downtown for an additional 1.5 hours on the body before rest. The first internal Asia leg is all night, un-augmented. The return leg is daylight-but all night body time-followed by another 1.5 hour cab ride downtown. The [opportunities for] rest were insufficient to maintain any alertness particularly on the last leg. Both the First Officer and I experienced periods of unintended sleep while at the controls. No amount of coffee or mental discipline was sufficient to stay awake!!! This is unsafe and made more unsafe by requiring: 1. Over 12 hours single augmented on the first leg. 2. Two un-augmented legs on the back side of the clock with long preflight awake hours. 3. Over 8 extra hours of "duty time" in CABS!!! Rework this trip before someone gets hurt. No one in the cockpit for the last 6 hours was at their peak to respond to irregular situations. We weren't even able to stay awake the whole time in the seat.

Synopsis

An international Captain described an onerous flight sequence in the Pacific he believed to be unsafe due to cumulative and predictable fatigue.

Page Break

ACN: 918399 *(13 of 256)*

Time / Day

Date : 201011
Local Time Of Day : 0001-0600

Place

Locale Reference.Airport : ZZZ.Airport
State Reference : US
Altitude.AGL.Single Value : 0

Environment

Light : Dawn

Aircraft

Reference : X
Aircraft Operator : Air Carrier
Make Model Name : Regional Jet 200 ER/LR (CRJ200)
Operating Under FAR Part : Part 121
Mission : Passenger
Flight Phase : Parked
Maintenance Status.Maintenance Deferred : Y
Maintenance Status.Records Complete : N
Maintenance Status.Released For Service : Y
Maintenance Status.Required / Correct Doc On Board : N
Maintenance Status.Maintenance Type : Unscheduled Maintenance
Maintenance Status.Maintenance Items Involved : Work Cards
Maintenance Status.Maintenance Items Involved : Installation

Component

Aircraft Component : Air Conditioning and Pressurization Pack
Manufacturer : Bombardier / Canadair
Aircraft Reference : X

Person

Reference : 1
Location Of Person : Hangar / Base
Location In Aircraft : Flight Deck
Reporter Organization : Air Carrier
Function.Maintenance : Other / Unknown
Qualification.Maintenance : Airframe
Qualification.Maintenance : Powerplant
ASRS Report Number.Accession Number : 918399
Human Factors : Training / Qualification
Human Factors : Situational Awareness
Human Factors : Confusion
Human Factors : Communication Breakdown
Human Factors : Fatigue
Communication Breakdown.Party1 : Maintenance
Communication Breakdown.Party2 : Maintenance
Analyst Callback : Attempted

Events

Anomaly.Aircraft Equipment Problem : Less Severe
Anomaly.Deviation - Procedural : FAR
Anomaly.Deviation - Procedural : Published Material / Policy
Detector.Person : Maintenance
Were Passengers Involved In Event : N
When Detected.Other
Result.General : Flight Cancelled / Delayed
Result.General : Maintenance Action

Assessments

Contributing Factors / Situations : Aircraft
Contributing Factors / Situations : Human Factors
Contributing Factors / Situations : Incorrect / Not Installed / Unavailable Part
Contributing Factors / Situations : MEL
Primary Problem : Human Factors

Narrative: 1

Authorized deferral of the #1 display unit supply fan (MEL 21-24-2c) due to a pilot write-up that the display 'Cool' caution message posted in flight at FL340. Station Maintenance stated that the fan needed to be replaced. During subsequent questioning about the reason for deferral, the Mechanic stated that the wrong P/N (Part Number) fan was installed and that was the reason it needed to be replaced; he provided the correct P/N. This happened early in the morning and I must not have been paying close enough attention because it did not register that we could not defer the system with the wrong part installed. This fact was pointed out to me when I arrived for work the following night by the Shift Supervisor. The aircraft was stopped and the part replaced and the MEL cleared. After being in the business for 40 plus years, I may becoming a little complacent or in need of re-education (refresher) on some of the intricacies of the FARs. I find classroom education much more valuable than self study or CBT (Computer Based Training). I need, and I think that anybody that has been in the business very long, needs real Recurrent Training periodically, just to prevent issues like this from creeping into the daily operation. As stated before, self-study or CBT education is not [as] effective as the real thing.

Synopsis

A Maintenance Controller reports he authorized a deferral of #1 display unit supply fan per MEL 21-24-2C, even after a Mechanic told him the wrong fan was installed and needed to be replaced on a CRJ-200 aircraft.

Page Break

ACN: 917804 *(14 of 256)*

Time / Day

Date : 201011
Local Time Of Day : 1201-1800

Place

Locale Reference.Airport : ZZZZ.Airport
State Reference : FO
Relative Position.Distance.Nautical Miles : 20
Altitude.MSL.Single Value : 10000

Environment

Flight Conditions : VMC
Light : Daylight
Ceiling : CLR

Aircraft

Reference : X
ATC / Advisory.TRACON : ZZZZ
Aircraft Operator : Air Carrier
Make Model Name : B737-800
Crew Size.Number Of Crew : 2

Operating Under FAR Part : Part 121
Flight Plan : IFR
Mission : Passenger
Flight Phase : Climb

Component

Aircraft Component : Pneumatic Valve/Bleed Valve
Aircraft Reference : X
Problem : Improperly Operated

Person : 1

Reference : 1
Location Of Person.Aircraft : X
Location In Aircraft : Flight Deck
Reporter Organization : Air Carrier
Function.Flight Crew : Captain
Function.Flight Crew : Pilot Flying
Qualification.Flight Crew : Air Transport Pilot (ATP)
ASRS Report Number.Accession Number : 917804
Human Factors : Training / Qualification
Human Factors : Human-Machine Interface
Human Factors : Distraction
Human Factors : Situational Awareness

Person : 2

Reference : 2
Location Of Person.Aircraft : X
Location In Aircraft : Flight Deck
Reporter Organization : Air Carrier
Function.Flight Crew : First Officer
Function.Flight Crew : Pilot Not Flying
ASRS Report Number.Accession Number : 918588
Human Factors : Training / Qualification
Human Factors : Situational Awareness
Human Factors : Fatigue
Human Factors : Distraction
Human Factors : Human-Machine Interface

Events

Anomaly.Deviation - Procedural : Published Material / Policy
Detector.Automation : Aircraft Other Automation
Detector.Person : Flight Crew
When Detected : In-flight
Result.Flight Crew : Became Reoriented
Result.Flight Crew : Took Evasive Action

Assessments

Contributing Factors / Situations : Human Factors
Primary Problem : Human Factors

Narrative: 1

Passing 10,000 FT MSL during climbout we got an intermittant altitude warning horn. I leveled off, we put on our oxygen masks, and noticed both bleed air switches were turned off. We selected manual pressurization, turned on the bleed switches and closed the outflow valve to get the pressurization under control. When the cabin pressurization returned to normal, auto was selected on the pressurization and the climb was continued without incident. The first officer stated during the post flight the night prior he turned off both bleed switches. Neither of us caught it during preflight or other checklists.

Narrative: 2

On climbout thru 10,000 FT got the cabin altitude warning horn. Donned O2 masks, noticed both engine bleed switches in the off position. Turned one bleed on, switched to manual pressurization, closed the outflow valve and waited for the cabin to stablilize and descend back down below 10,000 which only took about 1 minute. Turned on the remaining bleed, and went back to auto pressurization. It occured to me that on the inbound flight I must have inadvertantly turned off the engine bleed switches. It was a long duty day with almost 8 hours of flying. On the next morning, I didn't catch the switch position on the origination preflight.

Synopsis

A B737-800 First Officer turned the engine bleeds off after arrival the night before and forgot to open them the next morning during preflight. After climbing through 10,000 FT the CABIN ALTITUDE WARNING sounded, the bleeds were opened and pressurization restored.

~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~Page Break~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~

ACN: 916923 *(15 of 256)*

Time / Day

Date : 201010
Local Time Of Day : 1801-2400

Place

Locale Reference.Airport : ZZZ.Airport
State Reference : US
Altitude.MSL.Single Value : 3300

Aircraft

Reference : X
Aircraft Operator : Air Carrier
Make Model Name : ATR 42
Crew Size.Number Of Crew : 2
Operating Under FAR Part : Part 121
Flight Plan : IFR
Flight Phase : Climb

Component : 1

Aircraft Component : Ice/Rain Protection System
Aircraft Reference : X
Problem : Failed

Component : 2

Aircraft Component : Autoflight System
Aircraft Reference : X
Problem : Malfunctioning
~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~

Person

Reference : 1
Location Of Person.Aircraft : X
Location In Aircraft : Flight Deck
Reporter Organization : Air Carrier
Function.Flight Crew : Pilot Not Flying
Function.Flight Crew : Captain
Qualification.Flight Crew : Air Transport Pilot (ATP)
ASRS Report Number.Accession Number : 916923
Human Factors : Human-Machine Interface
Human Factors : Fatigue
Human Factors : Workload

Events

Anomaly.Aircraft Equipment Problem : Critical
Anomaly.Deviation - Altitude : Excursion From Assigned Altitude
Anomaly.Inflight Event / Encounter : Loss Of Aircraft Control
Anomaly.Inflight Event / Encounter : Weather / Turbulence
Detector.Person : Flight Crew
When Detected : In-flight
Result.General : None Reported / Taken

Assessments

Contributing Factors / Situations : Aircraft
Contributing Factors / Situations : Human Factors
Contributing Factors / Situations : Weather
Primary Problem : Aircraft

Narrative: 1

During climb out, while operating in icing conditions with level 3 icing systems engaged, the aileron/elevator horn anti-icing system faulted and was not recoverable. At this same time the AFCS [Auto Flight Control System] was not operating normally. The First Officer (PF) complained of controllability issues and an unfamiliar vibration was detected. The QRH checklist directed us to leave icing conditions, so the crew decided to turn back to our departure airport. During vectoring for ILS 27 an altitude deviation occurred of approximately 500 feet. The PIC assumed control of the aircraft for the remainder of the flight. During the ILS approach, with the AFCS restored, and after determining free and clear control of aircraft controls, the autopilot was engaged. The aircraft subsequently experienced an altitude loss. The PIC disconnected the autopilot, recovered to ILS profile and subsequently landed on Runway 27. Operating in icing conditions with horn heat inoperative probably caused control issues during the approach and airspeed decay may have led to the altitude loss. It is possible that a severe ice encounter occurred. Because of very gusty winds and icing conditions, and feeling fatigued. The PIC decided to engage the autopilot during approach because a difficult crosswind landing was imminent, with reported visibility of 1 mile due to blowing snow.

Synopsis

The loss of aileron and elevator horn anti-icing system while operating in moderate icing conditions likely contributed to an ATR-42 flight crew's failure to maintain cleared altitudes while returning to their departure airport.

Page Break

ACN: 916413 *(16 of 256)*

Time / Day

Date : 201010
Local Time Of Day : 1801-2400

Place

Locale Reference.ATC Facility : ZZZZ.ARTCC
State Reference : FO
Altitude.MSL.Single Value : 18000

Environment

Flight Conditions : Marginal

Aircraft

Reference : X
ATC / Advisory.Center : ZZZZ
Aircraft Operator : Air Carrier
Make Model Name : B747-400
Crew Size.Number Of Crew : 4
Operating Under FAR Part : Part 121
Flight Plan : IFR
Mission : Passenger
Flight Phase : Cruise
Flight Phase : Parked

Component : 1

Aircraft Component : Navigational Equipment and Processing
Aircraft Reference : X
Problem : Failed

Component : 2

Aircraft Component : PFD
Aircraft Reference : X
Problem : Failed

Person

Reference : 1
Location Of Person.Aircraft : X
Location In Aircraft : Flight Deck
Reporter Organization : Air Carrier
Function.Flight Crew : Pilot Flying
Function.Flight Crew : Captain
Qualification.Flight Crew : Air Transport Pilot (ATP)
Experience.Flight Crew.Total : 25000
Experience.Flight Crew.Last 90 Days : 60
Experience.Flight Crew.Type : 6000
ASRS Report Number.Accession Number : 916413
Human Factors : Workload
Human Factors : Troubleshooting
Human Factors : Time Pressure
Human Factors : Situational Awareness
Human Factors : Fatigue
Human Factors : Communication Breakdown
Human Factors : Distraction

Communication Breakdown.Party1 : Flight Crew
Communication Breakdown.Party2 : Ground Personnel

Events

Anomaly.Aircraft Equipment Problem : Critical
Anomaly.Flight Deck / Cabin / Aircraft Event : Smoke / Fire / Fumes / Odor
Anomaly.Deviation - Procedural : Maintenance
Anomaly.Deviation - Procedural : Published Material / Policy
Anomaly.Inflight Event / Encounter : Fuel Issue
Anomaly.Inflight Event / Encounter : Weather / Turbulence
Detector.Person : Flight Crew
Were Passengers Involved In Event : N
When Detected : Aircraft In Service At Gate
When Detected : In-flight
When Detected : Taxi
Result.General : Declared Emergency
Result.Flight Crew : Landed in Emergency Condition
Result.Air Traffic Control : Provided Assistance

Assessments

Contributing Factors / Situations : Aircraft
Contributing Factors / Situations : Company Policy
Contributing Factors / Situations : Human Factors
Contributing Factors / Situations : MEL
Contributing Factors / Situations : Procedure
Contributing Factors / Situations : Weather
Primary Problem : Ambiguous

Narrative: 1

Captain reviewed flight plan and discussed several issues with Dispatch. Several maintenance issues were noted regarding hydraulic leaks, APU electrical problems, and electrical issues with the aircraft that were deferred. Aircraft was load restricted because of approaching typhoon at our destination because of necessary fuel reserves. Aircraft was delayed at the gate due to an inoperative heading select knob on the mode control panel (MCP). Maintenance was trying to defer the MCP unit and that was not acceptable. Captain rejected the aircraft which became an issue with Maintenance personnel. The autopilot could not have been controlled in the heading select mode. That does not comply with SOP. Just prior to taxi another delay occurred trying to get final weights and we were told it was a "customer service problem". The Captain shutdown engines abeam the gate waiting for ACARS report to conserve fuel which almost became critical for arrival fuel at our destination. It is almost the rule now that aircraft are dispatched with some kind of maintenance issues or failures requiring additional stress issues for the crew. The flight went normally until about 3 hours out when there was an electrical problem with Bus #4 which then was isolated. About three hours later approaching our destination and the outer edge of the typhoon, Captain briefed crew and seated Flight Attendants early and prepared cabin for turbulence and high crosswind landing with windshear. Just approaching the arrival fix, descending to 18,000 FT, the crew heard popping noises at the right instrument panel and saw sparking from behind co-pilots PFD (Primary Flight Display) screen and smoke started to fill the cockpit. Both Co-pilot's screens went blank. Crew performed immediate checklist items for smoke from QRC checklist. Smoke continued to increase until Captain instructed a Relief Pilot to pull the right PFD and ND (Navigation Display) Circuit Breakers; which took time to find in the dark. The circuit breaker for the affected system had failed to pop out! The Captain ordered the Smoke Evacuation Handle on the overhead to be opened which was very hard to operate. He then instructed First Officer to declare an emergency with Center and request an immediate landing. The Flight Attendants were informed and an immediate turning high speed steep descent was performed to intercept the ILS to 07L. As a result of actions by the Relief First Officer- smoke gradually dissipated and although a high speed approach was performed while encountering windshear and crosswinds the aircraft made a smooth landing and quickly turned at an exit right in front of the airport fire station where fire trucks were standing by. The Flight Attendants and passengers were ordered to remain seated after stopping. We then taxied normally to gate where the Captain contacted Operations, Dispatch and Flight Duty Manager. Maintenance issues on all B747-400s are chronic problems! Items are broken and deferred on all flights and just resetting circuit breakers and ground checking equipment doesn't constitute thorough maintenance. Aircraft are shown to be "legal" to fly by paperwork standards for the release to the pilots, but are marginal in this respect. It should be automatic after an emergency of this nature for crews to be released from additional flying duty! This flight crew handled this emergency after 16 hours of flight, flying all night, minimum rest in the aircraft, and being 13 hours off normal body clock time. The Captain and the flying First Officer were then expected to continue flying in the typhoon region for three more segments for five more days. Adequate rest looks legal in the computer and meets FAA requirements, but is, in practical terms, inadequate. The checklist in the aircraft defining circuit breakers locations for quick activation is inadequate or missing. A QRC style circuit breaker location list should be in the cockpit listing all locations for equipment that will be disabled in alphabetical order and should be available for immediate use. It is impossible to call Maintenance Control under these circumstances and definitely impossible for crews to go looking through manuals to accomplish the appropriate procedure. Also, the aircraft needs to have an electronic checklist installed and brought up to today's standards. The fire/smoke checklist should be shown completely on the QRC without having to go to an additional checklist in the manual. This is a critical procedure and almost impossible to find in manual with the oxygen mask and smoke goggles on.

Synopsis

A B747-400 Captain believes he is observing a general deterioration in the maintenance standards at his airline, this report dealt with a detailed report of failed navigation displays, smoke and fire, fuel concerns and flight into a typhoon after 16 plus hours on duty.

---Page Break---

ACN: 916382 *(17 of 256)*

Time / Day

Date : 201010
Local Time Of Day : 1201-1800

Place

Locale Reference.Airport : ZZZ.Airport
State Reference : US
Altitude.AGL.Single Value : 1200

Environment

Weather Elements / Visibility : Rain
Light : Daylight
Ceiling.Single Value : 1300

Aircraft

Reference : X
ATC / Advisory.Tower : ZZZ
Aircraft Operator : Air Carrier
Make Model Name : B737 Undifferentiated or Other Model
Crew Size.Number Of Crew : 2
Operating Under FAR Part : Part 121
Flight Phase : Initial Approach
Airspace.Class B : ZZZ

Component

Aircraft Component : Flight Director
Aircraft Reference : X
Problem : Improperly Operated

Person

Reference : 1
Location Of Person.Aircraft : X
Location In Aircraft : Flight Deck
Reporter Organization : Air Carrier
Function.Flight Crew : Captain
Function.Flight Crew : Pilot Not Flying
Qualification.Flight Crew : Air Transport Pilot (ATP)
Experience.Flight Crew.Total : 16000
Experience.Flight Crew.Last 90 Days : 150
Experience.Flight Crew.Type : 10000
ASRS Report Number.Accession Number : 916382
Human Factors : Situational Awareness
Human Factors : Human-Machine Interface
Human Factors : Fatigue

Events

Anomaly.ATC Issue : All Types
Anomaly.Deviation - Procedural : Clearance
Anomaly.Inflight Event / Encounter : Unstabilized Approach
Anomaly.Inflight Event / Encounter : Weather / Turbulence
Detector.Person : Flight Crew
When Detected : In-flight
Result.Flight Crew : Executed Go Around / Missed Approach

Assessments

Contributing Factors / Situations : Human Factors
Contributing Factors / Situations : Procedure
Contributing Factors / Situations : Weather
Primary Problem : Human Factors

Narrative: 1

Flight was nearly 2 hours late due to a scheduled late report. Captain had 8 hours minimum rest due to dead heading delays the day before. First Officer indicated he himself didn't sleep well the night before. On approach, weather went below forecast with moderate rain. Airport was landing with tailwind landing components nearly at the limits. Aloft, there was a quartering tailwind of approximately 20 KTS. On base leg, we were held high due to crossing traffic underneath. This put us well above GS outside of the marker. Approach offered to give us another box pattern because "we didn't start down right away" (we were configuring) but we were high due to proximity traffic which delayed clearance. Nonetheless we felt we could recover within the IMC stabilized approach criteria, so we continued. However, on the assigned heading the crosswind pushed us north of the localizer and most likely the FD didn't fully center, so it never coupled. This lead to a full-scale deflection at about 1,200 FT AGL. We elected to execute the missed approach and Tower gave us a turn to 190 and a climb to 2,000 FT. During the missed approach the FD kept attempting to descend us to 1,500 FT (the initial approach altitude.) This forced us to fly raw data while we cleared the FD so we could re-arm the system from scratch. There were minor altitude deviations while we conducted the missed raw data. At first we should have requested another runway. After landing, we saw departing aircraft already taxiing for the opposite runway. Then when we were kept high for crossing traffic, we shouldn't have attempted to "salvage" a busted approach. During the go-around it's possible the TOGA switch didn't get pressed, which may have been a cause of the erroneous FD commands. All of the above wasn't helped by the fact I was on minimum rest.

Synopsis

B737 Captain reports a late descent clearance from Approach Control in IMC with a strong quartering tailwind. The approach becomes unstabilized and the crew elects to go around without pushing the TOGA button. This requires the pilot flying to ignore the flight director and attempt to fly raw data missed approach causing minor altitude deviations.

--Page Break--

ACN: 915712 *(18 of 256)*

Time / Day

Date : 201010
Local Time Of Day : 1801-2400

Place

Locale Reference.Airport : ZZZZ.Airport
State Reference : FO
Altitude.AGL.Single Value : 0

Environment

Flight Conditions : VMC
Light : Daylight

Aircraft

Reference : X
Aircraft Operator : Air Carrier
Make Model Name : B767-300 and 300 ER
Crew Size.Number Of Crew : 3
Operating Under FAR Part : Part 121
Flight Plan : IFR
Mission : Cargo / Freight
Flight Phase : Parked
Route In Use.Other

Person

Reference : 1
Location Of Person.Aircraft : X
Location In Aircraft : Flight Deck
Reporter Organization : Air Carrier
Function.Flight Crew : Pilot Not Flying
Function.Flight Crew : Captain
Qualification.Flight Crew : Air Transport Pilot (ATP)
ASRS Report Number.Accession Number : 915712
Human Factors : Physiological - Other
Human Factors : Fatigue
Human Factors : Situational Awareness

Events

Anomaly.Flight Deck / Cabin / Aircraft Event : Illness
Detector.Person : Flight Crew
Were Passengers Involved In Event : N
When Detected : Taxi
Result.General : Flight Cancelled / Delayed
Result.Flight Crew : Returned To Gate

Assessments

Contributing Factors / Situations : Human Factors
Primary Problem : Human Factors

Narrative: 1

Our flight time for the day was a bit more than 10+00 while duty time was approximately 13+30. When I got to the hotel, I changed clothes and worked out. When I returned to my room, I showered and lay down to take a nap. When I awoke, the local time was approximately XA30. I watched T.V. and had some fruit for dinner. I was unable to sleep, so I remained awake until about XK00 in the morning, and ordered room service for breakfast. I had 2 poached eggs with toast and grapefruit juice. After breakfast, I showered and then laid down to sleep prior to our departure from the hotel which was set for XT00 local time. My rest was sporadic. I would sleep for a while and then wake up. I would then start the process again, and this continued up to my wake up time. We left at XT00 and proceeded to the airport. After arriving at the aircraft, the preflight was completed and I returned to the cockpit to prepare for our departure. We completed our checklists, received our ATC clearance, and completed our preparations for departure. As we taxied out, I began to feel sick at my stomach. I also began to feel tired. When the sickness and fatigue did not pass, I decided to return to the gate as this was the safest course of action. As we returned to the gate, the feelings of fatigue and sickness continued. When we arrived at the gate we secured the aircraft. After this had been accomplished, the sickness began to subside a bit and I went to change my shirt as we prepared to go back to the hotel. I left the aircraft, walked down the stairs, retrieved my luggage and boarded the crew bus to the terminal in order to clear Immigration. We then took the car to the hotel. During our ride to the hotel I still felt tired and sick at my stomach but it was not as intense as it had been earlier. After checking into my room I ate a candy bar from the mini bar and almost immediately began to feel better. I showered and lay down and slept for approximately five hours when I received a call to set up a physical here. I accomplished the physical and later flew back to the U.S on commercial flights. In retrospect, I believe that I had a low blood sugar event which was compounded by a lack of quality sleep. The breakfast I had was likely not enough to carry me through the day, and I had skipped lunch so that I might get a bit more rest. This was a mistake that I will not make again. Also, I believe that I slept too long during my nap, and this kept me awake through the evening thereby disrupting my sleep cycle for the coming day.

Synopsis

Following a stressful layover which provided neither rest nor proper nourishment, the Captain of a B767-300 returned to the departure gate when he became ill during taxi for takeoff.

Page Break

ACN: 914141 *(19 of 256)*

Time / Day

Date : 201010
Local Time Of Day : 0001-0600

Place

Locale Reference.Airport : ZZZ.Airport
State Reference : US
Altitude.AGL.Single Value : 0

Environment

Light : Night

Aircraft

Reference : X
Aircraft Operator : Air Carrier
Make Model Name : A320
Operating Under FAR Part : Part 121
Mission : Passenger
Flight Phase : Parked
Maintenance Status.Maintenance Deferred : N
Maintenance Status.Records Complete : N
Maintenance Status.Released For Service : Y
Maintenance Status.Required / Correct Doc On Board : N
Maintenance Status.Maintenance Type : Scheduled Maintenance
Maintenance Status.Maintenance Items Involved : Work Cards
Maintenance Status.Maintenance Items Involved : Installation

Component : 1

Aircraft Component : Fuel Line, Fittings, & Connectors
Manufacturer : Airbus
Aircraft Reference : X

Component : 2

Aircraft Component : Fuel Tank
Manufacturer : Airbus
Aircraft Reference : X

Person : 1

Reference : 1
Location Of Person : Gate / Ramp / Line
Reporter Organization : Air Carrier
Function.Maintenance : Technician
Qualification.Maintenance : Airframe
Qualification.Maintenance : Powerplant
ASRS Report Number.Accession Number : 914141
Human Factors : Situational Awareness
Human Factors : Fatigue
Human Factors : Confusion
Human Factors : Communication Breakdown
Human Factors : Distraction
Communication Breakdown.Party1 : Maintenance
Communication Breakdown.Party2 : Maintenance

Person : 2

Reference : 2
Location Of Person : Gate / Ramp / Line
Reporter Organization : Air Carrier
Function.Maintenance : Technician
Qualification.Maintenance : Airframe

Qualification.Maintenance : Powerplant
ASRS Report Number.Accession Number : 914145
Human Factors : Situational Awareness
Human Factors : Fatigue
Human Factors : Confusion
Human Factors : Communication Breakdown
Human Factors : Distraction
Communication Breakdown.Party1 : Maintenance
Communication Breakdown.Party2 : Maintenance

Person : 3

Reference : 3
Location Of Person : Gate / Ramp / Line
Reporter Organization : Air Carrier
Function.Maintenance : Technician
Qualification.Maintenance : Airframe
Qualification.Maintenance : Powerplant
ASRS Report Number.Accession Number : 914644
Human Factors : Situational Awareness
Human Factors : Fatigue
Human Factors : Confusion
Human Factors : Communication Breakdown
Human Factors : Distraction
Communication Breakdown.Party1 : Maintenance
Communication Breakdown.Party2 : Maintenance

Events

Anomaly.Aircraft Equipment Problem : Critical
Anomaly.Deviation - Procedural : Published Material / Policy
Detector.Person : Maintenance
Were Passengers Involved In Event : N
When Detected : In-flight
Result.General : Maintenance Action
Result.General : Flight Cancelled / Delayed

Assessments

Contributing Factors / Situations : Aircraft
Contributing Factors / Situations : Chart Or Publication
Contributing Factors / Situations : Environment - Non Weather Related
Contributing Factors / Situations : Human Factors
Contributing Factors / Situations : Incorrect / Not Installed / Unavailable Part
Contributing Factors / Situations : Procedure
Primary Problem : Human Factors

Narrative: 1

An Engineering item was called out to replace left wing Fuel Pressure Holding Valve and I mistakenly replaced the same valve on the right wing by mistake. We were on feild trip to accomplish a tank entry to complete the job. It was our intent to just open the tank and start venting and return after rest to go in tank. But when we opened the access door to reach valve, discovered that it could be changed easily within five minutes, by reaching in approximately ten inches; no tank entry required so we completed the job. I can't explain why we changed the valve on the wrong side except to say that I asked which side and was told it was the right side, so there was some miscommunication.

Narrative: 2

I was called for field trip to replace a pressure holding valve on an A320 per Maintenance Engineering. After arriving we went to the aircraft. There was some discussion about the valve being replaced and other work on the aircraft. The Engineering callout required replacement of the left tank valve and I replaced the right tank valve. I am not sure how this happened except that there was some miscommunication. We did have some trouble bringing up the item in the Scheduled Maintenance computer, because we were at ZZZ and by this time it was [before sunrise].

Narrative: 3

Only after it flew, it was discovered that the wrong valve had been changed.

Synopsis

Three Line Mechanics report about a Maintenance Engineering call out to replace an A320 left wing fuel pressure holding valve on a field trip. Mechanics mistakenly replaced the right wing holding valve instead, with miscommunication cited as a contributor.

--Page Break--

ACN: 913773 *(20 of 256)*

Time / Day

Date : 201010
Local Time Of Day : 1801-2400

Place

Locale Reference.Airport : AVL.Airport
State Reference : NC
Altitude.MSL.Single Value : 5500

Environment

Flight Conditions : IMC
Weather Elements / Visibility : Turbulence
Weather Elements / Visibility : Thunderstorm
Light : Night

Aircraft

Reference : X
ATC / Advisory.Center : ZTL
Aircraft Operator : Air Carrier
Make Model Name : Commercial Fixed Wing
Crew Size.Number Of Crew : 2
Operating Under FAR Part : Part 121
Flight Plan : IFR
Mission : Passenger
Flight Phase : Initial Approach
Airspace.Class E : AVL

Person : 1

Reference : 1
Location Of Person.Aircraft : X
Location In Aircraft : Flight Deck
Reporter Organization : Air Carrier
Function.Flight Crew : Pilot Flying
Function.Flight Crew : First Officer

Qualification.Flight Crew : Commercial
ASRS Report Number.Accession Number : 913773
Human Factors : Fatigue
Human Factors : Confusion
Human Factors : Training / Qualification

Person : 2

Reference : 2
Location Of Person.Aircraft : X
Location In Aircraft : Flight Deck
Reporter Organization : Air Carrier
Function.Flight Crew : Pilot Not Flying
Function.Flight Crew : Captain
Qualification.Flight Crew : Air Transport Pilot (ATP)
ASRS Report Number.Accession Number : 913774
Human Factors : Situational Awareness
Human Factors : Confusion
Human Factors : Training / Qualification

Events

Anomaly.Deviation - Altitude : Crossing Restriction Not Met
Anomaly.Deviation - Track / Heading : All Types
Anomaly.Deviation - Procedural : Clearance
Anomaly.Deviation - Procedural : Published Material / Policy
Detector.Person : Air Traffic Control
When Detected : In-flight
Result.Flight Crew : Returned To Clearance
Result.Air Traffic Control : Issued Advisory / Alert
Result.Air Traffic Control : Issued New Clearance

Assessments

Contributing Factors / Situations : Human Factors
Contributing Factors / Situations : Procedure
Primary Problem : Human Factors

Narrative: 1

We were on our last leg of the day, flying into AVL. It was leg 5 for me on 11th hour of duty, leg 7 for the Captain almost 14 hours of duty; night; raining; non-towered; mountainous terrain airport; with an apparently confusing approach. Not a good setup. We were expecting the ILS 34, and I briefed and set up the approach. We were filed direct SUG direct AVL. Around SUG, we were told to descend to 7,000 FT. We were told maintain 7,000, then given direct Broad River (BRA) and cleared for the ILS 34 approach. In looking at the approach plate, the minimum altitude between SUG and BRA is 5,500 FT and the minimum altitude at BRA is 4,400 FT. No where on the plate does it say you must cross BRA at a higher altitude and use the procedure turn to descend. On the plate for ILS 16 in AVL it does depict this and is clear about it. So we began our descent so that we could cross BRA at 4,400 and continue on the ILS 34. ATC informed us we had busted altitude and to climb back to 7,000 until crossing BRA. At this time, we were not expecting to do a procedure turn, and the FMS was setup to continue the approach from BRA, so at 7,000, we turned inbound, knowing that there was no way we could land with a stabilized approach from this altitude. The Captain informed ATC, and she told us that we were expected to perform the procedure turn on the approach. We made a left 180 and then she vectored us out back towards SUG to send us in again. This second time, we made the procedure turn and landed uneventfully. To the best of my memory, I do not recall the Controller clearing us for the "full" approach. I think that would have made a difference in how we handled the situation. There are two prongs to that. If she did say cleared for the FULL approach, neither of us heard or acknowledged it. I think that is attributable to fatigue issues having to do with such a late flight, after a long day, with many factors complicating the flight. Also, she should have challenged the Captain's read back when he did not acknowledge the full approach and clarified that we needed to perform the procedure turn. If she did not say cleared for the "full" approach but we still should have done it, then we need to review phraseology and what the Controllers' commands do mean. It is possible that operating in the usual towered environment, we become so used to "cleared for the approach" meaning straight in when you get the localizer, when technically something else may be expected. In conclusion, I think we need to be highly vigilant to pinpoint any operations that may be out of the ordinary and be prepared to check and double check what we are doing. I think being aware of our physical limits when approaching fatigue and how they will affect our performance is also very important. Lastly, we need to be sure we understand what ATC expects of us, and clarify it with them whenever necessary.

Narrative: 2

We were cleared to the BRA NDB (on the ILS 34/AVL) at 7,000 FT. We were proceeding direct the NDB, and were with 10 miles of the navaid, when ZTL gave the instruction 'maintain 7,000 to BRA, cleared for the ILS 34 to KAVL'. We looked at this as a crew and determined that, since the approach plate indicated that we could cross BRA at 4,400 FT, that a descent was in order, otherwise we would have been too high to make a stabilized approach to Runway 34. ZTL questioned our descent and instructed us to climb back up to 7,000 FT, and again cleared us for the approach. We stated that we would not be able to make the required descent rate and asked ZTL what they wanted us to do. It was at this point that ZTL suggested that we enter the published hold and descend that way. (They never stated to us 'cleared for the FULL approach, which would have flagged us to do the procedure turn.) We were apparently expected to know that this was the standard procedure for this approach into this airport at night, but none of this information is stated on the approach plate. The plate does not make the procedure turn mandatory, hence the confusion. The Controller could have used the standard phraseology of 'Cleared for the Full Approach', but didn't. How this situation could have been avoided. 1) Additional information on the approach plate. 2) Use of more standardized phraseology by the Controller. 3) Crew should have been more questioning of ATC with apparently conflicting instructions. 4) After a 13 HR duty/almost 8 hour-7 leg day, being dispatched/scheduled to a mountainous airport at night is simply unsafe and the culmination of a fatigue inducing day. A less fatiguing day might have mitigated this event.

Synopsis

Air Carrier flight crew reports confusion over the requirement to fly the holding pattern procedure turn from SUG to the ILS 34 approach at AVL.

--Page Break--

ACN: 912360 *(21 of 256)*

Time / Day

Date : 201010
Local Time Of Day : 0601-1200

Place

Locale Reference.Airport : ZZZ.Airport
State Reference : US
Altitude.AGL.Single Value : 0

Environment

Flight Conditions : VMC
Light : Night

Aircraft

Reference : X
Aircraft Operator : Air Carrier
Make Model Name : Regional Jet 200 ER/LR (CRJ200)
Crew Size.Number Of Crew : 2
Operating Under FAR Part : Part 121
Flight Phase : Parked

Person

Reference : 1
Location Of Person.Aircraft : X
Location In Aircraft : Flight Deck
Reporter Organization : Air Carrier
Function.Flight Crew : Captain
Function.Flight Crew : Pilot Flying
Qualification.Flight Crew : Air Transport Pilot (ATP)
ASRS Report Number.Accession Number : 912360
Human Factors : Fatigue
Human Factors : Situational Awareness

Events

Anomaly.No Specific Anomaly Occurred : All Types
Detector.Person : Flight Crew
When Detected : In-flight
Result.General : None Reported / Taken

Assessments

Contributing Factors / Situations : Company Policy
Contributing Factors / Situations : Human Factors
Primary Problem : Human Factors

Narrative: 1

This is an incredible amount of flying for one day. We blocked 9 flights with approximately 6 hours 4 minutes of flying in 20-30 minute increments with no breaks. And this was Day 6 on duty for me. Our pilots are flying these schedules day in day out for up to 6 days in a row. After about 6 legs, I could sense my alertness and my reactions to our changing environments was beginning to deteriorate. In addition, I could sense that I my attention to detail was compromised; in other words, sloppiness. It's an alarming feeling as I play "Monday Morning QB". My First Officer and I talked about ourselves being tired, but we "pushed" on through to get the job done. Our schedules are failing to provide the highest standard of safety. Our job demands the highest standard of professionalism, alertness and safety. It's as if our pilots are covering the flying that could easily and safely be assigned to 2 pilots. I suggest that we reduce the maximum number of flights a day to 6. After 6, the "chain" of events that leads to mistakes, accidents, incidents and oversights tightens and the likelihood for error increases dramatically. A simple snapshot means that our pilots are flying essentially 36-48 flights a week. Six to nine legs a day 6 days in a row. Over a two week period that is approximately 72 flights! Please listen to the pilots.

Synopsis

CRJ200 Captain describes fatigue inducing six to nine leg duty days with up to six days on duty in a row.

--Page Break--

ACN: 911467 *(22 of 256)*

Time / Day

Date : 201009
Local Time Of Day : 0601-1200

Place

Locale Reference.ATC Facility : ZZZ.ARTCC
State Reference : US
Altitude.MSL.Single Value : 20000

Environment

Flight Conditions : VMC
Light : Daylight

Aircraft

Reference : X
ATC / Advisory.Center : ZZZ
Aircraft Operator : Air Carrier
Make Model Name : Dash 8-200
Crew Size.Number Of Crew : 2
Operating Under FAR Part : Part 121
Flight Plan : IFR
Mission : Passenger
Airspace.Class A : ZZZ

Person

Reference : 1
Location Of Person.Aircraft : X
Location In Aircraft : Flight Deck
Reporter Organization : Air Carrier
Function.Flight Crew : Captain
Qualification.Flight Crew : Air Transport Pilot (ATP)
Experience.Flight Crew.Total : 4000
Experience.Flight Crew.Last 90 Days : 175
Experience.Flight Crew.Type : 1700
ASRS Report Number.Accession Number : 911467
Human Factors : Workload
Human Factors : Time Pressure
Human Factors : Fatigue
Human Factors : Situational Awareness

Events

Anomaly.Deviation - Procedural : Published Material / Policy
Anomaly.Deviation - Procedural : Weight And Balance
Anomaly.Inflight Event / Encounter : Fuel Issue
Detector.Person : Flight Crew
Were Passengers Involved In Event : N
When Detected : In-flight
Result.General : None Reported / Taken

Assessments

Contributing Factors / Situations : Aircraft
Contributing Factors / Situations : Company Policy
Contributing Factors / Situations : Procedure
Primary Problem : Company Policy

Narrative: 1

While conducting our flight our fuel supply fell short of what was planned. We experienced no delays that would explain the shortage. We took off with fuel well above the minimum required and while in cruise realized it would be necessary to drop our planned alternate airport to land with legal fuel reserve. There was a head wind. I don't know if it was greater then the wind used to calculate the burn. We flew at FL200 instead of planned FL220. However, not even accounting for the additional fuel to climb to FL220 the difference in cruise burn was only 58 LBS, this is an insignificant difference. The fuel calculations were wrong. What is most disturbing is that my First Officer remarked that he had experienced this before at least a few times and other coworkers I have spoken with have also experienced the same thing. This has happened to me before with the fuel being short to even a much greater extent. On another recent flight we had an even greater margin of fuel reserve above the minimum required on the release. We experienced no delays that would account for the shortage. In fact our alternate was our departure airport so when we learned that we would not be able to land at our destination due to weather we were already closer to our alternate then if we would have had to go all the way to the destination airport and then go to the alternate. Our required 45 minute burn after reaching our farthest alternate was recently raised by the company to a higher amount and we did not even have enough for the previous required fuel reserve. There were thunderstorms that developed between us and our alternate that should have been taken into consideration and obviously were not. We changed our alternate to an airport which was very close and landed there. I was questioned a few days later by my Chief Pilot and did not tell him about the shortage. I believe that, based on past experience, if I had discussed it with him all possible efforts would be made to somehow twist the scenario into making this my fault. I was fatigued due to the very long work days that we experienced and was being rushed to try and get the flight out on time and we had weight and balance issues. Otherwise I may have had the time and foresight to take more fuel even though it was not required by the release. I believe that fuel planning is being intentionally manipulated to allow more passengers and bags on the aircraft. I have personally seen manipulations of the on time reports and believe that the company I work for conducts immoral and illegal practices on many levels and in many if not all of its departments on a regular basis.

Synopsis

A Dash 8 Captain reported instances of inaccurate planned fuel loads resulting in shortfalls of reserves enroute despite the lack of any obvious reasons for increased fuel burn. Reporter believes the fuel planning shortfalls are the result of conscious acts on the part of the company to maximize payloads.

--------------------Page Break--------------------

ACN: 911075 *(23 of 256)*

Time / Day

Date : 201009
Local Time Of Day : 0601-1200

Place

Locale Reference.ATC Facility : ZZZ.ARTCC
State Reference : US
Altitude.MSL.Single Value : 26000

Environment

Flight Conditions : VMC
Weather Elements / Visibility.Visibility : 5
Light : Daylight
Ceiling.Single Value : 5000

Aircraft

Reference : X
ATC / Advisory.Center : ZZZ
Aircraft Operator : Air Carrier
Make Model Name : A300
Crew Size.Number Of Crew : 2
Operating Under FAR Part : Part 121
Mission : Cargo / Freight
Airspace.Class A : ZZZ

Component

Aircraft Component : Air Conditioning and Pressurization Pack
Aircraft Reference : X
Problem : Malfunctioning

Person : 1

Reference : 1
Location Of Person.Aircraft : X
Location In Aircraft : Flight Deck
Reporter Organization : Air Carrier
Function.Flight Crew : Captain
Function.Flight Crew : Pilot Flying
Qualification.Flight Crew : Air Transport Pilot (ATP)
Experience.Flight Crew.Total : 15000
Experience.Flight Crew.Last 90 Days : 70
Experience.Flight Crew.Type : 2500
ASRS Report Number.Accession Number : 911075
Human Factors : Troubleshooting
Human Factors : Fatigue
Human Factors : Confusion

Person : 2

Reference : 2
Location Of Person.Aircraft : X
Location In Aircraft : Flight Deck
Function.Flight Crew : First Officer
Function.Flight Crew : Pilot Not Flying
Experience.Flight Crew.Total : 6000
Experience.Flight Crew.Last 90 Days : 100
Experience.Flight Crew.Type : 1000
ASRS Report Number.Accession Number : 911086

Events

Anomaly.Aircraft Equipment Problem : Critical
Detector.Automation : Aircraft Other Automation
Detector.Person : Flight Crew
When Detected : In-flight
Result.General : Maintenance Action
Result.Flight Crew : Diverted

Result.Flight Crew : Landed As Precaution
Result.Aircraft : Equipment Problem Dissipated

Assessments

Contributing Factors / Situations : Aircraft
Contributing Factors / Situations : Human Factors
Primary Problem : Aircraft

Narrative: 1

Ran normal checklists and departed uneventfully. Climbing out of FL255 both packs tripped. Leveled the aircraft at FL260 and advised ATC. Complied with ECAM and could not restore packs. Checked cabin altitude, which was at 4.5K and climbing at 500 fpm. Noted that pressure on bleed manifold was zero. Since cabin was climbing while level, coordinated descent with ATC and were initially cleared to FL180. At FL180 coordinated with Dispatch and Maintenance Control to inform them of our situation. During coordination, pack number one came back online. Soon later, pack number 2 came online. Solicited input from Dispatch and Maintenance Control. Discussed possible options/solutions. Since we could not determine what caused the packs to trip, we jointly agreed to divert in lieu of continuing over the ocean. Approaching parking, on taxi in, FO noted APU was on, and questioned whether he had turned it on after landing. This was in part due to having repeatedly turned on the APU immediately after landing all week at destination (they do not hook up ground power) and because of the intensity/time compression typically experienced in such events. FO advised Captain and Maintenance of this possibility while reviewing the situation. Although we agreed this was the most likely cause of the pack trips, since neither of us could definitively say whether it was on or not during the flight, Maintenance was compelled to investigate. ON THE GROUND: Maintenance changed engine # 1 and #2 start selector relay. Upon engine start, with all switches verified in the correct position, neither pack would come on line. Shut down aircraft. Maintenance did a full, hard shutdown and restart of the airplane. Second attempt: Started engines and Packs would not come online. Coordinated on headset with Maintenance to accomplish multiple resets of the packs, engine bleeds, and APU bleed. Packs would not come on line. A new part ordered and installed. Next day: Flew uneventfully to destination. On climb out for the return flight, noted audible surge from packs. Turned pack 1 off and surge stopped. Continued flight on pack 2. Logbook write up. Recent events at cargo airlines have created a heightened sense of awareness. Given this and rapid development of this situation, we cannot be sure what caused the packs to trip. Further, both the crew and Maintenance Control were inclined to troubleshoot this problem on the ground rather than in the air, since no obvious cause could be found. It is possible that further in-flight troubleshooting may have revealed the cause one way or the other. Lastly, it is noteworthy that both crew members felt tired on the day in question due to poor sleep for the past the past two nights caused by noise in the hotel. If real-time, in-flight Aircraft Health and Monitoring Data is available to Maintenance Control, including switch positions, in-flight warnings, etc, this data must be included in ground/flight communication to enhance the effectiveness of coordination, especially if that data will hasten a remedy or aid in an emergency.

Synopsis

A300 flight crew experienced a dual pack trip climbing out of FL255 which cannot be reset. During descent, while coordinating with Maintenance, both packs came back on the line. The crew elected to divert and discovers after landing that the APU may have been running in flight.

ACN: 910748 *(24 of 256)*

Time / Day

Date : 201009
Local Time Of Day : 1801-2400

Place

Locale Reference.Airport : ZZZ.Airport
State Reference : US

Environment

Flight Conditions : IMC
Light : Night
Ceiling.Single Value : 300

Aircraft

Reference : X
ATC / Advisory.Tower : ZZZ
Aircraft Operator : Air Carrier
Make Model Name : Medium Transport, Low Wing, 2 Turboprop Eng
Crew Size.Number Of Crew : 2
Operating Under FAR Part : Part 121
Flight Phase : Initial Approach
Airspace.Class D : ZZZ

Person

Reference : 1
Location Of Person.Aircraft : X
Location In Aircraft : Flight Deck
Reporter Organization : Air Carrier
Function.Flight Crew : Pilot Flying
Function.Flight Crew : Captain
Qualification.Flight Crew : Air Transport Pilot (ATP)
Experience.Flight Crew.Total : 3500
ASRS Report Number.Accession Number : 910748
Human Factors : Situational Awareness
Human Factors : Fatigue
Human Factors : Distraction
Human Factors : Other / Unknown

Events

Anomaly.Deviation - Procedural : Landing Without Clearance
Detector.Person : Air Traffic Control
When Detected : Taxi
Result.General : None Reported / Taken

Assessments

Contributing Factors / Situations : Company Policy
Contributing Factors / Situations : Human Factors
Contributing Factors / Situations : Weather
Primary Problem : Human Factors

Narrative: 1

I was operating as Captain of this flight and my First Officer had very little experience with the company (about 1 month flying the line). After receiving the one minute weather at destination (340 at 14, Overcast 300) we decided that it would be better if I flew the approach and he performed the duties of Pilot Not Flying. I briefed the ILS via the straight in feeder route. Since it was the First Officer's leg, we switched flight controls prior to the descent so that I could fly the approach. When we crossed the IAF, we were instructed to contact Tower which the First Officer did. Tower then instructed us to contact them upon crossing the FAF. My First Officer appeared to be overwhelmed with the situation (it was his first approach to minimums flying the line). His callouts were poor (some were missed, some were late). He also had some trouble reading the approach plate which led to additional task saturation on my part. We failed to report crossing the FAF and as a result did not get cleared to land by Tower. Upon landing we were informed by Tower that we failed to report and were not cleared to land. At our arrival time there were no other aircraft waiting for departure or moving about the airport surface and conditions were night IMC. Contributing factors to this incident include: 1) Fatigue (It was day 5 of 5 days on duty. We had also not finished until early in the morning the previous 3 nights on duty) 2) Task saturation 3) Inexperience of the First Officer (resulting in task saturation) 4) Failure of the Captain to monitor the First Officer's assigned duties 5) Poor "Final Checklist" procedure Recommendations: I feel that this incident could easily be prevented in the future by changing our "Final Checklist" procedure on this aircraft. As it currently stands, we cannot complete the Final Checklist until we go visual on an ILS which in this case was just over 200 FT above the runway. In this extremely critical phase of flight, the Pilot Not Flying must divert his/her attention away from the task at hand to read three checklist items, followed by three callouts. By the time "Cleared to Land" is stated, the aircraft is approximately 50 FT over the ground, which isn't the safest location to discover that you are not cleared to land. Below 200 FT you are busy calling out airspeeds and performing other duties so saying "Cleared to Land" becomes more of a trained reaction than an actual check. I have over 3,500 hours total time, 2,500 hours with the company and 1,400 hours as a Captain with this company and I have never come close to landing without a clearance until this incident. On my previous aircraft the Final Checklist was to be completed no lower than 1,000 FT AGL when IMC. This worked very well because it allows for the concentration to be focused on landing the aircraft as opposed to running a checklist at 200 FT AGL. My recommendation would be to have the same requirement for this aircraft.

Synopsis

Turboprop Captain reports landing without clearance after his recently hired First Officer becomes overloaded during a night IMC approach and forgets to call the Tower. Company checklist procedures are also cited as a contributing factor.

Page Break

ACN: 910698 *(25 of 256)*

Time / Day

Date : 201009
Local Time Of Day : 1801-2400

Place

Locale Reference.Airport : ZZZ.Airport
State Reference : US
Altitude.MSL.Single Value : 2000

Environment

Flight Conditions : Marginal
Light : Night

Aircraft

Reference : X
ATC / Advisory.Center : ZZZ
Aircraft Operator : Air Carrier
Make Model Name : B767-300 and 300 ER
Crew Size.Number Of Crew : 3

Operating Under FAR Part : Part 121
Flight Plan : IFR
Mission : Passenger
Flight Phase : Climb
Airspace.Class A : ZZZ

Component

Aircraft Component : Aircraft Cooling System
Aircraft Reference : X
Problem : Malfunctioning

Person

Reference : 1
Location Of Person.Aircraft : X
Location In Aircraft : Flight Deck
Reporter Organization : Air Carrier
Function.Flight Crew : Pilot Not Flying
Function.Flight Crew : Captain
Qualification.Flight Crew : Air Transport Pilot (ATP)
Experience.Flight Crew.Total : 22000
Experience.Flight Crew.Last 90 Days : 200
Experience.Flight Crew.Type : 6000
ASRS Report Number.Accession Number : 910698
Human Factors : Troubleshooting
Human Factors : Time Pressure
Human Factors : Fatigue
Human Factors : Confusion
Human Factors : Communication Breakdown
Communication Breakdown.Party1 : Flight Crew
Communication Breakdown.Party2 : Dispatch
Communication Breakdown.Party2 : Maintenance

Events

Anomaly.Aircraft Equipment Problem : Less Severe
Detector.Automation : Aircraft Other Automation
Detector.Person : Flight Crew
When Detected : In-flight
Result.General : Maintenance Action
Result.Flight Crew : Returned To Departure Airport

Assessments

Contributing Factors / Situations : Aircraft
Contributing Factors / Situations : Human Factors
Primary Problem : Aircraft

Narrative: 1

I had been up since early morning prior to international trip. The incident was, mentally, quite fatiguing. After takeoff we got EICAS "EQUIP COOLING OVERHEAT". [We] ran irregular checklist. Just a few minutes later, the First Officer's (pilot flying) primary altimeter goes inoperative, so I take controls. I told the First Officer the easiest way to communicate with Dispatch and Maintenance was via SATCOM. We set it up. The Relief Pilot could NOT communicate on SATCOM so First Officer did that, I flew and the Relief Pilot worked ATC radio. Several times during SATCOM call the SATCOM would drop off requiring another attempt to hook up and/or ACARS communications (slow, distracting, inefficient). Meanwhile there were other communication obligations with Flight Attendants to keep them in loop. Also the forward panels in cockpit were very hot. We were not sure if the loss of First Officer's altimeter was related to equipment cooling overheat. Nor were we sure that there would not be additional equipment failures. The Purser reported that the First Class temperature was very warm, to the point they were sweating. We had FINALLY come up with the resolution to return to our departure airport. [We] got rerouted [and] consideration given to "heavy" landing. It so happened we were below Maximum Landing Weight upon arrival. [We] followed SOPs. Uneventful landing, except brakes were hot from landing weight 318,000 LBS. Then came the additional mental gymnastics of explaining all to mechanics, passengers [and] coordinating with ground personnel. By late evening I realized how exhausted I was. I called Crew Desk and reported too fatigued to continue, which was the plan according to scheduling.

Synopsis

A B767 Captain called in fatigued after an EQUIPMENT COOLING OVERHEAT warning forced a return to land at the departure airport on the outbound leg of an international trip.

---Page Break---

ACN: 910683 *(26 of 256)*

Time / Day

Date : 201009
Local Time Of Day : 1801-2400

Place

Locale Reference.Airport : ZZZ.Airport
State Reference : US
Altitude.MSL.Single Value : 2000

Environment

Flight Conditions : VMC
Weather Elements / Visibility : Turbulence
Light : Night

Aircraft

Reference : X
ATC / Advisory.TRACON : ZZZ
Aircraft Operator : Air Carrier
Make Model Name : B737-700
Crew Size.Number Of Crew : 2
Operating Under FAR Part : Part 121
Flight Plan : IFR
Mission : Passenger
Flight Phase : Initial Approach
Route In Use : Visual Approach
Airspace.Class C : ZZZ

Component

Aircraft Component : Speedbrake/Spoiler
Aircraft Reference : X
Problem : Improperly Operated

Person : 1

Reference : 1
Location Of Person.Aircraft : X
Location In Aircraft : Flight Deck
Reporter Organization : Air Carrier
Function.Flight Crew : Pilot Flying
Function.Flight Crew : First Officer
Experience.Flight Crew.Last 90 Days : 233
ASRS Report Number.Accession Number : 910683
Human Factors : Training / Qualification
Human Factors : Time Pressure
Human Factors : Distraction
Human Factors : Confusion
Human Factors : Situational Awareness

Person : 2

Reference : 2
Location Of Person.Aircraft : X
Location In Aircraft : Flight Deck
Reporter Organization : Air Carrier
Function.Flight Crew : Captain
Function.Flight Crew : Pilot Not Flying
Qualification.Flight Crew : Air Transport Pilot (ATP)
Experience.Flight Crew.Last 90 Days : 211
Experience.Flight Crew.Type : 12000
ASRS Report Number.Accession Number : 910684
Human Factors : Time Pressure
Human Factors : Workload
Human Factors : Fatigue
Human Factors : Distraction
Human Factors : Situational Awareness

Events

Anomaly.Deviation - Procedural : Published Material / Policy
Anomaly.Inflight Event / Encounter : Weather / Turbulence
Detector.Person : Flight Crew
When Detected : In-flight
Result.General : Maintenance Action
Result.Flight Crew : Became Reoriented

Assessments

Contributing Factors / Situations : Human Factors
Contributing Factors / Situations : Manuals
Contributing Factors / Situations : Weather
Primary Problem : Human Factors

Narrative: 1

We were approximately 10 miles south of the airport and cleared for a visual/circle [to land approach]. We were at 4,000 FT at 250 KTS when we were cleared for the visual. I deployed the speedbrakes, descended to 2,000 FT, and slowed to 210 KTS. With a tailwind of 65 KTS at 2,000 FT and a very bumpy ride, I (by mistake) started configuring for landing with the speedbrakes still deployed.

Narrative: 2

We were flying a visual pattern in night VMC. The surface winds were 220/15G20. On the downwind, we had 65 KTS of tailwind at about 2,000 FT AGL. I was the pilot not flying. The speedbrakes were out and we were flying a proper pattern for the wind conditions. I normally arm the speedbrakes for landing at about 210 KTS preparing to configure for landing. On this approach, I was paying a lot of attention to the wind (calling it out to the pilot flying) and ground track and gave a PIREP to the Tower of the wind vector. The pilot flying called for flaps at proper speeds. We configured to landing flaps (30) and both realized the speedbrakes were still deployed. It was bumpy and the airspeed was fluctuating +/- 5 KTS. I stowed the speedbrakes, accomplished the Before Landing Checklist, and we landed. At the gate, I called Dispatch and Maintenance to make sure we didn't need to make a logbook entry. It was the last leg of a four-day trip and I think we were both a little fatigued and not as sharp and attentive as usual. The turbulence and unusual windy conditions made it hard to feel the slight rumbling of the speedbrakes deployed with the flaps. I think in the future, before I call for the first flap extension (or move the flap handle for the pilot flying, I will re-check that the speedbrake is armed for landing. This will prevent this from happening again.

Synopsis

A B737 crew reported that after configuring the aircraft to flaps 30 for landing they realized the speedbrake was still extended.

--Page Break--

ACN: 910121 *(27 of 256)*

Time / Day

Date : 201009
Local Time Of Day : 0601-1200

Place

Locale Reference.Airport : ZZZ.Airport
State Reference : US
Altitude.AGL.Single Value : 0

Environment

Flight Conditions : VMC
Light : Daylight

Aircraft

Reference : X
Aircraft Operator : Air Carrier
Make Model Name : Regional Jet 200 ER/LR (CRJ200)
Crew Size.Number Of Crew : 2
Operating Under FAR Part : Part 121
Mission : Passenger
Flight Phase : Parked
Maintenance Status.Maintenance Deferred : Y
Maintenance Status.Records Complete : N
Maintenance Status.Released For Service : Y
Maintenance Status.Maintenance Type : Unscheduled Maintenance
Maintenance Status.Maintenance Items Involved : Inspection

Component : 1

Aircraft Component : APU
Manufacturer : Bombardier / DeHavilland
Aircraft Reference : X

Component : 2

Aircraft Component : Oil Line
Manufacturer : Bombardier / DeHavilland
Aircraft Reference : X

Person

Reference : 1
Location Of Person.Aircraft : X
Location In Aircraft : Flight Deck
Reporter Organization : Air Carrier
Function.Flight Crew : Captain
Function.Flight Crew : Pilot Flying
Function.Maintenance : Other / Unknown
Qualification.Flight Crew : Air Transport Pilot (ATP)
ASRS Report Number.Accession Number : 910121
Human Factors : Situational Awareness
Human Factors : Fatigue
Human Factors : Confusion
Human Factors : Communication Breakdown
Communication Breakdown.Party1 : Maintenance
Communication Breakdown.Party2 : Maintenance
Communication Breakdown.Party2 : Other
Analyst Callback : Completed

Events

Anomaly.Aircraft Equipment Problem : Critical
Anomaly.Deviation - Procedural : MEL
Anomaly.Deviation - Procedural : Published Material / Policy
Detector.Person : Flight Crew
Were Passengers Involved In Event : N
When Detected : Pre-flight
Result.General : Release Refused / Aircraft Not Accepted
Result.General : Maintenance Action
Result.General : Flight Cancelled / Delayed

Assessments

Contributing Factors / Situations : Aircraft
Contributing Factors / Situations : Chart Or Publication
Contributing Factors / Situations : Company Policy
Contributing Factors / Situations : Environment - Non Weather Related
Contributing Factors / Situations : Human Factors
Contributing Factors / Situations : MEL
Contributing Factors / Situations : Manuals
Primary Problem : Company Policy

Narrative: 1

Picked up CRJ-200 aircraft in ZZZ1. Found paperwork and logbooks and MELs out. Looked like a crew had refused aircraft, but not sure. Read MEL which was a Right IDG Constant Speed Drive, which locks the Generator #2 out. Called Dispatch and Maintenance to confirm APU running and that numbers were applied, since [fuel burn] was not in the remarks. Dispatcher confirmed it was. Maintenance Control stated that MEL for the Generator #2 did not need to be applied to the MEL because Constant Speed Drive [was] included in the MEL. I felt it was correct due to the MEL for the CSD and the Generator consisted of the same (M) and (O) actions, and in VFR conditions (safe to Fly). The actions on the (M) required, that for future flight the APU oil be checked within a Flight Day. Flight Day consists of a 24-hour period (midnight to midnight). The oil was checked in ZZZ [earlier] that morning. So we were legal to depart. Once I landed found out that we were keeping aircraft for the next day. I called Dispatch to inform that the departure time would exceed the 24-hour period for the APU oil check, so on-call [Contract] Maintenance would have to do it. Trying to head-off a problem for the next day. Dispatch informed me that they would tell them. Went to hotel. Next day, called before leaving hotel and informed them again about the MEL APU oil check. Once at the aircraft for flight, found the oil check had not been performed. I feel the MEL requires the APU oil check because it also requires that APU run continuously for every flight, at altitudes up to FL200, where oil coking has been reported to cause problems. Not only that, but by the second flight from ZZZ2 to ZZZ3 and thereafter, we would be encountering weather, and night operations increasing the risk if a failure should occur. I called Dispatch to ask of the company's intentions and was put on hold for about ten minutes. So I called back and talked with my Dispatcher again and told him that I am eating up my minutes on my phone, so I left my cell phone number and asked that Maintenance call me. My phone did ring but it was my Chief Pilot on his personal line. I received two calls from him, one at XA:25, and the other at XA:31. First lasted four minutes and 15 seconds, which he was very professional, and asked me what was going on. I stated my concern and read to him the MEL for the Number-Two CSD requirements and then the definition of Flight Day out of the introduction page of the carrier's MEL book, and told him the times of the last APU oil check out of the Maintenance Logbook. He stated he was at a disadvantage because he did not have a MEL book in front of him. He then stated he will talk with Maintenance then call me back. I waited, then he called back; the second call lasted three minutes and 28 seconds. He stated he talked with Maintenance and they read it as a Calendar Day and that he feels it is safe to go. I reread the MEL and told him the page where it plainly states Flight Day. He told me if I feel it is unsafe that I can refuse the aircraft and they will get on-call Maintenance out to check it, but it would have to be looked into further, but he feels it is safe. He then told me they will check the APU oil in ZZZ2. I told him I am not the only one affected here and I have to speak to my crew, and see how they feel. He then asked me to call him back. Told the Crew what had transpired and told them that the first flight will be in VFR conditions so the risk of flight is severely reduced. Each thought the fallout from the company would be worse than any aircraft problem, and since we received no clarification from the Maintenance Department we weren't sure if we had misread the MEL. We all felt safe to go, and since the APU would be checked in ZZZ2, then the weather would pose no threat. I called Dispatch and told them that we would then go to ZZZ2 and asked [Dispatch] to please pass on to Chief Pilot. They told me he was still on the phone with them and they would. Called Operations and they stated that Maintenance Control called and stated the delay should not be coded on them. Operations then asked me how I wanted to code the delay; I stated code it on the me, (a small part of event, but felt it important). Left for ZZZ2 with a 30 minute delay. Landed in ZZZ2, [contacted] Dispatch through ACARS, if we should hold boarding or board, didn't know how long it would take to do an oil check. No answer. Then the gate Agent asked me to call Operations because the company had called and stated that the Maintenance action did not have to be done. So I told them that I would get hold of the company to find out what was going on. So I sent another ACARS. No answer. Finally Operations sent back that Maintenance would get to it when they had a chance. By that time the ZZZ2 gate Manager was on-board with us, so he had his answer. All was good, didn't have to worry, APU was getting checked before we had to fly into weather or night operations, severely reducing the risk to the crew and passengers if an unseen event may occur. Still was wondering about time line, so tried to call company through commercial radio, but at that time Contract Maintenance showed up. Sent to Dispatch that we were boarding and Maintenance was done, got a message right away from Dispatch saying thanks. Delay should of been shorter, but ZZZ2 Operations asked if they could board another regional carrier beside us. They had Weight and Balance issues and had to kick a jump seater person, leading to a delayed boarding. If the entry into the logbook had not been made the plane would have gone all the way back to ZZZ4 where the work on the IDG would have been done before an entry in the Maintenance Logbook would have ever been done for that Flight Day. It's terrible that our Maintenance Controllers will not even take the time to discuss an MEL with a crew before involving management into the decision. I feel this is a recurring event in the company lately, adding to a very stressful environment. After the event transpired, the moral and effort put forth by the crew was diminished causing fatigue. Last week, on the same last day, flight to ZZZ4, I had to deny [refuse] an aircraft for an IDG with an APU MEL. The APU MEL clearly stated that both main IDGs have to be operative, but Mr. "X" in Maintenance Control stated it was a typo, and when I told him that I can't take it [accept the aircraft], and before the Dispatcher and Mr. "X" could talk about getting Maintenance out to fix the problem, Mr. 'X" just hung up on me and the Dispatcher in the middle of our conversation. Just leaving me and my crew up in the air with no idea what was going to happen for the rest of the night. I talked with crew members and Dispatch and found out I was the second crew member to refuse that aircraft and then a third refused it. I don't know how it got fixed, but that day the weather was hard minimums and there was no way I was attempting those odds with peoples lives in my control. I felt it important to write this to try to improve the relation between crew members and Maintenance Control, to try to relieve the stress [that's] added when every time you call, is a conflict. I really don't know how to fix this. I spoke to our Union Representative after this occurrence and wanted him in the loop if he has to defend me in the future against the company. It seems to be an increasing trend when speaking to other pilots. Maybe an open discussion would be the way to go. The only Maintenance people the pilots come into contact with are the Maintenance people who fix the aircraft and the relations are great with those folks.

Callback: 1

Reporter stated he was later told their Flight Department agrees with Maintenance that the language in their carrier MEL should be "Calendar Day" instead of "Flight Day." But the issue continues because his carrier has not and does not plan to replace the words "Flight Day" with "Calendar Day" in their MEL. Reporter stated the CRJ-200 APU's can operate up to 37,000 FT (FL370). But there have been a number of APU's that have just quit running in flight at higher altitudes due to oil coking in the oil lines. Because the MEL allows an IDG/Generator inoperative deferral, as long as the APU is kept running, than departure is allowed. But the recent problems with APU inflight shutdowns, with an engine IDG/Generator already deferred, creates a safety of flight concern especially in IMC weather. So Bombardier has restricted the aircraft's Dispatch Release with an engine IDG/Generator out, to 20,000' FT (FL200) with the APU running continuously; providing the APU oil is checked once each Flight Day, or each Calendar Day, depending on who's interpretation prevails.

Synopsis

A CRJ-200 Captain reports about recurring conflicts with Maintenance Control involving an MEL requirement to check the APU oil within one "Flight Day" as the MEL states, or within one "Calendar Day" according to Maintenance, whenever an engine IDG/Generator is deferred. APU must remain running but oil coking in the APU oil lines shuts down the APU inflight, leaving only one Generator operating.

--Page Break--

ACN: 909690 *(28 of 256)*

Time / Day

Date : 201008
Local Time Of Day : 1801-2400

Place

Locale Reference.Airport : ZZZ.Airport
State Reference : US
Altitude.AGL.Single Value : 0

Environment

Light : Night

Aircraft

Reference : X
Aircraft Operator : Air Carrier
Make Model Name : B767-300 and 300 ER
Operating Under FAR Part : Part 121
Mission : Passenger
Flight Phase : Parked
Maintenance Status.Released For Service : Y
Maintenance Status.Maintenance Type : Unscheduled Maintenance
Maintenance Status.Maintenance Items Involved : Inspection
Maintenance Status.Maintenance Items Involved : Installation

Component

Aircraft Component : Nose Gear Tire
Manufacturer : Boeing
Aircraft Reference : X

Person : 1

Reference : 1
Location Of Person : Gate / Ramp / Line
Reporter Organization : Air Carrier
Function.Maintenance : Technician
Qualification.Maintenance : Airframe
Qualification.Maintenance : Nondestructive Testing (NDT)
Qualification.Maintenance : Powerplant
ASRS Report Number.Accession Number : 909690
Human Factors : Workload
Human Factors : Time Pressure
Human Factors : Fatigue
Human Factors : Distraction
Human Factors : Communication Breakdown
Human Factors : Situational Awareness
Communication Breakdown.Party1 : Maintenance
Communication Breakdown.Party2 : Maintenance
Analyst Callback : Completed

Person : 2

Reference : 2
Location Of Person : Gate / Ramp / Line
Reporter Organization : Air Carrier
Function.Maintenance : Technician
Qualification.Maintenance : Airframe
Qualification.Maintenance : Powerplant
ASRS Report Number.Accession Number : 904594
Human Factors : Situational Awareness
Human Factors : Communication Breakdown
Human Factors : Distraction
Communication Breakdown.Party1 : Maintenance
Communication Breakdown.Party2 : Maintenance

Person : 3

Reference : 3
Location Of Person : Gate / Ramp / Line
Reporter Organization : Air Carrier

Function.Maintenance : Technician
Qualification.Maintenance : Airframe
Qualification.Maintenance : Powerplant
ASRS Report Number.Accession Number : 905326
Human Factors : Situational Awareness
Human Factors : Communication Breakdown
Human Factors : Distraction
Communication Breakdown.Party1 : Maintenance
Communication Breakdown.Party2 : Maintenance

Events

Anomaly.Aircraft Equipment Problem : Less Severe
Anomaly.Deviation - Procedural : Published Material / Policy
Detector.Person : Maintenance
Were Passengers Involved In Event : N
When Detected.Other
Result.General : Maintenance Action
Result.General : Flight Cancelled / Delayed

Assessments

Contributing Factors / Situations : Aircraft
Contributing Factors / Situations : Company Policy
Contributing Factors / Situations : Environment - Non Weather Related
Contributing Factors / Situations : Human Factors
Contributing Factors / Situations : Procedure
Primary Problem : Human Factors

Narrative: 1

After working a B777 aircraft from the start of the shift that was going to be leaving that evening, we had a Service Check, logbook items, as well as deferrals to accomplish. We, Mechanic "Y" and I, wanted to finish the aircraft before we ate dinner. While eating dinner we were told that a nose tire needed to be changed on a B767-300 aircraft that was on the ramp and it needed to be done soon because the aircraft was needed for a trip. We finished eating, went to get all the equipment for changing the tire and found out the ramp was moving the aircraft to a different terminal for departure. We met the aircraft when it got there. The jetway [electrical] power was not working, so right off the bat we were trying to work with ramp on getting them out of way so we could get the [nose] tire done. Once the ramp was out of the way, we started to work, removed the tire and waited for the Supervisor to check the backup spacer. When the Supervisor showed up, so did ramp with a power unit and they wanted us to move our equipment. We were trying to finish our job and had to stop to move equipment. The Supervisor checked the spacer and Mechanic "Y" and I installed the tire. While we were doing this, the ramp was still having trouble and we just told them to move the power unit off to the side and wait until we were finished. We installed the tire with everything that came off and did not notice the axle nut washer was missing, applied the [initial] torque and the wheel nut torqued as per the paperwork. I spun the tire and Mechanic "Y" torqued. We finished the job and got out of everyones way, so that the aircraft could get ready for its departure. The next day was when we found out we had missed the washer when we had another aircraft coming from ZZZ1 without a washer on a nosewheel. Mechanic "Y" called me to ask about the washer. I didn't recall putting it on and neither did he, so we checked the removed nose tire and the washer was stuck in the grease on the rim; you could hardly see it until you looked for it. This was when we notified the Supervisor and Leads [of our incident] and filled out a report.

Callback: 1

Reporter stated the B767-300 that arrived from ZZZ1 was not the same B767 they had worked on the previous day. But the issue was the same. Mechanics in ZZZ1 had not reinstalled the axle washer on the left nose tire. A Mechanic working the Tire Shop in ZZZ1 had noticed the axle washer stuck to the grease on the wheel rim and quickly informed the mechanics who had changed the tire in ZZZ1, but the aircraft had just taken off, headed for Reporter's station; that's when he and his work partner from the previous day decided to check the left nose tire they had removed from the B767-300. Reporter stated the axle wheel nut can still be properly torqued even without the axle nut washer installed, because the nut does not bottom out when the washer is missing. When the washer is installed, approximately two and a half to three axle threads will be exposed on the externally threaded nose axle, as compared to five threads showing when the washer is not installed. Reporter stated one of their company mechanics at a different Maintenance Station had recently come up with a type of socket that could be used to tighten and torque the nose gear axle nut on the B767, only if the axle washer was installed. That socket is shallower, less deep than the socket they currently use to install and torque the axle nut with. His station does not have that socket yet. They do have a similar type of socket for the B757 and B767 main gear tire axle nuts. Their supervisors now have to view not only the inboard wheel spacer being installed, but the outboard axle washer as well.

Synopsis

Three mechanics report about a B767-300 nose gear axle nut washer that was not reinstalled during a nose tire change he had accomplished with another Mechanic. The mechanics found the axle nut washer the following day, still stuck in the grease on the wheel rim of the removed tire.

----------Page Break----------

ACN: 909292 *(29 of 256)*

Time / Day

Date : 201009
Local Time Of Day : 1201-1800

Place

Locale Reference.ATC Facility : ZZZ.ARTCC
State Reference : US
Altitude.MSL.Single Value : 4000

Environment

Ceiling : CLR

Aircraft

Reference : X
ATC / Advisory.TRACON : ZZZ
Aircraft Operator : Air Carrier
Make Model Name : B767-300 and 300 ER
Crew Size.Number Of Crew : 2
Operating Under FAR Part : Part 121
Mission : Passenger
Flight Phase : Initial Approach
Airspace.Class B : ZZZ

Component

Aircraft Component : Flap Control (Trailing & Leading Edge)
Aircraft Reference : X
Problem : Improperly Operated

Person

Reference : 1
Location Of Person.Aircraft : X

Location In Aircraft : Flight Deck
Reporter Organization : Air Carrier
Function.Flight Crew : Pilot Flying
Function.Flight Crew : First Officer
Experience.Flight Crew.Total : 11000
Experience.Flight Crew.Last 90 Days : 210
Experience.Flight Crew.Type : 4100
ASRS Report Number.Accession Number : 909292
Human Factors : Workload
Human Factors : Situational Awareness
Human Factors : Fatigue
Human Factors : Distraction
Human Factors : Communication Breakdown
Communication Breakdown.Party1 : Flight Crew
Communication Breakdown.Party2 : Flight Crew

Events

Anomaly.Deviation - Speed : All Types
Anomaly.Deviation - Procedural : Published Material / Policy
Detector.Automation : Aircraft Other Automation
Detector.Person : Flight Crew
When Detected : In-flight
Result.Flight Crew : Became Reoriented
Result.Flight Crew : Regained Aircraft Control

Assessments

Contributing Factors / Situations : Human Factors
Contributing Factors / Situations : Procedure
Primary Problem : Human Factors

Narrative: 1

Momentary (less than .5 second) stick shaker activation. We were turned by ATC to base leg at approximately 4,000 FT and 250 KIAS. Deployed speed brakes and landing gear in order lose energy. As airspeed decreased below maximum flap flap speed, I called for flaps 1 at the same time a radio call came in. The Captain did not hear my call for flaps and I did not follow up to insure flaps were being deployed. Airspeed had decreased to approximately VMC minus 15 when a very short "burst" of stick shaker warning was activated. Captain immediately retracted speed brakes and selected flaps 1 as I leveled the wings and added power. Normal, stabilized visual approach followed. Human factors: fatigue [it was the] end of long duty day. Complacency Captain and First Officer had flown together several times and trusted each other to not make mistakes. I should still verify that events I expect to take place (flaps extended) are taking place.

Synopsis

A B767-300 First Officer called for flaps 1 as ATC called and so the Captain failed to make the flap selection. The stall warning shaker sounded momentarily as the First Officer added power and the Captain extended flaps and retracted the spoilers.

Page Break

ACN: 906541 *(30 of 256)*

Time / Day

Date : 201008
Local Time Of Day : 1201-1800

Place

Locale Reference.Airport : ZZZ.Airport
State Reference : US
Altitude.AGL.Single Value : 0

Aircraft

Reference : X
Aircraft Operator : Air Carrier
Make Model Name : Q400
Crew Size.Number Of Crew : 2
Operating Under FAR Part : Part 121
Flight Plan : IFR
Mission : Passenger
Flight Phase : Takeoff

Component

Aircraft Component : Galley Furnishing
Aircraft Reference : X
Problem : Improperly Operated

Person

Reference : 1
Location Of Person.Aircraft : X
Location In Aircraft : Cabin Jumpseat
Reporter Organization : Air Carrier
Function.Flight Attendant : Flight Attendant (On Duty)
Qualification.Flight Attendant : Current
ASRS Report Number.Accession Number : 906541
Human Factors : Fatigue

Events

Anomaly.Flight Deck / Cabin / Aircraft Event : Other / Unknown
Anomaly.Deviation - Procedural : Published Material / Policy
Detector.Person : Flight Attendant
Were Passengers Involved In Event : N
When Detected : In-flight
Result.General : Physical Injury / Incapacitation

Assessments

Contributing Factors / Situations : Aircraft
Contributing Factors / Situations : Human Factors
Contributing Factors / Situations : Procedure
Primary Problem : Human Factors

Narrative: 1

[The caterers] put new full coffee pots in the galley cupboard but they did not secure the locks. As I was securing the galley I overlooked them as well. Upon takeoff the cupboard door flew open and all four pots flew out. My reflex was to put out my right foot to catch the flying pots, which was a stupid mistake! They proceeded to hit me just below the ankle at the soft spot on the right side of the foot. I believe this occurred because I was very tired. I did not sleep well the night prior. I was constantly watching the clock, in anticipation of my [early] wakeup call. I scanned all the galley locks, and just missed that these were not in the proper position. My mistake. As soon as we had our chime and I was able to get out of my jumpseat I placed all the coffee pots back into the cupboard and secured the locks. Then I fixed an icepack for the ankle.

Synopsis

After failing to insure the galley cupboard doors were locked during her preflight, a Flight Attendant was struck by full coffee pots which flew out of the doors on takeoff. Reporter cited fatigue due to inadequate rest during the preceding layover as a contributing factor..

---Page Break---

ACN: 905659 *(31 of 256)*

Time / Day

Date : 201008

Place

Locale Reference.Airport : ZZZ.Airport
State Reference : US
Altitude.AGL.Single Value : 0

Aircraft

Reference : X
Aircraft Operator : Air Carrier
Make Model Name : A320
Crew Size.Number Of Crew : 2
Operating Under FAR Part : Part 121
Mission : Passenger

Person

Reference : 1
Location Of Person.Aircraft : X
Location In Aircraft : General Seating Area
Reporter Organization : Air Carrier
Function.Flight Attendant : Flight Attendant In Charge
Qualification.Flight Attendant : Current
ASRS Report Number.Accession Number : 905659
Human Factors : Other / Unknown
Human Factors : Fatigue

Events

Anomaly.No Specific Anomaly Occurred : All Types
Detector.Person : Flight Attendant
Were Passengers Involved In Event : Y
When Detected : Pre-flight
When Detected : In-flight
Result.General : None Reported / Taken

Assessments

Contributing Factors / Situations : Company Policy
Contributing Factors / Situations : Human Factors
Primary Problem : Ambiguous

Narrative: 1

I was called for the ZZZ turn in the afternoon with an early evening check in. I woke up that day early morning and had no idea the ZZZ turn was a possibility. I had no time to prepare for this trip...to take a nap/rest/eat quality food etc. This turn is a danger to reserve Flight Attendants who get assigned this trip at the last minute. If reserves are going to get this trip we must be allowed a break. If reserves are given this trip we not only need the break but augmented staffing and have an additional working Flight Attendant. On this flight safety was compromised because I was tired and unprepared to have a duty day near 13 hours beginning in the evening. Reserve Flight Attendants who are given this trip are set up to fail because we cannot be at our best. We cannot be the best safety professionals we know we can be when we are trying to stay alert. Safety cannot be jeopardized like this on an airplane. Flight Attendants are truly the eyes ears and nose for the airplane and pilot and we cannot provide the best security of the passengers, crew, and aircraft when we have been up for 25+ hours. We have to have proper rest and advanced notice for a trip like this. I have been assigned this trip before on reserve and nothing has been done. I seriously hope the company and FAA will take these reports seriously because it is truly a huge danger when the safety professionals are exhausted.

Synopsis

Reserve Flight Attendant reports being assigned to an all night two leg flight with no prior warning, after sleeping normally the night prior and waking up in the morning.

Page Break

ACN: 905615 *(32 of 256)*

Time / Day

Date : 201008
Local Time Of Day : 0001-0600

Place

Locale Reference.Airport : ZZZ.Airport
State Reference : US
Altitude.AGL.Single Value : 1000

Environment

Weather Elements / Visibility : Windshear

Aircraft

Reference : X
ATC / Advisory.Tower : ZZZ
Aircraft Operator : Air Carrier
Make Model Name : Commercial Fixed Wing
Crew Size.Number Of Crew : 2
Operating Under FAR Part : Part 121
Flight Plan : IFR
Mission : Passenger

Flight Phase : Final Approach
Airspace.Class C : ZZZ

Person

Reference : 1
Location Of Person.Aircraft : X
Location In Aircraft : Flight Deck
Reporter Organization : Air Carrier
Function.Flight Crew : Pilot Not Flying
Function.Flight Crew : Captain
Qualification.Flight Crew : Air Transport Pilot (ATP)
Experience.Flight Crew.Total : 15000
Experience.Flight Crew.Last 90 Days : 240
Experience.Flight Crew.Type : 2500
ASRS Report Number.Accession Number : 905615
Human Factors : Fatigue
Human Factors : Communication Breakdown
Human Factors : Time Pressure
Communication Breakdown.Party1 : Flight Crew
Communication Breakdown.Party2 : Dispatch
Communication Breakdown.Party2 : Other

Events

Anomaly.Deviation - Procedural : Other / Unknown
Anomaly.Inflight Event / Encounter : Fuel Issue
Anomaly.Inflight Event / Encounter : Weather / Turbulence
Detector.Person : Flight Crew
When Detected : In-flight
Result.General : Flight Cancelled / Delayed
Result.General : Declared Emergency
Result.Flight Crew : Executed Go Around / Missed Approach
Result.Flight Crew : Diverted

Assessments

Contributing Factors / Situations : Company Policy
Contributing Factors / Situations : Human Factors
Contributing Factors / Situations : Weather
Primary Problem : Weather

Narrative: 1

Destination forecast included gusty wind conditions but high ceilings and good visibility. Wind conditions were well within crosswind limitations during the flight planning stage. Enroute to destination wind condition deteriorated prompting consultation with Dispatch. The conclusion was that if conditions didn't improve when the flight was equidistant to alternate and destination we would divert to alternate. Conditions did improve and Dispatch advised aircraft were landing at our destination. Deliberations were made for a potential divert to a new alternate and fuel burns were related from Dispatch. I decided to continue to our destination. Weather in the descent was moderate turbulence in non-convective rain. During vectors to the approach another Airbus went missed approach and diverted to a nearby airport. On approach we received a predictive windshear warning and the First Officer conducted the appropriate go-around procedure. I told Tower we were initiating a missed approach [and] that I was declaring an emergency due to low fuel and we were diverting to a nearby airport. Enroute to the airport was extremely labor intensive and it took some effort to locate the airport's charts. Time was compressed. I took the airplane from the First Officer who was doing a superior job but it looked like he needed a break. [We had] moderate chop/light turbulence and icing enroute. We were vectored below the weather, found the airport and flew a visual approach. Diverting to a relatively small general aviation field with no

Tower and limited services in the middle of the night proved to be a daunting proposition. We had several conflicting issues and priorities. Time was of the essence as we were approaching 12 hours on duty and needed to be SOMEWHERE in less than 14 hours of duty. The Airport Operations personnel advised limited facilities and no bathrooms. Dispatch advised no hotel rooms in the area and no transportation to original destination. Weather at our original airport was not improving. Decided to fuel up with enough gas to go to original destination and divert to a third airport. By the time we got gas it was too late to fly and I was getting fatigued. [I] told Dispatch to develop a flight plan directly to the third airport and weight and balance data and takeoff data. This took time as did dealing with fuelers, Flight Attendants and passengers. Our divert happened in the 11th hour of duty day. The divert was an extremely labor intensive situation. On the ground I had many things to consider and many distractions. Weather at our planned destination, fueling difficulties at our divert station, passenger considerations, the Flight Attendants, mountainous terrain, the dark of night and fatigue. Because I was conscious of our 14 hour duty limitation I called the crew desk on my cell phone. I needed an accurate departure time from the crew desk that would keep us legal and under the 14 hour limit. My first call was put on hold for an extremely long period of time. I had other priorities that required my attention. My second call was even more disappointing. The scheduler I spoke with gave me a time that just didn't add up. I was quoted a XA:47 departure to keep us legal. I didn't have confidence in this assertion, so the First Officer and I put everything on hold while we calculated a necessary departure time of XA:22. We departed at XA:17 from the general aviation airport to a new airport. We arrived there with just moments to spare in our effort to remain within 14 hours of duty. The crew desk estimate was wrong. This was either incompetence or deliberate dishonesty. Either way, the crew desk put the crew and passengers at risk. These crew duty limitations are there for a reason: SAFETY! I will never trust the crew desk again.

Synopsis

An A319 had to declare a fuel emergency and divert to a small airport when excessive winds and a windshear warning on approach at their destination forced them to go-around.

Page Break

ACN: 904829 *(33 of 256)*

Time / Day

Date : 201005
Local Time Of Day : 0001-0600

Place

Locale Reference.Airport : ZZZ.Airport
State Reference : US
Altitude.AGL.Single Value : 0

Environment

Work Environment Factor : Temperature - Extreme
Light : Night

Aircraft

Reference : X
Aircraft Operator : Air Carrier
Make Model Name : B717
Operating Under FAR Part : Part 121
Flight Plan : IFR

Mission : Passenger
Flight Phase : Parked
Maintenance Status.Maintenance Type : Scheduled Maintenance
Maintenance Status.Maintenance Items Involved : Installation
Maintenance Status.Maintenance Items Involved : Inspection
Maintenance Status.Maintenance Items Involved : Work Cards

Component : 1

Aircraft Component : Powerplant Fire Extinguishing
Manufacturer : Boeing
Aircraft Reference : X

Component : 2

Aircraft Component : APU Fire Extinguishing
Manufacturer : Boeing
Aircraft Reference : X

Person

Reference : 1
Location Of Person : Gate / Ramp / Line
Reporter Organization : Air Carrier
Function.Maintenance : Inspector
Qualification.Maintenance : Powerplant
Qualification.Maintenance : Airframe
ASRS Report Number.Accession Number : 904829
Human Factors : Situational Awareness
Human Factors : Communication Breakdown
Human Factors : Fatigue
Communication Breakdown.Party1 : Maintenance
Communication Breakdown.Party2 : Maintenance
Analyst Callback : Attempted

Events

Anomaly.Aircraft Equipment Problem : Critical
Anomaly.Deviation - Procedural : Published Material / Policy
Detector.Person : Maintenance
Were Passengers Involved In Event : N
When Detected : Routine Inspection
Result.General : Maintenance Action

Assessments

Contributing Factors / Situations : Aircraft
Contributing Factors / Situations : Chart Or Publication
Contributing Factors / Situations : Human Factors
Contributing Factors / Situations : Procedure
Primary Problem : Human Factors

Narrative: 1

A B717 aircraft was in for an A-check with a Task Card to replace the fixed airframe mounted engine/APU fire bottle squibs to comply with time change requirements. Of the two bottles (# 1 and # 2) located in the Aft Accessory Compartment, one of the two bottles required all three (engine 1, 2 and APU) squibs to be changed. The other bottle required only the engine squibs to be replaced. The Mechanic inadvertently replaced all three squibs on the wrong fire bottle and failed to replace the required APU squib on the other bottle. As the attending Inspector, it is my responsibility to assure that the work is done correctly; I failed to catch and correct the error, and did not realize it at the time, unaware of the mistake until it was brought to my attention later. The error was discovered by company Maintenance in ZZZ1 on the next A-Check on a follow-up Task Card. My understanding is that a Fire Bottle Squib DOM (Date of Manufacture) Tag Check Card was issued against a B717 aircraft and ZZZ1 Maintenance discovered that the squib in question had overflown its expiration date by approximately 19 days. The discrepancy was documented and repaired. B717 airframe engine/APU fire bottles are mounted in the Aft Accessory Compartment in very close confines. Installed clearances of components in the area are very compact and tight. The squibs are difficult to access and see and usually require a lot of positioning of one's self and the use of a mirror and strong flashlight. The compartment at the time was very hot and stuffy and the close confines can make breathing difficult, which is what happened to me. As a result, I may not have been as alert as I should have been and did not see the error. I may have been tired at the time this incident occurred. ZZZ1 Maintenance documented the discrepancy and replaced the expired APU squib. Astute absolute attention to detail: exactly what the task card is calling out and to make 100% certain that I identify bottle # 1 as distinguished from bottle # 2--and make 100% certain that the correct action was taken against the proper component!

Synopsis

A Maintenance Inspector reports he failed to notice a Mechanic had inadvertently replaced all three squibs on the wrong fire bottle. Mechanic had also failed to replace the required APU squib on the other bottle during the same A-Check. Company Maintenance at a different station discovered the expired squib date during the next follow-up A-Check.

----------Page Break----------

ACN: 904589 *(34 of 256)*

Time / Day

Date : 201008
Local Time Of Day : 0001-0600

Aircraft

Reference : X
Aircraft Operator : Air Carrier
Make Model Name : Commercial Fixed Wing
Crew Size.Number Of Crew : 2
Operating Under FAR Part : Part 121
Flight Plan : IFR
Mission : Passenger

Person

Reference : 1
Location Of Person.Aircraft : X
Location In Aircraft : Galley
Cabin Activity : Service
Cabin Activity : Safety Related Duties
Reporter Organization : Air Carrier
Function.Flight Attendant : Flight Attendant (On Duty)
Qualification.Flight Attendant : Current
ASRS Report Number.Accession Number : 904589
Human Factors : Workload
Human Factors : Fatigue
Human Factors : Physiological - Other

Events

Anomaly.Deviation - Procedural : Published Material / Policy
Detector.Person : Flight Attendant
Were Passengers Involved In Event : N
Result.General : Work Refused

Assessments

Contributing Factors / Situations : Company Policy
Contributing Factors / Situations : Human Factors
Contributing Factors / Situations : Staffing
Primary Problem : Company Policy

Narrative: 1

I am completely fatigued. Mentally and physically. I wish I was a better writer and had the ability to come up with some fantastic metaphor that would fully express just how tired and beaten down I am. Alas, I can not. However, I can truthfully say that military boot camp, where sleep deprivation and 3:00 am surprise barrack inspections were the norm, was the only other time in my life I have been this thoroughly exhausted. I slept fairly well last night. Not like a baby, the walls are simply too thin and the bed too hard at the layover hotel for that to happen, but as well as could be expected in a cheap hotel room away from home. The cumulative effects of month after month of 6 and 7 leg 12 hour plus duty days, followed by 12 hour or less overnights, routine and unavoidable circadian swaps have taken a toll. I am one burnt out Flight Attendant! On my first flight of the day, a short haul, I had difficulty remembering parts of the safety pre-departure announcement. When we got in the air, having only a water service to perform, I had difficulty setting up the cart. I couldn't seem to get through my head that I didn't need the ice, coffee cups or juice boxes. I set up the cart wrong 2 consecutive times with all the superfluous items! My flying partner had to essentially scream "water and cups!" at me a few times before I was able to perform that most basic task. As we were finishing the water service I got frustrated when I was unable to move the cart. I grit my teeth and pulled on the damn thing 5 times before I remembered I had to take the brake off. That is complete mental fatigue and makes me entirely unfit for flight. This fatigue call is the second in three weeks for me. I have until recently had an exemplary attendance record. I didn't miss a single day of work here in my first year plus on the job. There is simply a limited amount of time even the young and healthy can do the work of two before the body starts to rebel. Our airline must find a way to end the circadian swaps, start allowing flight attendants to use their accrued vacation time, and schedule a few more days every bid where we don't have to choose between sleeping and eating. My body, (and I am certainly not alone), simply can't handle these schedules in perpetuity.

Synopsis

A Flight Attendant reported the chronic deleterious effects of extended periods of physiologically debilitating scheduling practices at his airline.

---Page Break---

ACN: 904075 *(35 of 256)*

Time / Day

Date : 201008
Local Time Of Day : 0001-0600

Place

Locale Reference.Airport : ZZZ.Airport
State Reference : US
Altitude.AGL.Single Value : 0

Aircraft

Reference : X
Aircraft Operator : Air Carrier
Make Model Name : A319
Crew Size.Number Of Crew : 2
Operating Under FAR Part : Part 121
Flight Plan : IFR
Mission : Passenger

Component : 1

Aircraft Component : Air Conditioning and Pressurization Pack
Aircraft Reference : X

Component : 2

Aircraft Component : Normal Brake System
Aircraft Reference : X
Problem : Malfunctioning

Person

Reference : 1
Location Of Person.Aircraft : X
Location In Aircraft : Flight Deck
Reporter Organization : Air Carrier
Function.Flight Crew : Pilot Not Flying
Function.Flight Crew : First Officer
Experience.Flight Crew.Total : 12500
Experience.Flight Crew.Last 90 Days : 251
Experience.Flight Crew.Type : 6300
ASRS Report Number.Accession Number : 904075
Human Factors : Fatigue
Human Factors : Communication Breakdown
Human Factors : Time Pressure
Communication Breakdown.Party1 : Flight Crew
Communication Breakdown.Party2 : Ground Personnel

Events

Anomaly.Deviation - Procedural : Published Material / Policy
Detector.Person : Flight Crew
Were Passengers Involved In Event : N
When Detected : Aircraft In Service At Gate
Result.General : Work Refused
Result.General : Maintenance Action
Result.General : Release Refused / Aircraft Not Accepted

Assessments

Contributing Factors / Situations : Aircraft
Contributing Factors / Situations : Company Policy
Contributing Factors / Situations : Human Factors
Primary Problem : Company Policy

Narrative: 1

The main thrust of this report concerns the continued "pilot pushing" at our airline with another documented event that I directly experienced. Pilot sequence schedule X does not reveal the intended operation of Pilot sequence schedule X. Therefore, Pilot sequence schedule X must be examined in order to understand how this unfolded for the pilots of this ID. The beginning of this pilot pushing event began with the Captain's refusal of the Airbus 319 for flight XX/ZZZ-ZZZ2 due to a pack being deferred inoperative. While waiting on the ground in ZZZ for the call/notification that the A319 was either going to be repaired or replaced for the subject flight XX, no call to us from Maintenance Control, or Dispatch ever occurred during that afternoon. The only call to the Captain came from Regional Assistant Chief Pilot, Captain Y. The issues relayed to me from Captain X's message from Captain Y was that Captain Y wanted to "discuss" the refusal with Captain X along with Captain X's "plans for the passengers" I'm not sure what was meant by plans for the passengers in this context. In accordance with Aircraft Refusal, Flight Operations Manual (FOM) page 7.30.1, no other party besides the Captain, Dispatch, and/or Maintenance Control is to be involved in the refusal process unless the Captain concurs with other parties participation. Captain X did not need or request any further outside intervention on his/her decision for the A319's refusal, hence only the above parties (Captain, Dispatch, and Maintenance Control) should have been involved in this decision. Again, no call from an appropriate agency (Dispatch or Maintenance Control only) came during this period. After a period of time with no calls, I went back to the computer and checked on the A319's status and only then did I realize we had subsequently been assigned Aircraft YY for this flight. This aircraft was due to arrive at the gate in ZZZ at approximately XA:38 local time with flight XX's new departure time scheduled for XB:15L. After new papers and weather were checked, the release for flight XX with Aircraft YY was signed and we proceeded to the gate to meet the aircraft and flight attendants. During the latter part of the arriving flight's deplaning I proceeded outside to conduct the preflight. Upon my return all of the passengers were gone but the previous flight's pilots were still in the cockpit working on a discrepancy that was discovered upon landing at ZZZ. Both Captains (arriving/departing) were discussing what happened as I returned from the walk around. The history is available for retrieval if desired but the discrepancies that were submitted were BSCU #2 and BRAKES HOT ECAM's, but only on the left main. The right main was normal. After the off going crew departed, Captain X briefed me on the discussion that occurred with the off going Captain. Apparently, the previous Captain stated that as the aircraft exited the runway after a normal landing, the BSCU #2 ECAM and the high brake temperature occurred almost instantly after exiting the runway; highly unusual for the Airbus as brake temperatures will normally gradually increase at possibly an increased rate, but not instantly. Also, high brake temperatures by themselves do not fail a BSCU. Additionally, the previous Captain stated the left main had both a tire and brake change in ORD before their flight. Armed with this information for the present malfunction along with the previous history for the left main from the crew, Captain X then refused this aircraft as well due to a possible bad brake assembly on the left side or, some other malfunction that had not been defined to the crew. Soon after this decision was made, ZZZ Maintenance Control arrived to clear the BSCU/hot brake ECAM. Along with the mechanic, a Maintenance Control supervisor accompanied them on the flight deck. Is this necessary in and of itself (supervisor)? The technician recycled the BSCU/Nose wheel steering switch as the pilots are allowed to do in the flight manual to no avail. He subsequently reset the circuit breakers for the respective Maintenance Control procedure to no avail either. Only after the brake temp was below 300 degrees with the "Hot Brake" message cleared did the BSCU reset with another CB reset. The technician stated the BSCU will not reset until the brakes are below 300 degrees and that the overtemp likely caused the BSCU failure. Using his logic, I then asked the technician why when the BSCU #2 failed for this reason (high temperature), did the BSCU #1 NOT fail immediately as well, when that computer (BSCU #1) took over as the brake temperature at that moment was identical when BSCU #2 failed? He could not offer an explanation. Another system test was run in ACARS on the BSCU system after the Hot Brakes ECAM cleared and all tests passed. Both the Maintenance Control supervisor and technician proceeded downstairs to look at the left main and never returned to hopefully explain the previous brake issue and tire change to Captain X. During this exchange, the Captain was on the phone with Maintenance Control trying to further clarify the previous history and he stated that Maintenance Control asked them if local Maintenance Control had checked the brakes with a thermometer! Why is Maintenance Control asking the flight crew this question instead of asking their own local Maintenance Control personnel and then relaying the answer to the flight crew?! Shortly after the Maintenance Control team's departure Captain Y from ZZZ FO arrived at the aircraft with another person but I cannot remember his name. I believe by this time it was approximately XB:50L when Captain Y began his discussion with us. Captain X again described in great detail his rationale for the refusal of this A319, due to no one being able to "connect the dots" on the previous history and the BSCU failure along with the rapid brake temperature rise on the previous landing at ZZZ. At this point I feel is where the discussion from Captain Y should have ceased but it did not. He specifically asked us if we were willing to waive the contract for duty day limits and fly to FAR limits if they could find another aircraft as I presume he was already made aware of our impending duty day limit by the crew desk. The contractual limit for us on 10 August, was XC:14L and we were not willing to waive. Another comment was made by Captain Y that they them self would take the flight, but they guessed they would have to find another First Officer, if I was not going to waive the contractual limit, and I was not. This is absolutely, totally, out of line. First, NO flight operations management personnel were needed or requested on the aircraft, either operationally or via SOP in accordance with the FOM. Second, all duty day discussions are to be terminated immediately when the crew states they will NOT waive the contractual duty day limits. There is to be no "asking to waive" FAR limits ever. The discussion is over and nothing else is to be debated. Captain Y subsequently left the aircraft and we began to pack up and begin the discussion with scheduling to find a hotel for the night and what was to be done with the remainder of our flight sequence. During the initial call to the crew desk as the day was over, the desk set up rooms at an airport hotel but could not tell us what was going to happen with the remainder of the ID at that point. The room booking occurred at XC:25L according to the ID audit trail. A period of time passed and as we approached the main terminal we decided to check the computer room with the hopes of finding out what we were doing for the rest of the ID. At this point, after logging on and seeing the ID we discovered we were booked on another carrier (booking occurred at XC:43L) the next morning in order to pick up the remainder of the ID and the last leg to ZZZ3 from ZZZ2. No instructions were received from the crew desk for the flight except check in at ticket counter as per the ID audit trail. Had we followed these rather ill-advised instructions, we would not have made the flight using domestic rules (one hour show time)as we had been told. We then attempted to check in on the carrier's web site thinking we would be booked in first class and we did not want to lose the seats. During this process, we discovered we were booked in Row 30, not first class. At this point I called the desk back and inquired about the contractual language requiring us to be booked into first class as business class was not available on this flight and it was off line. This entire discussion itself grew bigger as the minutes wore on. Calls were made to our union contract hot line, our union reps, and the crew desk personnel as well with the hopes of researching the answer. The decision stood (no first class), and after speaking with the crew desk supervisor, I was then placed on hold and then Captain Y was placed on the phone to discuss this issue. After this entire firestorm we were denied first class seats but Captain Y's larger concern was that we were still at the airport and NOT in rest at the hotel. This discussion with Captain Y occurred at approximately XD:02L, just short of 14 hours before departure and was not even close to affecting our duty day for the next day. More importantly though, why is a crew being asked why are they not in rest when they are trying to understand why a completely black and white sentence in our contract states they should be in different deadhead seats that has to do with a current ID? Contractual rest is not to be interrupted by the company issues, especially when there is a question concerning the current ID that is in progress? So why then should the Assistant Chief Pilot be concerned that we were not in rest yet when he knew there were possible contractual issues being addressed for the reassignment? We were well within our rights to determine if the reassignment on the current ID was legal and within the bounds of the contract going into rest for the evening. I'm sorry, but the crew desk has been proven wrong on enough occasions on their decisions that requesting a simple explanation for an answer that they have provided that specifically goes against ONE sentence in the contract is well within reason to question. This was a reassignment made to this crew and all we were attempting to do was authenticate its legality as it was presented to us in the scheduling computer. Upon arriving at the pickup point for the transportation to the hotel, the Captain was told after he called company to see where they were at that they had not even received the voucher for the trip. This occurred at XD:30L, one hour and 5 minutes AFTER the "rooms needed" remark was placed into the audit trail. Where was the urgency for our rest from the crew desk if this event had not even been accomplished? The keys were issued to us at XD:45L at the hotel for the evening. I've attempted to portray "pilot pushing" events that continue at the company with this chronology as they played out for Pilot sequence schedule X August 2010 at ZZZ culminating with a refusal to waive contractual duty limits with ZZZ Flight Operations supervision. Apparently, the FAA has chosen to look at these events with a blind eye because they seem to occur over and over again, with only the flight operations management personnel changing for the next event but the methodology remains the same. This report is being filed via company channels, but I will retain a copy as well because it's quite obvious to many crews now that this behavior (questioning crews to determine if they will be waiving duty day limits, "helping" crews with flight operations management personnel visiting the aircraft after a refusal when they are not in the decision loop unless desired by the Captain in accordance with SOP) is both condoned and expected by senior management, and it continues to be allowed by the FAA. I want to be able to produce concrete evidence of senior management protocol in aircraft refusals since I doubt this FSAP will be "retrievable" if necessary for a potential future event at Company Airlines, if one were to occur.

Synopsis

An A319 First Officer reports efforts by his airline to inappropriately coerce the flight crew to accept two aircraft assigned to their flight when they had already deemed them unacceptable. Reporter avers this is a normal practice at his airline which he is documenting.

---Page Break---

ACN: 903940 *(36 of 256)*

Time / Day

Date : 201008
Local Time Of Day : 0001-0600

Place

Locale Reference.Airport : DCA.Airport
State Reference : DC
Altitude.MSL.Single Value : 1000

Environment

Flight Conditions : Marginal
Weather Elements / Visibility : Haze / Smoke
Light : Night

Aircraft

Reference : X
ATC / Advisory.TRACON : PCT
Aircraft Operator : Air Carrier
Make Model Name : A320
Crew Size.Number Of Crew : 2
Operating Under FAR Part : Part 121
Flight Plan : IFR
Mission : Passenger
Nav In Use : FMS Or FMC
Nav In Use.Localizer/Glideslope/ILS : LDA 19
Flight Phase : Final Approach
Flight Phase : Initial Approach
Airspace.Class B : DCA

Person

Reference : 1
Location Of Person.Aircraft : X
Location In Aircraft : Flight Deck
Reporter Organization : Air Carrier
Function.Flight Crew : Captain
Function.Flight Crew : Pilot Flying
Qualification.Flight Crew : Air Transport Pilot (ATP)
Experience.Flight Crew.Total : 15000
Experience.Flight Crew.Last 90 Days : 150

Experience.Flight Crew.Type : 4000
ASRS Report Number.Accession Number : 903940
Human Factors : Training / Qualification
Human Factors : Situational Awareness
Human Factors : Fatigue
Analyst Callback : Attempted

Events

Anomaly.Deviation - Track / Heading : All Types
Anomaly.Deviation - Procedural : Published Material / Policy
Anomaly.Deviation - Procedural : Clearance
Detector.Person : Flight Crew
When Detected : In-flight
Result.General : None Reported / Taken

Assessments

Contributing Factors / Situations : Airport
Contributing Factors / Situations : Airspace Structure
Contributing Factors / Situations : Chart Or Publication
Contributing Factors / Situations : Human Factors
Primary Problem : Human Factors

Narrative: 1

Late night arrival, we were first cleared for the visual to Runway 19. It was too hazy and dark for us to pick up the river in time. We were vectored around to the LDA approach. We quickly reviewed and briefed the approach and commenced the approach. The visibility was poor, though legal, for the approach. It was very difficult to see the visual landmarks and do the circling part of the approach. We were very aware of avoiding the prohibited areas and may have inadvertently strayed too far west. It was VERY difficult to see our exact position as it was after midnight on a very dark night with haze. I had never done this approach in my 30+ years of flying and we were both very fatigued. We made every effort to fly the approach correctly but this was, by far, the most difficult approach I have ever flown in my 5 years on the Airbus. I do not feel that the Commercial Chart pages and depictions are adequate for a night approach by someone unfamiliar with the airport and the extremely difficult approaches, especially at night and in reduced visibility. This approach should be a simulator training approach instead of a very simple NDB!

Synopsis

A320 Captain describes difficulties encountered during the LDA DME 19 approach to DCA. The approach occurred late at night in reduced visibility and was the first time for this reporter. Reporter believes that simulator training should be required prior to flying the actual approach.

Page Break

ACN: 903740 *(37 of 256)*

Time / Day

Date : 201007
Local Time Of Day : 0001-0600

Aircraft

Reference : X
Aircraft Operator : Air Carrier
Make Model Name : Q400
Crew Size.Number Of Crew : 2
Operating Under FAR Part : Part 121
Flight Plan : IFR
Mission : Passenger
Cabin Lighting : High

Person

Reference : 1
Location Of Person.Aircraft : X
Location In Aircraft : General Seating Area
Reporter Organization : Air Carrier
Function.Flight Attendant : Flight Attendant In Charge
Function.Flight Attendant : Flight Attendant (On Duty)
Qualification.Flight Attendant : Current
ASRS Report Number.Accession Number : 903740
Human Factors : Physiological - Other
Human Factors : Fatigue
Human Factors : Workload

Events

Anomaly.Other
Detector.Person : Flight Attendant
When Detected : Aircraft In Service At Gate
Result.General : None Reported / Taken

Assessments

Contributing Factors / Situations : Company Policy
Contributing Factors / Situations : Human Factors
Contributing Factors / Situations : Weather
Primary Problem : Ambiguous

Narrative: 1

Looking back on this day I am almost certain I was suffering from fatigue, I felt as if once in flight I hit a "wall" having to work twice as hard to be alert and awake. I and the other Flight Attendant observed we were tripping on things we normally would have noticed and I was having to double, triple and quadruple check simple tasks to ensure I was properly completely my duties. Prior to leaving I was tired and discussed with crew the possibility that after leaving on our last flight that THEN we would really start to feel the effects of a 15.5 hour day. Upon further reflection on the trip, and how hard simple tasks became I became aware I was probably fatigued on the flight to ZZZ. It was a scheduled 12 hour day. We were delayed due to a mechanical on the plane we were scheduled to deadhead on. After a plane swap we departed at 2.5 hours late. We then did a round trip almost three hours late, as there were no reserve crews to cover any flights that day. It was a turbulent flight both there and back due to storms. We then left to ZZZ three hours late as well. I think the scheduling of 15.5 hours is too long and potentially unsafe. I feel that when you factor in the early report time, plus factor in the drive to work and the time taken to get up and ready, that is an extremely long day. We should have been swapped out from the round trip and been on time to ZZZ.

Synopsis

A Q400 flight attendant described the physical fatigue effect of a fifteen and a half hour day.

Page Break

ACN: 903251 *(38 of 256)*

Time / Day

Date : 201008
Local Time Of Day : 1201-1800

Place

Locale Reference.ATC Facility : ZZZZ.ARTCC
State Reference : FO
Relative Position.Distance.Nautical Miles : 30
Altitude.MSL.Single Value : 15000

Environment

Flight Conditions : VMC
Light : Daylight

Aircraft

Reference : X
ATC / Advisory.Center : ZZZZ
Aircraft Operator : Air Carrier
Make Model Name : B767-300 and 300 ER
Crew Size.Number Of Crew : 2
Operating Under FAR Part : Part 121
Mission : Cargo / Freight
Flight Phase : Climb

Component

Aircraft Component : Altimeter
Aircraft Reference : X
Problem : Improperly Operated

Person : 1

Reference : 1
Location Of Person.Aircraft : X
Location In Aircraft : Flight Deck
Reporter Organization : Air Carrier
Function.Flight Crew : First Officer
Function.Flight Crew : Pilot Flying
Experience.Flight Crew.Total : 11600
Experience.Flight Crew.Last 90 Days : 115
Experience.Flight Crew.Type : 257
ASRS Report Number.Accession Number : 903251
Human Factors : Situational Awareness
Human Factors : Fatigue
Human Factors : Confusion

Person : 2

Reference : 2
Location Of Person.Aircraft : X
Location In Aircraft : Flight Deck
Reporter Organization : Air Carrier
Function.Flight Crew : Captain
Function.Flight Crew : Pilot Not Flying
Qualification.Flight Crew : Air Transport Pilot (ATP)
Experience.Flight Crew.Total : 12000
Experience.Flight Crew.Last 90 Days : 85
Experience.Flight Crew.Type : 5000
ASRS Report Number.Accession Number : 903252
Human Factors : Situational Awareness
Human Factors : Fatigue
Human Factors : Confusion

Events

Anomaly.Deviation - Altitude : Overshoot
Anomaly.Deviation - Procedural : Clearance
Anomaly.Deviation - Procedural : Published Material / Policy
Detector.Person : Air Traffic Control
When Detected : In-flight
Result.Flight Crew : Became Reoriented
Result.Flight Crew : Returned To Clearance

Assessments

Contributing Factors / Situations : Human Factors
Primary Problem : Human Factors

Narrative: 1

On departure from a Middle Eastern airport we leveled at 13,000 MSL. That was the transition altitude for the area that day. We got clearance to climb to 15,000 MSL. The autopilot was engaged and started a climb. Upon leveling, ATC questioned are altitude and asked if we had 1013 MB set in our altitude window. I was the flying pilot and disconnected the autopilot and returned to 15,000 MSL. The standard altimeter setting was never set to 1013 MB. Both the Captain and I had forgotten to do that. There were never any TCAS alerts or appeared to be another aircraft in our vicinity. The rest of the flight continued to destination without incident. The factors leading up to this incident could have been fatigue. Although the Captain and I felt we were able to operate this flight safely, our schedule leading up to this was causing fatigue issues that were unaware to both of us. This was the next to the last day of a 14 day trip around the world. Our circadian rhythm is routinely disrupted on these long trips around the world. More rest is needed on the layovers to properly get the crew ready for the task at hand. Just because it is legal in the eyes of the FAA and the company, doesn't mean its safe! I feel the system we operate in is a very good system, but some things need to change for the better. Our international schedules are very demanding on the mind and the body. I would like to see more stringent rest rules that correct circadian rhythm disruptions. Until then we as pilots will continue to be professionals and operate our aircraft in the safest way possible!

Synopsis

A B767-300 crew failed to set the current altimeter when passing the Transition Altitude for that day and leveled off high. ATC queried their altitude and so they returned to the assigned altitude. The crew was on day thirteen of a fourteen day trip and believe fatigue was an issue.

Page Break

ACN: 902881 *(39 of 256)*

Time / Day

Date : 201008

Place

Altitude.AGL.Single Value : 0

Aircraft

Reference : X
Aircraft Operator : Air Carrier
Make Model Name : A320
Operating Under FAR Part : Part 121
Mission : Passenger

Person

Reference : 1
Location Of Person.Aircraft : X
Location In Aircraft : General Seating Area
Reporter Organization : Air Carrier
Function.Flight Attendant : Flight Attendant (On Duty)
ASRS Report Number.Accession Number : 902881
Human Factors : Fatigue
Human Factors : Situational Awareness

Events

Anomaly.Deviation - Procedural : Published Material / Policy
Detector.Person : Flight Attendant
When Detected : In-flight
Result.General : None Reported / Taken

Assessments

Contributing Factors / Situations : Company Policy
Contributing Factors / Situations : Environment - Non Weather Related
Contributing Factors / Situations : Human Factors
Primary Problem : Ambiguous

Narrative: 1

This flight left two and half hours later than planned due to a mechanical. It arrives in Anchorage and flight crews come back. It is already scheduled as a 13 hour duty day. With a two hour delay we were at a 15 hour duty day. Flying all night with no ability to rest can be very dangerous. This flight arrived in Anchorage [in the middle of the night home time] and it was turned in 40 minutes. There was absolutely no time to close one's eyes for even a minute. The flight is five hours each way. There were several times on the way back that I was not fully alert and was beginning to nod off. I became very drowsy and tripped a couple of times as I was walking up and down the aisle to check on seat belts. It would have been very helpful to have a place to shut my eyes for a brief power nap to enable me to be more alert during the flight. I would suggest a crew rest seat be made available for this particular flight for flight attendants to be able to rotate a brief rest during this long flight in the middle of the night. After we landed [at home] and we were told to disarm doors I found myself having to concentrate very hard on the door to ensure that I disarm correctly. Additionally during my drive home I found myself nodding off.

Synopsis

A Flight Attendant reported extreme fatigue on an all night two-leg flight to ANC and back.

ACN: 902326 *(40 of 256)*

Time / Day

Date : 201008
Local Time Of Day : 1201-1800

Place

Locale Reference.Airport : ZZZ.Airport
State Reference : US
Relative Position.Angle.Radial : 062
Relative Position.Distance.Nautical Miles : 30
Altitude.MSL.Single Value : 10000

Environment

Flight Conditions : VMC
Light : Daylight

Aircraft

Reference : X
ATC / Advisory.TRACON : ZZZ
Aircraft Operator : Air Carrier
Make Model Name : Beech 1900
Crew Size.Number Of Crew : 2
Operating Under FAR Part : Part 121
Flight Plan : IFR
Mission : Passenger
Flight Phase : Climb
Route In Use.SID : Plains 4
Airspace.Class E : ZZZ

Person

Reference : 1
Location Of Person.Aircraft : X
Location In Aircraft : Flight Deck
Reporter Organization : Air Carrier
Function.Flight Crew : First Officer
Function.Flight Crew : Pilot Flying
Qualification.Flight Crew : Commercial
Qualification.Flight Crew : Multiengine
Experience.Flight Crew.Total : 2300
Experience.Flight Crew.Last 90 Days : 200
Experience.Flight Crew.Type : 1500
ASRS Report Number.Accession Number : 902326
Human Factors : Fatigue

Events

Anomaly.Deviation - Altitude : Overshoot
Anomaly.Deviation - Procedural : Clearance
Detector.Person : Air Traffic Control
When Detected : In-flight
Result.Air Traffic Control : Issued New Clearance

Assessments

Contributing Factors / Situations : Human Factors
Primary Problem : Human Factors

Narrative: 1

ATC had assigned 9,000 FT as our initial altitude however we had entered into our altitude preselect 10,000 and checked on with Departure that we were climbing to 10,000 FT. ATC didn't correct the altitude. We leveled off at 10,000 FT, which was 1,000 FT high. After a few minutes at that altitude, ATC asked what our altitude was and then gave us a climb. It did not appear that there was a loss of separation. One of the contributing factors to this occurrence was that we were fatigued. Neither the Captain nor I had slept well in our hotel [the previous night]. The Captain was on reduced rest, as he had come in on a later flight the night before. I had dead-headed in on an earlier flight in the day. The flight where the altitude deviation occurred was leg 6 of 7 for us and the last day of the trip. We had been working non-stop since early that morning. We did not have any time for any real meals. This is common practice for [our airline's] scheduling practices. We are very short staffed and our schedules are having us fly more than in the past. This type of event could be minimized by giving flight crews longer overnights, time for meals and shorter duty days. Reduced rest the night before and a 13:30 duty day with minimal breaks does not promote safety.

Synopsis

A BE1900 First Officer reported an altitude deviation that he attributed in large part to fatigue, citing his regional air carrier's policies as contributing to fatigue problems.

--------------------Page Break--------------------

ACN: 902322 *(41 of 256)*

Time / Day

Date : 201008
Local Time Of Day : 0001-0600

Place

Locale Reference.Airport : ZZZ.Airport
State Reference : US
Altitude.AGL.Single Value : 0

Environment

Work Environment Factor : Temperature - Extreme
Light : Night

Aircraft

Reference : X
Aircraft Operator : Air Carrier
Make Model Name : Regional Jet 200 ER/LR (CRJ200)

Operating Under FAR Part : Part 121
Mission : Passenger
Flight Phase : Parked
Maintenance Status.Released For Service : Y
Maintenance Status.Maintenance Type : Scheduled Maintenance
Maintenance Status.Maintenance Items Involved : Testing
Maintenance Status.Maintenance Items Involved : Inspection
Maintenance Status.Maintenance Items Involved : Work Cards

Component : 1

Aircraft Component : APU
Manufacturer : Bombardier / Canadair
Aircraft Reference : X

Component : 2

Aircraft Component : Oil Filler Cap
Manufacturer : Bombardier / Canadair
Aircraft Reference : X
Problem : Improperly Operated

Person

Reference : 1
Location Of Person : Hangar / Base
Reporter Organization : Air Carrier
Function.Maintenance : Inspector
Qualification.Maintenance : Airframe
Qualification.Maintenance : Powerplant
ASRS Report Number.Accession Number : 902322
Human Factors : Workload
Human Factors : Time Pressure
Human Factors : Distraction
Human Factors : Communication Breakdown
Human Factors : Fatigue
Communication Breakdown.Party1 : Maintenance
Communication Breakdown.Party2 : Maintenance

Events

Anomaly.Deviation - Procedural : Maintenance
Anomaly.Deviation - Procedural : Published Material / Policy
Detector.Person : Flight Crew
When Detected : Pre-flight
Result.General : Maintenance Action

Assessments

Contributing Factors / Situations : Company Policy
Contributing Factors / Situations : Human Factors
Contributing Factors / Situations : Staffing
Primary Problem : Human Factors

Narrative: 1

I was working a CRJ-200 aircraft August 2010 in the APU bay area, on the APU and other servicing routines for a Service Check and through maintenance for this aircraft. I had oil and fuel spillage in the [APU] bay area to clean up and had serviced the oil tank. I closed the cap on the oil tank and apparently thought the cap was on. I was bounced around other aircraft that night and had to come back to this aircraft to finish Leak and Run Checks which were good on the APU assembly. The aircraft had to go to the Run-Up [area] for engine runs and I was the only one qualified to Taxi and Run this aircraft. I felt that I was rushed to get aircraft out on time, delivered aircraft back to gate and went back to hangar to finish paperwork for this aircraft. Then I got a call to [to the] gate to Inspect oil servicing tank lid for security and found it loose, secured lid and found a rag behind the tank. Went to talk to the [Flight] Crew and told then I had secured the lid and found the rag. No documentation was noted in the Logbook, so I went back to the hangar and nothing was said. Too many projects started at one time, need to stay focused on task at hand. Jumping around to too many aircraft due to shortage of manpower. Feel that I am rushed under pressure due to gate times. Need more people to become more Taxi/Run qualified.

Synopsis

Mechanic feeling rushed and under pressure to get their aircraft to the gate for on-time departures, failed to properly secure an APU oil cap. Mechanic noted the difficulty working too many Maintenance Tasks on too many aircraft due to lack of manpower, fatigue and too few qualified Taxi/Run mechanics for the workload expected to be accomplished.

---Page Break---

ACN: 902289 *(42 of 256)*

Time / Day

Date : 201007
Local Time Of Day : 0001-0600

Place

Locale Reference.Airport : ZZZ.Airport
State Reference : US
Altitude.AGL.Single Value : 0

Environment

Light : Night

Aircraft

Reference : X
Aircraft Operator : Air Carrier
Make Model Name : Regional Jet 200 ER/LR (CRJ200)
Crew Size.Number Of Crew : 2
Operating Under FAR Part : Part 121
Flight Plan : IFR
Mission : Passenger
Flight Phase : Parked

Person

Reference : 1
Location Of Person.Aircraft : X
Location In Aircraft : Flight Deck
Reporter Organization : Air Carrier
Function.Flight Crew : Captain
Function.Flight Crew : Pilot Flying
Qualification.Flight Crew : Air Transport Pilot (ATP)
Experience.Flight Crew.Total : 7900
Experience.Flight Crew.Last 90 Days : 150
Experience.Flight Crew.Type : 6000

ASRS Report Number.Accession Number : 902289
Human Factors : Workload
Human Factors : Time Pressure
Human Factors : Fatigue

Events

Anomaly.Aircraft Equipment Problem : Less Severe
Anomaly.Inflight Event / Encounter : Fuel Issue
Anomaly.Inflight Event / Encounter : Weather / Turbulence
Detector.Person : Flight Crew
When Detected : In-flight
Result.Flight Crew : Diverted

Assessments

Contributing Factors / Situations : Company Policy
Contributing Factors / Situations : Human Factors
Contributing Factors / Situations : Weather
Primary Problem : Weather

Narrative: 1

At the gate, we were delayed an hour, until all 3 crew members came in. The plane was there but with a deferred APU and a line of thunderstorms were coming. We boarded and fueled the plane. We asked for an extra 500 LBS of fuel, as we thought we'd be delayed at the gate. If we came back to the gate, I would have timed out, as my duty day was stretched long. We pushed back and the airport closed until the storms passed. At that point we called Dispatch and moved out contingency fuel. We had enough for minimum fuel for takeoff. We also got a new clearance. Dispatch and the crew were ok with the route and the fuel. After takeoff we headed north approximately 80 miles then east. The storms built to our south in an east/west line. We couldn't break through. Fuel became an issue and we spoke to Dispatch over the #2 radio. All of us agreed we wouldn't make it to destination and chose an unplanned alternate. We diverted. Timed out and completed the flight the next day. I later called in sick, as it was day 6 and was fatigued, but I wanted the money. Fix the APU, staff airline properly, study weather patterns for the area, as well as interpret the TAF's.

Synopsis

CRJ50 Captain reports departure delays due to weather and late arriving crew members. Once airborne the flight is unable to reach their destination due to the line of thunderstorms and diverts. Duty time limitations result in the flight continuing the next day.

Page Break

ACN: 902265 *(43 of 256)*

Time / Day

Date : 201008
Local Time Of Day : 1801-2400

Place

Locale Reference.ATC Facility : ZZZZ.ARTCC
State Reference : FO
Altitude.MSL.Single Value : 35000

Environment

Light : Night

Aircraft

Reference : X
ATC / Advisory.Center : ZZZZ
Aircraft Operator : Air Carrier
Make Model Name : B777-200
Crew Size.Number Of Crew : 2
Operating Under FAR Part : Part 121
Flight Plan : IFR
Mission : Passenger
Flight Phase : Cruise
Airspace.Class A : ZZZZ

Person

Reference : 1
Location Of Person.Aircraft : X
Location In Aircraft : Flight Deck
Reporter Organization : Air Carrier
Function.Flight Crew : Captain
Function.Flight Crew : Pilot Not Flying
Qualification.Flight Crew : Air Transport Pilot (ATP)
Experience.Flight Crew.Total : 18000
Experience.Flight Crew.Last 90 Days : 160
Experience.Flight Crew.Type : 3000
ASRS Report Number.Accession Number : 902265
Human Factors : Fatigue

Events

Anomaly.No Specific Anomaly Occurred : All Types
Detector.Person : Flight Crew
When Detected : In-flight
Result.General : None Reported / Taken

Assessments

Contributing Factors / Situations : Company Policy
Contributing Factors / Situations : Human Factors
Contributing Factors / Situations : Staffing
Primary Problem : Ambiguous

Narrative: 1

The level of fatigue on this flight cannot be overstated. I am deeply concerned with the condition of myself and my First Officer on this flight with regard to fatigue and sleep deprivation. This is only the second transpacific international flight in five years that I have flown that is unaugmented; this after multiple sleep disruptions, flying on the backside of our body clocks with consecutive circadian rhythm disruptions. We were both exhausted from the flight planning phase to the landing. It is of great concern that we are scheduled to fly these trips with no consideration to the cumulative effect of sleep loss. The only consideration is that this one flight is under 8 hours block to block as if we are coming from days off, fully rested. Its 7:48 block to block and an accident waiting to happen in my opinion. When both pilots unintentionally fall asleep at their stations, safety is seriously compromised. Clearly, this flight should be augmented. We have the ability to measure fatigue by cumulative sleep loss and circadian disruptions and this information should be used to consider the need to augment.

Synopsis

A B777 Captain reported experiencing extreme fatigue on an unaugmented international flight.

Page Break

ACN: 901715 *(44 of 256)*

Time / Day

Date : 201007
Local Time Of Day : 1801-2400

Place

Locale Reference.Airport : ZZZ.Airport
State Reference : US
Altitude.AGL.Single Value : 0

Environment

Flight Conditions : Mixed
Weather Elements / Visibility : Thunderstorm
Weather Elements / Visibility : Windshear
Weather Elements / Visibility : Rain
Weather Elements / Visibility : Turbulence
Weather Elements / Visibility.Visibility : 1
Ceiling.Single Value : 3000

Aircraft

Reference : X
Aircraft Operator : Air Carrier
Make Model Name : B737 Undifferentiated or Other Model
Crew Size.Number Of Crew : 2
Operating Under FAR Part : Part 121
Flight Plan : IFR
Mission : Passenger
Flight Phase : Initial Approach
Route In Use : Vectors

Person

Reference : 1
Location Of Person.Aircraft : X
Location In Aircraft : Flight Deck
Reporter Organization : Air Carrier
Function.Flight Crew : First Officer
Function.Flight Crew : Pilot Flying
Qualification.Flight Crew : Flight Instructor
Qualification.Flight Crew : Air Transport Pilot (ATP)
Qualification.Flight Crew : Multiengine
Experience.Flight Crew.Total : 13000
Experience.Flight Crew.Last 90 Days : 210
Experience.Flight Crew.Type : 1000

ASRS Report Number.Accession Number : 901715
Human Factors : Time Pressure
Human Factors : Fatigue
Human Factors : Workload

Events

Anomaly.Deviation - Procedural : Published Material / Policy
Detector.Person : Flight Crew
When Detected : Pre-flight
Result.General : None Reported / Taken

Assessments

Contributing Factors / Situations : Company Policy
Contributing Factors / Situations : Human Factors
Primary Problem : Company Policy

Narrative: 1

Minimum rest and poor contract threatens flight safety. My Airline is known for minimum staffing and "efficient" operations. However, once weather and unforeseen conditions arise because of this "efficiency" crews are forced to fly fatigued. Even when weather isn't a factor many minimum hour scheduling practices are common, such as ten hours between duty in and duty out at hub airports. Common sense dictates ten hours is not enough time. I have a place twenty minutes from the airport (VERY CLOSE by most standards) and it takes me 1 hour to leave the airport and arrive at the parking lot of my apartment. Another thirty minutes minimum is required to unpack, repack and shower/get up... This equates to ten hours minus three hours equals seven hours of sleep. Seven hours of sleep IF you go right to sleep with no interruptions (forget about eating). Realistically you can expect five to six hours sleep and then be on duty for sixteen hours the next day! [This is] all perfectly legal. This is exactly what happened to me. After flying all five of my reserve days my day off was rolled and I was required to show for a mid morning departure. I was notified of this approximately eleven hours the night before while checking my schedule before leaving work for two days off. The show time was in the early AM. My return flight blocked into the gate at fourteen hours later. A full B737 takes fifteen to twenty minutes to deplane. Then I must walk across the airport and check my schedule before driving home. By the time I get to the employee bus and arrive home it takes an hour (with no traffic). After my early AM show that day for a round trip I am then drafted to do a maintenance flight. Maintenance flights might entail non-normal procedures. No problem on six hours of sleep. Completely legal, safe of course is another mater. Has anyone in the federal government figured out it does no good to regulate how safe airplanes are mechanically if the crews who fly them are too tired to think straight? I can only call in fatigued so many times before disciplinary action is taken against me. Of course the company sounds like a broken record and says they are complying with what is "legal". Please help.

Synopsis

A B737 First Officer described the "perfectly legal" scheduling practices which are employed by his airline but which cause him to have to work fatigued.

--Page Break--

ACN: 901688 *(45 of 256)*

Time / Day

Date : 201007

Aircraft

Reference : X
Aircraft Operator : Air Carrier
Make Model Name : Regional Jet CL65, Undifferentiated or Other Model
Crew Size.Number Of Crew : 2
Operating Under FAR Part : Part 121
Flight Plan : IFR
Mission : Passenger
Flight Phase : Parked
Route In Use.Other

Person

Reference : 1
Location Of Person.Aircraft : X
Location In Aircraft : Flight Deck
Reporter Organization : Air Carrier
Function.Flight Crew : Captain
Qualification.Flight Crew : Air Transport Pilot (ATP)
Experience.Flight Crew.Total : 5300
Experience.Flight Crew.Last 90 Days : 215
Experience.Flight Crew.Type : 4800
ASRS Report Number.Accession Number : 901688
Human Factors : Workload
Human Factors : Fatigue

Events

Anomaly.No Specific Anomaly Occurred : All Types
Detector.Person : Flight Crew
Were Passengers Involved In Event : N
When Detected : Pre-flight
Result.General : Work Refused

Assessments

Contributing Factors / Situations : Company Policy
Contributing Factors / Situations : Human Factors
Contributing Factors / Situations : Staffing
Primary Problem : Company Policy

Narrative: 1

Unsafe scheduling practices our airline is pushing pilots to the limits of exhaustion and is using tactics to intimidate pilots into flying when it is UNSAFE to do so. Just because it may be "LEGAL" does NOT mean it is "SAFE"! If the recent crash in Buffalo cannot change the rules than this industry and its pilots are in serious trouble. Today, I am scheduled to fly 8 legs with "quick" turns with essentially zero down time, [from mid-afternoon to late into the night]. And will do the same for the next 5 days in a row. Our schedules are 6 days on 2 days OFF...repeatedly. Our short staffing is our Company's responsibility, however, this means one pilot is flying and on duty that would ordinarily take 3 pilots to cover. In other words, one pilot is picking up the slack. Our FATIGUE calls are at an alarming rate!!! In fact, if pilots call FATIGUE more than once they are issued verbal warnings, letters or are sent to company headquarters for meetings which are rarely safety consciousness oriented. OUR PILOTS ARE PROFESSIONAL AIRLINE PILOTS THAT DESERVE BETTER. THE FLYING PUBLIC DESERVES BETTER! Hopefully, someone with authority to make and implement regulations and policies will listen.

Synopsis

A commuter air carrier Captain expressed his opinions about the airline's unsafe scheduling practices and their threats of discipline for pilots who exercise their responsibility to not fly when physically impaired due to fatigue induced by those practices.

Page Break

ACN: 901220 *(46 of 256)*

Time / Day

Date : 201007

Place

Altitude.AGL.Single Value : 0

Environment

Light : Night
Ceiling : CLR

Aircraft

Reference : X
ATC / Advisory.Ground : ZZZ
Aircraft Operator : Air Carrier
Make Model Name : B747-400
Crew Size.Number Of Crew : 4
Operating Under FAR Part : Part 121
Mission : Passenger
Flight Phase : Taxi

Person

Reference : 1
Location Of Person.Aircraft : X
Location In Aircraft : Flight Deck
Reporter Organization : Air Carrier
Function.Flight Crew : Relief Pilot
Function.Flight Crew : Pilot Not Flying
Experience.Flight Crew.Total : 13000
Experience.Flight Crew.Last 90 Days : 110
Experience.Flight Crew.Type : 5500
ASRS Report Number.Accession Number : 901220
Human Factors : Workload
Human Factors : Situational Awareness
Human Factors : Fatigue
Human Factors : Distraction
Human Factors : Communication Breakdown
Communication Breakdown.Party1 : ATC
Communication Breakdown.Party2 : Flight Crew

Events

Anomaly.Conflict : Ground Conflict, Less Severe
Anomaly.Deviation - Track / Heading : All Types
Anomaly.Deviation - Procedural : Clearance
Anomaly.Ground Incursion : Taxiway
Detector.Person : Flight Crew

When Detected : Taxi
Result.Flight Crew : Requested ATC Assistance / Clarification
Result.Flight Crew : Returned To Clearance

Assessments

Contributing Factors / Situations : Human Factors
Primary Problem : Human Factors

Narrative: 1

On taxi out Ground told us to "Taxi to the runway via B. Hold short of the runway". Our normal taxi out is via Taxiway A which is what the Captain proceeded to do. My head was down and I missed that he turned onto A. The other Relief Pilot asked me weren't we supposed to be on B. I immediately called out that we were on A instead of B and needed to let Ground know. The flying First Officer and Captain both said that they would get back on B at the next convenient taxiway. I advocated that we needed to let Ground know right away. Ground was notified that we were joining B. Ground responded Roger. A 757 with winglets was pushed back on an angle on A. It looked very tight to pass them. It was dark and difficult to see if would hit them or not. We stopped short until they moved out of the way. I am not sure that the Captain saw the problem until we brought it up. I think that the late night start and complacency nearly caused us some serious problems.

Synopsis

A B747-400 Relief Officer reported the Captain and First Officer both missed the taxi instructions and turned on Taxiway A when they were cleared via Taxiway B. ATC was notified and the aircraft transitioned to the correct taxiway. Reporter stated a late night start and complacency may have contributed.

Page Break

ACN: 901075 *(47 of 256)*

Time / Day

Date : 201007
Local Time Of Day : 0001-0600

Place

Locale Reference.Airport : ZZZ.Airport
State Reference : US
Altitude.AGL.Single Value : 0

Aircraft

Reference : X
Aircraft Operator : Air Carrier
Make Model Name : Commercial Fixed Wing
Crew Size.Number Of Crew : 2
Operating Under FAR Part : Part 121
Flight Plan : IFR
Mission : Passenger
Flight Phase : Parked

Person

Reference : 1
Location Of Person.Aircraft : X
Location In Aircraft : General Seating Area
Reporter Organization : Air Carrier
Function.Flight Attendant : Flight Attendant (On Duty)
Qualification.Flight Attendant : Current
ASRS Report Number.Accession Number : 901075
Human Factors : Fatigue

Events

Anomaly.No Specific Anomaly Occurred : All Types
Detector.Person : Flight Attendant
When Detected : Aircraft In Service At Gate
Result.General : Work Refused

Assessments

Contributing Factors / Situations : Company Policy
Contributing Factors / Situations : Human Factors
Primary Problem : Company Policy

Narrative: 1

[I] reported early morning for the last day of 3-day trip. Before my last leg home, I was pulled from my flight and told to call Scheduling. Upon calling Scheduling to find out what was happening, I was informed that I had additional flying added to my day. Initially, upon hearing that my release time was in the evening, I told Scheduling I couldn't work that late because I needed to get home and help care for my mom. I was marked down as sick and called and left a message for Inflight Supervisor. Today, when I was pre-writing another "fatigue" report, I realized that the flying that was added to my day was illegal. Three legs were added to my day, which would have resulted in a duty day of 15 hours and 27 minutes. I am forced to use sick days when I cannot or I'm unable to fly the legs Scheduling assigns to me. When I use more than 12 sick days in a 12 month period, I can be put on disciplinary action and potentially loose my job. With Scheduling abusing the scheduling system, I have now used two sick days in two weeks. At this rate, I will be out of a job in just a few months. This is wrong! The company is routinely scheduling Flight Attendants almost to their maximum with 12 and 12.5 hour duty days and 9-10 hour rests. Flight Attendants are calling in sick and Scheduling is frantically trying to fill the slots with the reserve Flight Attendants it has available, even if it means flying us beyond our physical well-being, as well as the safety of the passengers. The FAA needs to change the regulations governing duty hours of Flight Attendants. The company can use "irregular operations" every day, any time of day. Until the government changes the regulations, the company will continue to work us to the maximum, even if the maximum is not healthy or safe. The union contract cannot negotiate for better work conditions when the government says 14 hour duty days are ok and 8-10 hour rests are ok. Also, these short rests DO NOT take into consideration that our rest starts when we leave the aircraft and ends when we report back to the aircraft. Rest should begin when we get to the hotel and when we leave the hotel. With the current system, if you allow 20 minutes to hotel, 20 minutes in morning back to airport, as well as time for meals and showering (1.5 hours), there is not much time for sleep.....only 6-8 hours. That is not much rest, especially when you have another 12-14 hour duty day ahead of you.

Synopsis

Commuter Flight Attendant describes revised schedule that would have resulted in an over than 15 hour duty day. Reporter is assigned a sick day after declining the assignment due to fatigue.

Page Break

ACN: 900959 *(48 of 256)*

Time / Day

Date : 201007
Local Time Of Day : 0001-0600

Place

Locale Reference.Airport : ZZZZ.Airport
State Reference : FO
Altitude.MSL.Single Value : 2100

Environment

Flight Conditions : VMC
Light : Night
Ceiling : CLR

Aircraft

Reference : X
ATC / Advisory.Tower : ZZZZ
Aircraft Operator : Air Carrier
Make Model Name : B757-200
Crew Size.Number Of Crew : 2
Operating Under FAR Part : Part 121
Flight Phase : Initial Approach

Component

Aircraft Component : Altitude Alert
Aircraft Reference : X
Problem : Improperly Operated

Person

Reference : 1
Location Of Person.Aircraft : X
Location In Aircraft : Flight Deck
Reporter Organization : Air Carrier
Function.Flight Crew : Relief Pilot
Function.Flight Crew : Pilot Not Flying
ASRS Report Number.Accession Number : 900959
Human Factors : Situational Awareness
Human Factors : Distraction
Human Factors : Fatigue

Events

Anomaly.Deviation - Procedural : Published Material / Policy
Anomaly.Inflight Event / Encounter : CFTT / CFIT
Detector.Automation : Aircraft Other Automation
Detector.Person : Flight Crew

When Detected : In-flight
Result.Flight Crew : Returned To Clearance
Result.Flight Crew : Took Evasive Action

Assessments

Contributing Factors / Situations : Environment - Non Weather Related
Contributing Factors / Situations : Human Factors
Primary Problem : Human Factors

Narrative: 1

During the approach, while on base leg, I was preparing the aircraft logbook for our arrival. While my head was down, I heard the 1,000 FT call and raised my head, but did not see the runway in front of us. As I was realizing what happened the Captain (pilot flying) added power and began climbing back to a more appropriate altitude for the aircraft's current location. It appeared the problem was the result of 2,000 being set in the altitude window instead of a higher altitude. I cannot help but feel fatigue was likely a factor as we started the night about 1.5 hours late and were arriving very early in the morning on a flight that is not an 'all-nighter.' During the approach brief and during the approach for any visual approach that is not on a published approach segment, such as downwind, a minimum altitude (pattern altitude) should be determined and all pilots should ensure this altitude is set in the altitude window as added protection.

Synopsis

A B757 relief pilot in the jumpseat on an all night flight heard the 1,000 FT altitude alerter call and looked up to see that the aircraft was not near enough to the runway to be at 1,000 FT. The Captain took evasive actionand stated fatigue as a contributing factor.

Page Break

ACN: 900876 *(49 of 256)*

Time / Day

Date : 201007

Place

Locale Reference.Airport : ZZZ.Airport
State Reference : US
Altitude.AGL.Single Value : 0

Aircraft

Reference : X
Aircraft Operator : Air Carrier
Make Model Name : A320
Crew Size.Number Of Crew : 2
Operating Under FAR Part : Part 121
Flight Plan : IFR
Flight Phase : Parked

Person

Reference : 1
Location Of Person.Aircraft : X

Location In Aircraft : Cabin Jumpseat
Reporter Organization : Air Carrier
Function.Flight Attendant : Flight Attendant (On Duty)
ASRS Report Number.Accession Number : 900876
Human Factors : Fatigue

Events

Anomaly.Other
Detector.Person : Flight Attendant
Were Passengers Involved In Event : N
Result.General : None Reported / Taken

Assessments

Contributing Factors / Situations : Human Factors
Primary Problem : Human Factors

Narrative: 1

Fatigued. Too long of a day without crew rest is a safety issue. And that it can go to 16 hour duty day if irregular operations is unfathomable. We had a 11 hour 48 minute flight time, 14 hour 11 minute duty stop to refuel holding with passengers all this without any rest. Only one meal and no crew water (we ran out of bottled water).

Synopsis

A Flight Attendants report excessive duty times and lack of food an water during an irregular operation.

Page Break

ACN: 900350 *(50 of 256)*

Time / Day

Date : 201007
Local Time Of Day : 1801-2400

Place

Locale Reference.Airport : ZZZ.Airport
State Reference : US
Altitude.AGL.Single Value : 0

Environment

Light : Night

Aircraft

Reference : X
Aircraft Operator : Air Carrier
Make Model Name : Regional Jet 900 (CRJ900)
Operating Under FAR Part : Part 121
Mission : Passenger
Flight Phase : Parked
Maintenance Status.Released For Service : N
Maintenance Status.Maintenance Items Involved : Installation
Maintenance Status.Maintenance Items Involved : Inspection
Maintenance Status.Maintenance Items Involved : Work Cards

Component

Aircraft Component : Powerplant Mounting
Manufacturer : Bombardier /CRJ
Aircraft Reference : X
Problem : Improperly Operated

Person : 1

Reference : 1
Location Of Person : Hangar / Base
Reporter Organization : Air Carrier
Function.Maintenance : Technician
Qualification.Maintenance : Powerplant
Qualification.Maintenance : Airframe
ASRS Report Number.Accession Number : 900350
Human Factors : Training / Qualification
Human Factors : Situational Awareness
Human Factors : Fatigue
Human Factors : Confusion
Human Factors : Time Pressure
Analyst Callback : Attempted

Person : 2

Reference : 2
Location Of Person : Gate / Ramp / Line
Reporter Organization : Air Carrier
Function.Maintenance : Technician
Qualification.Maintenance : Powerplant
Qualification.Maintenance : Airframe
ASRS Report Number.Accession Number : 900352
Human Factors : Situational Awareness
Human Factors : Communication Breakdown
Human Factors : Confusion
Communication Breakdown.Party1 : Maintenance
Communication Breakdown.Party2 : Maintenance
Analyst Callback : Completed

Person : 3

Reference : 3
Location Of Person : Gate / Ramp / Line
Reporter Organization : Air Carrier
Function.Maintenance : Technician
Qualification.Maintenance : Airframe
Qualification.Maintenance : Powerplant
ASRS Report Number.Accession Number : 900351
Human Factors : Situational Awareness
Human Factors : Communication Breakdown
Human Factors : Confusion
Communication Breakdown.Party1 : Maintenance
Communication Breakdown.Party2 : Maintenance

Events

Anomaly.Aircraft Equipment Problem : Critical
Anomaly.Deviation - Procedural : FAR
Anomaly.Deviation - Procedural : Maintenance

Anomaly.Deviation - Procedural : Published Material / Policy
Detector.Person : Maintenance
Were Passengers Involved In Event : N
When Detected.Other
Result.General : Flight Cancelled / Delayed
Result.General : Maintenance Action

Assessments

Contributing Factors / Situations : Chart Or Publication
Contributing Factors / Situations : Company Policy
Contributing Factors / Situations : Human Factors
Contributing Factors / Situations : Manuals
Contributing Factors / Situations : Procedure
Primary Problem : Human Factors

Narrative: 1

Mechanic "A" and I volunteered to help with an engine change on a CRJ-900 aircraft. When we arrived, we were tasked with getting the bad engine ready for removal from the CRJ-900, while Local Maintenance removed the cannibalized (robbed) engine off of another -900. We worked by ourselves most of the time, and I prepped the forward engine mount for removal by cutting the safety wire and loosening the retainer bolts from the pylon side of the engine mount/yoke. While in the hanger, I took several pictures of the hanger and the CRJ-900 engine change process for my own use. After reviewing the pictures [two days later], I noticed that the engine mount yoke was still installed on the pylon with the engine removed. I loosened up the hardware of the yoke to remove it from the pylon, not the engine. This is the exact opposite procedure that I am familiar with while changing a CRJ-200 engine. After figuring out I loosened the hardware from the wrong side of the yoke, we contacted the Local Maintenance to determine if the hardware was retorqued and safetied. We could not get in touch with anyone that I knew. So we called Maintenance Control to ground the aircraft until it could be determined if the hardware was torqued and safetied. It was later determined that the hardware was indeed torqued and safetied. I figured out the yoke was loosened at the wrong point myself while reviewing pictures of the road trip once I was back at home. I noticed the yoke still installed on the pylon instead of the engine as I am accustomed to on a CRJ-200 engine change. We had access to the CRJ-900 Engine Change Task Card which clearly showed where to disconnect the engine mount yoke. We had fallen behind schedule while removing the pylon panels due to many screws that needed to be drilled out. We worked as fast as possible to remove the lines and plugs from the engine/pylon area. When it came time to remove the hardware from the engine mounts in preparation for the removal, I simply assumed that the sequence and location of the components was the same as that of a -200 removal due to the familiarity of the components. When we finally did remove the engine I was not in a position to see what hardware was actually removed. At that point in the shift, I had been up for 20 hours and we were getting ready to head to our hotel. I made no notice of what had actually been disconnected from the engine and pylon. This event occurred simply because I assumed the engine removal procedure was the same as a CRJ-200 due to the similarity of the hardware. Once the problem was noted, we asked Maintenance Control to ground the aircraft until the yoke to pylon attach point could be verified torqued and safetied, which it was found to be. Simply reviewing the Task Card would have avoided this situation.

Narrative: 2

Mechanic "B" and I went out to assist with an un-scheduled engine change on a CRJ-900 aircraft. There were two mechanics from another airport there (Mechanic "C" and Mechanic "A") that had removed the left-hand (LH) engine. Mechanic "B" and I showed up after the old engine was already removed. So, we coordinated with the project Lead and got to work hanging the new engine. While we were installing the new engine, I noticed that there were two loose retainer bolts on the forward yoke mount bolts. I took it upon myself to look up the torque specifications in the AMM; Mechanic "B" and I torqued and safetied the bolts and went on with the rest of the installation. I believe that the cutting of the safety and loosening of the bolts should have been documented on a Maintenance Write-up form. A form was completed. Be sure that we always document anything we do to anything.

Callback: 2

Reporter stated the CRJ-900 (General Electric) GE CF-34 engine was being replaced after internal damage was found during a Boroscope Inspection. He does not know why Bombardier changed the Removal and Installation procedures for the CRJ-900 compared to the CRJ-200, when the engines are basically the same.

Narrative: 3

Mechanic "D" and I were sent to help out on an unscheduled engine change. Two other mechanics, (Mechanic "C" and Mechanic "A") removed the engine off the aircraft, and we were to install the replacement. We arrived when both engines were on the stands. During the removal, they un-safetied and loosened the forward yoke mount retainer bolts. While we were installing the new engine we noticed that they had been loosened, and we torqued and safetied them (In Accordance With) IAW the AMM and continued on with the installation. Neither Mechanic "D" nor I looked into any paperwork as to why the bolts were loose. We simply resecured them and moved on. I believe that the cutting of the safety wire and loosening of the bolts should have been documented on a Maintenance Write-up form. Insure proper documentation is always accomplished when maintenance is performed.

Synopsis

Three Mechanics reported a left engine change on a CRJ-900 aircraft. One of the Mechanic's assumed the disconnect procedures for the CRJ-900's were the same as those on the CRJ-200, but they were not. Incorrect procedures were used.

Page 71: [233] Deleted **Martin Zhu** **1/23/2012 8:32:00 AM**

Accident DCA91MA021

A/C: DC-9-15, registration: N565PC Injuries: 2 Fatal

Date: 2/17/1991

Accident Summary: After takeoff, aircraft rolled to the right, then severely to the left past (90 degrees) and crashed. An ATC and some witnesses saw a fireball come out of the rear of the plane.

Probable Cause: Probable cause was determined to be failure of the flight crew to detect and remove ice from the aircrafts wings which was largely a result of lack of appropriate response by the FAA, Douglass aircraft company, and Ryan International airlines to the known critical effect that a minute amount of contamination has on the stall characteristics of the DC-9 series 10 airplane. NTSB considered possibility that fatigue influenced pilots' judgment & decision not to conduct exterior preflight inspection of A/C. Crew had flown same night-time schedule for 6 days, & PIC for 12 of 13 days, averaging 3.8 flight hours & 5 landings each night. His schedule had recently increased from flying for 5 days, then 9 days off at home in CA. Though his family said he was used to night flying, recent increase in duty & flight time could have induced fatigue. But BTSB was divided on exact role of fatigue; some wanted fatigue as a cause, others did not. But fatigue's presence was not disputed. In the end, however, the Board could not reach a firm conclusion & excluded fatigue as a cause or factor.

Flight Crew/Fatigue Related Information: The captain flew six successive night flights the week before the incident, and flew another six successive night flights with the same first officer each night, including the night of the event. The total flight time for the six successive night flights, which included the night of the incident was 19.6 hrs. The first officer's total flight time in the 7 days prior to the incident was 19.6 hrs, accumulated all during six successive night flights with the same captain.

On the six successive night flights, the captain and first officer came on duty around 2145. On the day before the accident, a van driver for the hotel overheard the pilots talking about how little sleep they get. On the day of the incident, an airline mechanic described the pilots as normal and rested. On the day of the accident, the operations supervisor stated the crew remained in the cockpit; normal crewmembers leave the airplane for a walk around. Supervisor described the captain as quiet and expressionless.

The captain was used to flying nights as a result of his military flying. Normal schedule was 5 nights on, 9 nights off. But a few weeks before accident, duty schedule changed as a result of airline contract to carry mail for US Postal Service. Airline subsequently hired new pilots and extended duty hrs of experienced pilots. The 2 weeks between his last visit home and the accidents were described as the longest period he had been on duty with the airline.

SCORE: 0.5 Requirements would place 200-hour limit on duty time in 672 consecutive hours (4 weeks). That might have changed PIC's schedule substantially.

August 18,1999 in Guantanamo Bay

A/C: DC-8, N814CK Injuries: 3 Serious

Date: 8/18/1993

Accident Summary: Aircraft collided with level terrain after captain lost control of aircraft while approaching airfield.

Probable Cause: Probable cause was determined to be the captains impaired judgment , decision making and flying abilities of the night crew due to the effects of fatigue; the captains failure properly assess the conditions for landing and maintaining vigilant situational awareness of the airplane while maneuvering onto final approach; his failure to prevent the loss of airspeed and avoid a stall while in steep band turn; and his failure to execute immediate action to recover from a stall

Flight Crew/Fatigue Related Information: At the time of the accident, the crew had been on duty for approx 18 hrs, having flown all night before accepting the accident flight. The board believes that the substandard performance by the experienced captain may have reflected the debilitating influence from fatigue. Captain testified feeling very lethargic and indifferent during the landing. First officer testified he felt fatigued earlier in the trip but felt exhilarated at the time of the landing.

The board’s analysis revealed the captain had been awake for 23.5 hrs at the time of the accident, the first officer 19hrs and flight engineer 21 hrs. the accident occurred at the end of the afternoon psychological low period, the crewmembers had been awake the previous 2 nights, and had attempted to sleep during the day complicating their circadian sleep disorders - thus fitting the 3 scientific criteria for susceptibility to the debilitating effects of fatigue.

At 0830, before crew left airport, chief scheduler found GTMO flight needed crew & was told “no legal problem” as it was “international flight.” Scheduler determined crew could reposition to Norfolk Naval Base (NGU), pick up A/C, fly to GTMO, then ferry under Part 91 to ATL, & remain just within company 24-hour duty limit. Crew discussed timing & agreed to take trip, though “it was pushing the edge.”

CAUSE: impaired judgment, decision-making, & flying abilities of PIC & crew due to fatigue; PIC's failure to properly assess conditions; loss of situational awareness while maneuvering onto final; failure to prevent loss of airspeed & avoid stall while in steep bank turn; & failure to execute immediate action to recover from stall. Factors; inadequacy of Part 121 flight & duty time regulations, supplemental air carrier, international operations, & circumstances that led to extended flight/duty hours & fatigue; inadequate CRM training & inadequate training & guidance by carrier for crew on operations at special airports, such as GTMO; & Navy's failure to provide system that would assure that local tower controller was aware of inoperative strobe light so as to advise crew.

SCORE: 0.9 At time of accident, PIC & FO had been awake about 24 hours & on duty 22 hours. After such a long day, crew was offered standard straight-in approach over ocean but they inexplicably chose very demanding approach in darkness. FE had said he got a rush on approach like they were shooting an approach to an aircraft carrier but FE noted that he was "tired & lethargic" as A/C approached airport & he "believed that the other 2 crew members were fatigued." By including ferry flights, the requirements in this final rule affect duty-day limits would have precluded this crew from taking this flight.

3.

Page 83: [234] Deleted Martin Zhu 1/23/2012 8:32:00 AM

, clouds few at 100 & scattered at 2500. On arrival at TLH, FO briefed for visual to 27. Minute later he asked PIC if they should use 09 instead. Some discussion followed but no decision. Ten 10 minutes later, SO asked pilots if they wanted to run approach checklist. FO again raised question of 09 vs 27 & crew decided on 09. Turned onto final 2.5 NM out.

At this point PAPI would have indicated 1 white & 3 red (low). But A/C continued to descend below glide slope & was at 200 AGL at 0.9 miles out. PAPI would have shown 4 red. CVR shows no discussion about PAPI or altitude other than comment by FO that '(I'm) gonna have to stay just little bit higher... I'm gonna lose end of runway', to which PIC replied 'yeah... yeah, okay.' About 18 seconds later PIC commented 'it's startin' to disappear in there little bit (isn't) it? Think we'll be alright, yeah.' Then hit trees 11 seconds later.

Crew believed they were on glide slope & showed no concern of undershooting. FO later said that 'from time I rolled out (on final), I saw that I was on glide slope... & it never changed.' Approach to 09 is over forest with no ground lights or other visual references (black hole), which can lead pilots to believe they are higher than they really are. NTSB notes that PAPI should have prevented this trap but FO's first class medical noted he had color vision defect. After accident, he failed 7 red/green vision tests. Specialists' report found that he had severe congenital deuteranomaly that could result in 'difficulties interpreting red/green & white signal lights.' Report added that '... he would definitely have had problems discriminating PAPIs... because red lights would appear not to be red at all, ... more indistinguishable from white than red... it would be extremely unlikely that he would be capable of seeing even color pink on PAPI... more likely combination of whites & yellows & perhaps, not even that difference.'

Probable Cause: Probable cause was determined to be the captain's and first officer's failure to establish and maintain a proper glidepath during the night visual approach to landing.

Flight Crew/Fatigue Related Information: The 3 accident flight crewmembers all had different flight, duty and sleep schedules before the accident. Flight and duty times since the last rest period for the caption, first officer and flight engineer are as follows: Captain (flight time - 1:23, duty time 2:35), first officer (flight time-4:02, duty time-10:29), flight engineer (flight time-3:43, duty time-10:41)

Captain reported not sleeping very well the 2 night leading up to the day of the accident but reported not feeling fatigued when he reported for the accident flight. Board found evidence of a sleep deficit for the captain based on reported sleep quality and small errors made during the accident flight the otherwise competent captain wouldn't normally make as indicated by past performance. First officer had normal sleep prior to accident, however he reported he felt good but he did not recall feeling alert and he seemed tired according to the captain. Board found the first officers sleep schedule was disrupted and found his performance deficient, which appears inconsistent with characterizations of his past performance. Flight engineer slept normally and appeared alert according to the captain and the board found minimal evidence he was fatigues, however his performance deficiencies may have been a result of workload during a rushed approach.

CAUSE: crew's failure to establish & maintain proper glidepath in night visual approach. Factors: combination of crew fatigue, failure to adhere to SOPs, FO's color vision deficiency & PIC & FO's failure to monitor approach. 3 crew serious

SCORE: 0.75 Performance of both pilots was deficient & below their usual standard during approach. NTSB believes this was due to fatigue. Besides back-of-clock, both pilots had difficulty getting adequate rest before flight. PIC said his sleep 2 days before had 'not really (been) good' or had been 'marginal' because he kept being woken by family dog. FO said he had difficulty adjusting his sleep cycle & inferred he did not sleep well during day. Friend described FO as looking tired & PIC commented on same bus that he 'might be little tired.' Even with color-blindness, causal statement justifies concluding that a better rested crew may have avoided the whole scenario early-on in the approach. But unsure exactly how NPRM would have addressed this case, since rest periods were reasonable (even if not well managed) & accident occurred on visual approach over a black hole with a color-blind pilot trying to use a PAPI. The strongest argument for fatigue must rely on the notion that a better rested crew might have monitored the glide slope better and/or might have run a more disciplined checklist & pre-landing brief, or that better rested PIC might have chosen the more common instrument approach to 27.

TAB 22

U.S. Department of Transportation

FEDERAL AVIATION ADMINISTRATION

Office of Aviation Policy and Plans

Washington, D.C. 20591

INITIAL SUPPLEMENTAL REGULATORY IMPACT ANALYSIS

Flightcrew Member Duty and Rest Requirements

PART 117

Final Rule

OFFICE OF AVIATION POLICY AND PLANS

October 4, 2012

Table of Contents

Purpose of this Supplemental Regulatory Impact Analysis (RIA)

On December 21, 2011, the Federal Aviation Administration (FAA) issued a final rule that was published in the Federal Register as *Flight Crew Member Duty and Rest Requirements* on January 4, 2011 (77 Fed. Reg. 330-01). The regulations, which are limited to passenger operations conducted under 14 CFR 121 (Part 121), become effective on January 4, 2014. On December 21, 2011, the FAA also issued a Regulatory Impact Analysis (original RIA) dated November 18, 2011 (FAA-2009-1093-2477). The original RIA provides the basis for the FAA's decision to (1) promulgate the final rule establishing new flight, duty and rest requirements for flight crews in passenger operations; and (2) exclude flight crews in cargo-only operations from the new mandatory requirements. While cargo-only operations are not required to meet the new regulations, the rule permits these operators to opt in to the rule if they so choose.

On December 22, 2011 the Independent Pilots Association (IPA) filed a timely petition for review. During the course of reviewing the administrative record for the purpose of preparing the government's brief, the FAA discovered errors in the original RIA that supports the final rule. The errors were associated with the scope of costs related to the implementation of the regulations for cargo-only operations. These errors appeared to be of a sufficient amount that the FAA concluded it was prudent to review the portion of the cost-benefit analysis related to cargo-only operations and allow interested parties an opportunity to comment on the corrected analysis.

On May 17, 2012, the FAA asked the United States Court of Appeals for the District of Columbia Circuit to suspend the litigation of the final rule while the agency corrected the inadvertent errors it had discovered. The court granted the FAA's motion on June 8, 2012. While the passenger operations rule is not at issue in the court proceedings, the FAA, in an abundance of caution, decided to have that portion of the original RIA reevaluated as well.

The FAA contracted with the John A. Volpe National Transportation Systems Center to review the original RIA for accuracy, correct any errors identified, and prepare a supplemental regulatory evaluation laying out the revised analysis. This Initial Supplemental RIA is the product of that review.

While this Initial Supplemental RIA largely mirrors the original RIA in both content and organizational structure, it provides more detail on the potential impacts the final rule would have on both passenger and cargo-only operations. In addition, this Initial Supplemental RIA provides expanded discussion of the methodology and information sources used in the analysis, corrects some reporting of results and minor calculation errors present in the original RIA, and presents sensitivity analysis on key assumptions used in the analysis.[1] A new Appendix B contains the results of those sensitivity analyses while Appendix C contains detailed data tables, which are summarized in the body of this Initial Supplemental RIA.

In the original RIA, the portion of scheduling costs related to cargo-only operations of air carriers that conduct both passenger and cargo-only operations (mixed operations carriers) were inadvertently excluded from the reported costs of extending the final rule to cargo-only operations. This Initial Supplemental RIA fixes that omission and that revision has significantly increased the estimates of the stated costs of extending the final rule to cargo-only operations. Due to inclusion of impacts on cargo-only operations, a few air carriers were reclassified for ease of explication.

This Initial Supplemental RIA does not serve to reevaluate the policy decisions behind the FAA's decision to issue a final rule implementing new flight, duty and rest requirements for

[1] Wherever possible, this Initial Supplemental RIA relies on the same data used for the original RIA. In some cases, new estimates were developed and more recent data sources were used.

Part 121 carriers engaged in carrying passengers. Table 1 and Table 2 summarize the differences between the original RIA and the Initial Supplemental RIA.

Table 1: Passenger Operations Nominal Costs and Benefits Over 12 Year Analysis Period

	Original RIA (millions)	Supplemental RIA (millions)	Difference (millions)
Total Benefits - Base Case	$376	$401	$25
Total Benefits - High Case	$716	$757	$41
Total Costs	$390	$457	$67

Table 2: Cargo Operations Nominal Costs and Benefits Over 12 Year Analysis Period

	Original RIA (millions)	Supplemental RIA (millions)	Difference (millions)
Total Benefits - Base Case	$20.35*	$5	
Total Benefits - High Case	$32.55*	$31	
Total Costs	$306	$550	$244

* FAA did not detail potential benefits to cargo-only operations in the original RIA. Rather, the FAA assumed that benefits associated with averting a single catastrophic accident involving a cargo plane would range between $20.35 million and $32.55 million.

Disposition of Issues Raised by Comments

The following summarizes the FAA's responses to the comments on the economic analysis. These responses address the most substantive comments made in response to the Notice of Proposed Rulemaking (NPRM). They are largely unchanged from the discussion in the original RIA. The comments addressed here include those made by Air Transportation Association (ATA), American Airlines, United Airlines, Cargo Airline Association (CAA), Federal Express, United Parcel Service (UPS), National Air Carriers Association (NACA), Atlas Air Worldwide Holdings, Lynden Air Cargo, Omni Air International, Inc., and Southern Air, Inc.

Commenters questioned the base year dollar and analysis period. The final rule uses 2012 (the year the final rule was published) as the base year with some preparatory costs incurred during the period 2012 through 2013. Recurring costs and the benefits of the final rule are presented for the 10-year period 2014 through 2023. We have provided sensitivity analysis based upon a discount rate of both seven percent and three percent. This 12-year analysis period is sufficient for the costs and benefits to be in a steady state.

The FAA also received comments questioning the validity of the accident set. To address the criticism of using the historical twenty-year analysis period, the FAA narrowed the accident set to the most recent ten years. However, while this approach addressed the issues raised by the commenters, narrowing of the analysis time period reduces the number of accidents/observations available for the benefit analysis. Consequently, while there is a sufficient accident basis to demonstrate a broad benefit basis justifying the cost of this rule, the data does not permit accident analysis for every industry segment.[2] The "high" benefit forecast incorporates expectations for larger airplanes and higher load factors in the future. Even though the rate of accidents may have declined in the last ten years, the future consequences of an individual crash may well be more catastrophic.

Commenters questioned that the historical accident rate is significantly higher than the probable accident rate for the period of analysis because accidents have declined in recent years.

The requirements contained in this final rule only address the rates of pilot fatigue. As Table 7 shows, the preventable accident rate related to fatigue has not significantly decreased in the last 10 years.

The original RIA also includes a list of appropriate accidents along with the final Commercial Aviation Safety Team (CAST) scoring. Appendix A: Relevant Accident History includes detailed fatigue information and the reasoning behind the final CAST scoring.

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[2] In this Initial Supplemental RIA, FAA has provided separate benefits estimates of the final rule for passenger operations and cargo-only operations.

After considering the comments on the original RIA for the NPRM, the FAA took a different approach to evaluate the final rule. In the analysis for the NPRM, the FAA attempted to show through statistical analysis and simulation that a broader fatigue problem existed than what could be shown through National Transportation Safety Board (NTSB) accident findings. In response to industry comments objecting to this approach, the FAA Office of Aviation Safety began by narrowing the set of accidents to those with a strong correlation to fatigue and hence narrowed the benefit analysis from a broader fatigue problem to the specific regulatory changes. As a result, the FAA re-examined every accident used in the NPRM and applied the CAST methodology only to the accidents whose likelihood would have been reduced if the requirements in the final rule had been effective prior to the accident. Using this methodology, the FAA re-analyzed the effectiveness of the provisions in the final rule in mitigating accidents where fatigue was identified as a factor in the accident, and removed accident cases that were not closely correlated with fatigue factors from the NPRM. From this exercise, a smaller set of accidents was determined appropriate for further economic analysis of the final rule. With a smaller number of accidents, a simulation methodology was no longer appropriate. Instead, the FAA used a commonly-used benefit methodology. This methodology is grounded in NTSB findings, uses the CAST methodology, and is also transparent and easily reproducible. The methodology is discussed in both the original RIA and this Initial Supplemental RIA.

Industry questioned the use of $12.6 million for a statistical life value. The use of $12.6 was for a sensitivity test. For the final rule, the FAA uses the $6.2 million as the value of an averted fatality as used commonly by the Department of Transportation (DOT).

Commenters also objected to the FAA's assumptions regarding the 25 percent cost-savings resulting from long-term scheduling optimization in the draft RIA evaluating the NPRM.

For the original RIA, the assumed long-term schedule optimization factor is dropped. Instead, operations and scheduling costs were analyzed using a crew scheduling optimizer. This different approach estimates operations and scheduling costs of the final rule by applying the duty and rest time restrictions of the final rule to industry scheduling data using Cygnus, CrewPairing's (CP) crew scheduling optimization model. [3] Cygnus has been used by more than 30 major airlines worldwide over the past 40 years and is currently used by a number of carriers.

Commenters also contended that the FAA underestimated the NPRM costs related to flight operations in that carriers would be forced to hire new crewmembers and increase flight duty periods (FDP).

In this Initial Supplemental RIA, the FAA has re-estimated the costs reflecting final rule modifications and used the above-referenced crew scheduling model to better estimate whether the rule would force carriers to hire new crewmembers. The use of a crew pairing optimizer enabled FAA to more accurately model the impacts of the rule on industry crew scheduling costs than was possible during NPRM cost analysis. The data in the original RIA included full bid line and pairing information for each flightcrew member. Because the crew pairing optimization results showed that the final rule resulted in relatively small increases in the number of credit hours needed to complete existing flight schedules, FAA determined that certificate holders could conduct existing operations under the final rule without hiring additional flightcrew

[3] A technical report detailing the Cygnus optimization can be found in the docket. See *Summary of Crew Pairings, Inc. Economic Analysis of Flightcrew Member Duty and Rest Requirements Rulemaking*, GRA Inc., September 2012.

members. The optimization also shows that where pilots worked more days in total under the final rule, they worked shorter days, thus obviating the need for additional pilots.[4]

Commenters did not support the costs related to schedule reliability and argued that they were underestimated. One commenter stated the costs would be as high as $9.6 billion. They argued that by excluding the cost of schedule buffering required by multiple provisions of the NPRM, the FAA omitted the major source of cost to the industry.

As stated in the preamble to the final rule, the FAA has largely removed schedule reliability from this rule. The FAA has instead adopted provisions that limit extensions of the FDP and requires reporting of FDP extensions and activities that were not otherwise permitted by the provisions of §117.11, §117.19 and §117.29 in the final rule. Under this amendment, costs to airline carriers are limited to reporting exceptional activities. As such, these costs are expected to be relatively minor.

Some commenters stated the appropriate average wage rate should be $297 per hour. The FAA notes this wage rate significantly contributed to the industry cost estimates. The $297 per hour wage rate as an average is almost two times the wage rate from Form 41 narrow-body pilots and four times the wage rate from the 2010 Census Bureau on the airline industry.

Commenters also argued that the FAA underestimates fatigue training cost described in the NPRM.

All carriers already are required to comply with Public Law 111-216 Section 212(b)(2)(B) with respect to the fatigue risk management plan and training (FRMP). In this final rule, the FAA removed the proposed requirement that pilots receive additional fatigue training

[4] See Summary of Crew Pairings, Inc. Economic Analysis of Flightcrew Member Duty and Rest Requirements Rulemaking, GRA Inc., September 2012.

that is not required by the FRMP. As such, the FAA expects the cost of fatigue education and training to be largely reduced. The final rule does expand the fatigue education and training requirements to dispatchers and certain members of management. The FAA made this change because air carriers operating under Part 121 will be in compliance with the statutory pilot training requirement as part of their FRMPs. Since the final rule extends fatigue training to management and dispatchers, it is expected to be added to existing fatigue risk management education and training program.

Numerous commenters stated that the FAA underestimated the cost of rest facilities due to the loss of first class seating and out-of-service time required for infrastructure installation.

The FAA re-analyzed the facility cost based upon the actual numbers and types of facilities that will need to be put in by querying the inspectors for the fleet of airplanes. The FAA assumed the worst case scenario (all Class 1 facilities). The FAA recalculated the number of airplanes needing additional upgraded rest facilities. Based on the existing fleet, the FAA estimates 225 airplanes used in passenger operations will need Class 1 facilities. In addition, the FAA re-estimated compliance costs of optimizing existing equipment and installing first class facilities. We have also estimated downtime and additional fuel burn costs. The final rule rest facility costs include purchase, design and engineering, physical installation of the facilities on the affected aircraft, downtime impact on revenue, and fuel burn cost. Therefore, the cost of rest facilities was estimated to the full extent in the final rule.

The commenters stated that the FAA's cost analysis does not factor in the costs of the cumulative limits. The FAA notes that all known constraints including the final rule monthly and annual constraints were imbedded in CP optimization.

The commenters submitted that the FAA assumed for the NPRM that the industry's collective bargaining agreements (CBAs) will be renegotiated to permit carriers to adapt to the new rules without any additional costs to the carriers and also assumes that any short term costs that result from conflicts between the new rule and existing CBAs should not be "counted" as part of the NPRM.

The final rule does not require renegotiation of current CBAs. In the final rule the FAA did not calculate potential gains based on the renegotiation of CBAs. The final rule will give a two-year buffer for carriers to implement all provisions. The FAA still believes that CBA negotiations could result in a change of economic interests between carriers and crewmembers. Any such change is a transfer of benefits and costs between carriers and bargaining units. Such transfers would be negotiated between parties and transfers do not change the total cost and benefits to society.

Many entities conducting supplemental operations stated that the rule would cause the nature of their operations to significantly change, which would result in lost revenue opportunities or much higher cost, or both.

The FAA adopted significant modifications in the final rule to mitigate the impact on supplemental operations. For example, in the final rule, the FAA made compliance with Part 117 voluntary for cargo-only operations. With regard to supplemental passenger operations, the FAA increased both the augmented and unaugmented FDP limits from the NPRM. The FAA also increased the split-duty credit and made that credit easier to obtain. In addition, the FAA notes that section 119.55 provides the mechanism to obtain deviation from existing regulations for military missions. Taken together the FAA has provided substantial flexibility for supplemental operations, and as a result, permits most existing revenue opportunities relative to flight safety risks based on the past ten years of NTSB accident findings.

The commenters contend that the FAA assumes, without any evidence, that there will be a reduction in absenteeism due to "improved fatigue management," and that reduced absenteeism costs will offset part of the cost of the NPRM.

The FAA believes that the final rule will improve productivity and reduce absenteeism by the enhanced fatigue management system. Center for Disease Control (CDC) research shows that chronic fatigue can cause illness and even death.[5] Comments and data received from Air Line Pilots Association (ALPA), the largest independent pilots' union in the world, devoting more than 20 percent of its dues income to support aviation safety, validated the FAA's estimation of cost saving from reducing flightcrew members fatigue and absenteeism.

Commenters questioned that there is no justification provided that sick leave use will be reduced by five percent.

The FAA notes that a study in the railroad industry found that fatigue counter measures reduced absenteeism from 4.79 percent to 1.94 percent, a decrease of 40 percent.[6] In addition, this Initial Supplemental RIA provides a sensitivity analysis on this assumption which can be found in Appendix B.

Commenters contended that accidents involving two pilots and a flight engineer should be analyzed separately because in the modern era almost all flights are operated without a flight engineer.

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[5] CDC' s MMWR, Weekly, February 29, 2008 / 57(08);200-203

[6] Sherry, "Fatigue Countermeasures in the Railroad Industry: Past and Current Developments," *Association of American Railroads*, 2000.

This rule does not distinguish between accidents involving a flight engineer and accidents without a flight engineer because it is difficult to attribute specific amounts of fatigue and accident causality to a flight engineer. More specifically, it is difficult to predict in a fatigue-related accident, how the two pilots would have handled the aircraft in question if a flight engineer had not been present. As such, because it is unclear how much flight-engineer fatigue contributed to past accidents and that this rule does not prohibit flight engineers from working on the flight deck, the original RIA used for this rule does not distinguish between accidents involving two pilots and those involving a flight engineer.

Some commenters stated that the FAA simply ignores flight cancellation costs despite the fact that of the NPRM will result in substantial increases in flight cancellations.

As discussed above, the FAA calculated the scheduling costs of this rule by running the pertinent data through the Cygnus crew scheduling optimization model. The Cygnus model did not indicate that there would be an increase in cancellations as a result of the changes imposed by this rule. This is because certificate holders will be able to use their existing staff members to cover the scheduled flights.

It was argued by commenters that by excluding the cost of schedule buffering required by multiple provisions of the NPRM, the FAA has omitted the major source of cost to the industry.

There are a few major changes related to crew scheduling made in the final rule from the NPRM, which significantly reduced the cost to the industry. The pertinent changes from the NPRM are: (1) a flight extension for unexpected circumstances that arise after takeoff, and (2) the removal of the requirement that "circumstances beyond the control of the certificate holder" have to be present in order to utilize the 2-hour FDP extension for certain unforeseen operational circumstances. Using the crew pairing optimizer to simulate operation schedule, costs that are attributable to the final rule were estimated to the full extent, including the cost of schedule buffering. The schedule optimization included buffers on flight and FDP limits to account for operational delays.

The commenters further stated that the FAA has omitted the cost estimation attributable to the provision of "three consecutive nights" (section 117.27, NPRM), which is more likely to impact cargo carriers partly because they have a substantial concentration of operations during the night time period and flight crew that are accustomed to night time operations.

As an initial matter, the FAA notes that, based on the cost-benefit analysis, cargo-only operations are not covered by the final rule. However, based on industry comments the FAA has mitigated the burden to cargo operators who may choose to operate under Part 117 by reducing (to two hours) the length of "mid-duty rest" that is necessary to schedule five consecutive nighttime FDPs. Moreover, UPS and FedEx stated in their comments that they currently provide their flightcrew members with a mid-duty breaks that are, on average, two hours long. Because the final rule permits five consecutive nights with two-hour breaks, the impact of the consecutive-night provision on cargo-only operators such as UPS and FedEx will be minimal should they choose to operate under Part 117. The consecutive nights rule is included in CP optimization.

The commenters also argued that, under the FAA's cost-benefit methodology, there is no benefit to limiting duty time below 15 hours.

The FAA agrees the risk of accident prevalence in the 15th hour block and beyond is much greater than that associated with duty times short of the 15th hour block. To evaluate this proposition, the FAA computed ratios of accidents to exposure duty hours (dividing accidents in a sequence of flight hour blocks by pilot exposure duty hours), which substantiated the conclusion that accident risk steeply increases in the 15th hour block and beyond. However, the FAA has also determined that FDPs of less than 15 hours can lead to unacceptably high accident risk. For example, the statistical evidence indicates that the ratio of accidents to block hours rises at a fast rate in the 13th to 14th hour block range. Therefore, the regulation of flight duty time being limited under the 15th hour block is necessary and beneficial.

Allied Pilots Association (APA) generally supported the NPRM but stated that the FAA overestimated computer programming cost, fatigue training costs due to overstated training, pay and rest facility installation costs. In addition, APA commented that the FAA underestimated the schedule optimization factor and the agility of air carriers when motivated to achieve efficiency.

The computer programing cost is a very small component of airline operation cost. Overall, the operation cost in the final rule was revised and turned out to be lower than that of NPRM. The fatigue training cost was revised to be lower than that of NPRM because of the changes made to the proposed fatigue training requirements by the final rule. The revised rest facility installation cost was also lower than that of the NPRM. APA's comment on the overestimation of the NPRM cost was based on the assumption that long-term optimization will occur at a much faster rate than implicit in the cost analysis, which would result in more savings in the long run than in the short run. The FAA agrees that long-term optimization of air carriers could be greater than expected. The FAA believes that the crew scheduling optimizer program provides a better estimate to the final rule. Therefore, the FAA believes that the final rule cost estimates incorporating crew scheduling optimization model accurately reflect the compliance costs.

ATA's Oliver Wyman analysis on September 14, 2011, "Estimated Job Loss Resulting from Flightcrew Member Duty and Rest Requirements" attached to the ATA petition on Flight, Duty and Rest asserted that the proposed rule would cause the loss of nearly 17,000 U.S. airline jobs, which would result in total job losses to the economy of 398,000 jobs.

The FAA believes that ATA's analysis of the jobs impact from the proposed Flightcrew Member Duty and Rest Rule is inaccurate. ATA's jobs impact analysis is based on its estimate, derived from its analysis of the NPRM, that this rule will cost $19.6 billion over a 12-year period. However, many of the major provisions of the final rule have been significantly altered from the NPRM, and, as discussed elsewhere, the FAA estimates that the final rule will cost approximately $457 million in nominal terms over 12 years. This $457 million cost is significantly smaller than the $19.6 billion cost on which ATA based its job impact analysis. CrewPairing's analysis of the final rule results in no change in pilot employment. Therefore, the FAA does not agree with ATA's job impact findings.

With regard to the accidents that were used to calculate the benefits for this rule, some commenters stated that the ATI 2/16/95 flight (RT2) was a Part 91 ferry flight, and that the issues leading to that flight's accident have been addressed by other rulemakings. Consequently, the commenters assert, this flight would not be permitted under current rules.

This comment refers to an accident involving ATI in Kansas City during a nighttime Part 91 engine-out ferry flight in a 4-engine DC-8. Prior to takeoff, the flight engineer had improperly determined the minimum control speed on the ground (VMCG), which produced a value that was 9 knots too low. On the first takeoff attempt, the pilot applied power too soon to the "asymmetrical engine" (the serviceable engine on the side with the failed engine) and was unable to maintain directional control during the takeoff roll. He rejected the takeoff and, in preparation for a second takeoff, the pilot agreed to have the flight engineer advance the throttle on the next takeoff attempt. This conflicted with the prescribed procedure.

At 3,215 feet into the takeoff roll, the DC-8 started to veer to the left. At 3,806 feet, the aircraft rotated with a tail strike but the tail remained in contact with the runway for another 820 feet. At 5,250 feet, the aircraft became airborne and climbed to 100 feet, then sank and crashed. All three crew members were killed.

NTSB focused on two core issues. First, NTSB found that the crew was flying after a shortened rest break, since rest periods were not required for ferry flights. According to the report, the crew was fatigued from lack of rest and lack of sleep, and from disrupted circadian rhythms. Second, NTSB found that the crew did not have adequate, realistic training in techniques or procedures for a 3-engine takeoff. NTSB added that the crew did not adequately understand 3-engine takeoff, and did not adequately understand the significance of VMCG.

In response to an NTSB recommendation related to training crews for a 3-engine takeoff (A-95-39), FAA issued a Flight Standards Information Bulletin (FSIB). The FSIB directed FAA principal operations inspectors to inform their respective operators to take additional measures to ensure: (1) that aircraft manual requirements for engine-out ferry flights are clear; (2) that crew training segments are clearly outlined for engine-out operations; and (3) that operators use only crews specifically trained and certified for engine-out operations. This has become FAA policy and NTSB found the action acceptable and closed the recommendation.

Consequently, the comment is appropriate to the degree that it addresses the issue of training, which is not part of the proposed rule. However, FAA believes that this flight also illustrates the role and risks associated with fatigue, which the FSIB noted above did not address. With or without training in three-engine takeoffs, NTSB's findings on fatigue in this accident remain pertinent to this rulemaking.

Benefit/Cost Summary

In this Initial Supplemental RIA, we have analyzed the benefits and the costs associated with the requirements contained in this final rule and our estimates are summarized in Table 3 and Table 4.

The final rule was changed significantly from the NPRM. The training requirement had been substantially reduced because the FAA has determined that pilots are already receiving the requisite training as part of the statutorily required Fatigue Risk Management Plans. The FAA also removed cargo-only operations from the applicability section of the new Part 117 because their estimated compliance costs as shown in the original RIA significantly exceed the quantified societal benefits.[7] This Initial Supplemental RIA revises and corrects the calculations used to estimate the costs and benefits of the final rule as it applies to passenger operations and to the estimates of costs and benefits if the rule were extended to cargo-only operations.

The costs associated with computer programing and rest facilities occur in the two years after the rule is published. The other costs of the rule and the benefits are then estimated over the next ten years.

We provide a range of estimates for the quantitative benefits of the final rule as it applies to passenger operations. Our base case estimate is $401 million ($263 million present value at seven percent and $332 million at three percent) and our high case estimate is $757 million ($497 million present value at seven percent and $627 million at three percent). The total estimated cost of the final rule as it applies to passenger operations is $457 million ($338 million

[7] Carriers may choose to have their cargo-only operations comply with the new Part 117 but are not required to do so. Since the carrier would decide voluntarily to comply with the new requirements, those costs are not attributed to the costs of this rule.

present value at seven percent and $398 million at three percent). Therefore, the costs of the final rule are somewhat higher than the base case benefits estimate but well below the high case estimate.

If the final rule were extended to cover cargo-only operations, the base case estimate of benefits for that population is $5 million ($3 million present value at seven percent and $4 million at three percent) and our high case estimate is $31 million ($21 million present value at seven percent and $26 million at three percent). In comparison total estimated cost of the final rule for that same population if it were extended to cargo-only operations is estimated to be $550 million ($377 million present value at seven percent and $464 million at three percent). This cost estimate far exceeds both the base and high case estimates of benefits.

Table 3: Summary of Benefits and Costs, Passenger Operations

Estimates	Total Nominal Cost (millions)	PV Cost at 7% (millions)	PV Cost at 3% (millions)
Total Benefits - Base Case	$401	$263	$332
Total Benefits - High Case	$757	$497	$627
Total Costs	$457	$338	$398
Net Benefits - Base Case	-$56	-$75	-$66
Net Benefits - High Case	$301	$159	$229

Table 4: Summary of Benefits and Costs, Cargo-only Operations

Estimates	Total Nominal Cost (millions)	PV Cost at 7% (millions)	PV Cost at 3% (millions)
Total Benefits - Base Case	$5	$3	$4
Total Benefits - High Case	$31	$21	$26
Total Costs	$550	$377	$464
Net Benefits - Base Case	-$545	-$374	-$459
Net Benefits - High Case	-$519	-$357	-$438

Benefit Analysis

This rule is intended to address the problem of fatigued pilots flying in Part 121 commercial service. The nature and extent of the problem is such that the NTSB continues to list pilot fatigue as one of the Most Wanted Transportation Safety Improvements. The NTSB recommendations are based on accident investigations and the NTSB safety study on airline safety. The requirements contained in this final rule address both NTSB recommendations and existing public law. This benefit estimate first examines the nature of fatigue, followed by its causes and how it relates to transportation. Second, we summarize some recent findings on fatigue and occupational performance. Next, we look at the magnitude of flightcrew fatigue in Part 121 passenger operations by briefly examining fatigue reports in the context of this final rule. We then re-analyze the likely effectiveness of the requirements contained in this final rule and the potential to decrease these types of accidents in the future. We project a likely number of preventable events that will occur in absence of this final rule. Finally, we estimate the benefits that will be derived from preventing such events. We provide a base case estimate, and a high case estimate, in addition to a threshold/break even analysis. The Initial Supplemental RIA also presents both base and high case estimates of the benefits if the final rule were extended to cargo-only operations.

The Nature of Fatigue

Most fatigue studies agree that, "fatigue refers to a subjective desire to rest and an aversion to further work, coupled with an objective decrease in performance."[8]

Fatigue is characterized by:

- "increasingly frequent lapses in performance,
- general cognitive slowing, including a lowering of optimum performance,
- memory problems,
- time on task decrements, and
- an increasing inability to maintain the vigilance required to perform the tasks required."[9]

Fatigue has been described as "a nonspecific symptom because it can be indicative of many causes or conditions including physiological states such as sleep deprivation….[s]ome describe fatigue in terms of physiological data or 'objective' observations of…decrements in work or performance….or time-related deterioration in the ability to perform certain mental tasks."[10] While physiological criteria related to fatigue can be readily measureable, subjective feelings of fatigue are not directly observable, and in some instances individuals who are

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[8] Jones, et al., "Working hours regulations and fatigue in transportation: A comparative analysis," *Safety Science*, Vol. 43, 2005.
[9] Ibid.
[10] Torres-Harding, Susan and Leonard A. Jason, "What is Fatigue? History and Epidemiology," *Fatigue as a Window to the Brain*, edited by John DeLuca. The MIT Press, 3-18, 2007.

exhibiting diminished performance levels also feel confident in their ability to focus and perform assigned tasks.

Causes of Fatigue

A number of factors increase the risk of fatigue.

- Time of day is very important, because the body follows a rhythm over an approximately 24-hour period, often referred to as a circadian cycle.
- The amount of recent sleep that a person has received also affects the level of fatigue risk; most people need an average of eight hours of sleep per 24 hour period.
- The number of continuous hours awake also increases fatigue risk, and for most individuals, once the number of continuous hours awake exceeds 17, fatigue risk increases significantly.
- Sleep debt, the difference between the amount of sleep needed to be fully rested and actual sleep, also contributes to fatigue. Sleep debt accumulates over time, and fatigue risk is higher if sleep debt exceeds eight hours.
- Work load and time on task can also affect fatigue risk. If work intensity is high and/or there is a long continuous period of time on task, the risk of fatigue increases.

Fatigue and Transportation

The nature of work in the transportation sector makes that sector especially susceptible to risks to performance, vigilance and response to hazards that are associated with fatigue. Workdays of those responsible for the safety of transportation operations can be characterized by long work periods, often at nighttime or early morning hours. Because transportation workers must sometimes rest or sleep away from home, conditions for rest and sleep quality are also important.

Analysts have examined the links between the specific features of work in the transportation industry, including commercial aviation, and the general features of human physiology and fatigue for decades. For commercial aviation, it has been nearly two decades since the first citation of fatigue as a probable cause for a major aviation accident. This accident, the crash of American International Airways flight 808 at Guantanamo Naval Air Station, Cuba, on August 18, 1993, was investigated by the NTSB. Probable causes of the accident identified by the NTSB included "the impaired judgment, decision making, and flying abilities of the captain and flightcrew due to the effects of fatigue…"

As part of the investigation of that accident, NASA researchers and contractors performed an analysis of the links between aviation risks and the effects of fatigue on human vigilance and performance. This research was reported as part of the NTSB report on the Guantanamo Bay accident and the research was later revised for inclusion in an NTSB report on DOT efforts to address fatigue issues in transportation.[11]

This NTSB research and literature summary provides a thorough and well-documented review of these issues. In the 1999 restatement of the research results in the context of addressing fatigue issues in transportation generally, the following summary is provided:

> *Fatigue, sleep loss and circadian disruption created by transportation operations can degrade performance, alertness and safety. An extensive scientific*

[11] Rosekind, et.al., "Appendix C: Summary of Sleep and Circadian Rhythms," *Evaluation of U.S. Department of Transportation Efforts in the 1990s to Address Operator Fatigue.* Washington D.C. NTSB Safety Report NTSB/SR-99/01, May 1999, pp.67-81. http://www3.ntsb.gov/publictn/1999/sr9901.pdf

literature exists that provides important physiological information about the human operator, which can be used to guide operations and policy. For example, there are human physiological requirements for sleep, predictable effects of sleep loss on performance and alertness and patterns for recovery from sleep loss. Additionally, the circadian clock is a powerful modulator of human performance and alertness, and in transportation operations, it can be disrupted by night work, time zone changes, and day/night duty shifts. Scientific examination of these physiological considerations has documented a direct relationship to errors, accidents and safety. This scientific information can provide important input to policy and regulatory considerations.

Recent Findings on Fatigue and Occupational Performance

Fatigue is prevalent in the U.S. workforce, with nearly 38 percent of workers reporting fatigue during a two-week period.[12] The National Sleep Foundation conducted a poll in 2008, which found that 29 percent have fallen asleep or become very sleepy while at work and two percent did not go to work due to sleepiness or a sleep problem.[13] Numerous studies have found that fatigue can significantly reduce productivity. A review of published studies on shift work and productivity found a large decrease in efficiency during the night shift, with the low occurring at 3:00 am. On average, the authors found that productivity was five percent lower at night.[14]

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[12] Ricci, et al., "Fatigue in the U.S. workforce: prevalence, and implications for lost productive work time," *Occup Environ Med*, Vol. 49(1): 1-10, 2007.
[13] National Sleep Foundation, "2008 Sleep in America Poll: Summary of Findings."
[14] Folkard and Tucker, "Shift work, safety and productivity," *Occupational Medicine*, Vol. 53, 2003.

A large-scale study was conducted at 40 companies and institutions in the Netherlands to investigate the relationship between fatigue and future sickness absence. The presence of fatigue was measured using self-reported symptoms, with employers providing absence data. The study controlled for numerous sociodemographic and work characteristics. The investigators found that higher levels of fatigue were statistically significant predictors of both short-term and long-term sickness absence.[15]

A study was conducted to estimate fatigue prevalence and associated health-related lost productive time (LPT) in U.S. workers. The investigators found that workers with fatigue were much more likely to report health-related LPT, with a cost of $136.4 billion annually. This amount exceeded health-related LPT reported by workers without fatigue by $101.0 billion.

A study compared the rate of errors made by medical residents working in the ICU on 80-hour weeks versus those on 63 hour weeks. The residents with the shorter work week schedule experienced half the rate of attention failures. The residents with the longer work week schedule made serious medical errors (those causing or having the potential to cause harm to a patient) at a rate 22 percent higher than the residents with the shorter work week schedule.[16]

The railroad industry is at a relatively high risk of fatigue, due to typical 24-hour per day operations. A number of railroads have implemented fatigue countermeasures, which generally reduced absenteeism. For instance, after implementation of fatigue countermeasures for CANALERT, absenteeism decreased from 8.1 to 3.2 percent. After fatigue countermeasures were implemented for the Conrail-Buffalo-Toledo IMPAC project, a statistically significant

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[15] Janssen, et al., "Fatigue as a predictor of sickness absence: results from the Maastricht cohort study on fatigue at work," *Occup Environ Med*, 2003, 60(Suppl I): i71-i76.
[16] Board on Health Sciences Policy, "Sleep Disorders and Sleep Deprivation: An Unmet Public Health Problem," *The National Academies Press*, 2006.

increase in attendance from 95.21 percent to 98.06 percent was observed.[17] This data demonstrates the potential for fatigue issues, which we will now examine within the specific requirements of this final rule.

Aviation Safety Reporting System (ASRS)

One can observe fatigue in aviation by examining the Aviation Safety Reporting System (ASRS). The ASRS collects, analyzes, and responds to voluntarily submitted aviation safety incident reports in order to lessen the likelihood of aviation accidents. It is part of a continuing effort by government, industry, and individuals to maintain and improve aviation safety by collecting voluntarily submitted aviation safety incident/situation reports from pilots, controllers, and others**.** The data in the ASRS is used to:

- Identify deficiencies and discrepancies in the National Aviation System (NAS) so that these can be remedied by appropriate authorities.
- Support policy formulation and planning for, and improvements to, the NAS.
- Strengthen the foundation of aviation human factors safety research. This is particularly important since it is generally conceded that over two-thirds of all aviation accidents and incidents have their roots in human performance errors.

ASRS assures confidentiality and data cannot be traced back to individual operators. So although we cannot claim the rule could prevent any specific ASRS events, it is a useful tool in evaluating and validating the presence of fatigue in Part 121 operations. We performed a query

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[17] Sherry, "Fatigue Countermeasures in the Railroad Industry: Past and Current Developments," *Association of American Railroads*, 2000.

for Part 121 ASRS for fatigue.[18] Since June of 2009, there were a total of 256 reports where fatigue was cited as a factor. We have neither culled the data nor edited any of the data that was reported to ASRS. The top seven results are listed in Table 5.

Table 5: ASRS Part 121 Fatigue Reports

Result	Total	Relative %
General None Reported / Taken (No action was taken as a result of the fatigue issue reported)	68	26.6%
General Work Refused (Fatigue caused a worker to refuse an	21	8.2%
General Maintenance Action (Typically a fatigue event related to a maintenance issue—not related to this final rule).	14	5.5%
Flight Crew Became Reoriented (Confusion related to some type of malfunction.)	10	3.9%
Flight Crew Took Evasive Action (Crew took action to avoid an accident or incident)	8	3.1%
Air Traffic Control Issued New Clearance (Substitute clearance given to get back on track)	5	2.0%
Flight Crew Executed Go Around / Missed Approach	5	2.0%

One captain on an international flight described an onerous flight sequence in the Pacific he believed to be unsafe due to cumulative and predictable fatigue:

> *This report concerns a trans-Pacific flight assignment including back to back all night pairings (body clock), two un-augmented inter-Asia segments and 36 hours of flight time. We started the sequence with a 12.7 hour actual flight, single augmented with an hour plus delay on the front end. When we arrived we*

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[18] We believe that this is a very conservative approach because other human factors can reveal fatigue, such as confusion and communications breakdown.

[19] Reason, James. "Human Error," Cambridge University Press, 1990.

cabbed to downtown for an additional 1.5 hours on the body before rest. The first internal Asia leg is all night, un-augmented. The return leg is daylight-but all night body time-followed by another 1.5 hour cab ride downtown. The [opportunities for] rest were insufficient to maintain any alertness particularly on the last leg. Both the First Officer and I experienced periods of unintended sleep while at the controls. No amount of coffee or mental discipline was sufficient to stay awake!!! This is unsafe and made more unsafe by requiring: 1. Over 12 hours single augmented on the first leg. 2. Two un-augmented legs on the back side of the clock with long preflight awake hours. 3. Over 8 extra hours of "duty time" in CABS!!! Rework this trip before someone gets hurt. No one in the cockpit for the last 6 hours was at their peak to respond to irregular situations. We weren't even able to stay awake the whole time in the seat.

Even if no anomalies occur during a flight, a fatigued crew may be poorer problem solvers than well-rested crews as noted in the research cited above, and thus add a degree of risk to the system. In addition, taking evasive action and missed approaches because of fatigue are serious safety events indicating substantial risk manifesting in the current system.

Effectiveness of Final Rule

It is usually the case that multiple factors can be identified as causes of specific accidents, and it is seldom the case that a specific rule is 100 percent effective at addressing a variety of accident causal factors. In particular, fatigue is rarely a primary or sole cause of an accident, and therefore this final rule will not likely prevent all future fatigue related accidents. For this final regulatory evaluation, we have established a modified effectiveness ratio to categorize accidents for which fatigue may be a contributing causal factor. This number represents the likelihood the requirements contained in this final rule would have prevented an accident from occurring. It is applied in the calculation of the number of forecasted fatigue accidents, if no action was taken to address the fatigue problem in Part 121 operations.

In its analysis of the effectiveness of the final rule, the FAA reviewed accidents that could have been prevented or could have been influenced by the requirements contained in this final rule. The effectiveness analysis works by assessing the likely capability of the requirements contained in the final rule to have prevented those accidents. As part of this analysis, the FAA Office of Accident Investigation reviewed the accident reports from NTSB and foreign investigative authorities on all accidents where the NTSB cited fatigue or fatigue was thought to be either a cause or factor. This was done in order to assess the likelihood that the provisions of the final rule would have averted those accidents (including positioning flights operating under Part 91).

A consistent definition was applied to the 20-year history as the requirements of the rule apply to all Part 121 operations. As such, we reviewed the accident history for all operations that would currently operate under Part 121. The final analysis takes into account NTSB findings, FAA's independent assessment, and comments to the docket. Some accidents reviewed scored "zero" because fatigue could not be established as a significant factor or because the final rule would not prevent such an event had the requirements been in place today. These accidents were removed from our effectiveness analysis and forecast. This discussion focuses on incidents involving passenger operations, because this final rule does not mandate compliance with Part 117 for cargo-only operations. However, this Initial Supplemental RIA provides estimates of both base and high case benefits if the final rule were extended to cargo-only operations which are based on the same methodology discussed here for passenger operations.

Each accident was then re-evaluated by conducting a scoring process similar to that conducted by the Commercial Aviation Safety Team (CAST), a well-documented and well understood procedure, similar to the NPRM. The FAA Office of Accident Investigation used the NTSB recommendations along with narratives, probable cause, contributing factors and other pertinent data to score the accidents. When these accidents were not well defined in the probable cause or contributing factors statements of the NTSB reports, Accident Investigation used a Joint Implementation Monitoring Data Analysis Team (JIMDAT)-like method. The JIMDAT-type scoring system is from zero to five, and the score is based on the likelihood that a proposed action would have mitigated that accident. The level and percentage of effectiveness criteria are detailed in Table 6.

Table 6: JIMDAT - Type Scoring System

5	90% effectiveness. The proposed requirement directly addresses the NTSB causal factors and would very likely prevent the accident in the future.
4	75% effectiveness. The proposed requirement directly addresses the majority of the NTSB causal factors and would probably prevent or is likely to reduce the risk of the respective accident, given the circumstances that prevailed.
3	50 % effectiveness. The proposed requirement directly addresses one of several NTSB causal factors and is likely to reduce the risk of the respective accident, given the circumstances that prevailed.
2	35% effectiveness. The proposed requirement generally addresses the NTSB causal factors and is likely to reduce the risk of the respective accident, given the circumstances that prevailed.
1	15% effectiveness. The proposed requirement is likely to have reduced the risk of the respective accident, given the circumstances that prevailed.
0	0% effectiveness. The proposed requirement would not reduce the risk of this type of accident in the future.

FAA applied this methodology to each pilot fatigue accident to reach an overall effectiveness ratio for the requirements contained in this final rule. The qualitative assessments ranged from zero (0) to very low (1), low (2), moderate (3), high (4), and very high (5). The qualitative assessments then were converted to quantitative effectiveness scores as follows: zero; 15%; 35%; 50%; 75%; and 90%.

For both the original RIA and this Initial Supplemental RIA, the FAA presents the quantified benefits and effectiveness analysis for a 10-year period. Although we only forecast ten years of benefits, we have included a 20-year history of accidents involving passenger operations, as these are the circumstances and events which have led to this final rulemaking. Table 7 summarizes the past 20 years of pilot fatigue accidents. Appendix A contains a summary of each accident and the corresponding effectiveness analyses.

Table 7: 20-Year Accident History

Date	Location	Service	Carrier	A/C	On Bd	Ftl	Ser	Dam-age	Scenario	Score
02/17/1991	Cleveland, OH	121 Cargo	Ryan International	DC-9-15	2	2	0	Dest	LOC Climb-out; Icing	0.5
08/18/1993	GTMO, Cuba	121 Cargo	Konnie Kallita	DC-8	3	0	3	Dest	Landed Short	0.9
07/02/1994	Charlotte, NC	121 Pax	US Air	MD-82	57	37	16	Dest	LOC on Approach; Icing	0.15
02/16/1995	Kansas City, MO	Ferry	ATI	DC-8-63	3	3	0	Dest	LOC in RTO; Engine Out	0.9
12/20/1995	Cali, Colombia	121 Pax	American	B757	164	160	4	Dest	CFIT High	0.35
08/25/1996	JFK, NY	121 Pax	TWA	L1011	262	0	0	Sub	Tail Strike Landing	0.35
01/22/1999	Hyannis, MA	Positioning	Colgan Air (Part 91)	BE-1900	4	0	0	Dest	Hard Landing (BETA)	0.15
05/08/1999	JFK, NY	121 Pax	American Eagle	SF34	30	0	1	Sub	RE Landing	0.5
06/01/1999	Little Rock, AR	121 Pax	American	MD-82	145	11	45	Dest	RE Landing	0.15
07/26/2002	Tallahassee, FL	121 Cargo	FedEx	B727-200	3	0	3	Dest	CFIT Low on Approach	0.75
10/19/2004	Kirksville, MO	121 Pax	Corporate Airlines as American Connexion	BAE-32	15	13	2	Dest	CFIT Low on Approach	0.75
08/27/2006	Lexington, KY	121 Pax	Comair as Delta Connection	CRJ-200	50	49	1	Dest	Wrong Runway T/O	0.35
02/18/2007	Cleveland, OH	121 Pax	Shuttle America as Delta Connection	ERJ-170	74	0	0	Sub	RE Landing	0.5
04/12/2007	Traverse City, MI	121 Pax	Pinnacle as NW Express	CRJ-200	52	0	0	Sub	RE Landing	0.9
06/20/2007	Laramie, WY	121 Pax	Great Lakes	BE-1900	11	0	0	Sub	LOC Bounced Landing	0.15
02/12/2009	Buffalo	121 Pax	Colgan Air	DHC-8-Q400	49	50	0	Dest	LOC In Flight; RE Landing	0.5
Passenger Average										52.5%

James Reason characterizes major accidents and catastrophic system failures as the consequences of multiple, smaller failures that lead up to the actual accident. It is a "Swiss cheese" model of human error and also a sequential theory of accident causation.[19] Reason's model describes four levels of human failure, each one influencing the next. O*rganizational influences* lead to instances of *unsafe supervision* which in turn lead to *preconditions for unsafe acts* and ultimately the *unsafe acts of operators*. The unsafe acts of operators are where most accident investigations are focused. It is a useful framework to illustrate how analyses of major accidents and catastrophic systems failures tend to reveal multiple, smaller failures leading up to the actual accident. The chances of the exact same circumstances happening again and causing the "same accident" are virtually nil but the possibility of preventing a similar set of circumstances is real.

This sequential "Swiss cheese" formulation is a very appropriate tool for characterizing the circumstances leading up to accidents. The nature of fatigue is such that actions, reactions and the thought processes of fatigued crews are more susceptible to the types of cascading errors of judgment described in Reason's model of catastrophic failure. The requirements contained in this final rule will decrease pilot fatigue and therefore the accompanying accidents that are associated with fatigue. While it is very difficult to accurately attribute all past accidents to one or more causes indisputably, we have developed the average effectiveness measure to apply to the estimates and recognize that there are additional uncertainties with preventing a future fatigue related event. First, we examine an accident that occurred on October 19, 2004:

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[19] Reason, James. "Human Error," Cambridge University Press, 1990.

At about 1937 central daylight time, a Corporate Airlines BAE Systems BAE-J3201, struck trees on final approach and crashed short of runway 36 at Kirksville Regional Airport, in Kirksville, Missouri. The captain, first officer, and 11 of the 13 passengers were fatally injured, and two passengers received serious injuries. The airplane was destroyed by impact and a post-impact fire.[20]

Research and accident history indicate that fatigue can cause pilots to make risky, impulsive decisions, to become fixated on one aspect of a situation, and to react slowly to warnings or signs that an approach should be discontinued. Fatigue especially affects decision making, and research shows that people who are fatigued become less able to consider options and are more likely to become fixated on a course of action or a desired outcome. A fatigued pilot might fail to discontinue a flawed approach or might make a risky decision to continue a dangerous approach.

The fatigued crew reported for duty at 0514. The accident was near end of 6th sector on a 'demanding' day. Crew had been on duty 14.5 hours and the pilot in command (PIC) is said to have slept poorly night before. The captain was observed resting on a small couch in the company crew room; however, the quality of rest the captain obtained during this time could not be determined. Company pilots stated that the crew room was a noisy meeting area that was not ideal for sleeping.

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[20] The NTSB evaluated fatigue as a possible factor in this accident and looked at the various circumstances present the day of the accident that might have contributed to the pilots' fatigue. The pilots' available rest time (from about 2100 to 0400) did not correspond favorably with either pilots' reported usual sleeping hours, resulting in much earlier than normal times to go to sleep and awaken. Additionally, the early wakeup call times would have been challenging to both pilots because the human body is normally physiologically primed to sleep between 0300 and 0500.

Additionally, the pilots' high workload during their long day may have increased their fatigue. The accident occurred during the sixth flight segment of the day while the pilots were performing a non-precision approach in low ceilings and reduced visibility. The pilot deficiencies observed in this accident are consistent with fatigue impairment.

Similarly, although the first officer's junior status with the company may have been an issue in his failure to challenge the captain during the approach, he may also have been suffering from fatigue; his failure to monitor and react to the captain's deviations from non-precision approach procedures was consistent with the degrading effects (slowed reactions and/or tunnel vision) of fatigue.

The NTSB concluded that, on the basis of the less than optimal overnight rest time available, the early reporting time for duty, the length of the duty day, the number of flight legs, the demanding conditions (non-precision instrument approaches flown manually in conditions of low ceilings and reduced visibilities) encountered during the long duty day (and the two previous days), it is likely that fatigue contributed to the pilots' degraded performance and decision-making.

Another fatigue related accident occurred in Traverse City, Michigan on April 12, 2007. The accident occurred well after midnight at the end of a demanding day during which the pilots had flown 8.35 hours, made five landings, had been on duty more than 14 hours, and been awake more than 16 hours. During the accident flight, the cockpit voice recorder (CVR) recorded numerous yawns and comments that indicate that the pilots were fatigued. Additionally, the captain made references to being tired at 2332:12, 2341:53, and 0018:43, and the first officer stated, “jeez, I’m tired” at 0020:41. Additionally, the pilots’ high workload (flying in inclement weather conditions, and in the captain’s case, providing operating experience for the first officer) during their long day likely increased their fatigue. The aircraft ran off the departure end of the runway during snowy conditions. Although there were no injuries among the 49 passengers, the aircraft was substantially damaged.

As we observe a clear accident history and the accompanying science dealing with fatigue, it is apparent that fatigue threatens aviation safety by increasing the risk of pilot error that could lead to an accident. Fatigue is characterized by a general lack of alertness and degradation in mental and physical performance. Fatigue manifests in the aviation context not only when pilots fall asleep in the cockpit while cruising, but perhaps more importantly, when they are insufficiently alert during take-off and landing. Each flight segment that is flown by a flightcrew member includes a takeoff and a landing, which are the most task and safety-intensive parts of the flight. A flightcrew member whose FDP consists of a single flight segment only has to perform one takeoff and landing, while a flightcrew member whose FDP consists of six flight segments will have to perform six sets of takeoffs and landings. Because takeoffs and landings are extremely task-intensive, it logically follows that a flightcrew member who has performed six sets of takeoffs and landings will be more fatigued than the flightcrew member who has performed only one takeoff and landing. Reported fatigue-related events have included procedural errors, unstable approaches, lining up with the wrong runway, and landing without clearances. As such, a fatigued crew is dangerous no matter what “type” or segment of operation is examined and the requirements in this final rule will eliminate the distinctions between various operations.

As we have shown, in an airplane accident, there is a series of errors (both causes and factors) that contribute to an accident. Accident scenarios can vary greatly depending on phase of flight, the type of operation, phase of flight and size of the airplane. While pilot fatigue can occur during any stage of flight, takeoff and landing are especially critical times for the crew to exhibit good judgment and sound decision making. The airplane is close to the ground and there is little room for error during these particular phases of flight.

Quantified Benefits

In this Initial Supplemental RIA, the FAA provides a range of benefit estimates for both passenger operations and cargo-only operations. The base case estimates only look at the historical events as an exact mirror for the future. The high case estimate for passenger operations assumes that regional carriers will begin flying larger planes. The high case estimate for cargo-only operations assumes a catastrophic crash with fatalities, in place of the one historic cargo-only crash which resulted in a hull loss and injuries, but no fatalities. We understand that future accidents will not be identical to historical accidents, but our approach provides a conservative look at the benefits of this rule based on a snapshot of the past.

Here the FAA provides a quantitative benefit estimate of historical-based accidents (base case), and a high case of expected benefits from future averted accidents once this rule is promulgated. Generally our benefit analysis begins using past history as an important reference from which to begin the benefit analysis. We believe the base case benefit estimate, which is based solely on the outcome of past accidents, may be low for passenger operations because today passenger load factors and aircraft size are already greater than they were in the past decade. On the other hand, we also note that this estimate may not fully take into account changes in regulatory requirements that postdate those accidents and that may mitigate the projected risk. As such, our base case estimate represents a snapshot of risk.

Airplane accidents are somewhat random both in terms of airplane size and the number of people on board. For these reasons, projections of future fatalities may be based on future risk exposure, and our projections are typically based on expected distributions around the mean. Our typical scenario incorporates increasing airplane size, expected load factors, and a breakeven analysis. However, our evaluation of the historical accidents showed a disproportionate risk among smaller, regional carriers. Accordingly, as we discuss below, the FAA has decided to base its high case estimate of passenger operations benefits on preventing an accident in a regional jet airplane.

In response to comments, we have reduced the analysis period from the 20 years provided in the proposed regulatory analysis to 10 years here. We received comments disputing the use of a 20 year time frame for accidents stating the accident rate has declined over time. While noting the wide range of operations over the last 20 years, we shortened the accident history to the last 10 years. A reduction in the length of the sample period introduces other problems, most importantly with less time there are fewer observations. Observations are important, as the nature of aviation accidents is that while they are rare events, very often these accidents result in severe, high consequences.

The FAA Office of Accident Investigation assessed the effectiveness of this rule to prevent the six fatigue-related accidents which occurred on passenger-carrying aircraft in a recent 10-year period. This office used the CAST methodology to assign a value to how effective the rule will be at preventing each accident. On average, we expect this rule would have been 52.5 percent effective in preventing the types of accidents had it been in effect over the last 10 years.

Passenger Operations Base Case Estimate

The passenger operations base case estimate only looks at the historical events as a specific reference point. In this estimate the exact number of fatalities for each past event is multiplied by the relative rule effectiveness score to obtain the historical number of deaths that would have been averted with the requirements contained in this final rule, had this rule been in effect at the time. The base case estimate supposes roughly six deaths will be averted annually. Multiplying six annual averted deaths by the $6.2 million value of statistical life equals $37.2 million annually. In addition, had the requirements been in place at the time of these historical accidents, $4.0 million in hull damage for each accident would have been averted,[21] which equals $12 million for ten years or $1.2 million annually. Finally, we use $5.6 million as the estimated accident investigation cost per accident, which equals $1.7 million annually.[22] This estimate is based on the investigation costs of federal agencies and private industries and aircraft wreckage removal.[23] When summed over the 10-year period 2014 through 2023, the base case estimate is $401 million ($263 million present value at seven percent and $332 million present value at three percent).

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[21] This Initial Supplemental RIA revises the base case estimate of hull value found in the original RIA. This estimate of hull damage is derived by averaging the low end estimated value of the aircraft types involved in the ten year accident history cited in Table 7 as found in Airliner Price Guide (Summer 2012). Note that three of the six historic accidents resulted in destroyed aircraft while the other three resulted in substantial damage. As a result, using replacement value of the aircraft as the estimate of the hull damage may overestimate benefits if repairing the damaged aircraft was less costly than replacing it after an accident.

[22] The inclusion of accident investigation costs as a benefit category is new to this Initial Supplemental RIA; it was not included in the original RIA. Rather, the cost associated with accident investigations was added to address a specific concern raised by pilots for cargo operators in associated litigation who asserted these costs should have been included. Since this cost is reasonably quantifiable, the FAA has determined that it is appropriate to consider in this Initial Supplemental RIA.

[23] The estimated accident investigation cost was derived from “Economic Values for FAA Investment and Regulatory Decisions, A Guide,” Oct. 3, 2007 by GRA for the FAA, pp. 8-4 and 8-5 and inflated using the GDP deflator. Specifically, the value for a major investigation ($10.5 million in 2011 dollars) was used for the three catastrophic crashes and the weighted average for air carriers ($0.6 million in 2011 dollars) was used for the non-catastrophic crashes, resulting in an average cost of $5.6 million in 2011 dollars.

Passenger Operations High Case Estimate

Because airplane accidents are relatively rare they are not necessarily representative of actual risk, especially with regard to airplane size and the number of people onboard. In addition, future conditions will be different than they were when the accident occurred. Thus, the base case estimate for passenger operations represents a snapshot of the risk that fatigue introduces in the overall operating environment. It considers neither the forecasted increase in load factors nor the larger aircraft types. The future preventable events that this rule addresses will not exactly mirror the past events because the airplane types, utilization, and seating capacity have changed.

To quantify the expected benefits in the passenger operations high case scenario, we narrowed the analysis to three of the six historic accidents which were catastrophic (all onboard died). In this case the expected number of preventable catastrophic accidents equals the three accidents multiplied by the 52.5 percent effectiveness rate. Thus over a 10-year time period the expected number of preventable accidents is 1.575. Using the Poisson distribution there is roughly a 20 percent chance for no accident; however, there is also a 47 percent probability of two or more accidents.

While the 20-year accident history has a broader range of catastrophic accidents, in the shorter 10-year historical period all the three catastrophic accidents were on regional airplanes. We recognize that as regional airplanes are smaller than the 'typical' passenger jet, assuming all future accidents would be on a regional jet understates the relative risk across the fleet of aircraft affected by this rule. It does, however, represent historical accidents and may be somewhat representative of actual future risk, since the mainline carriers typically have collective bargaining agreements that are already largely reflective of the requirements of this rule.[24]

The B737 and A320 represent typical sized airplanes in the forecast period with an expected number of passengers and crew of 123 given a forecasted 143 seat airplane and a load factor of 83 percent.[25] Even though there was a (relatively large) B757 passenger airplane accident in the 20 year history, if one looks at the past 10 years as truly representative of risk, the preventable accident would likely be on a regional airplane.

For the high case the FAA backed away from a benefit outcome based on mean fleet, flight hours, and occupant numbers because ultimately we were persuaded there was information which could not be ignored by the three regional passenger accidents occurring without a mainline passenger accident. For this reason, we selected an 88 seat regional jet (like an ERJ-175) to be the representative airplane for the high case. This size airplane is also consistent with the fact that regional operators are expected to fly somewhat larger airplanes in the future.

The expected benefit from this high case follows a simple methodology for estimating and then valuing the expected number of occupants in a prevented accident. With a total of 0.3 accidents per year over the ten year period multiplied by the 52.5 percent effectiveness rate, the analysis assumes 0.1575 average accidents per year. The estimated occupant value for each averted accident equals the average number of seats (88) multiplied by the load factor of 77

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[24] It is unusual that collective bargaining agreements would closely mirror regulatory requirements. However, flight and duty limitations are unique because they address both safety considerations, which are regulatory in nature, and lifestyle considerations, which are properly addressed in collective bargaining agreements. Because of the impact of collective bargaining agreements on the number of hours that pilots work, those agreements were considered by the FAA in calculating both the costs and benefits of this rule.

[25] Table 6 and Table 9, FAA Aerospace Forecasts Fiscal Years 2011-2031

percent plus four crew members for a total of 72 averted fatalities.[26] Each of these prevented fatalities is multiplied by a $6.2 million value of statistical life. The expected value of a preventable accident equals the sum of the averted fatalities at $446.4 million added to the value of the airplane hull loss ($24.0 million replacement value),[27] and accident investigation costs ($10.5 million for a major investigation) for a prevented accident benefit of $480.9 million. Over a ten year period the value of preventing the expected 1.575 accidents equals approximately $757 million ($497 million present value at seven percent and $627 million present value at three percent).

Cargo-only Operations Base Case Estimate

Just as in the benefit analysis for passenger operations, the cargo-only base case estimate uses historical events to determine the preventable accident benefits for the future benefits. There was one air cargo accident during the ten-year analysis period, which occurred July 26, 2002. In this accident three crewmembers were seriously injured and the hull and cargo were destroyed. Thus, the benefit of preventing such an accident in the future consists of averting serious injury to three pilots, the value of the hull and the cargo, and the public and private cost of the accident investigation. After estimating the value of each benefit, we apply an effectiveness rating of 75 percent to the sum of these benefits.

The value of averting three seriously injured pilots is $1.95 million. This value is based on the DOT policy guidance that states the value of a person losing productivity from a "serious"

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[26] Assumed load factor of 77 percent is based on forecasted load factors for regional carriers found in Table 25, FAA Aerospace Forecasts Fiscal Years 2011-2031.

[27] This Initial Supplemental RIA revises the high case estimate of hull value found in the original RIA. The value for an ERJ-175 taken from Airliner Price Guide (Summer 2012).

injury is 10.5 percent of the value of statistical life.[28] Thus, the value of a serious injury to one pilot is $0.65 million (10.5 percent multiplied by $6.2 million), or $1.95 million for three pilots.

If the rule prevented a catastrophic accident today of a B727-200F,[29] the average replacement value of such an airplane produced between 1981 and 1984 is approximately $1.8 million.[30]

We estimate the average value of cargo on a B727-200F to be $2.7 million. 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 from the 2007 Freight Analysis Framework (FAF) Survey.[31] Because both the airfreight weight of shipment and airfreight value of commodities vary by origination or destination, the average was used. Inflation adjusted average cargo value per ton of $87,082 was calculated by dividing the origin-destination averaged airfreight value of commodities by the corresponding averaged airfreight weight of shipment, with inflation rate based upon the Gross Domestic Product deflator. The average cargo value of $2.7 million was calculated by multiplying the maximum cargo weight capacity of a B727-200F aircraft (31 tons) by the average cargo value per ton ($87,082).[32] This estimate is based on a cargo load factor of 100 percent.

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[28] This guidance can be found at http://ostpxweb.dot.gov/policy/reports/vsl_guidance_072911.pdf
[29] The only cargo accident during the 10 year history involved a B727-200.
[30] Airline Price Guide, Summer Edition 2011, volume 68, pp.81-82. As with the passenger base case, use of the replacement value of the aircraft as a component of the estimate of benefits from avoiding a non-catastrophic crash may be an over estimate, if the costs of repairing the aircraft are lower than the replacement value of the aircraft.
[31] Data based on 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/)
[32] NASA/CR- 1998-207655, "Air Cargo Operations Cost Database," Table 5-3, pp. 5-4

We include the weighted average cost of accident investigation ($0.6 million) as a benefit category.[33]

The total of the averted costs from three serious injuries of $1.95 million, complete loss of a B727-200 hull valued at $1.8 million, complete loss of $2.7 million in cargo value, and investigation costs of $0.6 million equals base case benefits of $7.1 million. This rule is estimated to have an effectiveness rating of 75 percent.[34] Multiplying the potential benefits of $7.1 million by the 75 percent effectiveness yields a base case benefit estimate of $5.3 million. The FAA assumes the likelihood of an accident occurring in any year of the forecast period is equal, or uniformly distributed. The present value benefits are $3.5 million when discounted at seven percent rate and $4.4 million when discounted at three percent rate.

High Case Estimate

The high benefit case is based on the same accident scenario as in the base case, that is, a single accident, but with a more severe outcome. The high case estimate projects preventing one catastrophic air cargo accident over a 10-year period, thus averting 2 fatalities and avoiding the loss of a high valued narrow-body hull (B757-200F), along with its entire cargo. In addition, we continue to assume a cargo load factor of 100 percent. Similar to the base case analysis, we include accident investigation costs, which include public and private accident investigations cost, and aircraft wreckage removal.

The estimation of benefits is calculated as follows. First, the value from preventing two fatalities equals $12.4 million (2 x $6.2 million/averted fatality). Second, the hull value of a

[33] "Economic Values for FAA Investment and Regulatory Decisions, A Guide," Oct. 3, 2007 by GRA for the FAA, pp. 8-4 and 8-5 and inflated using the GDP deflator.
[34] This effectiveness rating was determined using the JIMDAT-type process described earlier in this document.

B757-200F equals $15.2 million based on an average replacement value for a B757-200F made between 1983 and 1999.[35] Third, at a 100 percent load factor, the complete loss of the cargo carried is valued at about $3.7 million. The cargo value is determined based on the maximum cargo weight capacity of 42.9 tons for a B757-200F aircraft,[36] multiplied by an average cargo value per ton of $87,081. Lastly, we add the estimated cost of a major accident investigation: $10.5 million.[37]

In total, the estimated benefit of preventing an accident in the high case is $41.8 million. Multiplying the estimated benefit of a preventing an accident by a 75 percent effectiveness rating equals $31.4 million. Thus the total benefits for the high case equals $31.4 million ($20.6 million present value at seven percent, and $26.0 million present value at three percent).

Benefit Summary

The new requirements in this final rule will eliminate the current rest and duty distinctions between domestic, flag and supplemental operations as the requirements apply universally to all Part 121 certificate holders conducting passenger operations. The sleep science, while still evolving, is clear in a few important respects: most people need eight hours of sleep to function effectively, most people find it more difficult to sleep during the day than during the night, resulting in greater fatigue if working at night; the longer one has been awake and the longer one spends on task, the greater the likelihood of fatigue; and fatigue leads to an increased

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[35] Source: Airline Price Guide, summer edition 2011, volume 68, pp.138-141.

[36] NASA/CR- 1998-207655, "Air Cargo Operations Cost Database," Table 5-3, pp. 5-4

[37] Petitioners in the related litigation argued that the FAA should have included the impact of averted hazardous material spills in calculating benefits. Potential costs from hazardous materials on-board are not included here. There is no historical basis to project any impact, as DOT reporting indicates there were only two “hazmat” accidents involving aviation in the last ten years and there was no cost to the public from those accidents (Hazmat Intelligence Portal, U.S. Department of Transportation. Data as of 9/10/2012).

risk of making a mistake. The requirements contained in this final rule and the accompanying analysis are designed to reduce the factors that lead to fatigue in most individuals and for all flight crew.

The actual benefits of the final rule will depend upon the type and size of accident that the rule averts. Because we recognize the potential variability in the quantified benefits of this final rule, we provide a base case estimate and a high case estimate for both passenger and cargo-only operations. Our base case estimate of the benefits of the final rule as applied to passenger operations is $401 million ($263 million present value at seven percent and $332 million at three percent) and our high case estimate is $757 million ($497 million present value at seven percent and $627 million at three percent). We also note that saving just 84 lives in a 10 year period would cause this rule to be cost beneficial.[38] Further, even if this rule was only 36 percent effective at preventing accidents due to fatigue (as opposed to the 52.5 percent effectiveness estimated in this analysis) the rule would still be cost beneficial.[39]

If the final rule were extended to cargo-only operations, our base case estimate of benefits for that population is $5 million ($3 million present value seven percent and $4 million present value three percent) and our high case estimate is $31 million ($21 million present value at seven percent and $26 million present value at three percent).

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[38] This comparison is made assuming the lives saved are distributed uniformly over the 10 year analysis period for benefits and using a seven percent discount rate.
[39] This calculation is performed using the parameters from high case benefits analysis and uses seven percent as the discount rate.

Cost Analysis

The cost of the final rule to Part 121 passenger air carriers can be categorized into three main cost components: flight operations, training, and rest facilities. Flight operations cost consists of three subcomponents: crew scheduling cost, computer programming of crew management systems cost, and cost savings associated with reduced use of sick time by pilots because of reduced fatigue. Training cost consists of two subcomponents: dispatchers and management fatigue training cost, and curriculum development cost. Rest facilities cost consists of four subcomponents: engineering cost, installation cost, aircraft downtime cost, and increased fuel usage cost. The final rule costs were calculated using industry-provided data whenever possible, along with expert analysis.

The total estimated cost of the final rule is $457 million for the 12-year period from 2012 to 2023. The present value is $338 million and $398 million using a seven percent and a three percent discount rate, respectively. If the rule were extended to cover cargo-only operations, the additional cost of the rule would be $550 million in nominal terms, $377 million and $464 million using seven percent and three percent discount rates, respectively.

The 2014 effective date of the final rule allows two years for carriers to become compliant with the final rule. The FAA classified costs into three main components and estimated the accompanying costs. Data used for the cost estimation was obtained from various industry sources, the sources of which are explained in each section.

Table 8 and Table 9 present the estimates of the three main cost components for passenger operations and cargo-only operations, respectively.[40] Flight operations costs account for approximately 64 percent of the total nominal cost of the rule. Rest facilities account for approximately 32 percent of the total nominal cost of the rule. Roughly four percent of the nominal costs contained in this analysis are attributable to training. If the final rule were to be extended to cargo-only operations, 87 percent of the total nominal cost of the rule would be from flight operations costs, 12 percent from rest facility costs, and one percent from training costs. Each of the main cost components are explained in-depth in the following sections of this document.

Table 8: Cost Summary, Passenger Operations

Cost Component	Total Nominal Cost (millions)	PV Cost at 7% (millions)	PV Cost at 3% (millions)
Flight Operations	$294	$195	$245
Rest Facilities	$146	$132	$139
Training	$17	$11	$14
Total	$457	$338	$398

Table 9: Cost Summary, Cargo-Only Operations

Cost Component	Total Nominal Cost (millions)	PV Cost at 7% (millions)	PV Cost at 3% (millions)
Flight Operations	$479	$315	$397
Rest Facilities	$66	$59	$62
Training	$6	$4	$5
Total	$550	$377	$464

[40] Note that for this table and others, items may not sum to reported totals due to rounding.

Flight Operations Cost

The flight operations cost component of the final rule is composed of three subcomponents: crew scheduling costs, crew management system computer programming costs, and payroll cost savings from reducing flightcrew member fatigue.[41] Table 10 and Table 11 provide a summary of the three subcomponents of the flight operations cost for passenger operations and cargo-only operations respectively. The derivations of subcomponent costs are explained in-depth in the following sections of the document. The explanation for these different cost components found in this Initial Supplemental RIA is structured slightly differently than the explanation found in the original RIA. Additionally, in a few instances, the manner of calculating these cost components has been modified for clarity, consistency, and to correct some calculation and reporting errors.

Table 10: Summary of Flight Operations Costs, Passenger Operations

Flight Operations Cost Subcomponent	Total Nominal Cost (millions)	PV Cost at 7% (millions)	PV Cost at 3% (millions)
Crew Scheduling	$479	$315	$397
Computer Programming	$8	$7	$7
Payroll Savings from Reducing Fatigue	-$193	-$126	-$159
Total Flight Operations	$294	$195	$245

[41] Operators might be able to reduce their flight operations costs by developing and implementing a fatigue risk management system (FRMS). The FAA is not imposing an FRMS program requirement on Part 121 carriers, but does allow carriers the FRMS option. Carriers might develop an FRMS program as an alternative to the final rule flightcrew member duty and rest requirements when the crew scheduling cost savings equal or exceed the costs of the FRMS program. Carriers might do this for ultra-long flights, which have flight times over 16 hours. FRMS is optional and would only be implemented by an operator if their compliance costs could be reduced as FRMS only provides cost relief. We did not estimate this potential savings as we do not know how many operators would use FRMS and the cost of FRMS has a wide range.

Table 11: Summary of Flight Operations Costs, Cargo-only Operations

Flight Operations Cost Subcomponent	Total Nominal Cost (millions)	PV Cost at 7% (millions)	PV Cost at 3% (millions)
Crew Scheduling	$521	$342	$431
Computer Programming	$2	$2	$2
Payroll Savings from Reducing Fatigue	-$44	-$29	-$36
Total Flight Operations	$479	$315	$397

Crew Scheduling

Overview

Numerous commenters objected to FAA's assumptions regarding the 25 percent cost-savings resulting from long-term scheduling optimization in the NPRM. To address these concerns, the FAA estimated the scheduling compliance costs using a commercial crew scheduling program. The final rule's impact on crew scheduling costs was evaluated using Cygnus, a pairing and bid line optimizer developed by CrewPairings, Inc.[42] A selection of Part 121 air carriers provided actual crew schedule data to the FAA for assistance in the cost analysis of the Flightcrew Member Duty and Rest Requirements Rulemaking. Each carrier provided data for one or more "cases." A case is defined as a carrier fleet, which usually consists of one aircraft type. In some of the cases, the carrier schedules multiple aircraft types using the same pool of flightcrew members; the methodology in the original RIA (also used in this Initial Supplemental RIA) mirrors actual carrier practice.

In total, carriers provided data for eight cases. This analysis is necessarily limited by the willingness of carriers to provide this detailed crew scheduling data. However, we believe the

[42] Cygnus has been used by more than 30 major airlines worldwide over the past 40 years.

cases used in this analysis represent the spectrum of cost structures present in the Part 121 air transportation industry. Mainline passenger carriers were represented with two short-haul, narrow-body aircraft cases and two long-haul, wide-body aircraft cases. Regional passenger carriers were represented with two cases.[43] Freight carriers were represented with one short-haul, narrow-body aircraft case and one long-haul, wide-body aircraft case.

In addition to the eight cases based on actual carrier fleets, a synthetic supplemental carrier case was created because no supplemental carriers provided crew schedule data. Creation of the synthetic supplemental carrier involved modification of the freight wide-body case. The flight schedules and crew bases of the freight wide-body case were retained because cargo carriers comprise the major share of supplemental carriers. The freight carrier CBA rules were replaced with those reflecting a representative supplemental carrier CBA. The representative supplemental carrier CBA reflected rules from a number of actual supplemental carrier CBAs. These changes reflect the impacts of this final rule on actual supplemental passenger carriers operating wide-body aircraft with route structures similar to the freight wide-body aircraft case.

The crew schedule data consisted of one scheduling period (month) per case. The specific periods varied by carrier, based on data availability. The data included flight schedules, aircraft flow information, pairings and the carrier's rule set (contractual, management, and discretionary rules). The use of a pairing and bid line optimizer enabled the FAA to more accurately model the impacts of the final rule on industry crew scheduling costs than was possible during NPRM cost analysis. The pairing and bid line optimizer has been used worldwide by many types of airlines

[43] Most regional carriers operate code-share flights for a number of mainline partners; crew scheduling is usually performed separately for each mainline partner. This analysis was conducted using the same process as the actual carrier, so each regional carrier case represents a sub-fleet.

for their own crew scheduling needs and addresses the optimization and scheduling limitations in the NPRM cost analysis. Due to this extensive real-world experience, results for these eight cases can be expected to accurately portray the impacts of the final rule on crew scheduling costs for the cases studied.

Crew Scheduling Analysis

Accurately analyzing the final rule's impact on crew scheduling costs for each of the cases required isolating the final rule's impact from the impacts of various contractual, management, and discretionary crew scheduling practices. The pairing and bid line optimizer was first calibrated to ensure that it was capable of creating crew schedules virtually identical to the crew schedules provided by the carriers. After calibration, existing federal regulations relevant to flightcrew member scheduling were removed from the optimizer and replaced with the final rule requirements. Changes in crew scheduling cost could then be attributed solely to the final rule.

The first step in optimizer calibration was receiving and formatting the input data from carriers. The input data included flight schedules, aircraft flow information, pairings, regulations, carrier's unit costs (credit hour pay rate, per diem, and hotel room costs), and the carrier's rule set from the carriers' crew management systems. Carrier rule sets included parameters for crew bases, maximum/minimum flight time, rest time, duty time, and ground time to allow aircraft changes and are based on contractual, management, and discretionary rules. The pairings that were received directly from the carriers in this first step are referred to as the "production solution." Since no modifications were made to the production solution by the FAA or the optimizer, the production solution accurately represents the current crew scheduling environment, including all regulatory, contractual, management, and discretionary rules.

Once the production solution was established, the bid lines and pairings were set aside. The optimizer was run using only the flight schedules, aircraft flow information, federal aviation regulations and the carrier's rule set. The optimizer then created its own bid lines and pairings, which are referred to as the "baseline solution." The baseline solution was compared to the production solution using a number of metrics, such as the amount of credit hours, duty periods, hotel room nights required, distribution of time among crew bases, number of aircraft swaps, etc. Once the baseline solution was identical or virtually identical to the production solution, the optimizer was deemed calibrated for each of the cases.

This calibration of the optimizer verified that the optimizer could accurately reproduce the crew scheduling process at each of the carriers. That is, the baseline solution could be substituted for the production solution at each carrier with no material change in crew scheduling cost.

To determine the impact of the final rule, the regulations in the baseline solution were replaced with the final rule. All provisions of the final rule were implemented in this analysis, including maximum flight time, maximum flight duty time, minimum rest time, and cumulative limits. All other, non-regulatory rules from the baseline solution were retained. Using these inputs, the optimizer created bid lines and pairings referred to as the "final rule solution." Since the only difference between the baseline solution and the final rule solution was the substitution of the final rule for the existing regulations, the change in cost components between the solutions is solely attributable to the final rule.

In the course of reviewing the calculations used in estimating scheduling costs in support of drafting this Initial Supplemental RIA, FAA became aware that in the original RIA, in eight of the nine cases, the number of aircraft block hours differed slightly between the baseline run and the final rule run. This minor difference is due to the treatment of so called "carry-in/carry-out" flights. Industry practice is to construct each trip pairing such that each flightcrew member starts and ends the scheduling period at their crew base. Consequently, some bid lines outputted by the optimizer would have left flightcrew members away from their crew base at the beginning or end of the scheduling period (month). In those instances, it is airline practice to include those segments as part of the bid lines for the adjoining month (i.e., "carrying" the pilot in or out of the month). While that is reasonable practice for airlines, the practice resulted in introducing a source of variation between the baseline and final rule run that was not caused by the final rule. That is, because the final rule results in different bid lines being constructed, the segments identified as carry-in or carry-out often differ as well.

FAA continues to use the original results as the basis for this Initial Supplemental RIA. However, Appendix B contains a sensitivity analysis whereby the final rule results are adjusted to explore the possible magnitude of the impact of the difference in aircraft block hours on the crew scheduling cost estimates caused by the carry-in/carry-out variation.

Table 12 shows the change in cost components attributable to final rule for each case. Note that cases which had no changes in either domestic or international time away from base (TAFB) were cases that were either solely domestic or solely international. More details on the analysis of each case used in this analysis can be found in the GRA summary report found in the docket associated with this rule-making.[44]

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[44] GRA, Incorporated, "Summary of CrewPairings, Inc. Economic Analysis of Flightcrew Member Duty and Rest Requirements Rulemaking," September 2012.

Table 12: Change in Monthly Flightcrew Scheduling Cost Elements Due to Final Rule, by Case

Industry Group	Case	Baseline Solution Flightcrew Members	Change in Credit Hours	Change in Domestic TAFB Hours	Change in International TAFB Hours	Change in Hotel Stays
Passenger Narrow-body	A	924	2,187	18,660	0	660
	B	1,698	-429	-15,035	1,030	-944
Passenger Wide-body	C	1,121	-70	3,863	8,348	791
	D	430	-965	0	-2,741	-34
Regional	E	300	57	5,812	0	280
	F	240	37	4,148	-16	144
Supplemental	I	806	4,642	3,159	9,759	756
Freight Narrow-body	G	330	560	890	2,390	54
Freight Wide-body	H	1,053	984	6,197	862	240

It is interesting to note that in some instances, the rule change results in the potential for cost savings. For instance, while one provision of the final rule requires increased rests between duty periods for domestic operations, the final rule also allows for increased flying time in certain situations as well as reduced rest times between duty periods for some international operations.

Given that maximum flight time and flight duty period time now depend on time of day, acclimation, number of flightcrew members, and number of segments, there are situations where flightcrew members can work more hours per duty period under the final rule than under the previous rule or where a flight previously requiring additional flightcrew members can now be flown with fewer flightcrew members.

In some cases, the changes are small. For instance, maximum flight time per duty period for domestic flights was extended from 8 to 9 hours for duty periods beginning from 0500-1959.

However, the flight time limits now are in effect for actual flight time, rather than planned flight time, which means in practice carriers will not be able to fully schedule the additional hour of flight time but instead will leave a buffer to allow for instances of unplanned flight delays. In other cases, though, airlines can potentially see significant savings; international flights with three flightcrew members were previously limited to 12 hours flying and have now been increased to 13 flight hours and up to 17 flight duty hours under certain time of day and rest facility combinations. For some classes of long-haul flying, this means that instead of needing two additional flightcrew members, only one additional flightcrew member is needed. Similarly, rest periods have also potentially decreased for some route types (particularly international), reducing the amount of TAFB and credit hours accruing to pilots.

As an example, Case D depicted in Table 12 shows *savings* in terms of credit hours, international TAFB, and hotel stays due to the final rule. The flight segments in Case D were exclusively international flights and the existing schedules already allowed rest periods that exceeded the minimum rest period required by the final rule. Additionally, Case D had instances where the increase in flight time allowed by the rule was particularly beneficial and allowed certain flights to Europe to be operated with one less flightcrew member which resulted in significant cost savings.

One of the passenger narrow-body cases and both passenger wide-body cases (Cases B – D) demonstrated decreases in credit hours. The other passenger narrow-body case (Case A) showed an increase in credit hours of 2.9 percent while both regional carriers (Cases E and F) had credit hour increases of only 0.2 percent. The freight and supplemental cases (Cases G – I) had credit hour increases ranging from 1.2 percent to 7.2 percent. TAFB and hotel rooms rose for some passenger carrier cases and fell for others (but generally less than 7.5 percent in either direction), depending largely on the relevant schedule and collective bargaining agreement. TAFB and hotel rooms increased for the regional cases (between 5 percent and 9 percent) as their current scheduling practice is optimized around the minimum rest time of the current rule. Freight and supplemental carriers saw across-the-board increases in time away from base and hotel rooms.

In terms of the final rule's impact on the work schedules of flightcrew members at an individual level, the most striking change is for the supplemental case. Flightcrew members in the supplemental case under the final rule will now have two fewer duty hours per duty period, on average, whereas the other cases showed more modest changes in the number of duty hours per duty period (fewer than 30 minutes increase or decrease). The discrepancy results because the difference between the current rules and final rule was most pronounced for supplemental operations.

More details on the specifics of each of the cases can be found in the GRA summary report.[45]

Estimates of Unit Costs

We made separate estimates of each of the unit costs for each cost component (credit hour costs, per diem hourly rates, and cost per hotel room) for different types of air carriers. The estimates are based on actual cost data for a variety of air carriers, wherever possible.

The first step of the unit cost estimation process was to define a collection of industry groups that would collectively cover all Part 121 air carriers and that would group air carriers

[45] GRA, Incorporated, "Summary of CrewPairings, Inc. Economic Analysis of Flightcrew Member Duty and Rest Requirements Rulemaking," September 2012.

together based on similarity of characteristics that would influence their crew scheduling costs. Air carriers were assigned to one of the resulting eight industry groups based on a number of metrics such as operating authority, aircraft fleet, aircraft utilization, markets served, collective bargaining agreements, etc. In a few cases, a carrier might have been classified as a freight carrier even if it did not perform any cargo-only operations (or as a passenger carrier even if it did not perform any passenger operations). In these instances other characteristics of the air carrier, such as fleet type or collective bargaining agreement, were considered to be a more influential factor on crew scheduling costs than whether the carrier transported passengers or cargo. Note that the eventual allocation of costs between passenger and cargo-only operations was based on what the air carrier actually transports, not its industry group classification. Table 13 lists the number of air carriers in each group and the number of flightcrew members in each group. [46] Table C.1 in Appendix C presents further detail regarding the air carrier classifications.

Table 13: Air Carrier Classification into Industry Groups

Industry Group	Number of Part 121 Carriers	Total Number of Flightcrew Members
Passenger Integrated	7	36,013
Passenger Narrow-body	14	11,899
Passenger Wide-body	1	150
Regional	38	20,511
Supplemental	8	1,674
Freight Integrated	3	7,230
Freight Narrow-body	16	846
Freight Wide-body	3	914
Total	90	79,237

[46] The original RIA differed from the classifications used here in a few instances.

Table 14 presents a summary of the data and calculations used to estimate average credit hour costs per flightcrew member. Bureau of Transportation Statistics Form 41 data (Item 51230, Pilots and Copilots, from Schedule P-5.2) was used to determine the total flightcrew cost for each carrier. Block hours for each carrier were taken from the AirHoursRamp item in the Air Carrier Summary Data, T2: U.S. Air Carrier Traffic and Capacity Statistics by Aircraft Type report. Both data sources were the most current available at the time of the drafting of the original RIA, reflecting the first three quarters of 2010.[47] Total flightcrew cost data and aircraft block hour data were each summed across carriers by relevant industry group.[48] Each industry group's sum of total flightcrew cost was divided by that industry group's sum of aircraft block hours. For the passenger integrated carriers, this information was summarized separately for narrow-body and wide-body aircraft to preserve the distinction between narrow-body and wide-body flightcrew member pay rates.[49] These calculations resulted in the average total flightcrew cost per aircraft block hour (Column [A] in Table 14). To determine the average cost per block hour for an individual flightcrew member (Column [C] in Table 14), it was necessary to divide

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[47] There was no adjustment made for inflation, as pilot wages are negotiated through contracts.

[48] Note that here and elsewhere where data on aircraft block hours are used, the block hours associated with Beechcraft Beech 18 C-185 and Cessna 208 Caravan have been omitted because corresponding Pilot/CoPilot costs were not available. In addition, the records relating to Arrow Air, Inc. have been excluded from this analysis as that carrier ceased operations in the middle of 2010.

[49] The Form 41 data for freight integrated carriers did not support separate calculations for narrow-body and wide-body credit hour costs. The resulting pay rates would have inferred that pay rates for narrow-body pilots are higher than wide-body pay rates, a finding which does not correspond with usual industry practice. The issue appears to lie with the detailed reporting of this block hour and Pilot/CoPilot cost data by aircraft type. To avoid these reporting issues for freight carriers, we use only total Pilot/CoPilot cost and aircraft block hours for each carrier in the freight industry groups.

the average total flightcrew cost per aircraft block hour by the average number of pilots per flight (Column [B] in Table 14).[50]

Further adjustments were necessary to convert the estimates of average cost per block hour per flightcrew member to the average cost per credit hour per flightcrew member. First, estimated monthly credit hours per flightcrew member for each industry group were derived from analysis of AIR Inc. Salary Survey data (Column [D] in Table 14).[51] The AIR Inc. Salary Survey provided estimated monthly credit hours per flightcrew member for 36 carriers. Weighted average estimated monthly credit hours for each industry group were calculated using carrier block hour data from AirHoursRamp item in the Air Carrier Summary Data, T2: U.S. Air Carrier Traffic and Capacity Statistics by Aircraft Type report. Next, crew scheduling data provided by nine carriers to the FAA were analyzed to estimate the average number of block hours per flightcrew member per month for each industry group (Column [E] in Table 14). Each of the nine carriers provided data for two separate scheduling periods, with data for one scheduling period considered to be a "busy" month and data for the other considered to be a "slow" month.[52] The estimates of block hours per pilot for the two months were averaged

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[50] Narrow-body aircraft (including regional) were assumed to have two pilots per flight in all cases. Note that for narrow-body aircraft that require three flightcrew members (such as B727), the third flightcrew member is the flight engineer and is not reported in the Pilots and CoPilots cost item on Form 41 Schedule P-5.2. Because no cost data specific to flight engineers is available, this analysis uses the calculated pilot and copilot cost as the estimated cost for flight engineers. For wide-body aircraft, the average number of flightcrew members per flight was estimated using proprietary data provided to the FAA by a number of carriers. The average number of pilots per flight for integrated carriers is the average of the number of pilots per flight for narrow-body and wide-body flights, weighted by narrow-body and wide-body block hours from AirHoursRamp item in the Air Carrier Summary Data, T2: U.S. Air Carrier Traffic and Capacity Statistics by Aircraft Type report. The average number of pilots per flight for passenger wide-body has been revised in this Initial Supplemental RIA to correct a calculation error present in the original RIA.

[51] Darby, Kit and Dan Gradwohl, “2006 Salary Survey,” Aviation Information Resources, Inc., 2007.

[52] The data relating to narrow-body operations of passenger carriers were used as estimates for the passenger narrow-body industry group while the data relating to wide-body operations of passenger carriers were used for

together. (These data are provided in Table C.2 in Appendix C.) Dividing the average flightcrew member block hours per month by the average flightcrew member credit hours per month resulted in a ratio of block hours per month to credit hours per month, for each of the industry groups (Column [F] in Table 14).[53] Finally, the average cost per block hour per flightcrew member (Column [C] in Table 14) was then multiplied by the ratio of block hours per month to credit hours per month (Column [F] in Table 14) to derive the average credit hour cost per flightcrew member for each of the industry groups (Column [G] in Table 14).[54]

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the passenger wide-body industry group. The data for all operations of passenger carriers was used for the passenger integrated group. The same method was used for the freight industry groups.

[53] We note that the estimate of the average credit hours per month comes from a 2006 survey, while the average block hours per month comes from carrier data reflecting more recent years. When constructing a ratio, using data from the same time periods would obviously be preferred; however, data from contemporaneous time periods were not available.

[54] This method for estimating credit hour cost per flightcrew member differs from the method used in the original RIA, and results in higher estimates of crew scheduling costs due to the final rule. The method used in the original RIA produced separate estimates of credit hour cost per flightcrew member for the passenger wide-body and passenger narrow-body industry groups. Those two estimates were then combined to produce an estimate of crew scheduling costs for the passenger integrated industry group. The revised method used in this Initial Supplemental RIA produces separate estimates of credit hour cost per flightcrew member for four different passenger industry groups: carriers operating exclusively passenger narrow-body aircraft, those operating only passenger wide-body aircraft, narrow-body aircraft operations by air carriers comprising the passenger integrated industry group, and wide-body aircraft operations of carriers making up the passenger integrated industry group. (Three industry groups are used for freight: carriers operating only narrow-body aircraft, carriers operating only wide-body aircraft and carriers that operate both narrow-body and wide-body aircraft.)

The impetus for this change was the observation that the estimate of credit hours per month per flightcrew member for the passenger wide-body industry group reported in the original RIA (60 credit hours per month) was much different from the estimate of credit hours per flightcrew member per month for passenger integrated carriers (78 credit hours per month). One would expect the estimate of credit hours per flightcrew member for the passenger integrated group to be approximately equal to the weighted average of the narrow-body and wide-body estimates. However, averaging 60 credit hours per month (the estimate for passenger wide-body operations) with 82 credit hours per month (the estimate for passenger narrow-body operations) using the relative weights as shown in Table B.4 in Appendix B results in an estimate of 72 credit hours per month, which is much different than the 78 credit hours per month observed for the passenger integrated industry group. For that reason, the observed 60 credit hours per month did not appear to be an appropriate value to use for calculating costs for the passenger integrated industry group. (Note that the estimate of 78 credit hours per month per flightcrew member for the passenger integrated group that was reported in Table 10 of the original RIA was not used in calculating costs for passenger integrated carriers, because that estimate did not differentiate between narrow-body and wide-body operations.)

This approach to calculating the average credit hour cost per flightcrew member addresses NPRM comments made by several commenters. Commenters stated that the salary data used in the NPRM RIA "does not approximate current, real world flightcrew unit costs…"[55] ATA suggested that the FAA use DOT Form 41 data for calculation of crew salary costs. The approach to crew salary costs presented in Table 14 responds to this comment by using the most recent 2010 DOT Form 41 data available as of April 2011 for the calculation of average credit hour costs per flightcrew member. This approach does not include payroll taxes, because these represent a transfer rather than a cost. This approach also does not include pension and benefit costs, because these costs will not be affected by the marginal change in credit hours attributable to the final rule.

The methodology used in this Initial Supplemental RIA still relies on the estimate of 60 credit hours per month per flightcrew member for the passenger wide-body industry group, but minimizes its influence by using it only to estimate costs for carriers that conduct passenger wide-body operations exclusively. While using this revised method means that the estimate of credit hours per month per flightcrew member for the passenger and freight integrated industry groups does not distinguish between the narrow-body and wide-body operations of carriers in those groups (since separate credit hour per flightcrew member data for their narrow- and wide-body operations are not available), we believe it results in more reliable estimates of their unit costs.

[55] Comments of the Air Transport Association of America, Inc. in the matter of Notice of Proposed Rulemaking for Flightcrew Member Duty and Rest Requirements, Docket No. FAA-2009-1093, November 15, 2010.

Table 14: Average Flightcrew Member Cost per Credit Hour

Industry Group	Total Flightcrew Cost per Block Hr	Flightcrew Members per Flight	Average Flightcrew Member Cost per Block Hr	Average Flightcrew Member Credit Hrs/Month	Average Flightcrew Member Block Hrs/month	Ratio of Block Hrs/Month to Credit Hrs/Month	Average Flightcrew Member Cost per Credit Hr
	[A]	*[B]*	*[C]*	*[D]*	*[E]*	*[F]*	*[G]*
Passenger Integrated	*$499*	*2.16*	*$231*	*78*	*59*	*0.76*	***$176***
Passenger Integrated: Narrow-body	$404	2.00	$202	78	59	0.76	**$154**
Passenger Integrated: Wide-body	$629	2.37	$265	78	59	0.76	**$202**
Passenger Narrow-body	$436	2.00	$218	82	60	0.73	**$159**
Passenger Wide-body	$667	2.37	$281	60	59	0.98	**$275**
Regional	$179	2.00	$89	82	48	0.59	**$53**
Supplemental	$712	2.16	$329	71	44	0.61	**$201**
Freight Integrated	$1,481	2.09	$709	88	44	0.50	**$357**
Freight Narrow-body	$734	2.00	$367	62	34	0.55	**$201**
Freight Wide-body	$847	2.09	$405	66	45	0.67	**$273**

Per-diem costs were calculated by multiplying the change in TAFB from the baseline solution to the final rule solution by the appropriate per diem rate. Because flightcrew members at some carriers receive different per diem rates based on whether TAFB is domestic or international, the pairings summary in each of the solutions provided domestic and international TAFB separately. The per diem rates used in this analysis were a block hour weighted average of carriers reporting per diem rates in the AIR Inc. Salary Survey.[56] Again the block hours for each carrier were taken from Air Carrier Summary Data, T2: U.S. Air Carrier Traffic and Capacity Statistics by Aircraft Type report. Table 15 shows the weighted average hourly per diem rates by operator type used in this analysis.[57]

Table 15: Hourly per Diem Rates

Operator Type	Weighted Average Domestic *per Diem* Rate	Weighted Average International *per Diem* Rate
Passenger	$1.94	$2.28
Regional	$1.60	$1.99
Supplemental	$2.06	$2.28
Freight	$1.99	$2.87

Hotel costs were calculated by multiplying the change in required hotel room nights from the baseline solution to the final rule solution by hotel room cost. In practice, hotel costs can vary by a number of factors including the carrier's negotiating power with hotel chains, city size, domestic or international location, etc. The hotel room costs used in this analysis were estimated based on data provided to the FAA by various carriers and are presented in Table 16.[58]

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[56] Darby, Kit and Dan Gradwohl, "2006 Salary Survey," Aviation Information Resources, Inc., 2007.

[57] The per diem rates are from the 2006 AIR, Inc. survey. FAA did not adjust those per diem rates for inflation as the rates are negotiated in contracts. However, where the AIR, Inc. survey reported per diem rates for future years that had been negotiated into contracts as of the time of the survey, those future rates are included.

[58] The hotel costs used in this Initial Supplemental RIA differ slightly from those used in the original RIA, which differed by case. This Initial Supplemental RIA uses a simplified hotel room cost structure for ease of explication.

Table 16: Hotel Room Costs

Operator Type	Average Hotel Room Cost
Passenger	$65.00
Regional	$58.00
Supplemental	$75.00
Freight	$75.00

Cost per Flightcrew Member Estimation

As discussed above, eight industry groups were created for the final rule cost analysis. The changes in each of the cost components for the two narrow-body passenger cases were summed for the passenger narrow-body industry group and for the narrow-body component of the passenger integrated industry group. The two wide-body passenger cases were summed for the passenger wide-body industry group and for the wide-body component of the passenger integrated group. The two regional cases were summed for the regional group. The freight narrow-body case was used for the freight narrow-body industry group while the freight wide-body case was used for the freight wide-body industry group. The freight narrow-body case and freight wide-body case were summed for the freight integrated case. Table 17 shows the results of combining the case results to form estimates for each industry group and industry group subcomponent. Appendix B contains a sensitivity analysis to explore an alternative method for combining the individual case results to create an industry group level estimate of crew scheduling costs.

Table 17: Change in Flightcrew Scheduling Cost Elements due to Final Rule, by Industry Group

Industry Group	Baseline Solution Flightcrew Members	Change in Credit Hours	Change in Domestic TAFB Hours	Change in International TAFB Hours	Change in Hotel Stays
Passenger Integrated: Narrow-body	2,622	1,758	3,625	1,030	-284
Passenger Integrated: Wide-body	1,551	-1,035	3,863	5,607	757
Passenger Narrow-body	2,622	1,758	3,625	1,030	-284
Passenger Wide-body	1,551	-1,035	3,863	5,607	757
Regional	540	94	9,960	-16	424
Supplemental	806	4,642	3,159	9,759	756
Freight Integrated	1,383	1,544	7,087	3,252	294
Freight Narrow-body	330	560	890	2,390	54
Freight Wide-body	1,053	984	6,197	862	240

To estimate the costs of the final rule for each industry group the changes in cost elements due to the final rule were then multiplied by industry group and subcomponent-specific estimates of the unit costs for those cost components, namely average credit hour pay rates, average domestic and international per diem hourly rates, and hotel room costs. The derivations of those estimates of unit costs are explained above.[59] The results of those calculations are shown in Table 18.

[59] The original RIA used a different method whereby first the costs for each case were calculated using the respective narrow-body and wide-body unit costs and then the costs were summed to create estimates of the integrated industry groups. This Initial Supplemental RIA changes that method so that the unit costs specific to the integrated carriers are incorporated.

Table 18: Monthly Change in Flightcrew Scheduling Cost due To Final Rule

Industry Group	Baseline Solution Flightcrew Members	Change in Credit Hour Cost	Change in Domestic TAFB Cost	Change in International TAFB Cost	Change in Hotel Cost	Total Change in Scheduling Cost
Passenger Integrated: Narrow-body	2,622	$270,504	$7,048	$2,346	-$18,460	$261,438
Passenger Integrated: Wide-body	1,551	-$208,842	$7,510	$12,774	$49,205	-$139,353
Passenger Narrow-body	2,622	$280,437	$7,048	$2,346	-$18,460	$271,371
Passenger Wide-body	1,551	-$284,705	$7,510	$12,774	$49,205	-$215,217
Regional	540	$4,953	$15,972	-$31	$24,592	$45,486
Supplemental	806	$930,922	$6,509	$22,270	$56,700	$1,016,401
Freight Integrated	1,383	$551,083	$14,099	$9,330	$22,050	$596,562
Freight Narrow-body	330	$112,588	$1,771	$6,858	$4,050	$125,267
Freight Wide-body	1,053	$268,610	$12,328	$2,472	$18,000	$301,411

For each industry group, the change in each of the cost components was divided by the number of flightcrew members in the baseline solution to determine the monthly final rule crew scheduling cost per flightcrew member for that industry group. For the passenger integrated industry group, the change in each of the cost elements is summed across sub-components (narrow-body and wide-body) before dividing by the sum of baseline solution flightcrew members. The final rule crew scheduling cost is valued by summing the change in credit hour cost, per diem costs, and hotel cost from the baseline solution to the final rule solution. The annual final rule crew scheduling cost per flightcrew member was calculated by multiplying the monthly cost by 12. Table 19 shows the monthly change in flightcrew scheduling cost due to the final rule per flightcrew member.

Table 19: Monthly Change in Flightcrew Scheduling Cost per Flightcrew Member due to Final Rule

Industry Group	Baseline Solution Flightcrew Members	Change in Credit Hour Cost	Change in Domestic TAFB Cost	Change in International TAFB Cost	Change in Hotel Cost	Total Change in Scheduling Cost
Passenger Integrated	4,173	$15	$3	$4	$7	$29
Passenger Narrow-body	2,622	$107	$3	$1	-$7	$103
Passenger Wide-body	1,551	-$184	$5	$8	$32	-$139
Regional	540	$9	$30	$0	$46	$84
Supplemental	806	$1,155	$8	$28	$70	$1,261
Freight Integrated	1,383	$398	$10	$7	$16	$431
Freight Narrow-body	330	$341	$5	$21	$12	$380
Freight Wide-body	1,053	$255	$12	$2	$17	$286

Extrapolation of Crew Scheduling Analysis

The number of flightcrew members presented in Table 20 reflects the number of flightcrew members listed on each Part 121 carrier's operating certificate in the FAA's Vital Information Subsystem (VIS) as of December 2010. The total industry final rule cost would be overstated if extrapolation was based on the number of VIS flightcrew members because not all of these flightcrew members are lineholders. Recall that the cost estimates are calculated as the change in crew scheduling cost per lineholding flightcrew member. Each carrier employs a significant number of reserve flightcrew members. The FAA estimated that, on average, reserves comprise 15 percent of flightcrew members for the average Part 121 passenger air carrier based on APA published information.[60] However, the available information also shows that carriers vary widely in regards to the percent of their pilot workforce that are reserves. Appendix B contains a sensitivity analysis on this key parameter. The extrapolation of the crew scheduling analysis to the Part 121 passenger air transportation industry used the number of flightcrew members (lineholders) shown in Table 20 to determine the final rule crew scheduling cost.

Table 20: Tally of Flightcrew Members, By Industry Group

Industry Group	Number of Part 121 Carriers	Total Number of Flightcrew Members	Total Number of Flightcrew Members Adjusted For 15% Reserves
Passenger Integrated	7	36,013	30,611
Passenger Narrow-body	14	11,899	10,114
Passenger Wide-body	1	150	128
Regional	38	20,511	17,434
Supplemental	8	1,674	1,423
Freight Integrated	3	7,230	6,146
Freight Narrow-body	16	846	719
Freight Wide-body	3	914	777
Total	90	79,237	67,351

The number of flightcrew members in each industry group shown in Table 20 was multiplied by the appropriate annual cost per lineholding flightcrew member in Table 19 to extrapolate the estimated cost to the Part 121 air transportation industry, as shown in the "Total Annual Crew Scheduling Costs" column in Table 21. This total cost figure is then allocated to passenger operations and cargo-only operations using the share of revenue departures attributable to each class of operation in 2010 as reported in Database T1: U.S. Air Carrier Traffic and Capacity

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[60] "Productivity," American Airlines Negotiations. Accessed on August 1, 2012 at http://www.aanegotiations.com/apaProductivity.asp.

Summary by Service Class from the Bureau of Transportation Statistics. The percentage of revenue departures that are passenger and cargo-only for each carrier is presented in Table C.1 in Appendix C. As shown in Table 21, there is a total of $48 million a year in flightcrew scheduling costs for all passenger operations due to the final rule associated with flightcrew credit hours, per diem costs, and hotel room costs. If the final rule applied to cargo-only operations, there would be approximately $52 million in additional costs per year.

Table 21: Annual Crew Scheduling Costs

Industry Group	Final Rule Annual Cost per Flightcrew Member	Reserve-Adjusted Flightcrew Members	Total Annual Crew Scheduling Costs (millions)	Passenger Operations Annual Crew Scheduling Costs (millions)	Cargo-Only Operations Annual Crew Scheduling Costs (millions)
Passenger Integrated	$351	30,611	$11	$11	$0
Passenger Narrow-body	$1,242	10,114	$13	$13	$0
Passenger Wide-body	-$1,665	128	$0	$0	$0
Regional	$1,011	17,434	$18	$17	$0
Supplemental	$15,133	1,423	$22	$6	$15
Freight Integrated	$5,176	6,146	$32	$0	$32
Freight Narrow-body	$4,555	719	$3	$0	$3
Freight Wide-body	$3,435	777	$3	$1	$2
Total			$100	$48	$52

Limitations of Crew Scheduling Analysis

The FAA believes that carriers will be able to reduce much of the cost shown in Table 21. Carriers will engage in additional network optimization to reduce crew scheduling costs, which the FAA is unable to quantify at this point. In the long run, this may involve re-timing flights, changing schedule frequency, and entering or leaving markets. However, there may also be costs associated with these actions such as changes in aircraft utilization and revenue losses. At this time, the FAA has not estimated potential long-run optimization of crew scheduling costs.

The final rule economic costs are best measured as society's willingness to be compensated for consumption opportunities forgone as a result of resources being diverted to the production of improved aviation safety. Because these opportunity costs are difficult to estimate, our estimates of crew scheduling costs reflect, for the most part, financial costs that will be incurred by affected air carriers. These financial costs are likely to overstate the economic costs of the proposed rule.

A large part of estimated crew scheduling costs is increased compensation to flightcrew members for the additional time spent in avoiding pilot fatigue. These compensation costs will reflect economic costs only if flightcrew wage rates are accurate measures of the forgone value of goods and services that could otherwise be produced. However, it is likely that flightcrew members will be able to use some of the time spent avoiding fatigue in productive activities, including the production of leisure activities. Our cost estimates do not include offsets for the value of these activities.

Increased per diem cost estimates do not include offsets that are likely to occur. For example, meals consumed on the road by flight crew members are substitutes for meals that would otherwise be consumed at home. Resource savings (the value of labor and food used to produce meals at home in this example) are not reflected in our cost estimates. Similarly, the costs associated with increased hotel expenses do not include offsets for at-home savings that will likely occur—e.g., reduced energy and water consumption and avoided cleaning costs.

Computer Programming

Carriers will incur computer programming costs as they will need to update their crew management systems and their schedule optimization systems with the constraints imposed by the final rule.

A one-time cost will be incurred in 2013 as carriers update their crew management systems. Crew management system update costs were estimated for each individual carrier, based on the number of flightcrew members listed on the carrier's operating certificate.

Carriers were assigned to one of three groups based on the number of flightcrew members. Computer programming costs, which vary with size of carriers, are estimated using number of person-days and staff costs. Person-days required to perform the system update were estimated to be 400, 160, and 80 days for large (more than 1,000 flightcrew members), average (250 to 1,000 flightcrew members), and small (less than 250 flightcrew members) carriers, respectively.[61] A daily professional staff cost was assumed to be $625. As shown in Table 22, crew management system update costs due to the final rule for passenger carriers is estimated to be approximately $8 million. If the final rule was extended to cargo-only operations, those carriers who perform just cargo-only operations would experience an estimated $2 million in costs.[62]

[61] The classification of carriers has changed slightly in this Initial Supplemental RIA compared to the original RIA.

[62] Since the final rule applies only to passenger operations, a carrier that performs both passenger and cargo-only operations was assigned to the passenger carrier category because we assumed they would incur the full programming costs necessary to support compliance of their passenger operations with the final rule.

Table 22: Crew Management System Update Costs

Flightcrew Members	Cost per Carrier	Passenger Carriers (Count)	Freight Carriers (Count)	Passenger Carriers (millions)	Freight Carriers (millions)
>1,000	$250,000	16	2	$4	$1
250-1,000	$100,000	20	3	$2	$0
<250	$50,000	31	18	$2	$1
Total		67	23	$8	$2

Payroll Cost Savings from Reducing Flightcrew Members Fatigue

The final rule is designed to reduce the risk to flight operations attributable to fatigued flightcrew members by limiting the maximum number of hours they are permitted to be on duty, the number of hours they actually fly during duty periods, and by ensuring that they receive adequate rest periods before reporting for duty. According to CDC, "chronic sleep loss is an under-recognized public health problem that has a cumulative effect on physical and mental health. Sleep loss and sleep disorders can reduce quality of life and productivity, increase use of health-care services, and result in injuries, illness, or deaths."[63] It is expected that the final rule will result in better-rested flightcrew members and reduce flightcrew member fatigue, thus reducing the use of sick time by flightcrew members. When a flightcrew member is scheduled for duty and calls in sick or fatigued, the carrier must use a reserve flightcrew member to complete the scheduled duty. The final rule will reduce the use of reserve flightcrew members to cover fatigue-induced sick call-ins by flightcrew members, which will reduce the flight operations cost associated with fatigue issues for carriers.

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[63] CDC's MMWR, Weekly, February 29, 2008 / 57(08);200-203.

While the current share of current sick time attributable to fatigue is unknown, it is almost certainly greater than zero. Similarly, while the precise amount by which the final rule will reduce sick time is unknown, it is also most likely greater than zero. Labor representatives have informed the FAA that sick time is approximately five percent of payroll costs. This data is consistent with data collected in the rail industry (see footnote 17). In light of this information, the FAA adopts the assumption that sick time accounts for five percent of total industry flightcrew member pay. Moreover, FAA has also assumed for this analysis that the final rule is expected to reduce the use of sick time by five percent. As a result, FAA estimates the cost savings from reducing use of sick time as 0.25 percent (five percent of five percent) of flightcrew payroll costs. Appendix B presents a sensitivity analysis for this assumption whereby it is assumed that the final rule will instead reduce use of sick time by three percent or seven percent.

Total industry flightcrew member pay was calculated from Form 41 pilot cost data.[64] Form 41 data covers only those air carriers with at least $20 million in annual revenues. These carriers employ approximately 96 percent of all pilots; therefore we factor up the Form 41 pilot payroll costs by approximately five percent to account for this small gap in coverage of the data.[65]

These cost savings were then allocated to passenger and cargo-only operations, again using share of revenue departures for each carrier that were passenger operations or cargo-only operations in 2010 as reported in Database T1: U.S. Air Carrier Traffic and Capacity Summary

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[64] The original RIA used a different method for estimating total payroll costs for the industry, but the resulting two cost estimates are very similar

[65] The Form 41 data used in the original RIA only covered the first three quarters of 2010. This analysis factors those three quarters of data to account for a full year of pilot payroll costs. Tables C.3 in Appendix C provide details of these calculations.

by Service Class from the Bureau of Transportation Statistics. Each carrier's passenger/cargo-only split was weighted by the number of pilots the carrier employs to create an overall passenger/cargo-only split for each industry group. The annual nominal value of the cost savings is approximately $19 million for passenger operations and an additional $4.4 million if the rule were extended to cargo-only operations. Table 23 provides details of these calculations of cost savings from reducing flightcrew member fatigue.

Table 23: Payroll Cost Savings from Reducing Flightcrew Member Fatigue

Industry Group	Annual Adjusted Total Pilot and CoPilot Costs[1] (thousands)	Annual Total Payroll Cost Savings from Reducing Fatigue[2] (thousands)	Percent of Payroll Cost Savings Allocated to Passenger Operations	Percent of Payroll Cost Savings Allocated to Cargo-only Operations	Annual Passenger Payroll Cost Savings (thousands)	Annual Cargo Payroll Cost Savings (thousands)
Passenger Integrated	$4,710,694	$11,777	100%	0%	$11,770	$6
Passenger Narrow-body	$1,750,075	$4,375	100%	0%	$4,375	$0
Passenger Wide-body	$13,606	$34	100%	0%	$34	$0
Regional	$1,162,836	$2,907	99%	1%	$2,871	$36
Supplemental	$154,248	$386	30%	70%	$115	$271
Freight Integrated	$1,473,257	$3,683	0%	100%	$0	$3,683
Freight Narrow-body	$67,816	$170	15%	85%	$25	$145
Freight Wide-body	$115,858	$290	21%	79%	$61	$228
Total	$9,448,391	$23,621			$19,251	$4,370

1 Source: Table C.3

2 Adjusted Total Pilot and CoPilot Costs x 5% x 5%

Flight Operations Cost Summary

The total flight operations cost is composed of the additional crew scheduling costs (flightcrew member salary, hotel, and per diem), plus the computer programming costs, and less the cost savings from reducing flightcrew member's fatigue. The total net nominal flight operations cost for the period of analysis is approximately $294 million for passenger operations. If the final rule were extended to cargo-only operations the total net nominal flight operations costs over the analysis period would increase by $479 million. Table 24 presents the nominal flight operations costs attributable to the final rule for passenger operations for each year in the analysis period. Table 25 presents the nominal flight operations cost for cargo-only carriers.

Table 24: Total Flight Operations Cost, Passenger Operations

Year	Scheduling Cost (millions)	Computer Programming Cost (millions)	Payroll Cost Savings from Reducing Fatigue (millions)	Total Nominal Cost (millions)
2012				$0
2013		$8		$8
2014	$48		-$19	$29
2015	$48		-$19	$29
2016	$48		-$19	$29
2017	$48		-$19	$29
2018	$48		-$19	$29
2019	$48		-$19	$29
2020	$48		-$19	$29
2021	$48		-$19	$29
2022	$48		-$19	$29
2023	$48		-$19	$29
Total	$479	$8	-$193	$294

Table 25: Total Flight Operations Costs, Cargo-Only Operations

Year	Scheduling Cost (millions)	Computer Programming Cost (millions)	Payroll Cost Savings from Reducing Fatigue (millions)	Total Nominal Cost (millions)
2012				$0
2013		$2		$2
2014	$52		-$4	$48
2015	$52		-$4	$48
2016	$52		-$4	$48
2017	$52		-$4	$48
2018	$52		-$4	$48
2019	$52		-$4	$48
2020	$52		-$4	$48
2021	$52		-$4	$48
2022	$52		-$4	$48
2023	$52		-$4	$48
Total	$521	$2	-$44	$479

Rest Facilities

The final rule establishes maximum flight-duty period limits for augmented operations that are dependent on the start time of the flight duty period, the number of flightcrew members assigned to the flight, and the class of rest facility installed on the aircraft. The final rule establishes detailed specifications for each of the three classes of rest facilities. Class 1 rest facilities are most conducive to reducing the risk of fatigue in augmented operations; accordingly, the maximum flight duty time permitted for augmented operations conducted with Class 1 rest facility-equipped aircraft is greater than the maximum flight duty time permitted for augmented operations conducted with either Class 2 or 3 rest facility-equipped aircraft. The definitions of the rest facilities are as follows:

- A Class 1 rest facility is a bunk or other surface that allows for a flat sleeping position and is located separate from both the flight deck and passenger cabin in an area that is temperature-controlled, allows the crewmember to control light, and provides isolation from noise and disturbance.
- A Class 2 rest facility is a seat in an aircraft cabin that allows for a flat or near flat sleeping position; is separated from passengers by a minimum of a curtain to provide darkness and some sound mitigation; and is reasonably free from disturbance by passengers or crewmembers.
- A Class 3 rest facility is a seat in an aircraft cabin or flight deck that reclines at least 40 degrees and provides leg and foot support.

There are four subcomponents of the rest facility cost component of the final rule. The first subcomponent consists of the rest facility design and engineering costs. The second subcomponent consists of the cost resulting from the physical installation of the facilities on the affected aircraft. The third subcomponent is the value of the aircraft downtime required to install the rest facilities. The final subcomponent is additional aircraft fuel consumption cost due to the weight of the rest facilities. We estimate that this engineering cost will be incurred in the first year that the rule is published (2012) to allow enough time for the facilities to be installed in the second year after the rule is published (2013).[66] This work will need to be accomplished before the rule is implemented in 2014. Once a facility is installed on a particular aircraft, additional fuel will be consumed by that aircraft. For that reason, during the second year of the analysis

[66] Delay in issuing the final advisory circular related to rest facilities means that carriers may not be able to develop all the necessary engineering work in 2012. This means some of the costs anticipated for 2012 may shift to 2013 and carriers may need to compress the time for installation of rest facilities. This would not change the nominal cost of the rule, and might decrease the net present value slightly due to costs being incurred further in the future.

period one-half of the estimated annual incremental fuel consumption is included in this cost analysis. The following paragraphs discuss how the FAA estimated each of the rest facility cost subcomponents, and Table 26 details the total cost of each of subcomponents for passenger operations while Table 27 presents the total costs for cargo-only operations. The total rest-facility cost for passenger operations is approximately $146 million in nominal terms, $132 million when discounted at seven percent. If the rule were extended to cover cargo-only operations, the additional cost would be $66 million in nominal terms, $59 million when discounted at seven percent.[67]

Table 26: Rest Facility Cost Overview, Passenger Operations

Rest Facilities Cost Subcomponent	Total Nominal Cost (millions)	PV Cost at 7% (millions)	PV Cost at 3% (millions)
Engineering	$13	$13	$13
Installation	$100	$94	$97
Downtime	$12	$11	$12
Fuel	$21	$14	$17
Total	$146	$132	$139

[67] These cost estimates differ slightly from those in the original RIA due corrections of some minor calculation errors present in the original RIA, a more significant error in how fuel costs were calculated, and changes in how carriers were classified.

Table 27: Rest Facility Cost Overview, Cargo-Only Operations

Rest Facilities Cost Subcomponent	Total Nominal Cost (millions)	PV Cost at 7% (millions)	PV Cost at 3% (millions)
Engineering	$3	$3	$3
Installation	$48	$45	$46
Downtime	$6	$5	$5
Fuel	$10	$7	$8
Total	$66	$59	$62

Engineering

During NPRM cost analysis, the FAA obtained detailed cost estimates from two supplemental type certificate (STC) holders. For the original RIA and this Initial Supplemental RIA, we delineated between engineering and kit/installation costs, as the engineering cost per operator would be a one-time, non-recurring cost for each type (make and model) of aircraft. We continue using the data provided by the STC holders as the basis for engineering and installation. The engineering costs are non-recurring design costs. These consist of system, development, engineering, analysis, and certification costs. We conservatively use the engineering cost of $0.5 million per make/model as estimated by the STC holders. We estimate that 26 designs will be required for passenger operators while five additional designs would be required if the rule was extended to cargo-only operations.[68] The estimates are derived from information gathered by FAA inspectors and are proprietary. The estimated engineering cost is approximately $13 million ($0.5 million x 26) for passenger operators. If the rule were extended to cover cargo-only operations there would be additional $2.5 million ($0.5 million x 5) in costs.

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[68] In the original RIA, it was estimated that 25 designs would be needed. This estimate has changed because of changes in how carriers are classified.

Installation

Based upon public comments in response to the NPRM, the FAA has refined the estimate of the number of aircraft that will require rest facility installation. The FAA now estimates, based on data collected from FAA inspectors, that 225 aircraft used for passenger operations will need crew rest modifications to comply with the final rule.[69] This is an increase from the estimate of 104 aircraft used in passenger operations in the NPRM cost analysis. However, it is lower than the estimates of some NPRM commenters. The FAA believes that the final rule estimate of 225 aircraft represents the worst case scenario because aircraft will be re-optimized based upon current configurations. The FAA estimates that any additional aircraft, beyond the approximate 225 aircraft used in this analysis, will already have adequate rest facilities. Once the additional 225 aircraft have rest facilities installed, each fleet will be re-optimized for the most efficient use. As such, we conservatively assume all of these 225 aircraft will have a Class 1 facility installed for an upper-bound estimation. If the final rule were extended to cover cargo-only operations, 107 additional aircraft would require facilities to be installed.

We continue to use the equipment and labor cost provided by an STC holder for our estimate of installation costs to the carriers. The kit and the installation for each of the individual airplanes will cost roughly $350,000 and $95,000, respectively. As such, the total cost of each installation will be roughly $445,000 ($350,000 + $95,000). When multiplied by the affected fleet of 225 aircraft used for passenger operations, the total facility installation cost will be approximately $100 million ($445,000 x 225). If the rule were extended to cover cargo-only

[69] All aircraft used in augmented operations by carriers conducting both cargo-only and passenger operations are included in this estimate, since it is not possible to identify whether aircraft are used *exclusively* in cargo-only operations. In the original RIA it was estimated that 223 aircraft would require facilities to be installed. This estimate has changed because of changes in how carriers are classified.

operations, the additional total facility installation cost would be approximately $48 million ($445,000 x 107).

Downtime

Commenters indicated that an aircraft could be out of service for two weeks during rest facility installation. The FAA estimates the cost to Part 121 operators for this potential additional planned time out of service, or *downtime*, to install the rest facilities. STC designers have indicated that with proper planning, a modifier can install rest facilities in two to four days. We conservatively use a four-day estimate for the calculation of the downtime cost. The FAA conservatively assumes that if an aircraft was to be out of service for any part of a day, that airplane would be out of service for the entire day.

For this analysis, the FAA uses the opportunity cost of capital to approximate the planned downtime cost to the operators. Using guidelines prescribed by the Office of Management and Budget, the FAA uses seven percent as a proxy for average annual rate of return on capital. The FAA uses $69 million as the estimated market value of an aircraft in this analysis.[70] The yearly opportunity cost of capital per aircraft would be $4.83 million, roughly $13,233 per day. When multiplied by the affected fleet (225 aircraft) and the days out of service (4 days), the downtime cost for the fleet is $12 million (225 x 4 x $13,233) for passenger operations. If the final rule were extended to cargo-only operations, the additional cost would be approximately $6 million.

[70] November, 2010 The Airline Monitor. This number represents the appraised value of a 767-300. p.33

Fuel Consumption Costs

We have analyzed the costs associated with the design and installation of Class 1 rest facilities. We assume the rest facilities will be installed in the most efficient manner possible, with no impact on passenger seats or the revenue that they generate. As such, we do not estimate loss of revenue from a Class 1 rest facility because, as defined by the rule, the facilities will be located separate from both the flight deck and passenger cabin and will not necessarily require the removal of passenger seats. For example, a Class 1 rest facility can be located in the aircraft belly or overhead area, neither of which requires the removal of passenger seats. Although there will be no revenue impact, there will be an additional cost that will add to the aircraft operating costs due to the estimated additional impact of weight changes on each aircraft. Estimates for the additional incremental weight impact are used to calculate the additional fuel consumption for the affected fleet.

The estimated cost of fuel uses data from the 2011 FAA Aerospace Forecast. We use the fuel consumption methodology as derived from the FAA's guidance,[71] along with the estimated average fuel cost of approximately $2.45 per gallon.[72] To calculate the additional annual cost of fuel per aircraft, we multiply the 300 additional pounds by the fuel consumption factor of 0.005 gallons per hour per pound (consistent with a two-engine, wide-body aircraft) and arrive at 1.5 gallons per hour per aircraft. This product is then multiplied by the average annual flight hours per aircraft of 2,380 and finally by the cost of fuel ($2.45) to arrive at the total annual estimated

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[71] GRA, "Economic Values for FAA Investment and Regulatory Decisions, A Guide," Oct. 3, 2007.

[72] Average of annual system mainline fuel prices forecasts for period 2014 through 2023 (in FY 2010 dollars) from Table 18, FAA Aerospace Forecast 2011 – 2031. This estimate of fuel price differs from the original RIA.

additional cost of fuel per aircraft of $8,746.50.[73] When multiplied by the affected annual fleet (225 aircraft), the annual incremental fuel consumption cost is approximately $2 million. If the rule were extended to cover cargo-only operations, the additional annual incremental fuel consumption would be approximately $1 million.

Table 28 presents the estimated costs of each of the subcomponents described above. Table 29 presents the total rest facility costs for passenger operations while Table 30 presents the additional total rest facility costs if the final rule were extended to cargo-only operations. Carriers that conduct both passenger and cargo-only operations have all of these facilities costs ascribed to their passenger operations because FAA was informed that given the small magnitude of the rest facility costs, carriers would avoid having to manage two separate fleets, i.e. those aircraft with facilities and those aircraft without facilities.

Table 28: Rest Facilities Costs

Rest Facility Cost Subcomponent	Unit Cost	Passenger Quantity	Passenger Cost	Freight Quantity	Freight Cost
Engineering	$500,000	26	$13,000,000	5	$2,500,000
Installation	$445,000	225	$100,125,000	107	$47,615,000
Down Time	$52,932	225	$11,909,700	107	$5,663,724
Annual Fuel Cost	$8,746.50	225	$1,967,962.50	107	$935,875.50

[73] The estimate of additional weight (300 pounds) was provided by an STC holder. Fuel consumption factor of .005 gallons per hour is from Table 6.1 of "Economic Values for FAA Investment and Regulatory Decisions, A Guide" (October 2007) written by GRA, Inc. The estimate of 2,380 annual flight hours per aircraft comes from BTS Form 41 Schedule T2-restricted, based on data for the 12-month period October 2009 through Sept 2010 using Account 810 (Aircraft Days Assigned) and Account 650 (HoursAirborne) for a selection of aircraft.

Table 29: Rest Facilities Total Costs, Passenger Operations

Year	Engineering	Installation	Downtime	Fuel	Total Nominal Cost (millions)
2012	$13				$13
2013		$100	$12	$1	$113
2014				$2	$2
2015				$2	$2
2016				$2	$2
2017				$2	$2
2018				$2	$2
2019				$2	$2
2020				$2	$2
2021				$2	$2
2022				$2	$2
2023				$2	$2
Total	$13	$100	$12	$21	$146

Table 30: Rest Facilities Total Costs, Cargo-Only Operations

Year	Engineering	Installation	Downtime	Fuel	Total Nominal Cost (millions)
2012	$3				$3
2013		$48	$6	$0	$54
2014				$1	$1
2015				$1	$1
2016				$1	$1
2017				$1	$1
2018				$1	$1
2019				$1	$1
2020				$1	$1
2021				$1	$1
2022				$1	$1
2023				$1	$1
Total	$3	$48	$6	$10	$66

Fatigue Training

In accordance with the Airline Safety and Federal Aviation Administration Extension Act of 2010, Section 212, each air carrier conducting operations under Part 121 must have submitted a fatigue risk management plan (FRMP) to the Administrator for review and acceptance. A FRMP is an air carrier's management plan outlining policies and procedures for reducing the risks of flightcrew member fatigue and improving flightcrew member alertness. In this final rule the FAA kept the requirement for pilots to receive fatigue training, but the original RIA and this Initial Supplemental RIA do not include an incremental cost of compliance because the operators are already in compliance with FRMP. The final rule introduces a new requirement for management, schedulers, dispatchers, and any other individual directly involved in operational control of the flight to have fatigue training and the requirement for curriculum development for that fatigue training. Therefore the original RIA and this Initial Supplemental RIA estimate the costs of these new requirements.[74] As shown in Table 31, this rule change reduces the fatigue training cost requirement to $17 million in nominal terms for passenger operations, $11 million when discounted using a seven percent discount rate. Table 32 shows that there would be an additional nominal cost of $6 million in fatigue training costs if the final rule were extended to cover cargo-only operations, $4 million when discounted using a seven percent discount rate.

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[74] The NPRM had originally included estimates costs for fatigue training and curriculum development for pilots.

Table 31: Fatigue Training Cost Overview, Passenger Operations

Training Cost Subcomponents	Total Nominal Cost (millions)	PV Cost at 7% (millions)	PV Cost at 3% (millions)
Initial Training (First Year of Rule)	$3	$3	$3
Initial Training (New Hires and Churn)	$1	$1	$1
Recurrent Training	$12	$7	$10
Curriculum Development	$0	$0	$0
Total	$17	$11	$14

Table 32: Fatigue Training Cost Overview, Cargo-only Operations

Training Cost Subcomponents	Total Nominal Cost (millions)	PV Cost at 7% (millions)	PV Cost at 3% (millions)
Initial Training (First Year of Rule)	$1	$1	$1
Initial Training (New Hires and Churn)	$0	$0	$0
Recurrent Training	$4	$2	$3
Curriculum Development	$0	$0	$0
Total	$6	$4	$5

The final rule requires that dispatchers and upper management having operational control over flightcrew members be given fatigue training. The number of dispatchers in the U.S. air transportation industry is equal to approximately three percent of the number of pilots.[75] FAA estimates the number of management personnel (immediate supervisors and schedulers) to be approximately nine percent of flightcrew members. Therefore, the total number of dispatchers and management personnel required to receive fatigue training is estimated to be approximately 12 percent of total flightcrew members. We further estimate that each manager and dispatcher

[75] VIS, October 22, 2009.

will require 5 hours of training when compliance with the final rule is required in 2012 which has been valued at a rate of 60 percent of the credit hour cost per flightcrew member for each industry group as found in Table 14. In out years, this initial training will need to be given to new employees entering the workforce and to employees who switch carriers due to industry churn. We estimate these groups account for 3.3 and 1.0 percent of the current workforce respectively. Additionally, in the out years the dispatchers and managers will require two hours of recurring training each year. These initial training costs are allocated to passenger and cargo-only operations, again using percent of revenue departures for each carrier that were passenger operations or cargo-only operations in 2010 as reported in Database T1: U.S. Air Carrier Traffic and Capacity Summary by Service Class from the Bureau of Transportation Statistics. Table 33 and Table 34 show the annual costs for these categories of training for passenger and cargo-only operations, respectively. For passenger operations, the final rule will result in $3.43 million in nominal fatigue training costs for management and dispatchers in the first year of the rule and additional $13 million in nominal fatigue training costs during the following nine years. If the final rule were extended to cargo-only operations, there would be an additional $1.14 million in nominal fatigue training costs for management and dispatchers in the first year of the rule, and an additional $4 million in nominal fatigue training costs during the following nine years.

In addition, carriers will incur a one-time cost to develop a fatigue training curriculum. According to industry standard, curriculum development takes three hours for each hour of course required. Therefore, the time needed to develop the initial training curriculum will be fifteen hours and the time needed to develop the recurrent training curriculum will be six hours. The FAA assumes that the wage rate of the curriculum developer is approximately $100 per hour. Each of the 67 Part 121 air carriers that had passenger operations will need to develop its own curriculum. The total nominal cost of curriculum training is $140,700. If the final rule is extended to cargo-only operations then there will be an additional $48,300 in nominal curriculum costs for the 23 carriers that conduct only cargo-only operations.[76]

Table 33: Total Fatigue Training Costs, Passenger Operations

Year	Initial Training (First Year of Rule)	Initial Training (New Hires and Churn)	Recurrent Training	Curriculum Development	Total Nominal Cost (millions)
2012					$0.00
2013					$0.00
2014	$3,426,813			$140,700	$3.57
2015		$147,353	$1,311,784		$1.46
2016		$147,353	$1,311,784		$1.46
2017		$147,353	$1,311,784		$1.46
2018		$147,353	$1,311,784		$1.46
2019		$147,353	$1,311,784		$1.46
2020		$147,353	$1,311,784		$1.46
2021		$147,353	$1,311,784		$1.46
2022		$147,353	$1,311,784		$1.46
2023		$147,353	$1,311,784		$1.46
Total	$3,426,813	$1,326,177	$11,806,055	$140,700	$16.70

[76] The curriculum development costs associated with air carriers that conduct both passenger and cargo-only operations are counted under the costs associated with passenger operations.

Table 34: Total Fatigue Training Costs, Cargo-only Operations

Year	Initial Training (First Year of Rule)	Initial Training (New Hires and Churn)	Recurrent Training	Curriculum Development	Total Nominal Cost (millions)
2012					$0.00
2013					$0.00
2014	$1,143,289			$48,300	$1.19
2015		$49,161	$437,651		$0.49
2016		$49,161	$437,651		$0.49
2017		$49,161	$437,651		$0.49
2018		$49,161	$437,651		$0.49
2019		$49,161	$437,651		$0.49
2020		$49,161	$437,651		$0.49
2021		$49,161	$437,651		$0.49
2022		$49,161	$437,651		$0.49
2023		$49,161	$437,651		$0.49
Total	$1,143,289	$442,453	$3,938,859	$48,300	$5.57

Cost Analysis Summary

The cost of the final rule to Part 121 passenger operations over the twelve-year period of analysis is estimated to be $457 million in nominal value, $338 million when discounted at seven percent, or $398 million when discounted at three percent. Flight operations account for approximately 64 percent of the nominal total cost (58 percent of present value cost discounted at seven percent); crew scheduling cost is the largest subcomponent of flight operations cost. Rest facilities account for roughly 32 percent of the nominal total cost (39 percent of present value cost discounted at seven percent); rest facility installation is the largest subcomponent of rest facilities cost. Roughly four percent of the nominal cost of the final rule is attributable to training (three percent of present value cost discounted at seven percent).

If the final rule were extended to cover Part 121 cargo-only operations, over the twelve-year period of analysis there would be additional costs of $550 million in nominal value, $377 million when discounted at seven percent, or $464 million when discounted at three percent. Flight operations account for approximately 87 percent of the nominal total cost (84 percent of present value cost discounted at seven percent); crew scheduling cost is the largest subcomponent of flight operations cost. Rest facilities account for roughly 12 percent of the nominal total cost (16 percent of present value cost discounted at seven percent); rest facility installation is the largest subcomponent of rest facilities cost. Roughly one percent of the nominal cost of the final rule is attributable to training (one percent of present value cost discounted at seven percent).

Table 35 and Table 36 summarize the results of the cost estimation for passenger and cargo-only operations, respectively. All final rule cost components were calculated using industry-provided data whenever possible, along with expert analysis.

Table 35: Cost Summary, Passenger Operations

Cost Component	Total Nominal Cost (millions)	PV Cost at 7% (millions)	PV Cost at 3% (millions)
Flight Operations	$294	$195	$245
Rest Facilities	$146	$132	$139
Training	$17	$11	$14
Total	$457	$338	$398

Table 36: Cost Summary, Cargo-only Operations

Cost Component	Total Nominal Cost (millions)	PV Cost at 7% (millions)	PV Cost at 3% (millions)
Flight Operations	$479	$315	$397
Rest Facilities	$66	$59	$62
Training	$6	$4	$5
Total	$550	$377	$464

Benefit Cost Summary

The total estimated cost of the final rule as it applies to passenger operations over 12 years is $457 million ($338 million present value at seven percent and $398 million at three percent). We provide a range of estimates for our quantitative benefits over the same period. Our base case estimate of the benefits of the final rule as applied to passenger operations is $401 million ($263 million present value at seven percent and $332 million at three percent) and our high case estimate is $757 million ($497 million present value at seven percent and $627 million at three percent). Therefore, the costs of the final rule are somewhat higher than the base case benefits estimate but well below the high case estimate. We also note that saving just 84 lives in a 10 year period would cause this rule to be cost beneficial.[77] Further, even if this rule was only 36 percent effective at preventing accidents due to fatigue (as opposed to the 52.5 percent effectiveness estimated in this analysis) the rule would still be cost beneficial.[78]

The total estimated cost of the final rule as it applies to cargo operations over 12 years is $550 million ($377 million present value at seven percent and $464 million at three percent). We provide a range of estimates for our quantitative benefits over the same period. Our base case estimate is $5 million ($3 million present value at seven percent and $4 million at three percent) and our high case estimate is $31 million ($21 million present value at seven percent and $26 million at three percent). Neither estimate results in positive net benefits.

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[77] This comparison is made assuming the lives saved are distributed uniformly over the 10 year analysis period for benefits and using a seven percent discount rate.

[78] This calculation is performed using the parameters from high case benefits analysis and uses seven percent as the discount rate.

Appendix A: Relevant Accident History

1. Accident DCA91MA021

A/C: DC-9-15, registration: N565PC Injuries: 2 Fatal

Date: 2/17/1991

Accident Summary: After takeoff, aircraft rolled to the right, then severely to the left past (90 degrees) and crashed. An ATC and some witnesses saw a fireball come out of the rear of the plane.

Probable Cause: Probable cause was determined to be failure of the flight crew to detect and remove ice from the aircrafts wings which was largely a result of lack of appropriate response by the FAA, Douglass aircraft company, and Ryan International airlines to the known critical effect that a minute amount of contamination has on the stall characteristics of the DC-9 series 10 airplane. NTSB considered possibility that fatigue influenced pilots' judgment & decision not to conduct exterior preflight inspection of A/C. Crew had flown same night-time schedule for 6 days, & PIC for 12 of 13 days, averaging 3.8 flight hours & 5 landings each night. His schedule had recently increased from flying for 5 days, then 9 days off at home in CA. Though his family said he was used to night flying, recent increase in duty & flight time could have induced fatigue. But BTSB was divided on exact role of fatigue; some wanted fatigue as a cause, others did not. But fatigue's presence was not disputed. In the end, however, the Board could not reach a firm conclusion & excluded fatigue as a cause or factor.

Flight Crew/Fatigue Related Information: The captain flew six successive night flights the week before the incident, and flew another six successive night flights with the same first officer each night, including the night of the event. The total flight time for the six successive night flights, which included the night of the incident was 19.6 hrs. The first officer's total flight time in the 7 days prior to the incident was 19.6 hrs, accumulated all during six successive night flights with the same captain.

On the six successive night flights, the captain and first officer came on duty around 2145. On the day before the accident, a van driver for the hotel overheard the pilots talking about how little sleep they get. On the day of the incident, an airline mechanic described the pilots as normal and rested. On the day of the accident, the operations supervisor stated the crew remained in the cockpit; normal crewmembers leave the airplane for a walk around. Supervisor described the captain as quiet and expressionless.

The captain was used to flying nights as a result of his military flying. Normal schedule was 5 nights on, 9 nights off. But a few weeks before accident, duty schedule changed as a result of airline contract to carry mail for US Postal Service. Airline subsequently hired new pilots and extended duty hrs of experienced pilots. The 2 weeks between his last visit home and the accidents were described as the longest period he had been on duty with the airline.

SCORE: 0.5 Requirements would place 200-hour limit on duty time in 672 consecutive hours (4 weeks). That might have changed PIC's schedule substantially.

August 18,1999 in Guantanamo Bay

A/C: DC-8, N814CK Injuries: 3 Serious

Date: 8/18/1993

Accident Summary: Aircraft collided with level terrain after captain lost control of aircraft while approaching airfield.

Probable Cause: Probable cause was determined to be the captains impaired judgment , decision making and flying abilities of the night crew due to the effects of fatigue; the captains failure properly assess the conditions for landing and maintaining vigilant situational awareness of the airplane while maneuvering onto final approach; his failure to prevent the loss of airspeed and avoid a stall while in steep band turn; and his failure to execute immediate action to recover from a stall

Flight Crew/Fatigue Related Information: At the time of the accident, the crew had been on duty for approx 18 hrs, having flown all night before accepting the accident flight. The board believes that the substandard performance by the experienced captain may have reflected the debilitating influence from fatigue. Captain testified feeling very lethargic and indifferent during the landing. First officer testified he felt fatigued earlier in the trip but felt exhilarated at the time of the landing.

The board's analysis revealed the captain had been awake for 23.5 hrs at the time of the accident, the first officer 19hrs and flight engineer 21 hrs. the accident occurred at the end of the afternoon psychological low period, the crewmembers had been awake the previous 2 nights, and had attempted to sleep during the day complicating their circadian sleep disorders - thus fitting the 3 scientific criteria for susceptibility to the debilitating effects of fatigue.

At 0830, before crew left airport, chief scheduler found GTMO flight needed crew & was told "no legal problem" as it was "international flight." Scheduler determined crew could reposition to Norfolk Naval Base (NGU), pick up A/C, fly to GTMO, then ferry under Part 91 to ATL, & remain just within company 24-hour duty limit. Crew discussed timing & agreed to take trip, though "it was pushing the edge."

CAUSE: impaired judgment, decision-making, & flying abilities of PIC & crew due to fatigue; PIC's failure to properly assess conditions; loss of situational awareness while maneuvering onto final; failure to prevent loss of airspeed & avoid stall while in steep bank turn;

& failure to execute immediate action to recover from stall. Factors; inadequacy of Part 121 flight & duty time regulations, supplemental air carrier, international operations, & circumstances that led to extended flight/duty hours & fatigue; inadequate CRM training & inadequate training & guidance by carrier for crew on operations at special airports, such as GTMO; & Navy's failure to provide system that would assure that local tower controller was aware of inoperative strobe light so as to advise crew.

SCORE: 0.9 At time of accident, PIC & FO had been awake about 24 hours & on duty 22 hours. After such a long day, crew was offered standard straight-in approach over ocean but they inexplicably chose very demanding approach in darkness. FE had said he got a rush on approach like they were shooting an approach to an aircraft carrier but FE noted that he was “tired & lethargic” as A/C approached airport & he “believed that the other 2 crew members were fatigued.” By including ferry flights, the requirements in this final rule affect duty-day limits would have precluded this crew from taking this flight.

3. Accident DCA94MA065

Date: 7/2/1994

July 2, 1994 in Charlotte, NC

A/C: MD-82, N954VJInjuries: 37 Fatal, 16 Serious

Accident Summary: Aircraft collided with trees and a private residence near the Charlotte/Douglas International Airport, Charlotte, North Carolina (CLT), shortly after the flightcrew executed a missed approach from the instrument landing system (ILS) approach to runway

Probable Cause: Probable cause was determined to be the flightcrew’s decision to continue an approach into severe convective activity that was conducive to a microburst: 2) the flightcrew's failure to recognize a windshear situation in a timely manner, 3) the flightcrew's failure to establish and maintain the proper airplane attitude and thrust setting necessary to escape the windshear; and 4) the lack of real-time adverse weather and windshear hazard information dissemination from air traffic control, all of which led to an encounter with and failure to escape from a microburst-induced windshear that was produced by a rapidly developing thunderstorm located at the approach end of runway.

Flight Crew/Fatigue Related Information: The captain was off duty for 3 days before the beginning of the accident trip. On the morning of June 28, 1994, he flew with his National Guard squadron, which is based at Wright Patterson Air Force Base Ohio, near his home. On the day of the accident he awoke about 0455 drove to the airport in Dayton Ohio, and departed on a flight to Pittsturgh at around 0745. The reporting time for the trip that included the accident flight was 0945, and the departure time for LGA was at 1045. The first officer flew a 4-day trip that ended around 0930 on July 2. On the day of the accident, he arose about 06 I5 and flew the leg to Pittsburgh that departed St. Louis at 0810. He arrived in Pittsburgh at 0030.

SCORE: 0.15 Fatigue could have affected FO's performance (PF). PIC, who was off-duty preceding 3 days, was much less vulnerable to fatigue, but he too had already had a long day. Accident occurred 14 hours into PIC's day. He awoke at 0455, drove to Dayton from home, then flew to PIT to begin duty day. Accident occurred at 1843, at end of third of 4 scheduled legs. His long day may have contributed to his failure to make 2 standard call-outs on approach at 1000 AGL & 100 AGL. As NTSB notes, failure to make these call-outs contributed to PIC's loss of situational awareness, his directing FO to go-around "to the right" instead of following runway heading as directed, & directing FO to "push down" after FO had initiated 15-degree nose-up & right banking turn.

FO was more vulnerable to fatigue. His duty day ended June 30 at 2230 at Blountsville, TN. NTSB report does not say when that duty day began, nor when FO awoke that day. At Blountville, he went to bed at 0130 & awoke at 0900. His next duty day ended at STL at 2040 EDT. He went to bed at 2230 & awoke at 0615 on accident day. He then flew to PIT & began pairing with accident PIC. Like PIC, FO was nearly 14 hours into his day when accident occurred. He was PF on PIT-LGA leg & on accident leg from CAE. Fatigue could have contributed to incomplete pre-flight brief, failure to maintain sterile cockpit below 10,000 feet, approach briefing in which he omitted field elevation, FAF altitude, DH, & MAP altitudes, all of which NTSB noted had contributed to lack of situational awareness by both pilots. Finally, all the above contributed to crew's choice to initiate non-standard go-around. Other factors were important, including ATC performance, A/C's inadequate windshear algorithm, & abnormally severe windshear. In short, hard to justify a high score, but equally hard to argue that fatigue was irrelevant.

4. Accident DCA95MA020

Date: 2/16/1995

NTSB Identification: DCA95MA020, Air Transport International

February 16, 1995 in Kansas City, MO

A/C: DC-8-63, N782AL Injuries: 3 Fatal

Accident Summary: Aircraft was destroyed by ground impact and fire during attempted takeoff.

Probable Cause: Probable cause was determined to be loss of directional control by pilot in command during the takeoff roll, flightcrews lack of understanding of the three-engine takeoff procedures and their decision to modify these procedures and the failure of the company to ensure that the flight crew had adequate experience, training and rest to conduct the non-routine flight

Flight Crew/Fatigue Related Information: Safety board believes the captain and other crew members were experiencing fatigue at the time of the accident. The captain's performance in the accident reveals many areas of degradation in which fatigue is probably a factor. Accident report notes a demanding Delaware -Germany overnight round trip flight (6 time zones crossed) and a daytime rest period which caused disruptions in circadian rhythms. Additionally, the captains last rest period was repeatedly interrupted by the company. Report also notes that since flight was non-revenue flight, it was under different duty rules and the same flight, were it a revenue flight, would have been illegal given the rest periods the crew had.

SCORE: 0.9 Fatigue was a significant problem in this accident. With or without crew's inadequate training & knowledge of 3-engine T/O, NPRM would preclude this crew from this ferry trip. Also, all 3 crew performed poorly & all 3 likely were fatigued, per NTSB, & all 3 exhibited "performance degradation" symptomatic of fatigue (difficulties in setting proper priorities & continuation of T/O attempt despite disagreement & confusion on important issues).

5. Date: 12/20/1995

NTSB Identification: DCA96RA020, American Airlines

December 20, 1995 in Cali, Colombia

A/C: B757-200, N651AA Injuries: 160 Fatal, 4 Serious

Accident Summary: Aircraft crashed 38 miles north of Cali, Columbia into mountainous terrain during a descent under instrument flight rules

Probable Cause: Probable causes were determined to be the flight crew's failure to adequately plan and execute the approach to runway 19 at SKCL and their inadequate use of automation; Failure of the flightcrew to discontinue the approach into Cali, despite numerous cues alerting them of the inadvisability of continuing the approach; The lack of situational awareness of the flightcrew regarding vertical navigation, proximity to terrain, and the relative location of critical radio aids; Failure of the flightcrew to revert to basic radio navigation at the time when the FMS-assisted navigation became confusing and demanded an excessive workload in a critical phase of the flight.

Flight Crew/Fatigue Related Information:

At 2138 CFIT at 9000; peak at 9190. Night VOR/DME approach from MIA; 2 hrs late. PIC concerned to get cabin crew on ground to meet AAL rules on cabin crew rest (for next day return flight). Cali in long N/S valley; high terrain west & east. Cleared to Cali VOR; readback "cleared direct," entered "direct;" way points go off display. Later cleared to interim Tulua VOR. Expecting "direct," crew became unsure of location. CVR shows crew fumbled with charts & Tulua ID, but already past Tulua. When crew finally entered Tulua, A/C began turning back to Tulua; PIC overrode. Then ATC offered direct approach from north (was 01; now 19). Crew rushed to get down. Put in single-letter ID for ROSO, but Colombia has 2 navaids with single-letter "R." Per ICAO, software defaults to "R" with more traffic (well north at Romeo VOR--Bogota); had to punch in all 4 letters for ROSO. Again A/C began turning back. Crew now very confused & they knew it. FO (PF): "where are we?" PIC says go S/SE – now east of valley, 13 miles off course & below terrain between A/C & Cali. Now more confused; reading DME to ROMEO, thinking it was ROSO. Stepped down early, configured to land as GPWS sounded.

Pulled up but did not retract spoilers; slow climb (184 knots at impact). Hit east slope nose up, skidded over top & down west side. Both pilots, 6 FA & 152 pax fatal; 4 pax serious.

CAUSE per Colombian CAA: 1. crew's failure to adequately plan & execute approach to runway 19 & inadequate use of automation; 2. Failure to discontinue approach, despite numerous cues; 3. lack of situational awareness regarding vertical navigation, proximity to terrain, & relative location of critical radio aids; 4. Failure to revert to basic radio nav when FMS-nav became confusing & demanded excessive workload. Factors: 1. crew's ongoing efforts to expedite approach & landing to avoid potential delays from exceeding company duty time limits; 2. execution of GPWS escape maneuver with speed brakes deployed; 3. FMS logic that dropped all intermediate fixes from display(s) upon execution of direct routing; 4. FMS-generated nav information that used different naming convention from that published in nav charts."

SCORE: 0.35 Crew certainly would have been tired, despite being first of their duty tour. PIC had been awake close to 17 hours & FO had been awake at least 15 hours (14 & 17 hours are key thresholds in fatigue). Yet even if each had been operating earlier in their day, they likely would not have sorted out confusion created by single-letter identifier for Rozo & Romeo. Yet more rested crew may have avoided readback-hearback error related to “direct” with interim way points. Crew clearly knew they were very confused & that they were uncertain of their position in rugged terrain. More alert crew might have responded more appropriately, either by climbing above terrain to sort things out, or by reverting to radio nav until they re-established their position, or may have recognized that over-ride of northbound turn had pushed them across ridge line, east of valley. Though crew certainly would be tired, fatigue was less than a show-stopper. Key factors would have remained with or without alert crew: non-radar environment; confusion from multiple identifiers; self-induced pressure; unexpected change to unfamiliar step-down approach at night in mountainous terrain; & significantly delayed flight. The requirements might have led to avoiding confusion or to more appropriate response to confusion.

6. NTSB Identification: NYC96FA174, TWA

August 25, 1996 in JFK, NY

A/C: L-1011, N31031 Injuries: None

Date: 8/25/1996

Accident Summary: Aircraft was substantially damaged when the tail struck the runway, while landing at John F. Kennedy International Airport, Jamaica, New York (JFK).

On arrival in JFK area, wx was ¼-mile in fog, scattered at 200, & temp/dew of 66/66F. Crew expected 4R, but before reaching FAF, 4R went below minimum & ATC offered 4L (still above minimum). PIC accepted & FO (PF) transitioned to 4L. Inspection methods from Lockheed & adopted by TWA did not adequately specify how to check slat drive system for slack.

But crew failed to reset altimeter bug for new runway (100 feet higher than 4R). PIC also missed several required call-outs on approach & no charts for 4L were on board. When PF asked for charts, PIC said "just fly the approach." A/C was slow & unstable throughout approach & when altimeter read 50 feet (in fact 150 feet), A/C began to flare. FO recognized they were high & pushed nose over. On landing, A/C had tail strike & substantial damage. Failure to reset altimeter & absence of charts were fundamental in this accident.

Probable Cause: Probable cause was determined to be the failure of the flight crew to complete the published checklist and to adequately cross-check the actions of each other, which resulted in their failure to detect that the leading edge slats had not extended and led to the aircraft's tail contacting the runway during the computer-driven, auto-land flare for landing.

Flight Crew/Fatigue Related Information: The captain reported that he had difficulty adjusting to disruptions in his sleeping schedule, and for this reason did not bid to fly international routes. According to his sleep schedule, he had been awake about 24 hours at the time of the accident and reported that he that he felt, ""awful, just tired and exhausted."" The first officer said that the captain attempted to rest during the cruise portion of the flight to JFK, with his head back in the seat, but that there were visiting crewmembers in the cockpit and the captain might not have received good rest. In addition, the captain commented that he had not slept well in the hotel.

The first officer reported that he had flown the LAS layover trip several times during July, and had learned the importance of good sleep for flying it. He reported that he had in excess of 14 hours of rest in the scheduled 24 hours of off duty, which was split over two periods. At the time of the accident he had been awake for over 9 hours following a rest in excess of 5 1/2 hours.

The flight engineer reported that she had not slept well in the hotel on the layover. Additionally, she reported that she felt rested when the accident trip began; however, at the time of the landing she was getting tired

SCORE: 0.35 Had crew been better rested, they may not have missed altimeter reset, may have recognized or acted upon unstable approach, or may have gone around, as required by company procedures when not stable at 500 feet. NPRM's treatment of night operations may have affected this flight. Conversely, crews have made similar errors when well rested & flying at mid-day. FAA believes that avoidable fatigue contributed to crew's failures on approach.

7. NTSB Identification: NYC99LA052, Colgan Air

January 22, 1999 in Hyannis, MA

A/C: BE-1900, N215CJ Injuries: None

At 1719 (dusk), Beech 1900D by Colgan substantially damaged on landing at HYA. No injury to PIC, FO & 2 employees as pax on positioning flight from BOS to HYA in IMC. Started taxi at BOS at 1600. T/O & en route uneventful. But RVR at HYA went below minimum while en route. Wx was 100-foot ceiling in fog, with variable winds at 3 knots.

On arrival at HYA, PIC performed 2 missed approaches. Before trying 3rd approach, he advised tower & pax that this was last shot, or they return to BOS. On third approach, both PIC & FO visually acquired runway. FO said PIC lined up with centerline & requested flaps. FO said A/C "floated at 20 feet over runway at normal transition when I heard PIC taking power levers over flight idle gate by sound of engine/props.' This placed prop in 'BETA' range. A/C then started to sink, & PIC pulled back on control yoke.

Main gear struck ground & fractured during +2.9G touchdown, which occurred 2500 feet beyond approach end of 5,252 foot runway. Ran off right side of runway, 4700 feet beyond approach end & stopped. To place throttles in BETA, it was necessary to lift power levers over flight idle stop. Flight manual included warning: 'Do not lift power levers in flight.'

On accident day, PIC reported for duty at 0535, with first departure from HYA at 0620. He returned to HYA at 0920, after 3 flights & 2:31 flight time. Then with different FO, PIC T/O for Boston at 1100. They flew 5 more flights for 3:53 flight hours, then returned to BOS at 1540.

Probable CAUSE: PIC's improper placement of power levers in BETA position while in flight. Factors: fog & dusk conditions.

SCORE: 0.15 Accident report summarizes only Captain's flight day, not his preceding 72 hours. Clearly had a long day & difficulty getting into HYA did not help. Started taxi at BOS 12.5 hours into duty day for flight to HYA, so he needed to be on ground at HYA within half-hour to beat new NPRM max duty day. May have precuded this PIC from this flight (or not – close call). Also, though better rested PIC may have handled flare better, others have pulled throttle & props into beta. Fatigue might help explain PIC's decision to take 3 shots at landing below mimium,

8. NTSB Identification: NYC99FA110, American Eagle

May 8, 1999 in JFK, NY

A/C: SF34, N232AE Injuries: 1 Serious

Accident NYC99FA110

Accident Summary: Aircraft sustained substantial damage during landing at John F. Kennedy International Airport (JFK)

Probable Cause: Probable cause was determined to be the pilot-in-command's failure to perform a missed approach as required by his company procedures. Factors were the pilot-in-command's improper in-flight decisions, the pilot-in-command's failure to comply with FAA regulations and company procedures, inadequate crew coordination, and fatigue

Flight Crew/Fatigue Related Information: On May 6, 1999, the captain went off duty about 2030, drove home, and was asleep about 2300. On May 7, 1999, he awoke about 0700. He attempted to nap about 1200, but was unsuccessful. He reported for duty about 2200. The first officer was off duty on May 6, 1999. He departed Las Vegas, Nevada (commuting on a jumpseat) at 1230, and arrived at JFK about 1730. He ate, then rested in the pilot's crew room, but did not sleep. There was a 3 hour time difference between Las Vegas and JFK. The trip sequence scheduled the pilots to depart JFK at 2246, arrive at BWI at 2359, on May 7, 1999; and depart BWI for JFK at 0610 on May 8, 1999. They were provided with individual rooms at a local hotel, approximately 10 minutes from the airport. Due to a takeoff delay at JFK, the flightcrew did not arrive at BWI until 0025. They arrived at the hotel about 0100. The captain stated that he was asleep by 0130. He awoke at 0445 for the scheduled 0530 van ide back to the airport. The first officer stated that he was asleep between 0130 and 0200. He received a wake-up call at 0445. During post-accident interviews, both pilots stated that they were fatigued.

At 0702, SF34 by American Eagle substantially damaged on landing at JFK; 1 pax serious; no injury to 26 pax, FA & 2 pilots. En route from BWI uneventful. On arrival in NY area, crew completed checklists & briefings for runway 04 when ATC advised crew that RVR for 04 was 1,600. Crew needed 1800 so ATC cleared them to holding fix at 4,000. While flying toward holding fix, RVR increased. ATC offered crew ILS approach, but advised that they might be too high. PIC accepted clearance nevertheless. Controller asked if crew could make approach from their position. PIC said yes & continued entire approach with excessive altitude, airspeed, & rate of descent, while remaining above glide slope. This violated company procedures & FAR 91.175. Crew then failed to respond to 4 audible GPWS warnings. During approach, FO failed to make required callouts, including missed approach callout. Landed 7,000 feet beyond approach end, at 157 knots, & overran.

During interviews, both pilots said they were fatigued. Crew was working continuous duty overnight schedule. Continuous duty overnights (CDO) at American Eagle identifies trip sequence that is flown during late night hours, extending into early morning hours, with significant elapsed time period between one arrival & next departure. Since break between flights is not sufficient to qualify as free from duty rest period, crew remains continuously on duty, though carrier may have provide hotel room for rest.

On May 6, PIC went off duty at 2030, drove home, & was asleep at 2300. On May 7, he awoke at 0700. He tried to nap about noon but was unsuccessful. He reported for duty at 2200. FO was off duty on May 6. He departed LAS (commuting on jumpseat) at 0930 local time on May 7 (1230 EDT) & arrived at JFK at 1730. He ate then rested in crew room, but did not sleep. Trip sequence scheduled crew to depart JFK at 2246, arrive BWI at 2359, & then depart BWI for JFK at 0610 on 5/8. They were provided with individual rooms at hotel 10 minutes from airport. But, due to delays at JFK, crew did not arrive at BWI until 0025. They arrived at hotel at 0100 & PIC was asleep by 0130. He awoke at 0445 for scheduled 0530 van ride back to airport. FO said he was asleep between 0130 and 0200. He received wake-up call at 0445. CAUSE: PIC's failure to perform missed approach as required by company procedures. Factors: PIC's improper in-flight decisions, failure to comply with FARs & company procedures, inadequate crew coordination, & fatigue.

SCORE: 0.5 Crew likely was tired, & helps to explain why crew did little right on or before the approach. Yet, the requirements would not reach the practice of “Continuous Duty Overnight, but it would have reached the FO’s continuous day starting with his commute. This would not have helped PI, but it might have ensured at least one alert crewmember.

9. NTSB Identification: DCA99MA060, American

June 1, 1999 in Little Rock, AR

A/C: MD-82, N215AA Injuries: 11 Fatal, 45 Serious

Accident DCA99MA060

Accident Summary: Aircraft crashed after it overran the end of runway

Flight Crew/Fatigue Related Information: The captain went to sleep about 2200 the night before the accident and slept until between 0700 and 0730. On nonflying days, he would typically go to sleep between 2130 and 2200, wake up about 0515, and leave for work about 0600. On May 30, 1999, the first officer traveled from his home outside Los Angeles, California, to Chicago. The first officer indicated that he had been commuting from his home to the Chicago-O'Hare base for about 3 months and that, as a result, he was adjusted to the central time zone. The first officer indicated that he was involved in routine activities while in the Chicago area. He went to bed between 2000 and 2200 the night before the accident and woke up about 0730.

The board found that at the time of the accident (2350:44), the captain and the first officer had been continuously awake for at least 16 hours. Also the accident time was nearly 2 hours after the time that both pilots went to bed the night before the accident and the captain's routine bedtime (between 2130 and 2200), meaning their circadian systems were not actively promoting alertness. The Safety Board concludes that the flight crew's degraded performance was consistent with known effects of fatigue.

CAUSE: failure to discontinue approach when severe thunderstorms & associated hazards to flight operations had moved into airport area, & crew's failure to ensure that spoilers had extended after touchdown. Factors: flight crew's (1) impaired performance resulting from fatigue & situational stress associated with intent to land under the circumstances, (2) continuation of approach when company's max crosswind component was exceeded, & (3) use of reverse thrust greater than 1.3 engine pressure ratio after landing.

SCORE: 0.15 FO was 5 months into 1-year probation & paired with Chief Pilot from ORD base. But FO later testified of good working relationship with PIC & said rank of Chief Pilot was no barrier. Accident occurred 14 hours into duty day & nearly 17 hours after awakening. Long day & disrupted flight into & from DFW. FO showed signs on CVR of recognizing that landing was not a good idea, but PIC focused on landing. Was this fatigue or task fixation? Would more rest have made recently hired FO more willing to speak up to PIC-Chief Pilot? Call-outs were made & SOPs indicate crew was engaged. Perhaps a less worn-out PIC would have considered diverting (or not), or may at least have responded to implied warnings from tower. Would have exceeded the requirements contained in this final rule by 12 minutes at impact; may have changed sequence before T/O (had to be released by 2316 - - 2304 might have made a difference).

10. NTSB Identification: DCA02MA054, Federal Express

July 26, 2002 in Tallahassee, FL

A/C: B727-200, N487FE Injuries: 3 Serious

Accident AAR0402

Date: 7/26/2002

Accident Summary: Aircraft struck trees on short final approach and crashed short of runway 9 at airport.

At 0537 (night), A/C destroyed by impact & post impact fire when it undershot on visual approach to 09, striking trees along extended centerline 3,650 feet short into black hole. FO flying. Wx: calm, visibility 8, clouds few at 100 & scattered at 2500. On arrival at TLH, FO briefed for visual to 27. Minute later he asked PIC if they should use 09 instead. Some discussion followed but no decision. Ten 10 minutes later, SO asked pilots if they wanted to run approach checklist. FO again raised question of 09 vs 27 & crew decided on 09. Turned onto final 2.5 NM out.

At this point PAPI would have indicated 1 white & 3 red (low). But A/C continued to descend below glide slope & was at 200 AGL at 0.9 miles out. PAPI would have shown 4 red. CVR shows no discussion about PAPI or altitude other than comment by FO that '(I'm) gonna have to stay just little bit higher... I'm gonna lose end of runway', to which PIC replied 'yeah... yeah, okay.' About 18 seconds later PIC commented 'it's startin' to disappear in there little bit (isn't) it? Think we'll be alright, yeah.' Then hit trees 11 seconds later.

Crew believed they were on glide slope & showed no concern of undershooting. FO later said that 'from time I rolled out (on final), I saw that I was on glide slope... & it never changed.' Approach to 09 is over forest with no ground lights or other visual references (black hole), which can lead pilots to believe they are higher than they really are. NTSB notes that PAPI should have prevented this trap but FO's first class medical noted he had color vision defect. After accident, he failed 7 red/green vision tests. Specialists' report found that he had severe congenital deuteranomaly that could result in 'difficulties interpreting red/green & white signal lights.' Report added that '... he would definitely have had problems discriminating PAPIs... because red lights would appear not to be red at all, ... more indistinguishable from white than red... it would be extremely unlikely that he would be capable of seeing even color pink on PAPI... more likely combination of whites & yellows & perhaps, not even that difference.'

Probable Cause: Probable cause was determined to be the captain's and first officer's failure to establish and maintain a proper glidepath during the night visual approach to landing.

<u>Flight Crew/Fatigue Related Information:</u> The 3 accident flight crewmembers all had different flight, duty and sleep schedules before the accident. Flight and duty times since the last rest period for the caption, first officer and flight engineer are as follows: Captain (flight time - 1:23, duty time 2:35), first officer (flight time-4:02, duty time-10:29), flight engineer (flight time-3:43, duty time-10:41)

Captain reported not sleeping very well the 2 night leading up to the day of the accident but reported not feeling fatigued when he reported for the accident flight. Board found evidence of a sleep deficit for the captain based on reported sleep quality and small errors made during the accident flight the otherwise competent captain wouldn't normally make as indicated by past performance. First officer had normal sleep prior to accident, however he reported he felt good but he did not recall feeling alert and he seemed tired according to the captain. Board found the first officers sleep schedule was disrupted and found his performance deficient, which appears inconsistent with characterizations of his past performance. Flight engineer slept normally and appeared alert according to the captain and the board found minimal evidence he was fatigues, however his performance deficiencies may have been a result of workload during a rushed approach.

CAUSE: crew’s failure to establish & maintain proper glidepath in night visual approach. Factors: combination of crew fatigue, failure to adhere to SOPs, FO's color vision deficiency & PIC & FO's failure to monitor approach. 3 crew serious

SCORE: 0.75 Performance of both pilots was deficient & below their usual standard during approach. NTSB believes this was due to fatigue. Besides back-of-clock, both pilots had difficulty getting adequate rest before flight. PIC said his sleep 2 days before had 'not really (been) good' or had been 'marginal' because he kept being woken by family dog. FO said he had difficulty adjusting his sleep cycle & inferred he did not sleep well during day. Friend described FO as looking tired & PIC commented on same bus that he 'might be little tired.' Even with color-blindness, causal statement justifies concluding that a better rested crew may have avoided the whole scenario early-on in the approach. But unsure exactly how NPRM would have addressed this case, since rest periods were reasonable (even if not well managed) & accident occurred on visual approach over a black hole with a color-blind pilot trying to use a PAPI. The strongest argument for fatigue must rely on the notion that a better rested crew might have monitored the glide slope better and/or might have run a more disciplined checklist & pre-landing brief, or that better rested PIC might have chosen the more common instrument approach to 27.

11. NTSB Identification: DCA05MA004, Corporate Airlines as American Connection

October 19, 2004 in Kirksville, MO

A/C: BAE-32, N875JX Injuries: 13 fatal, 2 Serious

Accident AAR0601

Accident Summary: Aircraft struck trees on final approach and crashed short of runway.

At 1937 on LOC/DME final at Kirksville in IMC, hit trees at 33 feet QFE on center line 1.3 NM out. WX: wind 020 at 6, visibility 4, mist & 300 overcast. On final, PIC (PF) maintained constant descent of 1200 FPM until impact (met company SOP but exceeded that recommended by FAA for descent below 1000 AGL). At MDA, PIC said 'I can see ground there' (as PF, he should have been on instruments). Continued through MDA & asked FO 'what do you think?' FO: 'I can't see (expletive).' Seconds later PIC said 'yeah, there it is. Approach lights in sight' just as GPWS called “200” & FO announced 'in sight, continue'. (Both looking out window; nobody on instruments). Never recognized low altitude until seeing trees 2 seconds before impact. Wx complicated approach but crew never seemed too concerned about wx. Flew approach in casual fashion & lack of professionalism: no sterile cockpit (casual conversation); non-standard phraseology; humming; etc. PIC known for sense of humor & was said to 'emphasize fun in the cockpit'.

Crew was fatigued: reported for duty at 0514. Accident was near end of 6th sector on 'demanding' day in IMC. Crew had been on duty 14.5 hours & PIC is said to have slept poorly night before. PIC commuted from home in NJ to STL & FO commuted from Ohio. Reported for duty at 1345 on 10/17 (2 days before accident). Flew 3 flights in 8-hour duty day & arrived at over-night destination (Quincy) at 2125. On 10/18, departed Quincy at 1415 after more than 15 hours off. Flew 3 flights & 6:20 duty day. Arrived at over-night destination in Burlington at 1945. On 10/19, duty day began at 0514 after 9 hours off. Departed BRL at 0544 to STL & arrived 0644. Next 2 flights cancelled due to wx. T/O for round-trip from STL-Kirksville (IRK) at 1236. Landed STL at 1745.

Probable Cause: failure to follow procedures & improper non-precision instrument approach at night in IMC, including descent below MDA before acquiring runway environment. Factors: non-standard callouts; unprofessional demeanor; & crew fatigue.

Probable cause was determined to be 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

Flight Crew/Fatigue Related Information: Captain reportedly did not sleep well the night before the accident but did not report feeling tired. He was later observed resting on a couch the morning of the accident. First officer reportedly did not have any trouble sleeping the night before the accident and the day of the accident seemed alert and happy.

However, the flight crews rest time (2100-0400) did not correspond favorably with either ones sleeping patterns and at the time of the accident, they had been on duty 14.5 hrs and it had been 15 hrs since their last rest period. The board suggests that the pilot deficiencies observed could be consistent with fatigue impairment

SCORE: 0.75 Accident flight T/O STL at 1842 for IRK on 6th flight of day after 6:14 flight time & 14.5-hour day already. Long, brutal day in IMC that started with limited rest period. Crew was familiar with each other & with IRK. WX & PIC's established practice of "fun in the cockpit" also were factors. Fatigue had to be a big player, though PIC's history of "fun in cockpit implies other issues. The requirements in this final rule would have precluded this crew from taking this flight.

12. NTSB Identification: DCA06MA064, Comair as

August 27, 2006, Lexington, KY

A/C: CRJ-200, N431CA Injuries: 49 Fatal, 1 Serious

Accident AAR0705

Date: 8/27/2007

Accident Summary: Aircraft crashed during takeoff from Blue Grass Airport, Lexington, Kentucky.

At 0607 Comair 5191 crashed on T/O from Blue Grass Airport (LEX) for ATL. A/C ran off end of Runway 26 & was destroyed by impact forces & post crash fire. T/O wrong runway; had been cleared to T/O on Runway 22. PIC, FA & all 47 pax fatal; FO serious. Threshold for 22 & 26 are close & common taxiway had construction near thresholds, possibly inviting confusion in darkness after short taxi from nearby terminal. Also, sole controller in tower turned away after clearing A/C for T/O (A/C was the only active A/C on the airport).

Runway 22 had minor construction work underway preceding week with NOTAM for “some” lights out. Crew also appeared behind the curve early: approached wrong RJ on ramp (corrected by ramp staff); called Toledo tower rather than LEX (corrected by tower); called wrong flight number (corrected by tower); & vocally ran through checklist on taxi so quickly NTSB had to slow CVR read-out to understand it. Crew then taxied onto darkened, closed short runway (26). Initiated rolling T/O, further reducing chance to recognize wrong runway, crossed intersection with active runway, lighted 7,000-foot Runway 22, 500 feet from start of rolling T/O on 26, continued & rotated just as they ran out of pavement. Ran onto grass & nose lifted slightly (with main gear tracks deepening in grass) just as A/C struck perimeter fence, then rolled at high speed into trees & burned out. PIC, FA & 47 pax fatal; FO serious. CAUSE: crew's failure to use available cues & aids to identify A/C's location on airport surface during taxi & their failure to cross-check & verify that A/C was on correct runway before T/O. Factors: crew's non-pertinent conversation during taxi, which resulted in loss of positional awareness, & FAA's failure to require that all runway crossings be authorized only by specific ATC clearances.

Probable Cause: Probable cause was determined to be s 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

Flight Crew/Fatigue Related Information: The captain and the first officer received more than the minimum required rest periods during their respective trips in the days before the accident, and their flight and duty times in the week and month before the accident would not have precluded them from obtaining adequate sleep. Also, both pilots had only been awake for about 2 hours at the time of the accident. Two factors in the pilots' schedules just before the accident could have been associated with the potential development of a fatigued state: acute sleep loss and circadian disruption - The captain and the first officer also awakened on the day of the accident at a time when they would normally be asleep.

Overall, The Safety Board concludes that, even though the flight crewmembers made some errors during their preflight activities and the taxi to the runway, there was insufficient evidence to determine whether fatigue affected their performance

SCORE: 0.35 Fatigue likely was not an issue for PIC (PNF) but it may have affected FO's performance (PF). FO began his duty tour on 8/25 at JFK. He drove that morning to FLL near his home for flight to JFK. Departed FLL at 0559 & arrived JFK at 0832. NTB does not note when FO awoke, but it likely would have been around 0400 to reach his 0559 departure at FLL. His duty day then began with flight from JFK to ROC at 1305. Return flight to JFK T/O at 1600 but crew had to divert to BDL for fuel & did not land at JFK until nearly 2000. Due to late arrival, crew was asked to reposition A/C to LEX. Departed gate at 2130 but were not able to T/O until 2300; arrived at LEX at 0140. FO reached his hotel at 0210 on 8/26. By the time he got to bed, FO would have had nearly a 23-hour day. On 8/26, FO had day off. He told his wife that morning by phone that he had "slept in" & planned to go to bed early that night. Phone records, hotel key cards, & credit card records indicate normal day of activity through at least 1830 on his rest day, when FO paid for meal in hotel restaurant (probably asleep no earlier than 2000). On 8/27 he & PIC reported for duty at 0515. FO likely had same wake-up call as PIC (0415).

Though FO had free day before accident, 8/25 was 23-hour day, with very late time to bed, followed on 8/27 by very early start to his day. Despite "sleeping in" on 8/26, FO would have been coping with sleep deficit. This could partly explain his confusion or inattention prior to departing gate. It also could have made him more vulnerable to visual confusion caused by minor construction & related barriers, & his failure to respond to visual cues of unlighted runway & crossing active runway that was fully lighted. Yet other factors also may explain these failures. For example, FO had flown into LEX 2 nights before when "lights were out all over the place." That was at end of his 23-hour day; neither he nor that Captain apparently recognized that outages had been NOTAMed on 8/25. On morning of accident, runway end identifier lights were out of service. Closeness of 2 runway ends with single taxiway also increases risk of wrong runway T/Os. Finally, with terminal close to runway ends, taxi time was short, increasing percentage of head-down time, at least for PNF. The requirements would have precluded FO from taking positioning flight & extending very long duty day on first day. This may have averted the entire scenario.

13. NTSB Identification: DCA07MA072, Shuttle America

February 18, 2007, Cleveland, OH

A/C: ERJ-170, N862RW Injuries: None

Accident AAR0801

Accident Summary: Aircraft overran the end of the runway during a landing in snowy conditions and stuck an ILS antenna and fence, and the nose gear collapsed.

Flight Crew/Fatigue Related Information: The day of the accident, the captain had been awake for all but about 1 hour of the previous 32 hours; he stated that his lack of sleep affected his ability to concentrate and process information to make decisions and, as a result, was not "at the best of [his] game." The captain also reported that he had insomnia, which began 9 months to 1 year before the accident and lasted for several days at a time. From Feb 11-14 the first officer flew a total of 18hrs 27 mins. On Feb, he started a 3-day 6-leg trip and by the 18th, his total flight time was 11 hrs 50 mins. At the time of the accident, the first officer had been on duty about 9 hrs 15 mins with a total flight time of 5 hrs 30 mins. The first officer agreed to be the flying pilot because of the captain's references to fatigue and lack of sleep the night before.

A contributing factor to the accident was the pilot's fatigue which affected his ability to effectively plan and monitor the approach and landing. The Safety Board concludes that the captain was fatigued, which degraded his performance during the accident flight.

CAUSE: failure to execute a missed approach when visual cues for runway were not distinct & identifiable. Factors: (1) crew's decision to descend to ILS DH instead of localizer (glideslope out) MDA; (2) FO's long landing on short, contaminated runway & crew's failure to use reverse thrust & braking to max effectiveness; (3) PIC's fatigue, which affected his ability to effectively plan for & monitor approach; & (4) carrier's failure to administer attendance policy that permitted crew to call in as fatigued without fear of reprisals.

SCORE: 0.5 A better rested PIC likely would have flown this leg, & likely would have increased chances of going around. However, it but probably would not have changed confusion over glideslope & ILS DH versus localizer MDA. Either way, the requirements would have enabled PIC to opt out of flight.

14. NTSB Identification: DCA07FA037, Pinnacle as Northwest Express

April 12, 2007, Traverse City, MI

A/C: CRJ-200, N8905F   Injuries: None

Accident AAR-0802

Date: 4/12/2007

Accident Summary: Aircraft ran off the departure end of the runway during snowy conditions.

Probable Cause: Probably cause was determined to be the pilots' decision to land at TVC without performing a landing distance assessment, which was required by company policy because of runway contamination initially reported by TVC ground operations personnel and continuing reports of deteriorating weather and runway conditions during the approach. This poor decision making likely reflected the effects of fatigue produced by a long, demanding duty day, and, for the captain, the duties associated with check airman functions

Flight Crew/Fatigue Related Information: The accident occurred well after midnight at the end of a demanding day during which the pilots had flown 8.35 hours, made five landings, been on duty more than 14 hours, and been awake more than 16 hours. During the accident flight, the CVR recorded numerous yawns and comments that indicate that the pilots were fatigued. Additionally, the captain made references to being tired at 2332:12, 2341:53, and 0018:43, and the first officer stated, "jeez, I'm tired" at 0020:41. Additionally, the pilots' high workload (flying in inclement weather conditions, and in the captain's case, providing operating experience for the first officer) during their long day likely increased their fatigue.

SCORE: 0.9 Crew was clearly tired & had been on duty 15 hours as of accident time & 12:44 hours at pushback; The requirements would have precluded this crew from taking this flight.

15. NTSB Identification: DEN07LA101, Great Lakes Airlines

June 20, 2007, Laramie, WY

A/C: BE-1900D, N253GL Injuries: None

Accident DEN07LA101

Date: 6/20/2007

Accident Summary: The airplane landed long, bounced, and touched down again. The captain tried to slow down and turn the airplane off the runway on to a taxiway at high speed. During the turn attempt, the airplane departed the runway and the airplane's right propeller struck the top of an electrical box that powered the runway approach lighting system.

Probable Cause: Probable cause was determined to be The pilot's improper decision, his misjudgment of his speed and distance, and his failure to perform a go-around resulting in the airplane overrunning the runway and striking an electrical box. Factors contributing to the accident were the failure of the crew to perform proper crew resource management, the first officer's failure to intervene before the accident occurred, and the electrical box.

Flight Crew/Fatigue Related Information: Only mention of flight crew schedule is the crew was on the third day of a three-day trip, which had started in Cortez, Colorado, that morning at 0520. The crew had flown from Cortez to Denver, Colorado, to Farmington, New, Mexico, back to Denver, then to Laramie, and then to Worland.

SCORE: 0.15 Given number of days & segments flown, the accident occurred precisely at NPRM's proposed limit of 11-hour duty day. The requirements might have made a difference.

16. NTSB Identification: DCA09MA027, Colgan Air as Continental Connection

February 12, 2009, Clarence Center, NY

A/C: DHC-8-400Q, N200WQ Injuries: 50 Fatal

Accident DCA09MA027

Accident Summary: Aircraft crashed into residence 5 nautical miles northeast of the airport and was destroyed by impact and post-crash fires.

At 2217 Dash 8-Q400 by Colgan Air as Continental Connection crashed on ILS approach to runway 23 at BUF 5 NM NE of airport in Clarence Center. FO arrived EWR on red-eye from West Coast via MEM at 0623. First flight @ 1300 cancelled. Accident flight delayed; T/O EWR at 2120. Newly upgraded PIC (110 hours in M/M); FO (PF) had 700 hours in type. Steady, non-pertinent chatter enroute & throughout approach. FO notes little knowledge of icing. Other pilots describe light-moderate rime icing b/ 6,500 & 3,500 but none at 2,300. Accident A/C was in icing 9 minutes. De-icing system was "on" (which increases speed at which crews get low-speed cue, but does not affect actual stall speed).

At 22:15:14 BUF Approach cleared flight for ILS approach to runway 23 (acknowledged). At 22:16:02, engine power levers were reduced to flight idle & Approach instructed crew to contact Tower. Crew extended gear & auto flight system captured ILS 23 localizer. PIC then moved engine conditions levers forward to max RPM position as FO acknowledged instructions to Tower. At 22:16:28 FO moved flaps to 10°, & 2 seconds later stick shaker activated (warning of impending stall) & autopilot disconnected, with ”disconnect” horn sounding until impact. Stickpusher then activated (to correct actual stall). Crew added power to 75% torque. At 2216:37, FO told PIC that she had put flaps up; airspeed now 100 knots, & roll angle reached 105 degrees right wing down before A/C began to roll back to left & stick pusher activated second time (about 2216:40). Roll angle then reached 35 degrees left wing down before A/C began to roll again to right. FO then asked whether she should put gear up; PIC responded "gear up" with expletive. Pitch & roll had reached 25 degrees nose down & 100 degrees right wing down, when A/C entered steep descent. Stick pusher activated third time (at 2216:50), followed by impact. All 4 crew & 45 pax fatal; 1 ground fatal. (Not an icing accident.)

Both pilots likely were significantly fatigued. Both pilots were based at EWR. PIC lived near Tampa & FO lived near Seattle. Neither had "crash pad" at EWR & both regularly used crew room to sleep. PIC tried to bid trips that ensured some nights in hotels at out-stations. At EWR he usually slept in crew room. FO always slept in crew room at EWR & was open about it.

PIC, recently upgraded, commuted to EWR on 2/9 from TPA; arrived EWR at 2005 & spent night in crew room. Phone records & log-ins to crew tracking system indicate he got little sleep. Reported for duty at 0530 on 2/10, flew 3 flights & arrived at BUF at 1300& had hotel room. Left hotel at 0515 on 2/11 to report at 0615. Again flew 3 flights & returned to EWR at 1544; spent rest of day & night in crew room. Again, phone, tracking system & contact with others indicate very little sleep.

FO commuted to EWR from SEA. She awoke on 2/11/ at 0900, arrived at PDX at 1730 for FedEx flight to MEM; arrived MEM at 0230 EST (2230 PST); had about 90 minutes of sleep on flight. She then T/O MEM at 0418 & arrived EWR at 0623, sleeping for "much of" 2-hour flight. At EWR, she spent day in crew room & napped, but phone, tracking system & conversations show she got little sleep.

On 2/12, crew was scheduled for 3 flights: EWR-ROC; ROC-EWR; & EWR-BUF. First 2 cancelled due to winds at EWR & ground delays. Dispatch estimated 1910 departure for accident flight. Multiple delays; pushed back at 1945 & finally T/O 2120 for BUF. FO noted multiple times that she was not feeling well & before T/O said she was "ready to be at hotel" at BUF.

CAUSE: Captain's inappropriate response to activation of stick shaker, which led to stall from which A/C did not recover. Factors: (1) crew's failure to monitor airspeed in relation to rising position of low-speed cue, (2) crew's failure to adhere to sterile cockpit procedures, (3) PIC's failure to effectively manage flight, & (4) Colgan's inadequate procedures for airspeed selection & management during approaches in icing conditions. NOTE: NTSB Cited fatigue in findings, but not in causal statement because NTSB said it could not determine "the extent of their impairment & degree to which it contributed to performance deficiencies." But clearly suggests it did contribute. NOTE: NTSB was divided on the issue, with some arguing that the overwhelming issue was skills-based: pulling up to 30 degrees, not pushing power up all the way even well into the stall, and thereby missing several opportunities to allow the aircraft to fly out of the stall. In short, debate is this: though the crew clearly was fatigued, would the outcome have been any different if the same crew were better rested?

Flight Crew/Fatigue Related Information: On the day of the accident, the captain was scheduled to report to EWR at 1330. Because his duty period on February 11, 2009, had ended about 1544, he had a 21-hour, 16-minute scheduled rest period before his report time. However, at 0310 on February 12, the captain logged into Colgan's CrewTrac computer system. This activity would have meant that he had, at a minimum, a 5-hour opportunity for sleep followed by another sleep opportunity of about 4 hours. During the 24 hours that preceded the accident, the first officer was reported to have slept 3.5 hours on flights and 5.5 hours in the crew room.

At the time of the accident, the captain would have been awake for at least 15 hours if he had awakened about 0700 and for a longer period if he had awakened earlier. The accident occurred about the same time that the captain's sleep opportunities during the previous days had begun and the time at which he normally went to sleep. The first officer had been awake for about 9 hours at the time of the accident, which was about 3 hours before her normal bedtime. The captain had experienced chronic sleep loss, and both he and the first officer had experienced interrupted and poor-quality sleep during the 24 hours before the accident

The pilots' failure to detect the impending onset of the stick shaker and their improper response to the stick shaker could be consistent with the known effects of fatigue. The NTSB concludes that the pilots' performance was likely impaired because of fatigue, but the extent of their impairment and the degree to which it contributed to the performance deficiencies that occurred during the flight cannot be conclusively determined

SCORE: 0.5 Accident had many issues, but fatigue clearly was one of them. Both pilots had to be exhausted when they initiated approach to BUF. PIC was completing 4th day since awakening on 2/ 9. He had opportunity for quality sleep only on night of 2/10, & that was cut short with departure from hotel at 0515 on 2/11. Both pilots essentially stayed up all night on 2/11, with no opportunities for deep sleep, then found themselves operating late-night flight after day-long cancellations & delays. At one level, any rule that might have diminished this crew's fatigue could have been a show-stopper with a high score. However, crew had other basic problems. PIC clearly was not well versed in stall recognition nor response to stall (never went to full power, which likely would have enabled the aircraft to fly out of the stall in at least 2 points during the sequence). Same lack of recognition & knowledge appears true of FO; she raised flaps during a stall. Being well rested would not have provided this crew with any more skill than they already had, it would not necessarily have averted the chatter sustained throughout flight, nor would it necessarily have led crew to enter proper ref speeds for conditions. BUT more rest may have at least kept them tuned in enough to monitor airspeed. That alone could have averted the entire scenario. However, too many other fundamental issues to score above 50%.

SCORE: 0.5 Accident had many issues, but fatigue clearly was one of them. Both pilots had to be exhausted when they initiated approach to BUF. PIC was completing 4th day since awakening on 2/ 9. He had opportunity for quality sleep only on night of 2/10, & that was cut short with departure from hotel at 0515 on 2/11. Both pilots essentially stayed up all night on 2/11, with no opportunities for deep sleep, then found themselves operating late-night flight after day-long cancellations & delays. At one level, any rule that might have diminished this crew's fatigue could have been a show-stopper with a high score. However, crew had other basic problems. PIC clearly was not well versed in stall recognition nor response to stall (never went to full power, which likely would have enabled the aircraft to fly out of the stall in at least 2 points during the sequence). Same lack of recognition & knowledge appears true of FO; she raised flaps during a stall. Being well rested would not have provided this crew with any more skill than they already had, it would not necessarily have averted the chatter sustained throughout flight, nor would it necessarily have led crew to enter proper ref speeds for conditions. BUT more rest may have at least kept them tuned in enough to monitor airspeed. That alone could have averted the entire scenario. However, too many other fundamental issues to score above 50%.

Appendix B: Sensitivity Analysis

This appendix presents results from performing sensitivity analysis on four key components of the analysis supporting estimates of the costs of the rule:

- Adjusting for minor difference in aircraft block hours between baseline runs and final rule runs
- Weighting of individual case results to represent industry groups
- Percent of pilots who are reserves
- Percent of flightcrew sick time costs that could be saved due to the final rule

Sensitivity #1: Adjusting for Block Hour Discrepancy

As explained the body of this Initial Supplemental RIA, when reviewing the calculations supporting the estimates of crew scheduling costs due to the final rule, FAA became aware of a small difference in the number of aircraft block hours between the baseline runs and the final rule runs. This minor difference is due to the treatment of so called “carry-in/carry-out” flights. Industry practice is to construct each bid line such that each flightcrew member starts and ends the scheduling period at their home base. Some bid lines outputted by the optimizer would have left flightcrew members away from their home base at the beginning or end of the scheduling period (month). In those instances, it is airline practice to include those segments as part of the bid lines for the adjoining month (i.e., “carrying” the pilot in or out of the month). While that is reasonable practice for airlines, it introduced a source of variation in costs that was not caused by the final rule. Because the final rule results in different bid lines being constructed, the segments identified as carry-in or carry-out often differ as well. For all cases, the discrepancy in aircraft block hours was well below one percent. In some cases the aircraft block hours was greater in the baseline run while in other cases the final rule run had more aircraft block hours included.

To explore the possible impacts of this difference on the estimates of the cost impacts of the final rule, we factored the final rule run estimates of each of the four cost elements (credit hours, domestic and international TAFB, and hotel rooms) by the ratio of baseline aircraft block hours to final rule aircraft block hours for each case. If the final rule had slightly fewer aircraft block hours than the baseline run, the ratio would be slightly larger than one and the estimates of each cost element would increase slightly. The difference between the adjusted final rule runs and the baseline runs for each cost element for each case is presented in Table B.1.

Table B.1 Adjusted Change in Monthly Flightcrew Scheduling Cost Elements due to Final Rule, by Case

Industry Group	Case	Baseline Solution Flightcrew Members	Change in Credit Hours	Change in Domestic TAFB Hours	Change in International TAFB Hours	Change in Hotel Stays
Passenger Narrow-body	A	924	2,203	18,717	0	662
	B	1,698	-503	-15,215	947	-952
Passenger Wide-body	C	1,121	-104	3,811	8,264	787
	D	430	-872	0	-2,441	-30
Regional	E	300	68	5,857	0	282
	F	240	37	4,149	-15	144
Supplemental	I	806	4,656	3,183	9,802	758
Freight Narrow-body	G	330	594	1,014	2,402	59
Freight Wide-body	H	1,053	1,014	6,247	943	244

The rest of the scheduling cost estimation methodology is the same as described in the body of the Initial Supplemental RIA except that Table B.1 replaces Table 12. This approach in effect applies the average scheduling cost per aircraft block hour from the final rule run to the small difference in the number of block hours between the baseline and final runs as a method of neutralizing the impacts of the carry-in/carry-out issue. To precisely estimate the crew scheduling costs of each specific flight segment related to the carry-in/carry-out issue, a more in-depth analysis would be required. As shown in Table B.2, this adjustment increased the estimated cost of the final rule for passenger operations by $2 million in nominal terms. Table B.3 shows that the adjustment increased the estimated cost of the rule for cargo-only operations by $16 million.

Table B.2 Cost Summary for Block Hour Adjustment, Passenger Operations

Cost Component	Total Nominal Cost (millions)	PV Cost at 7% (millions)	PV Cost at 3% (millions)
Flight Operations	$296	$196	$246
Rest Facilities	$146	$132	$139
Training	$17	$11	$14
Sensitivity Total	$458	$339	$399
Initial Supplemental RIA Total	$457	$338	$398
Difference	$2	$1	$1

Table B.3 Cost Summary for Block Hour Adjustment, Cargo-only Operations

Cost Component	Total Nominal Cost (millions)	PV Cost at 7% (millions)	PV Cost at 3% (millions)
Flight Operations	$494	$325	$410
Rest Facilities	$66	$59	$62
Training	$6	$4	$5
Sensitivity Total	$566	$388	$477
Initial Supplemental RIA Total	$550	$377	$464
Difference	$16	$10	$13

Sensitivity #2: Alternative Weighting of Case Results

As explained in the body of this Initial Supplemental RIA, the estimates of crew scheduling costs from the rule are derived using crew scheduling software to build pairings and bid lines for nine cases for a baseline run that replicates current scheduling practices and a final rule run that replaces the current requirements with the final rule. These nine cases were combined to estimate average costs for each of the eight industry groups used in this analysis. The passenger narrow-body, passenger-wide body, and regional industry group each had two representative cases. The change in each of the cost elements was summed across the cases, multiplied by the appropriate unit price for the industry group, and divided by the combined total number of flightcrew members (lines) in the baseline run for both cases to derive the estimate of average cost per flightcrew member. For the freight integrated industry group, the change in each of the cost elements for the freight narrow-body case and freight wide-body case were summed, and then multiplied by the unit costs for the freight integrated industry group. For the passenger integrated industry group, the unit costs specific to the particular subcomponent of the passenger integrated industry group were applied to the sum of the cost elements of the respective passenger narrow-body and passenger wide-body cases. Then the narrow-body and wide-body results were summed and then divided by the sum of the number of baseline solution flightcrew members. Such a method implicitly weights each case in relation to the number of flightcrew members in that case, which may or may not be an accurate representation of the prevalence of carriers with similar cost structures for the industry as a whole. As can be seen in Table 12, in some instances, the final rule caused very different cost impacts even for cases in the same industry group. For example, in the passenger wide-body industry group, Case C shows modest increases in the cost elements due to the rule, while Case D shows *decreases* in the cost elements due to the rule. Several different factors contribute to the differing impacts of the rule, including collective bargaining agreements, flight schedules, network structure, etc. Many of these attributes are difficult to observe for every carrier in the industry, and the limited number of cases means that an exact matching of every carrier to one of the case results is not possible. Therefore, it is difficult to determine what the appropriate relative weighting of the cases should be for extrapolation to the entire industry group.

In the absence of information on how to weight the individual cases, an alternative to implicitly weighting the case results by the number of baseline flightcrew members, is to weight the two cases *equally* when deriving an estimate for those industry groups derived from multiple cases.

An estimate of the change in each of the cost elements per flightcrew member for integrated industry groups was built from a weighted average of the change in cost elements for the respective narrow-body and wide-body industry groups. The relative weights for the passenger integrated industry group were based on the number of block hours for both narrow-body and wide-body aircraft flown by air carriers classified in the passenger integrated industry group multiplied by estimates of average crew size, as shown in Table B.4. A corresponding procedure was used for the freight integrated industry group. The resulting estimates of average scheduling cost per flightcrew member are found in Table B.5. The resulting total costs of this sensitivity are found in Table B.6 and Table B.7. Changing to this weighting scheme reduces the estimated cost to the passenger operations by $13 million in nominal terms and $9 million when discounted at seven percent. The impact on the estimated costs to cargo-only operations was larger, decreasing the costs by $39 million, $26 million at 7%.

Table B.4 Relative Weight of Narrow-body and Wide-body Operations for Integrated Carriers

Industry Group	Block Hours[1]	Average Crew Size[2]	Relative Weight
Passenger Integrated:			
Narrow-body	4,054,243	2.00	54%
Wide-body	2,954,370	2.37	46%
Freight Integrated:			
Narrow-body	38,311	2.00	5%
Wide-body	700,230	2.09	95%

[1] Source: Form 41 Q1-Q3 2010

[2] Source: Proprietary Carrier Data

Table B.5 Sensitivity Analysis on Weighting of Cases: Change in Flightcrew Scheduling Cost per Flightcrew Member due To Final Rule

Industry Group	Monthly Cost per Flightcrew Member	Annual Cost per Flightcrew Member
Passenger Integrated	$0	-$1
Passenger Narrow-body	$185	$2,226
Passenger Wide-body	-$292	-$3,507
Regional	$83	$994
Supplemental	$1,261	$15,133
Freight Integrated	$379	$4,544
Freight Narrow-body	$380	$4,555
Freight Wide-body	$286	$3,435

Table B.6 Cost Summary for Alternative Weighting of Case Results, Passenger Operations

Cost Component	Total Nominal Cost (millions)	PV Cost at 7% (millions)	PV Cost at 3% (millions)
Flight Operations	$281	$187	$234
Rest Facilities	$146	$132	$139
Training	$17	$11	$14
Sensitivity Total	$443	$329	$387
Initial Supplemental RIA Total	$457	$338	$398
Difference	-$13	-$9	-$11

Table B.7 Cost Summary for Alternative Weighting of Case Results, Cargo-only Operations

Cost Component	Total Nominal Cost (millions)	PV Cost at 7% (millions)	PV Cost at 3% (millions)
Flight Operations	$440	$289	$364
Rest Facilities	$66	$59	$62
Training	$6	$4	$5
Sensitivity Total	$511	$352	$432
Initial Supplemental RIA Total	$550	$377	$464
Difference	-$39	-$26	-$32

Sensitivity #3: Alternative Assumptions Regarding Percent of Flightcrew Members Who Are Reserves

The estimates of costs are calculated on a per flightcrew member basis for each case. To extrapolate the cost impact of the rule to the entire industry, the estimated costs per flightcrew member are multiplied by the number of lineholder flightcrew members in the industry group as a whole. While the total number of pilots employed by each carrier is readily available from VIS data, information on the number of lineholders was not readily available. On average, it is estimated that 15 percent of pilots are reserves, at least for the large passenger network carriers,[79] although this figure apparently varies widely across carriers. Data supplied by nine different carriers shows that the percent of total pilot workforce who are reserves varied from a low of 12 percent at one carrier to as high as 26 percent at another carrier. Table B.8 and Table B.9 show the estimated cost of the final rule using a 12 percent assumption, for passenger and cargo-only operations respectively. Using a 12 percent reserve figure increases the total estimated cost of the rule by $17 million in nominal terms, and by $11 million when discounted at seven percent for passenger operations. For cargo-only operations, using a 12 percent reserve figure increases the total estimated cost of the rule by $18 million in nominal terms, and by $12 million when discounted at seven percent. Table B.10 and Table B.11 show the estimated cost of the final rule using a 26 percent assumption, for passenger and cargo-only operations respectively. Using a 26 percent reserve figure reduces the estimated cost of the rule by $62 million ($41 million when discounted at seven percent) for passenger operations. For cargo-only operations, using a 26 percent reserve figure reduces the estimated cost of the rule by $67 million ($44 million when discounted at seven percent).

[79] "Productivity," American Airlines Negotiations. Accessed on August 1, 2012 at http://www.aanegotiations.com/apaProductivity.asp.

Table B.8 Cost Summary for Alternative Assumption that 12% of Pilots are Reserves, Passenger Operations

Cost Component	Nominal Cost (millions)	PV Cost at 7% (millions)	PV Cost at 3% (millions)
Flight Operations	$311	$206	$259
Rest Facilities	$146	$132	$139
Training	$17	$11	$14
Sensitivity Total	$474	$349	$412
Initial Supplemental RIA Total	$457	$338	$398
Difference	$17	$11	$14

Table B.9 Cost Summary for Alternative Assumption that 12% of Pilots are Reserves, Cargo-only Operations

Cost Component	Nominal Cost (millions)	PV Cost at 7% (millions)	PV Cost at 3% (millions)
Flight Operations	$497	$327	$412
Rest Facilities	$66	$59	$62
Training	$6	$4	$5
Sensitivity Total	$568	$389	$479
Initial Supplemental RIA Total	$550	$377	$464
Difference	$18	$12	$15

Table B.10 Cost Summary for Alternative Assumption that 26% of Pilots are Reserves, Passenger Operations

Cost Component	Nominal Cost (millions)	PV Cost at 7% (millions)	PV Cost at 3% (millions)
Flight Operations	$232	$155	$193
Rest Facilities	$146	$132	$139
Training	$17	$11	$14
Sensitivity Total	$395	$298	$347
Initial Supplemental RIA Total	$457	$338	$398
Difference	-$62	-$41	-$51

Table B.11 Cost Summary for Alternative Assumption that 26% of Pilots are Reserves, Cargo Operations

Cost Component	Nominal Cost (millions)	PV Cost at 7% (millions)	PV Cost at 3% (millions)
Flight Operations	$411	$270	$341
Rest Facilities	$66	$59	$62
Training	$6	$4	$5
Sensitivity Total	$483	$333	$408
Initial Supplemental RIA Total	$550	$377	$464
Difference	-$67	-$44	-$56

Sensitivity #4: Alternative Assumption Regarding Percent of Sick Time that would be Saved Due to the Final Rule

Since it is not possible to precisely estimate the reduction in sick time that will result from the final rule, this section presents a sensitivity analysis to explore the possible range of impacts. In the central analysis of this Initial Supplemental RIA, it was explained that five percent of payroll costs are generally attributable to sick time and it was assumed that five percent of those sick time payroll costs would be saved because of the final rule. Table B.12 and Table B.13 show the results of assuming that three percent of sick time pilot payroll costs will be saved because of the final rule for passenger operations and cargo-only operations, respectively. While Table B.14 and Table B.15 provide the same information when assuming that seven percent of sick time will be saved due to the final rule, the two assumptions result in altering the total estimated cost of the rule by ±$77 million in nominal terms, and by ±$51 million when discounted at seven percent for passenger operations. For cargo-only operations, these two assumptions result in altering the total estimated cost of the rule by ±$17 million in nominal terms, and by ±$11 million when discounted at seven percent.[80]

Table B.12 Cost Summary for Alternative Assumptions that 3% Sick Time will be Saved, Passenger Operations

Cost Component	Nominal Cost (millions)	PV Cost at 7% (millions)	PV Cost at 3% (millions)
Flight Operations	$371	$246	$309
Rest Facilities	$146	$132	$139
Training	$17	$11	$14
Sensitivity Total	$534	$389	$462
Initial Supplemental RIA Total	$457	$338	$398
Difference	$77	$51	$64

Table B.13 Cost Summary for Alternative Assumptions that 3% Sick Time will be Saved, Cargo-only Operations

Cost Component	Nominal Cost (millions)	PV Cost at 7% (millions)	PV Cost at 3% (millions)
Flight Operations	$496	$326	$411
Rest Facilities	$66	$59	$62
Training	$6	$4	$5
Sensitivity Total	$567	$389	$478
Initial Supplemental RIA Total	$550	$377	$464
Difference	$17	$11	$14

[80] If there were no cost savings from reduced fatigue, the nominal costs of the rule for passenger operations would be $649 million, $465 when discounted at seven percent. These estimated costs are still below the high case benefits estimates for passenger operations.

Table B.14 Cost Summary for Alternative Assumptions that 7% Sick Time will be Saved, Passenger Operations

Cost Component	Nominal Cost (millions)	PV Cost at 7% (millions)	PV Cost at 3% (millions)
Flight Operations	$217	$145	$181
Rest Facilities	$146	$132	$139
Training	$17	$11	$14
Sensitivity Total	$380	$288	$334
Initial Supplemental RIA Total	$457	$338	$398
Difference	-$77	-$51	-$64

Table B.15 Cost Summary for Alternative Assumptions that 7% Sick Time will be Saved, Cargo-only Operations

Cost Component	Nominal Cost (millions)	PV Cost at 7% (millions)	PV Cost at 3% (millions)
Flight Operations	$461	$303	$382
Rest Facilities	$66	$59	$62
Training	$6	$4	$5
Sensitivity Total	$352	$366	$449
Initial Supplemental RIA Total	$550	$377	$464
Difference	-$17	-$11	-$14

Appendix C: Detailed Data Tables

Table C.1: Categorization of Air Carriers

Operator[1]	Industry Group	Flightcrew Members[1]	Percent of Revenue Departures: Passenger[2]	Percent of Revenue Departures: Cargo-only[2]	Explanation[3]
ABX AIR INC	Freight Integrated	313	0%	100%	
FEDERAL EXPRESS CORP	Freight Integrated	4,227	0%	100%	
UNITED PARCEL SERVICE CO	Freight Integrated	2,690	0%	100%	
AEKO KULA INC (Aloha Air Cargo)	Freight Narrow-body	22	0%	100%	
AERO MICRONESIA INC (Asia Pacific Airlines)	Freight Narrow-body	17	0%	100%	
AIR TRANSPORT INTERNATIONAL LIMITED LIABILITY CO	Freight Narrow-body	208	17%	83%	
AMERIJET INTERNATIONAL INC	Freight Narrow-body	72	0%	100%	
AMERISTAR AIR CARGO INC	Freight Narrow-body	17	17%	83%	
ASTAR USA INC	Freight Narrow-body	120	0%	100%	
CAPITAL CARGO INTERNATIONAL AIRLINES INC	Freight Narrow-body	140	0%	100%	
CARIBBEAN SUN AIRLINES INC	Freight Narrow-body	8	100%	0%	fleet type is similar to freight narrow-body case and aircraft utilization is assumed to be more like freight narrow-body case than passenger narrow-body or regional case
DYNAMIC AIRWAYS LLC	Freight Narrow-body	8	100%	0%	aircraft utilization is assumed to be more like freight narrow-body case than passenger narrow-body or regional case
FALCON AIR EXPRESS INC	Freight Narrow-body	25	100%	0%	aircraft utilization is assumed to be more like freight narrow-body case than passenger narrow-body or regional case
KALITTA CHARTERS II LLC	Freight Narrow-body	35	0%	100%	
LYNDEN AIR CARGO L L C	Freight Narrow-body	77	0%	100%	
NATIONAL AIR CARGO GROUP INC	Freight Narrow-body	31	5%	95%	
NORTHERN AIR CARGO INC	Freight Narrow-body	24	0%	100%	
SIERRA PACIFIC AIRLINES INC	Freight Narrow-body	10	100%	0%	aircraft utilization is assumed to be more like freight narrow-body case than passenger narrow-body or regional case
SKY KING INC	Freight Narrow-body	32	100%	0%	aircraft utilization is assumed to be more like freight narrow-body case than passenger narrow-body or regional case
ATLAS AIR INC	Freight Wide-body	531	2%	98%	CBA is assumed to be more like freight wide-body case than supplemental case and operation kind listed on airline certificate is domestic and flag
NORTH AMERICAN AIRLINES	Freight Wide-body	185	100%	0%	CBA is assumed to be more like freight wide-body case than supplemental case, operation kind listed on airline certificate is domestic and flag, and aircraft utilization is assumed to be more like freight wide-body case than passenger wide-body case
POLAR AIR CARGO WORLDWIDE INC	Freight Wide-body	198	0%	100%	CBA is assumed to be more like freight wide-body case than supplemental case and operation kind listed on airline certificate is domestic and flag
ALASKA AIRLINES INC	Passenger Integrated	1,420	99%	1%	
AMERICAN AIRLINES INC	Passenger Integrated	9,463	100%	0%	
CONTINENTAL AIRLINES INC	Passenger Integrated	4,103	100%	0%	
DELTA AIR LINES INC	Passenger Integrated	10,791	100%	0%	
HAWAIIAN AIRLINES INC	Passenger Integrated	403	100%	0%	
UNITED AIR LINES INC	Passenger Integrated	5,456	100%	0%	
US AIRWAYS INC	Passenger Integrated	4,377	100%	0%	
AIRTRAN AIRWAYS INC	Passenger Narrow-body	1,683	100%	0%	
ALLEGIANT AIR LLC	Passenger Narrow-body	326	100%	0%	
BRENDAN AIRWAYS LLC (USA 3000)	Passenger Narrow-body	54	100%	0%	
CONTINENTAL MICRONESIA INC	Passenger Narrow-body	123	100%	0%	
FRONTIER AIRLINES INC	Passenger Narrow-body	681	100%	0%	
JETBLUE AIRWAYS CORPORATION	Passenger Narrow-body	1,979	100%	0%	
MIAMI AIR INTERNATIONAL INC	Passenger Narrow-body	80	100%	0%	
MN AIRLINES LLC (Sun Country)	Passenger Narrow-body	143	100%	0%	
SOUTHWEST AIRLINES CO	Passenger Narrow-body	5,885	100%	0%	
SPIRIT AIRLINES INC	Passenger Narrow-body	453	100%	0%	
SWIFT AIR L L C	Passenger Narrow-body	27	100%	0%	CBA is assumed to be more like passenger narrow-body case than freight narrow-body case
TEM ENTERPRISES INC (Casino Express)	Passenger Narrow-body	40	100%	0%	
VIRGIN AMERICA INC	Passenger Narrow-body	330	100%	0%	
VISION AIRLINES INC	Passenger Narrow-body	95	100%	0%	
RYAN INTERNATIONAL AIRLINES INC	Passenger Wide-body	150	100%	0%	
AERODYNAMICS INC	Regional	5	100%	0%	
AIR WISCONSIN AIRLINES CORPORATION	Regional	753	100%	0%	
AMERICAN EAGLE AIRLINES INC	Regional	2,525	100%	0%	
ATLANTIC SOUTHEAST AIRLINES INC	Regional	1,668	100%	0%	
AVIATION SERVICES LTD (Freedom Air)	Regional	7	97%	3%	

Table C.1: Categorization of Air Carriers

Operator[1]	Industry Group	Flightcrew Members[1]	Percent of Revenue Departures: Passenger[2]	Percent of Revenue Departures: Cargo-only[2]	Explanation[3]
CHAMPLAIN ENTERPRISES INC (CommutAir)	Regional	163	100%	0%	
CHAUTAUQUA AIRLINES INC	Regional	638	100%	0%	
COLGAN AIR INC	Regional	440	100%	0%	
COMAIR INC	Regional	1,037	100%	0%	
COMPASS AIRLINES LLC	Regional	408	100%	0%	
EMPIRE AIRLINES INC	Regional	45	0%	100%	CBA is assumed to be more like regional case than freight narrow-body case
ERA AVIATION INC	Regional	54	100%	0%	
EXECUTIVE AIRLINES INC	Regional	286	100%	0%	
EXPRESSJET AIRLINES INC	Regional	2,100	100%	0%	
GOJET AIRLINES LLC	Regional	246	100%	0%	
GREAT LAKES AVIATION LTD	Regional	292	100%	0%	
GULF AND CARIBBEAN CARGO INC	Regional	48	0%	100%	CBA is assumed to be more like regional case than freight narrow-body case
GULFSTREAM INTERNATIONAL AIRLINES INC	Regional	158	100%	0%	
HAWAII ISLAND AIR INC (Island Air Hawaii)	Regional	38	100%	0%	
HORIZON AIR INDUSTRIES INC	Regional	621	100%	0%	
HYANNIS AIR SERVICE INC (Cape Air)	Regional	13	98%	2%	
LYNX AVIATION INC (Frontier)	Regional	29	100%	0%	
MESA AIRLINES INC	Regional	1,257	100%	0%	
MESABA AVIATION INC	Regional	935	100%	0%	
MOUNTAIN AIR CARGO INC	Regional	54	0%	100%	
PENINSULA AIRWAYS INC	Regional	80	93%	7%	
PIEDMONT AIRLINES INC	Regional	505	100%	0%	
PINNACLE AIRLINES INC	Regional	1,255	100%	0%	
PRESCOTT SUPPORT CO	Regional	10	0%	100%	CBA is assumed to be more like regional case than freight narrow-body case
PSA AIRLINES INC	Regional	517	100%	0%	
REPUBLIC AIRLINES INC	Regional	681	100%	0%	
RHOADES AVIATION INC	Regional	2	0%	100%	
SEABORNE VIRGIN ISLAND INC	Regional	25	100%	0%	
SHUTTLE AMERICA CORPORATION	Regional	525	100%	0%	
SKYWEST AIRLINES INC	Regional	2,746	100%	0%	
TATONDUK OUTFITTERS LTD	Regional	56	11%	89%	CBA is assumed to be more like regional case than freight narrow-body case
TRANS STATES AIRLINES LLC	Regional	237	100%	0%	
USA JET AIRLINES INC	Regional	52	26%	74%	CBA is assumed to be more like regional case than freight narrow-body case
CENTURION AIR CARGO INC	Supplemental	47	0%	100%	Fleet type is similar to supplemental case and operation kind listed on airline certificate is supplemental
EVERGREEN INTERNATIONAL AIRLINES INC	Supplemental	185	0%	100%	Fleet type is similar to supplemental case and operation kind listed on airline certificate is supplemental
FLORIDA WEST INTERNATIONAL AIRWAYS INC	Supplemental	32	0%	100%	Fleet type is similar to supplemental case and operation kind listed on airline certificate is supplemental
KALITTA AIR LLC	Supplemental	334	0%	100%	Fleet type is similar to supplemental case and operation kind listed on airline certificate is supplemental
OMNI AIR INTERNATIONAL INC	Supplemental	315	100%	0%	Fleet type is similar to supplemental case and operation kind listed on airline certificate is supplemental
SKY LEASE I INC (Tradewinds Airlines)	Supplemental	59	0%	100%	Fleet type is similar to supplemental case and operation kind listed on airline certificate is supplemental
SOUTHERN AIR INC	Supplemental	281	0%	100%	Fleet type is similar to supplemental case and operation kind listed on airline certificate is supplemental
WORLD AIRWAYS INC	Supplemental	421	43%	57%	Fleet type is similar to supplemental case and operation kind listed on airline certificate is supplemental

Notes:
[1] Source: FAA Vital Information Subsystem (VIS) December 2010
[2] Source: BTS, Database T1: U.S. Air Carrier Traffic and Capacity Summary by Service Class (2010)
[3] Airline Certificate Source: http://av-info.faa.gov/OperatorsName.asp

Table C.2: Block Hours per Pilot from Carrier Supplied Data

First Month of Data

Industry Group	Pilots[1]	Flight Minutes	Block Hrs per Pilot
Passenger Integrated	12,292	42,834,514	58.1
Passenger Narrow-body	6,144	21,905,688	59.4
Passenger Wide-body	6,149	20,928,826	56.7
Regional	1,195	3,323,147	46.3
Supplemental	682	1,627,920	39.8
Freight Integrated	3,669	10,606,019	48.2
Freight Narrow-body	833	2,090,926	41.8
Freight Wide-body	2,906	8,515,093	48.8

Second Month of Data

Industry Group	Pilots[1]	Flight Minutes	Block Hrs per Pilot
Passenger Integrated	12,267	44,687,045	60.7
Passenger Narrow-body	6,075	22,139,229	60.7
Passenger Wide-body	6,195	22,547,816	60.7
Regional	1,395	4,165,528	49.8
Supplemental	563	1,598,946	47.3
Freight Integrated	3,059	7,322,455	39.9
Freight Narrow-body	636	1,004,179	26.3
Freight Wide-body	2,586	6,318,276	40.7

Average of Two Months of Data

Industry Group	Block Hrs per Pilot
Passenger Integrated	59.4
Passenger Narrow-body	60.1
Passenger Wide-body	58.7
Regional	48.1
Supplemental	43.6
Freight Integrated	44.0
Freight Narrow-body	34.1
Freight Wide-body	44.8

[1] Pilots that flew at least one segment during month

Table C.3: Adjusting Form 41 Pilot and CoPilot Cost Data

Industry Group	Pilot and CoPilot Costs Q1-Q3 2010[1] (thousands)	Pilot and CoPilot Costs Q1-Q4 2010[2] (thousands)	Total Pilots[3]	Pilots at Carriers that Report Form 41	Adjustment Factor	Adjusted Total Pilot and CoPilot Costs (thousands)
Passenger Integrated	$3,498,191	$4,710,694	36,013	36,013	100%	$4,710,694
Passenger Narrow-body	$1,281,923	$1,726,249	11,899	11,737	101%	$1,750,075
Passenger Wide-body	$10,104	$13,606	150	150	100%	$13,606
Regional	$757,814	$1,020,479	20,511	18,000	114%	$1,162,836
Supplemental	$108,319	$145,863	1,674	1,583	106%	$154,248
Freight Integrated	$1,094,050	$1,473,257	7,230	7,230	100%	$1,473,257
Freight Narrow-body	$23,811	$32,064	846	400	212%	$67,816
Freight Wide-body	$86,037	$115,858	914	914	100%	$115,858
Total	$6,860,249	$9,238,071	79,237	76,027	105%	$9,448,390.64

[1] Source: Bureau of Transportation Statistics Form 41 data (Item 51230, Pilots and Copilots, from Schedule P-5.2)

[2] Source: Q1-Q3 costs multiplied by approx 1.347 (the ratio of full year costs to Q1-Q3 costs)

[3] Source: FAA Vital Information Subsystem (VIS) December 2010

TAB 23

BEFORE THE
DEPARTMENT OF TRANSPORTATION
FEDERAL AVIATION ADMINISTRATION
WASHINGTON, D.C.

In the matter of:	:	
	:	
Flightcrew Member Duty and Rest Requirements	:	
Supplemental Regulatory Impact Analysis	:	**Docket No. FAA-2009-1093**
	:	

Airlines for America Comments

On December 12, 2012, the Federal Aviation Administration (FAA) published a notice of an Initial Supplemental Regulatory Impact Analysis (cost benefit analysis or CBA) in the Federal Register at 77 Fed. Reg. 73911, seeking comment on a revised Flightcrew Member Duty and Rest Requirement (flight and duty time or FDT) final rule cost benefit analysis. Airlines for America on behalf of our members,[1] has a strong interest in the flight and duty time regulations and respectfully submits the following comments in response to the notice.

Flight and Duty Time Final Rule

On January 4, 2012 the FAA published a Flight and Duty Time (FDT) final rule that will take effect on January 4, 2014.[2] The FAA also issued a CBA dated November 11, 2011 that provides the basis for FAA's decisions in the rulemaking.[3] A4A member carriers are focused on safety, deeply proud of their record of safety and have vigorously participated in the present rulemaking with the goal of securing a final rule based on science and sound analysis. Our part 121 carrier members covered by the Final Rule are fully engaged in preparing to implement that rule.

Cost Benefit Analysis Review

The Independent Pilots Association (IPA) petitioned to review the FDT final rule before the United States Court of Appeals for the District of Columbia Circuit (DC Circuit) asking the court to remand the final rule and direct FAA to reconsider the decision to continue to regulate cargo-only operations under current rules. In preparing the government brief in the IPA case, the FAA discovered errors in reviewing the administrative record associated with cargo-only operator implementation costs. The FAA concluded it should review the CBA and give interested parties the opportunity to comment on the corrected analysis. The FAA asked the DC Circuit to suspend the FDT final rule litigation while the agency corrected the CBA and gave the public an opportunity to comment on the corrected CBA. In addition, in response to one of IPA's arguments in the petition for review, the FAA stated it would provide the IPA and other interested parties with an opportunity to present its view as to whether or not Public Law 111-216 precludes the FAA from conducting a FDT CBA. The DC Circuit suspended the FDT litigation on June 8, 2012, allowing the FAA time to review and correct the CBA.

The revised CBA was placed in the FDT docket and a Federal Register notice was published on December 12, 2012 seeking comments on (1) the revised CBA, and (2) whether Public Law 111-216 permits the FAA to conduct a cost-benefit analysis.

The Revised CBA Supports the FDT Final Rule

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[1] A4A airline members are: Alaska Airlines, Inc.; American Airlines, Inc.; Atlas Air, Inc.; Delta Air Lines, Inc.; Federal Express Corporation; Hawaiian Airlines; JetBlue Airways Corp.; Southwest Airlines Co.; United Continental Holdings, Inc.; United Parcel Service Co.; and US Airways, Inc. Air Canada is an associate member.
[2] 77 Fed. Reg. 330.
[3] The FAA's Initial Regulatory Impact Analysis was issued on September 14, 2010. See Docket No. FAA-2009-1093-0019.

The revised CBA more comprehensibly explains and justifies the FAA's analyses and decision-making process. The CBA now includes a more complete breakdown of the costs and benefits of extending the rule to all-cargo operations versus the costs and benefits of the rule as it applies to passenger operations,[4] which provides greater transparency on the high impact cost to cargo-only operations versus the low benefits. This greater transparency further supports the case why the FAA could not justify mandating cargo-only compliance with the new FDT final rule.

In addition to providing more transparency, the FAA also increased the total estimated passenger-carrying nominal costs by $67 million from $390 million to $457 million over 12 years. Passenger-carrying benefits were also increased by $25 million, from $376 million to $401 million. Cargo-only nominal costs were increased by $244 from $306 million to $550 million over 12 years, and benefits were reduced from $20.35 million to $5 million. While there is a small upward adjustment in costs to passenger carriers in the new CBA, A4A and its member carriers continue to maintain that the actual costs of the present rule vastly exceed both the initial and revised benefits in the present CBA as quantified and documented extensively in this docket.

We also note, however, that the revised CBA continues to include and to quantify as benefits the mitigation of the same potential aircraft accidents that the FAA also credited as projected benefits in the Regulatory Evaluation for the Qualification, Service and Use of Crewmembers and Aircraft Dispatchers supplemental notice of proposed rulemaking (SNPRM) Docket FAA-2008-0677. A4A expects that the FAA will review its calculation of the projected benefits in both the SNPRM and the final FDT CBA to ensure that the aggregate calculated benefits across the two rules do not overstate the effective total projected mitigation benefit.[5]

<u>Public Law 111-216 Does Not Prohibit the FAA From Conducting a Cost Benefit Analysis</u>

The FAA is not statutorily foreclosed from issuing and relying on a FDT CBA. Section 212 of Public Law 111-216, which addresses pilot fatigue, does not expressly forbid the FAA from following the normal federal agency regulatory practice for the past 30 years of analyzing regulatory costs and benefits.[6] Not only does Section 212 not foreclose consideration of cost-benefit analysis, Section 212(a)(2) expressly states that "the Administrator <u>shall</u> consider and review…[a]ny other matters the Administrator considers appropriate. [emphasis added]"[7] Thus, the words of the statute do not direct the FAA to refrain from

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[4] See revised CBA Summary Tables 3 & 4 pages 17, 18; Cargo-only Benefits, pages 40-44 and various cargo-only cost adjustments pages 45-48.

[5] For instance we note that the SNPRM assigned a 75% effectiveness rating for the February 12, 2009 Colgan Air accident and this CBA claims an additional 50% effectiveness rating, totaling 125%. Likewise, the SNPRM assigned a 35% effectiveness rating for the April 12, 2007 Pinnacle accident and this CBA assigns a 90% effectiveness rating, totaling 125%. Finally, the SNPRM assigned a 35% effectiveness rating for the October 19, 2004 Corporate Airlines accident, while this CBA assigns a 75% effectiveness rating totaling 110%.

[6] See Office of Regulatory and Information Affairs describing regulatory cost and benefit review for the past 30 years at http://www.whitehouse.gov/omb/OIRA_QsandAs.

[7] Section 212(a) of Public Law 111-216 states:

> FLIGHT AND DUTY TIME REGULATIONS.—
> (1) IN GENERAL.—In accordance with paragraph (3), the Administrator of the Federal Aviation Administration shall issue regulations, based on the best available scientific information, to specify limitations on the hours of flight and duty time allowed for pilots to address problems relating to pilot fatigue.
> (2) MATTERS TO BE ADDRESSED.—In conducting the rulemaking proceeding under this subsection, the Administrator shall consider and review the following:
>> (A) Time of day of flights in a duty period.
>> (B) Number of takeoff and landings in a duty period.
>> (C) Number of time zones crossed in a duty period.
>> (D) The impact of functioning in multiple time zones or on different daily schedules.
>> (E) Research conducted on fatigue, sleep, and circadian rhythms.
>> (F) Sleep and rest requirements recommended by the National Transportation Safety Board and the National Aeronautics and Space Administration.
>> (G) International standards regarding flight schedules and duty periods.
>> (H) Alternative procedures to facilitate alertness in the cockpit.
>> (I) Scheduling and attendance policies and practices, including sick leave.

conducting a cost-benefit analysis. Clearly in this instance, like other significant rulemakings, the FAA has issued over the past 30 years, the FAA concluded it was appropriate to conduct a CBA.

The Supreme Court recently considered whether an agency is authorized to compare costs with benefits when issuing a final rule in *Entergy Corp. v. Riverkeeper, Inc.*[8] In *Entergy*, environmental groups and various states challenged an Environmental Protection Agency (EPA) final regulation arguing that relied in part on an analysis of costs and benefits to support its final rule. The petitioners argued that because the statutory provision supporting the rule included certain criteria but was silent on cost-benefit, EPA was precluded from conducting and relying on a CBA in making its determination as to the appropriate burden to impose on industry.[9] The Supreme Court, however, found that EPA did not need express authority to conduct a CBA and that statutory failure to mention a cost-benefit analysis does not preclude an agency from conducting a regulatory CBA.[10] Like the provision at issue in *Entergy*, Section 212's silence cannot be read to prohibit the FAA from conducting a cost-benefit analysis. That conclusion is strengthened by Congress' express authorization for the Administrator to consider "any other matters the Administrator considers appropriate."

In addition, Executive Orders 12866 and 13563 direct the FAA to conduct and rely on a cost benefit analysis when considering what to include in a regulation. Executive Order 12866 orders federal agencies to "assess all costs and benefits of available regulatory alternatives, including the alternative of not regulating. Costs and benefits shall be understood to include both quantifiable measures (to the fullest extent that these can be usefully estimated) and qualitative measures of costs and benefits that are difficult to quantify, but nevertheless essential to consider."[11] It continues by directing that "Each agency shall assess both the costs and the benefits of the intended regulation and, recognizing that some costs and benefits are difficult to quantify, propose or adopt regulation only upon a reasoned determination that the benefits of the intended regulation justify the costs."[12]

Likewise, Executive Order 13563 orders that "It [regulatory system] must identify and use the best, most innovative and least burdensome tools for achieving regulatory ends. It must take into account benefits and costs, both quantitative and qualitative."[13] Executive Order 13563 also supplements and reaffirms the principles, structures and definitions that were established in Executive Order 12866, including adopting a regulation only upon a reasoned determination that benefits justify costs and that regulations should impose the least burden on society, taking into account the costs of cumulative regulations.[14]

Congress, of course, is presumed to know the administrative process agencies are obligated to follow by executive order. Nothing in the text of Section 212 or in its legislative history states or even suggests that Congress intended to override the process and policies embodied in these Executive Orders. On the other hand, Congress has shown that when it wants to impose special requirements regarding agency rulemaking, it knows how to do so. For example, in *Whitman v. American Trucking Assns., Inc.,* the Supreme Court found that section 109 of the Clean Air Act "interpreted in its statutory and historical context … unambiguously bars cost considerations."[15]

(J) The effects of commuting, the means of commuting, and the length of the commute.
(K) Medical screening and treatment.
(L) Rest environments.
(M) Any other matters the Administrator considers appropriate.
(3) RULEMAKING.—The Administrator shall issue—
(A) not later than 180 days after the date of enactment of this Act, a notice of proposed rulemaking under paragraph (1); and
(B) not later than one year after the date of enactment of this Act, a final rule under paragraph (1).

[8] 556 U.S. 208 (2009).
[9] Id at 222.
[10] Id.
[11] Exec. Order No. 12,866, 58 Fed. Reg. 51735 (Sept. 30, 1993) at Section 1.
[12] Id. at Section 1(b)(6).
[13] Exec. Order No. 13563 76 Fed. Reg. 3821 (January 21, 2011) at Section 1(a).
[14] Id. at Section 1(b); OFFICE OF INFORMATION AND REGULATORY AFFAIRS, OFFICE OF MGMT. & BUDGET, EXEC. OFFICE OF THE PRESIDENT, M-11-10, EXECUTIVE ORDER 13563, "IMPROVING REGULATION AND REGULATORY REVIEW" (2011), page 1.
[15] 531 U.S. 457, 471 (2001).

For all of these reasons, there is no basis for construing Section 212 as prohibiting the FAA from conducting a cost-benefit analysis with respect to the final flight and duty time rule.

We appreciate the opportunity to comment and the FAA's willingness to receive stakeholder input in this proceeding.

Sincerely,

Douglas Mullen
Assistant General Counsel
Airlines for America

February 11, 2013

TAB 24

BEFORE THE
FEDERAL AVIATION ADMINISTRATION
WASHINGTON, D.C.

FLIGHTCREW MEMBER DUTY AND REST REQUIREMENTS INITIAL SUPPLEMENTAL REGULATORY IMPACT ANALYSIS	Docket No. FAA-2009-1093

COMMENTS OF ATLAS AIR WORLDWIDE HOLDINGS, INC.

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February 11, 2013

BEFORE THE
FEDERAL AVIATION ADMINISTRATION
WASHINGTON, D.C.

FLIGHTCREW MEMBER DUTY AND REST REQUIREMENTS	Docket No. FAA-2009-1093
INITIAL SUPPLEMENTAL REGULATORY IMPACT ANALYSIS	

COMMENTS OF ATLAS AIR WORLDWIDE HOLDINGS, INC.

Atlas Air Worldwide Holdings, Inc. ("AAWW"), on behalf of itself and its air carrier subsidiaries, Atlas Air, Inc. ("Atlas") and Polar Air Cargo Worldwide, Inc. ("Polar"), respectfully submits these comments on the Initial Supplemental Regulatory Impact Analysis ("ISRIA") issued by the Federal Aviation Administration ("FAA") on December 12, 2012. The ISRIA contains a revised benefit-cost analysis ("BCA") for the FAA's Final Rule which amended flight duty and rest regulations applicable to certain certificate holders and their flightcrew members ("Final Rule"). 77 Fed. Reg. 73911 (December 12, 2012). AAWW also supports the comments filed by the Cargo Airline Association ("CAA") and Airlines for America.

Background.

On December 22, 2011, the FAA issued a Final Rule establishing new flightcrew member duty and rest requirements. 77 Fed. Reg. 330 (January 4, 2012). The new rule takes effect on January 4, 2014. 77 Fed. Reg. 28763 (May

16, 2012). The FAA determined to limit the new Final Rule only to passenger operations under Part 121 and "removed all-cargo operations" from application of the new regulations "because their compliance costs significantly exceed the quantified societal benefits." 77 Fed. Reg. at 330-32. In making that determination, the FAA found that "[t]he projected cost for all-cargo operations is $306 million ($214 million present value at 7% and $252 million at 3%)," while "[t]he projected benefit of avoiding one fatal all-cargo accident ranges between $20.35 million and $32.55 million." 77 Fed. Reg. at 332, n.1.

A petition for review of the Final Rule was filed by the Independent Pilots Association ("IPA") in the U.S. Court of Appeals for the District of Columbia Circuit, challenging the exclusion of all-cargo operations from the new rule. During the course of preparing the government's responsive brief, the FAA discovered certain "errors" in the original BCA, which were significant enough to warrant FAA's review and correction. The D.C. Circuit granted the FAA's motion to suspend the litigation pending FAA's further analysis. Although the errors related to the impact of implementation of the proposed rules for cargo-only operations, "in an abundance of caution" (77 Fed. Reg. at 73911), the FAA decided to reevaluate the BCA for both passenger and cargo operations. On December 12, 2012, the FAA issued and requested comments on the ISRIA in which the FAA revised the BCA for the Final Rule.

The Revised BCA Provides Even Greater Support for the FAA's Decision to Exclude All-Cargo Operations from the Final Rule.

The original BCA demonstrated that the costs of including all-cargo operations in the rule would overwhelm the limited benefits. Under the revised BCA, costs are even greater and benefits are even smaller than they were in the original BCA. As the FAA concluded, the new analysis "has significantly increased the estimates of the stated costs of extending the final rule to cargo-only operations." 77 Fed. Reg. at 73911.

The revised BCA increased all-cargo costs by $244 million, and reduced the benefits by more than $15 million in the Base Case and by over $1.5 million in the High Case. Table 2, 77 Fed. Reg. at 73912. For the Base Case, costs total $550 million compared to benefits of only $5 million, resulting in a costs-to-benefits ratio of $110 to $1. For the High Case, costs total $550 million compared to benefits of $31 million, producing a costs-to-benefits ratio of $17.74 to $1. This means that **for every dollar of benefit, there would be $110 of costs in the Base Case, and $17.74 of costs in the High Case**. Under either case, the costs overwhelmingly swallow the benefits and by any reasoned analysis cannot justify extending the Final Rule to cover all-cargo operations. The FAA has correctly determined that:

> "The Initial Supplemental RIA results in data that provides greater justification for the exclusion of cargo operations from the final rule, and continues to provide justification for the final rule on passenger operations. As a result, the FAA has determined that no revisions to the final rule on either cargo or passenger operations is warranted." 77 Fed. Reg. at 73911.

Moreover, as CAA's comments point out, even the revised BCA's costs are understated and its benefits are overstated. For example, the FAA failed to take into account estimated costs of $87 million that would be incurred to hire and train new crew members prior to implementation of the Final Rule. Indeed, contrary to the FAA's view that no additional flightcrew members would be needed in order to operate current schedules in compliance with the Final Rule, *see* ISRIA at 6-7, AAWW estimated that the rule would increase Atlas' and Polar's crew costs by 20%, an increase directly supported and confirmed by crew optimization results delivered by a leading flight crew optimization software provider. *See* AAWW November 15, 2010 Comments, at 5. The ISRIA ignores this issue and as a result significantly understates the actual costs if the Final Rule were extended to all-cargo operations.

Conversely, the estimated benefits are greatly overstated. In reaching its revised estimate of $5 million in benefits in the Base Case, the FAA assumed that if the Final Rule had been in place and had covered all-cargo operations, there would have been a 75% chance (referred to as the "effectiveness rate") that a 2002 all-cargo accident (the only one referenced by the FAA) would have been avoided. ISRIA at 40-42. But, as CAA notes, a review of the record demonstrates that the new Part 117 would have had zero impact on avoiding that accident. In fact, the ISRIA concedes as much: "But unsure exactly how NPRM would have addressed this case, since rest periods were reasonable (even if not well managed) & accident occurred on visual approach over a black hole with a color-blind pilot trying to use a PAPI." ISRIA at 111. Accordingly, eliminating this

2002 accident from the "Base Case" analysis would reduce the already minimal benefits from $5 million to zero.

The estimated benefits of $31 million for the High Case are even more speculative than the Base Case estimate. The High Case benefits are based on the assumption that there would be one catastrophic accident with a B-757 cargo aircraft, with a total loss of hull and cargo and two deaths. ISRIA at 42-43. This is unsupported in the record and indeed is unsupportable. There have been no all-cargo accidents in the past ten years attributable to fatigue. For the last ten years, all-cargo airlines operated over 10,000,000 takeoffs and landings with no fatigue-related accidents. This exemplary record is supported by the fact that all-cargo airlines operate fewer block hours and offer greater rest opportunities to their flightcrew members than passenger carriers.

In sum, the ISRIA firmly establishes that the costs of extending the Final Rule to all-cargo operations vastly exceed the minimal benefits.

The FAA is Legally Entitled to Consider Benefit-Cost Analyses.

The FAA invited comments on whether Section 212 of the Airline Safety and Federal Aviation Administration Extension Act of 2010, Public Law No. 111-216 (hereinafter "Safety Act"), "permits the FAA to conduct a cost-benefit analysis." 77 Fed. Reg. at 73911. AAWW submits that the Safety Act does not foreclose, but rather authorizes the FAA to consider the costs and benefits of the Final Rule.

Section 212(a)(2) required the FAA "to issue regulations, based on the best available scientific information, to specify limitations on the hours of flight and duty time allowed for pilots to address problems relating to pilot fatigue." Nothing in Section 212(a)(2) or anywhere else in the Safety Act specifically precludes the examination of costs and benefits when promulgating the rule required by Section 212. In fact, just the opposite. Section 212(a)(2) lists several factors "the FAA shall consider and review" (emphasis added). Not only is there no statutory limitation on the factors the FAA is allowed to consider, Section 212(a)(2) expressly directs the FAA to consider and review "[a]ny other matters the Administrator considers appropriate."

It has been longstanding practice for the FAA to consider BCAs in its rulemakings. Indeed, there are two Presidential Executive Orders which require Federal agencies to consider costs and benefits. Executive Order 12866 (September 30, 1993) requires agencies to "assess all costs and benefits of available regulatory alternatives, including the alternative of not regulating." Executive Order 13563 (January 18, 2011) states that "costs and benefits must be taken into account" and requires agencies to "propose or adopt a regulation only upon a reasoned determination that its benefits justify its costs . . . ."

The FAA's consideration of the costs and benefits of the Final Rule is also in line with Federal Court decisions. Under established precedent, unless expressly prohibited by statute (which, as discussed above, is not the case here), costs and benefits can be considered by federal agencies in rulemakings. *See State of Michigan v. EPA,* 213 F.3d 663, 678 (D.C. Cir. 2000): "It is only where there is 'clear congressional intent to preclude consideration of cost' that we find agencies barred from considering costs." The recent Supreme Court decision in *Entergy Corp. v. Riverkeeper, Inc.*, 556 U.S. 208 (2009), supports the FAA's use of a BCA as part of its rulemaking determination here. In *Entergy*, the Supreme Court sanctioned EPA's consideration of the costs and benefits of a proposed regulation when the governing statute was silent on the issue: "It is eminently reasonable to conclude that Section 1326(b)'s silence is meant to convey nothing more than a refusal to tie the agency's hands as to whether cost-benefit analysis should be used, and if so to what degree." 556 U.S. at 222 (emphasis added).

Here, the statute is not silent. The Safety Act expressly authorizes the FAA to consider "[a]ny other matters the Administrator considers appropriate." Consequently, it is entirely appropriate for the FAA to consider costs and benefits in determining whether to extend the rule to all-cargo operations.

In conclusion, AAWW supports the FAA's consideration of the costs and benefits of the flight duty and rest rule and its determination to exclude all-cargo operations from the Final Rule.

Respectfully submitted,

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February 11, 2013

TAB 25

BEFORE THE
FEDERAL AVIATION ADMINISTRATION
WASHINGTON, D.C.

Flightcrew Member Duty and Rest Requirements
Docket No. FAA-2009-1093

Initial Supplemental Regulatory Impact Analysis

COMMENTS OF THE CARGO AIRLINE ASSOCIATION

<u>Introduction</u>:

On December 22, 2011, the Federal Aviation Administration (FAA) issued a final rule establishing new flight crew member duty and rest requirements for large aircraft passenger operations (the Final Rule). At the same time, this new regulation (14 CFR Part 117) specifically excluded all-cargo operations. All-cargo operations remain subject to the pre-existing duty and rest requirement regulations in Part 121 (14 CFR Section 121.471). The decision not to include all-cargo operations was based on an FAA cost-benefit analysis, embodied in a Regulatory Impact Analysis (RIA) issued with the Final Rule, which clearly showed that the substantial costs of the new rules, if applied to all-cargo operations, greatly outweighed the rule's minimal benefits.

Subsequently, the Independent Pilots Association filed a petition for review of the FAA's decision to exclude all-cargo carriers from the new rules in the U.S. Court of Appeals for the

District of Columbia Circuit. During the course of this litigation, the FAA discovered errors in the RIA and contracted with the John A. Volpe National Transportation Systems Center to prepare a supplemental regulatory evaluation. Thereafter, on December 12, 2012, the FAA published a Notice (FAA Notice) seeking comment on the resulting Initial Supplemental Regulatory Impact Analysis (Supplemental RIA). *See Flightcrew Member Duty and Rest Requirements*, 77 Fed. Reg. 73911 (Dec. 12, 2012).[1] As explained by the FAA:

> During the course of reviewing the administrative record for the purpose of preparing the government's brief [in the court challenge filed by the Independent Pilots Association], the FAA discovered errors in the original RIA that supports the final rule. The errors were associated with the scope of the costs related to the implementation of the regulations for cargo-only operations. These errors appeared to be of a sufficient amount that the FAA concluded it was prudent to review the portion of the cost-benefit analysis related to cargo-only operations and allow interested parties an opportunity to comment on the corrected analysis.

Id. at 73911.

The Supplemental RIA recalculation of the costs and benefits attributable to applying Part 117 to the all-cargo air carrier industry produced the following results:

Cargo Operations Cost and Benefits

	Costs	**Benefits**	**Cost-Benefit Ratio**
Base Case	**$550 million**	**$5 million**	**$110 to $1**
High Case	**$550 million**	**$31 million**	**$18[2] to $1**

This represents a significant upward revision of the costs attributable to applying Part 117 to the all-cargo air carrier industry (an increase in costs from $306 million to $550 million) and a

[1] The Initial Supplemental Regulatory Impact Analysis also recalculates Part 117's costs and benefits on the passenger air carrier industry segment, but these Comments will be limited to the impact on the all-cargo air carrier industry.
[2] The exact calculation is $17.74 to $1.00 which is rounded to $18 to $1 for ease of discussion.

downward revision of the expected benefits (a decrease in the base case from $20.35 million to $5 million and an adjustment in the high case from $32.55 million to $31 million). The FAA has therefore now found the ratio of costs to benefits ranges from 110:1 (base case) to 18:1 (high case). In other words, every $1 of benefit extending the rules to cargo operations produces $110 in costs in the base case and $18 in costs in the high case. As a result of these conclusions, the FAA has found that:

> The Initial Supplemental RIA results in data that provides **greater justification for the exclusion of cargo operations from the final rule**, and continues to provide justification for the final rule on passenger operations. As a result, the FAA has determined that no revisions to the final rule on either cargo or passenger operations is warranted.

Id. at 73911 (Emphasis added).

The FAA has invited comments on the Initial Supplemental RIA, as well as on the issue of whether Public Law 111-216 prohibits the FAA from conducting a cost-benefit analysis. Following are the comments of the Cargo Airline Association (CAA).

<u>A Cost-Benefit Analysis is Not Precluded by Statute and is Wholly Appropriate in this Case:</u>

The FAA's Notice observes that the "FAA does not believe that it is statutorily foreclosed from . . . considering the costs and benefits of the flight, duty, and rest rule." 77 Fed. Reg. at 73911. That determination is entirely correct and well-supported by statute, case law, and FAA practice.

Public Law 111-216, the Airline Safety and Federal Aviation Administration Extension Act of 2010 (Safety Act), was enacted on August 1, 2010, and contains a provision specifically applicable to the pilot fatigue issue. Section 212 required the FAA to issue regulations designed to mitigate pilot fatigue and set forth matters to be addressed in the rule. *See* Section 212(a)(2).

Nothing in Section 212, or anywhere else in the Safety Act, precludes the examination of safety-related benefits and costs when promulgating the rule required by Section 212. To the contrary, the Act specifically authorizes the FAA to issue regulations "based on the best available scientific information." Section 212(a)(1). In using such language, Congress plainly intended for the FAA to consider scientifically sound cost-benefit analysis. There is no dichotomy between "scientific information" and consideration of costs and benefits. Indeed, "benefits" could not even be calculated without using scientific information about the avoidance of plane crashes, and it is impossible to consider the optimal level of rest without considering the methods and costs of providing that level of rest. *See Michigan v. EPA*, 213 F.3d 663, 678 (D.C. Cir. 2000) (explaining it is effectively impossible to evaluate whether a rule is "significant" if costs cannot be considered because "[w]ithout consideration of cost it is hard to see why *any* ozone-creating emissions should not be regarded as fatally 'significant'") (emphasis in original).

Moreover, the Act expressly authorizes the Administrator to consider "[a]ny other matters the Administrator considers appropriate." Section 212(a)(2)(M). Clearly, the relationship of costs to benefits is an appropriate area of inquiry that can and should be considered by the Administrator. The FAA has long used cost-benefit analysis for rulemaking under its organic statute — a practice that is public and well-known to Congress — and Congress would have considered it "appropriate" for the FAA to continue its well-established practice in interpreting the Safety Act. Indeed, Executive Order 13563 (E.O. 13563), issued by President Obama on January 18, 2011, specifically provides that, as a general principle of regulation, **costs and benefits must be taken into account.** See E.O. 13563, Section 1 (Emphasis added). Accordingly, to comply with the terms of the Executive Order, ". . .each agency must, among other things: (1) propose or adopt a regulation only upon a reasoned determination that its benefits justify its costs. . . ." That is precisely what the FAA has done in this proceeding. It has examined the costs and benefits of applying Part 117 to all-cargo carriers and has correctly concluded that the costs overwhelm the benefits and that the rule cannot therefore be made applicable to the all-cargo industry.

Finally, even if the statute had been silent on the Administrator's authority to consider costs and benefits (which, as explained above, it is not), the Federal courts have made it abundantly clear that an analysis of costs and benefits is an appropriate area of inquiry, unless specifically barred by statute. For example, in the landmark case of *Entergy Corp. v. Riverkeeper, Inc.*, 556 U.S. 208 (2009), the United States Supreme Court, in ruling on the legality of the EPA regulation of cooling water intake structures, found that the comparison of costs and benefits was permissible where the statute under which the regulation was enacted was silent on the cost-benefit issue. As the Court stated:

> It is eminently reasonable to conclude that Section 1326(b)'s silence is meant to convey nothing more than a refusal to tie the agency's hands as to whether cost-benefit analysis should be used, and if so to what degree.

556 U.S. at 222. Similarly, the United States Court of Appeals for the District of Columbia, in *State of Michigan v. EPA* 213 F.3d 663, 678 (DC Cir. 2000 found that "[i]t is only where there is 'clear congressional intent to preclude consideration of cost' that we find agencies barred from considering costs." 213 F.3d at 678 (citing *National Resources Defense Council v. EPA*, 824 F.2d 1146, 1163 (DC Cir. 1987)). And in *United States Air Tour Association v. FAA*, 298 F.3d 997, 1005 (DC Cir. 2002), a case in part involving the scope of FAA authority, the Court found that, as to questions of statutory construction, where legislation is "silent or ambiguous with respect to [a] specific issue," we are obligated to defer to an agency's interpretation as long as it

is "based on a permissible construction of the statute." (citing *Chevron v. National Resources Defense Council*, 467 U.S. 837, 843 (1984)).

Significantly, it is also important to note that the Supreme Court in *Riverkeeper* specifically rejected an argument that the Court's decision in *Whitman v. American Trucking Associations, Inc.*, 531 U.S. 457 (2001), compelled a contrary result. In *American Trucking*, a case relied upon heavily by the Independent Pilots Association in its attack on the FAA's consideration of a cost-benefit analysis in this case, the Court found that section 109 of the Clean Air Act "interpreted in its statutory and historical context … **unambiguously bars cost considerations"**. 531 U.S. at 471 (emphasis added). In the proceeding currently before the FAA, as in *Riverkeeper*, no such conclusion can be drawn. *See Riverkeeper*, 556 U.S. at 223.

In short, the Safety Act contains language that authorizes cost-benefit analysis in two separate statutory provisions – its requirement to use the "best available" information and its authority for the Administrator to consider all "matters the Administrator considers appropriate". Even assuming that the Act had been silent on the permissibility of cost-benefit analysis, such silence would have permitted the agency to take costs and benefits into account since nothing in the Act *precludes* a cost-benefit analysis. The FAA's consideration of costs and benefits under these circumstances is thus wholly appropriate.[3]

[3] Indeed, under these circumstances, it would have been arbitrary and capricious to ignore the FAA's *own* finding that the costs of extending the new rule to cover all-cargo operations *vastly* outweigh the benefits. *See* 77 Fed. Reg. at 73812; *Process Gas Consumers Group v. FERC*, 930 F.2d 926, 939 n. 9 (D.C. Cir. 1991) (finding agency decision arbitrary and capricious where project was "net loser" on agency's own calculations); *Corrosion Proof Fittings v. EPA*, 947 F.2d 1201, 1218 (5^{th} Cir. 1991) (criticizing agency cost-benefit methodology); *see also Business Roundtable v. SEC*, 647 F.3d 1144, 1153 (D.C. Cir. 2011) (agency cannot "arbitrarily ignore[]" costs and benefits).

The Initial Supplemental Regulatory Impact Analysis More Accurately Reflects the Costs and Benefits of Applying Part 117 to All-Cargo Operations but Further Adjustments are Warranted:

The FAA's revised cost-benefit study more strongly supports the FAA's decision to exclude all-cargo operations from the new Part 117 of the Agency's regulations and results in an even greater, indeed an overwhelming, imbalance of costs to benefits. However, even with the significant increases in costs and reduction in benefits, a number of relevant cost elements have still been omitted from the analysis and the projected benefits have been substantially overstated.

Initially, it is important to note that the FAA has once again correctly recognized that the United States aviation industry is made up of a number of differing segments, all of which have different operational characteristics. In this case, the Agency has appropriately noted the unique operational imperatives of all-cargo operations and has therefore given separate consideration to the impact of applying Part 117 to the all-cargo industry.

The Cost Calculation – In reviewing and revising the FAA's original cost-benefit analysis, the Volpe analysis has included costs omitted from the original analysis and has used a different methodology in calculating the economic effects of applying Part 117 to the various industry segments.

The methodology used in the Supplemental RIA corrects mistakes in the original FAA analysis and results in a much more transparent, and therefore easy to understand, calculation. In particular, the new analysis estimates costs for the passenger and all-cargo airlines separately, leading to a conclusion that all-cargo airline costs would account for more than half of the rule's total costs and just 1-4% of the rule's benefits.[4] While there are still areas where it is not possible to re-create calculations, most of the assumptions are sourced and calculations explained. Finally, the forecast time period used for the implementation and operational phases is now consistent for both cost and benefit calculations. The result of this effort is an upward adjustment of the projected costs on all-cargo operations from $306 million to $550 million.

In constructing its costs, Volpe has established three separate components of the cost equation – Flight Operations, Rest Facilities and Training. In turn, both the Flight Operations and Rest Facilities components are further broken down into the relevant areas of inquiry. An Association summary of the FAA 12-year nominal cost calculations reveals the following:

Cost Component	Passenger	**Cargo**	Total
Flight Operations			
Crew Scheduling	$479	**$521**	$1,000
Computer Programming	$8	**$2**	$10
Reduced Sick Time	($193)	**($44)**	($237)
Subtotal	$294	**$479**	$773
Rest Facilities			
Engineering	$13	**$3**	$16
Installation	$100	**$48**	$148
Downtime	$12	**$6**	$18
Fuel	$21	**$10**	$31
Subtotal	$146	**$66**	$212
Training	$17	**$6**	$23
Total	$457	**$550**	$1,007

[4] All-cargo operations account for 55% of the total nominal costs and 53-54% of the NPV costs (depending on which discount rate is used), while generating just 1% of nominal benefits for the "Base Case" and 4% for the "High Case".

It is clear from this chart that the majority of costs attributable to the application of Part 117 to both the passenger and all-cargo industry segments are concentrated in the "Crew Scheduling" component. Therefore, the CAA comments will focus on the method used to calculate these crew scheduling costs.

In the Volpe methodology, crew scheduling costs have been calculated using a well known crew scheduling model (Cygnus developed by CrewPairings, Inc.) rather than the widely criticized limited airline survey originally used by the FAA. In addition, the new methodology also adjusts the way in which credit hour cost per flightcrew member is calculated, resulting in higher, more realistic, estimates for crew scheduling costs.[5] The extrapolation of model-based crew scheduling impacts is better described and can be replicated. The unsupported assumption that schedule optimization would result in a 25% cost reduction for airlines was dropped by Volpe. These adjustments to the original FAA analysis result in more accurate crew scheduling costs for all industry segments, with the all-cargo cost calculated at $521 million.

The latest analysis also more accurately reflects initial costs for fleet modifications. In the original RIA, the FAA assumed that there would be no rest facility costs for all-cargo fleets, but the latest analysis includes $56 million of upfront modification costs and $1 million in annual fuel costs during the operational phase.

In spite of a more realistic assessment of the true costs of applying Part 117 to all-cargo operations, the Supplemental RIA still omits certain significant cost elements that would be impacted by application of the Final Rule to all-cargo operations. The largest cost category not covered in the latest analysis is the initial cost for fatigue training which the FAA now estimates at just $1.1 million for training only dispatchers and upper management. The CAA estimated $147.1 million of crew training would be required prior to rule implementation.

[5] Initial Supplemental RIA, p. 59, fn. 54.

While the FAA does estimate costs for additional crew time during the operational phase of the rule, it failed to estimate costs that would be incurred to hire and train new crew members prior to implementation (estimated by the CAA to be $87 million). And the FAA does not capture the full costs to airlines for payroll taxes, pensions and other employee benefit costs.

A final concern of CAA is that the summary results for passenger airlines (see Table 18 in the latest RIA) show that the rule would result in crew scheduling cost savings for certain operational categories. Airlines schedule crews for a variety of reasons other than the specific fatigue requirements. It is unrealistic to assume that the final rule would result in any cost savings and such should be eliminated if they are included in the "net" all-cargo crew scheduling costs.

In summary, the Supplemental RIA uses a more realistic method of calculating the actual costs of applying Part 117 to the all-cargo industry and finds that the estimated costs are significantly higher than estimated in the original Regulatory Impact Analysis.[6]

The Benefit Calculation – Unlike the cost calculations which appear somewhat understated, the benefits of applying Part 117 to all-cargo carriers are seriously overstated in the Supplemental RIA. Both the "base case" and "high case" estimates have significant flaws which result in calculations that far exceed the true benefits.

The "base case" number of $5 million is arrived at using a ten-year "look back" at historical accidents and assuming a similar accident rate in the next ten years.[7] In this case, the only all-cargo accident cited is a Federal Express crash at Tallahassee, Florida, on July 26, 2002, where the aircraft struck a stand of trees and crashed short of the runway. The FAA, in citing

[6] $550 million v. $306 million.
[7] The Association supports the use of a maximum ten year period as reasonably representing the likelihood of future events.

this accident, has assumed that application of the new Part 117 would have had a 75% probability of avoiding the accident.[8] The Association respectfully disagrees.

While fatigue may have been one of several contributing factors to the July 26, 2002, accident, a review of the record clearly indicates that application of the Part 117 standards clearly would have had no impact on this particular accident. As the FAA itself has noted:

> Performance of both pilots was deficient & below their usual standard during approach. NTSB believes this was due to fatigue. Besides back-of-clock, both pilots had difficulty getting adequate rest before flight. PIC said his sleep 2 days before had 'not really (been) good' or had been 'marginal' because he kept being woken (sic) by family dog. FO said he had difficulty adjusting his sleep cycle & inferred he did not sleep well during day. Friend described FO as looking tired and PIC commented on same bus that he 'might be a little tired.' Even with color-blindness, causal statement justifies concluding that a better rested crew may have avoided the whole scenario early-on in the approach. **But unsure exactly how NPRM would have addressed this case, since rest periods were reasonable (even if not well managed) & accident occurred on visual approach over a black hole with a color-blind pilot trying to use a PAPI**.

Initial Supplemental RIA, pp.110-111 (Emphasis added).[9]

Finally, and perhaps most telling, FedEx has reviewed the actual rest received by the flight crew before the July 26, 2002, accident and has determined that, in fact, **the crew's rest would have been in compliance with the provisions of the new Part 117, if that regulation had been in effect at the time of the crash.** The chart below explains in detail the rest received by the crew and how that rest relates to Part 117 requirements.

[8] The scoring system used by the FAA is based on the Joint Implementation Monitoring Data Analysis Team (JIMDAT) system, where a score of "4" indicates 75% effectiveness. "The proposed requirement directly addresses the majority of the NTSB causal factors and would probably prevent or is likely to reduce the risk of the respective accident, given the circumstances that prevailed." Initial Supplemental RIA, p. 28.

[9] PAPI is a Precision Approach Path Indicator that relies on red and white lights to inform pilots if they are on a proper glide slope for landing.

	Captain		First Officer		Second officer	
	Allowed Limits	Per Schedule	Allowed Limits	Per Schedule	Allowed Limits	Per Schedule
117.11 Flight Time Limits	8:00	1:24	9:00	4:03	9:00	4:05
117.13 Flight Duty Chart	9:00	2:24	11:00	10:18	12:00	10:30
117.19.(a).1 FDP Extensions	11:00	2:35	13:00	10:29	13:00	10:41
117.19.(a).2 FDP Extensions	>30 mins Once	0	>30 mins Once	0	>30 mins Once	0
117.21 Reserve *	13:00	4:47	N/A	N/A	N/A	N/A
117.23.(b).1 Cumulative Limits	100 flt/ 672hrs	45:54	100flt/ 672hrs	44:32	100flt/ 672hrs	27:15
117.23.(b).2 Cumulative Limits	1000 flt/ 365 days	427:21	1000flt/ 365 days	631:42	1000flt/ 365 days	401:19
117.23.(c).1 Cumulative Limits	60 fltduty/ 168hrs	16:41	60 fltduty/ 168hrs	21:04	60 fltduty/ 168hrs	14:19
117.23.(c).2 Cumulative Limits	190 fltduty /672hrs	76:26	190 fltduty /672hrs	73:24	190 fltduty /672hrs	45:38
117.25.(b) Rest Period	30 in 168	received 80:51	30 in 168	received 41:54	30 in 168	received 95:44
117.25.(e) Rest Period	10:00	12:00	10:00	11:03	10:00	10:22
117.27 Consecutive Nights	3 max nights	1	3 max nights	2	3 max nights	2

* The captain was assigned in reserve status, the sum of his reserve availability period plus the duty allowed per table B can not exceed 13 hours given his reserve availabilty start time.

In view of these facts and conclusions, there is simply no justification for using this flight as the foundation for a "base case" analysis (and certainly no reason for assigning a JIMDAT score of "4" which assumes a 75% probability of accident avoidance if Part 117 were in effect). If the July 26, 2002, flight is correctly removed from consideration, there are **no fatigue related all-cargo accidents in the past ten years** and the actual "base case" benefit for the all-cargo industry is zero.

Similarly, there is no basis for the FAA's "high case" estimate of $31 million. This projected benefit is based on the assumption that there will be one catastrophic fatigue-related crash of a fully loaded all-cargo B-757-200 aircraft, with a resulting total loss of hull and cargo and the loss of two lives. However, there is nothing in the record of this case that can possibly support this conclusion. And even if one could conclude that a catastrophic all-cargo crash might occur in which fatigue were a factor, there is no basis for assuming that such a crash would be caused by failure to apply the new Part 117 standards.

To the contrary, the record clearly reveals that an all-cargo aircraft crash in the next ten years that can be traced to failure to apply Part 117 standards is highly unlikely. As noted above, there have been **no all-cargo aircraft** accidents in the past ten years that can be traced to fatigue. In fact, from 2003 through the second quarter of 2012, all-cargo airlines have operated 10.1 million take-offs and landings with absolutely no fatigue-related accidents.[10] And NTSB data reveal that there have been only two fatigue-related all-cargo accidents in the 1982-2010 time period and neither of these incidents resulted in loss of life.[11] Moreover, there have been absolutely **no fatigue-related accidents** in long range operations performed with an augmented crew. None of these data should be surprising in view of the demonstrated safety commitment of the all-cargo industry, including the fact that **all-cargo pilots already fly significantly fewer block hours per month than their passenger counterparts and receive significantly more rest opportunities.**[12] The only conclusion that can be drawn from these facts is that it is unreasonable for the FAA to conclude that there is a "high case" benefit of $31 million by assuming one catastrophic (fatal) fatigue-related all-cargo crash traceable to a failure to impose Part 117 standards in the next ten years.

Taken together, these facts clearly demonstrate that the benefits to be measured against the costs of all-cargo carrier implementation of Part 117 are extremely small, and certainly less than the estimates made by the FAA .

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[10] Data from DOT Form 41, T-2, for Atlas Air, Capital Cargo, Federal Express, Kalitta Air, Polar Air Cargo and United Parcel Service Co.

[11] See, The Effects of Commuting on Pilot Fatigue, National Research Council (2011), p. 3-9.

[12] See, Initial Supplemental RIA, p. 61, Table 14, which lists freight block hours per month between 34 and 45, while the passenger block hours per month are either 59 or 60.

Conclusion:

The FAA has a long history of using cost-benefit analyses in its rulemaking process to ensure that proposed regulations are economically justified. Where, as here, the projected costs are not offset by the anticipated safety benefits, it is appropriate that such rules not be finalized. Inclusion of the consideration of costs and benefits is, of course, not limited to the FAA – it is a basic tenet of all government rulemaking as set forth in E.O. 13563 issued by President Obama in January 2011. And the use of cost-benefit considerations has been specifically upheld by the federal courts, except where specifically precluded by statute, a circumstance not applicable here. The application of cost-benefit principles is especially important in cases such as this, where the anticipated benefits are minimal and are far outweighed by the significant anticipated costs.

In this case, the FAA, in recognizing certain deficiencies in its original Regulatory Impact Analysis, has now had an independent third party (Volpe) recalculate the projected costs and benefits of applying Part 117 to the all-cargo industry. Using more transparent methods, considering cargo and passenger operations separately and including the costs attributable to carriers performing both passenger and cargo operations, the Agency has now concluded that the imbalance of costs to benefits runs between 110:1 (base case) and 18:1 (high case). As described above, the Association submits that even these calculations are low and that the imbalance is even greater. Therefore, the rule cannot be justified and the FAA has correctly concluded that it is therefore not in the public interest to extend Part 117 to the all-cargo industry.

Finally, it is important to point out that the basic reason for the wide discrepancies between costs and benefits in this case can be traced directly to the lack of benefits in applying Part 117 to all-cargo carriers. With respect to flight crewmember rest requirements and duty time limits, all-cargo air carrier operations are currently regulated by Part 121 of the Federal Aviation Regulations (14 CFR Section 121.471). As documented above, these regulations have proven extremely effective in ensuring that pilots in this industry segment are adequately rested before performing their assigned duties. Moreover, the Safety Act requires that all Part 121 carriers, including the members of the all-cargo industry, institute a Fatigue Risk Management Program (FRMP) approved by the FAA.[13] Each of the all-cargo carriers has had this required program approved by the FAA, thus adding another layer of safety to the already exemplary record compiled by all-cargo carriers.

In view of all the facts and circumstances described herein, the Association submits that the Agency has once again correctly concluded that it is inappropriate to apply Part 117 to the all-cargo air carrier industry.

Respectfully submitted,

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[13] P.L. 111-212(b).