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 II of V
PAGES 788-1557

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.

W. Eric Pilsk
epilsk@kaplankirsch.com
KAPLAN, KIRSCH & ROCKWELL, LLP
1001 Connecticut Avenue, NW
Washington, D.C. 20036
Telephone: (202) 955-5600
Facsimile: (202) 955-5616

Counsel to Independent Pilots Association

William C. Trent,
General Counsel
INDEPENDENT PILOTS
ASSOCIATION
3607 Fern Valley Road
Louisville, KY 40219
(502) 967-0341 ext. 2205
(502) 753-3252 (fax)
btrent@ipapilot.org

JOINT APPENDIX
TABLE OF CONTENTS

VOLUME II of V

TAB 9

BEFORE THE
DEPARTMENT OF TRANSPORTATION
FEDERAL AVIATION ADMINISTRATION
WASHINGTON, D.C.

In the matter of	:	
Notice of Proposed Rulemaking for Flightcrew Member Duty and Rest Requirements	:	**Docket No. FAA-2009-1093**

COMMENTS OF THE
AIR TRANSPORT ASSOCIATION OF AMERICA, INC.

Communications with respect to this document should be sent to:

David A. Berg
Vice President & General Counsel
Douglas K. Mullen
Senior Attorney
AIR TRANSPORT ASSOCIATION OF AMERICA, INC.
1301 Pennsylvania Avenue, NW
Washington, DC 20004
dberg@airlines.org
dmullen@airlines.org

November 15, 2010

Executive Summary

The fundamental purpose of this rulemaking is to establish operational rules that are based on science and data, including safety and operational data garnered from the U.S. and international airline industry. ***ATA supports this goal***. Although the current regulations setting maximum pilot duty and flight time limits and minimum rest requirements have served the public well over the years – as the industry's safety record makes clear--they are many decades old and, to a large extent, were *ad hoc* decisions with little or no scientific support. Furthermore, interpretations of the regulations issued by the FAA over the years, which have added degrees of complexity to their implementation, likewise reflect individual judgments about safety rather than decisionmaking based on science, data and analysis.

Unfortunately, this proposed rule only partially achieves the goal of 21st century rules. Had the FAA limited the proposal to the three core elements of science-based flight duty periods ("FDP"), cumulative FDP and realistic minimum rest requirements, plus Fatigue Risk Management Systems, the FAA would have achieved this goal and it would have the industry's backing. Instead, the FAA went well beyond what current scientific research and operational data can support and added many other measures and requirements that, like the regulations they are intended to replace, are based on individual judgments driven by extraneous considerations, including perceptions about the political environment and what is acceptable. These measures include strict daily flight time limits, limits on extending the FDP, treating "short call" reserve as duty, a new schedule reliability test and limitations on split duty rest.

The consequence of these scientifically and operationally unjustified requirements is that the proposed rule, taken as a whole, is operationally onerous with duplicative measures that do little to mitigate fatigue or increase safety beyond what the core elements provide. FAA has promulgated a rule that treats the airline industry as operating under a single model instead of a complex industry with a variety of models and operating environments and demands. It treats broad scientific principles that should be applied differently to different operating environments as specific operational limits and applies them uniformly notwithstanding the weight of scientific support for different approaches to different demands. The FAA's failure to faithfully base the proposed rule on scientific research is compounded by the lack of rigor in its data analysis. The NPRM relies on specific accidents in which fatigue was not determined to be the cause or the primary cause; accidents in which the primary cause has been addressed by other regulations; and accidents that are dated and do not represent the current operating and regulatory environment. In addition, the NPRM essentially ignores the safety improvements from the recommendations of the Commercial Aviation Safety Team ("CAST") adopted by industry and government over the past 12 years.

The NPRM also ignores the operational experience of the international airline community. Neither the United Kingdom's CAP-371 regulation nor the European Union's Subpart Q regulation, for example, has a daily flight time limit. This is because the body of scientific research and literature demonstrates that in the face of a reasonable FDP, a daily limit is duplicative and unnecessary.

Finally, for a variety of reasons, the proposed rule is procedurally defective. The most obvious of these defects, as demonstrated by the Oliver Wyman report accompanying these comments, is that the FAA's cost-benefit analysis is fatally flawed. FAA's incomplete cost analysis calculates the cost of the rule to be $1.254 billion over ten years. This calculation is off by a magnitude of 15. The actual nominal cost—including direct passenger costs of at least $3.14 billion over ten years— will be $19.641 billion over ten years. Likewise, FAA's estimated benefits of $659.4 million over ten years overstate the true benefits, which Oliver Wyman estimates at no more than $395.6 million, a 40% difference. In addition to the flawed cost-benefit analysis, the NPRM's safety analysis is similarly flawed. The factual record that the FAA organized is riddled with mistakes and the analysis fails to make a rational connection between the facts, science and operational experience on the one hand, and the regulatory choices made on the other.

Furthermore, the rulemaking process itself was defective in at least two ways. The Administrator set an unreasonable, arbitrary deadline for the 2009 Aviation Rulemaking Committee (ARC) to complete its work, which prevented the stakeholders from fully considering the information and evidence to support new rules or the range of regulatory measures to address pilot performance and fatigue countermeasures, including many of the objectionable requirements in the proposed rule. Also the time allowed to comment on the proposed rule was unreasonable, as was the Administrator's decision to deny the stakeholder requests for additional time to comment. The FAA worked on the proposed rule for just over a year after the ARC concluded. Allowing the public just 60 days to comment was unreasonable.

For all of these reasons, The NPRM should be withdrawn and revised. Once revised, FAA should publish a Supplemental Notice of Proposed Rulemaking and a new Regulatory Impact Analysis, and allow interested parties a meaningful opportunity to comment on both.

TABLE OF CONTENTS

TABLE OF AUTHORITIES

Statutes

Executive Order and Other Directives

Case Law

<u>FAA Rulemaking, Policy Proceedings, and Interpretations</u>

Expert Reports

Other Authorities & References

BEFORE THE
DEPARTMENT OF TRANSPORTATION
FEDERAL AVIATION ADMINISTRATION
WASHINGTON, D.C.

In the matter of	:	
Notice of Proposed Rulemaking for Flightcrew Member Duty and Rest Requirements	:	**Docket No. FAA-2009-1093**

COMMENTS OF THE
AIR TRANSPORT ASSOCIATION OF AMERICA, INC.

I. INTRODUCTION

Safety is of paramount importance to the Air Transport Association of America, Inc. ("ATA") and its members.[1] Decades of safely transporting passengers and cargo have given ATA members a deep-rooted understanding of the importance of having rested and alert crewmembers prepared to safely operate commercial aircraft around the world. ATA's members and their affiliates transport over 90% of all U.S. passenger and cargo traffic, and thus have a significant interest in mitigating the risk of crewmember fatigue. We recognize that pilot duty limits and rest requirements are necessary and strongly support scientifically validated and data-driven counter-measures to prevent fatigue with the goal of producing tangible safety benefits.[2]

Over the years, ATA members have implemented, on a voluntary basis, many highly-effective policies and programs that far exceed current regulatory requirements designed to address crewmember fatigue. Knowledge gained from practical experience and fatigue science

[1] ATA member carriers are ABX Air, Inc.; AirTran Airways; Alaska Airlines, Inc.; American Airlines, Inc.; ASTAR Air Cargo, Inc.; Atlas Air, Inc.; Continental Airlines, Inc.; Delta Air Lines, Inc.; Evergreen International Airlines, Inc.; Federal Express Corporation; Hawaiian Airlines; JetBlue Airways Corp.; Southwest Airlines Co.; United Air Lines, Inc.; United Parcel Service Co.; and US Airways, Inc. ATA Airline Associate Members are Air Canada; Air Jamaica Ltd.; and Mexicana.

[2] *See Pilot Duty Time and Fatigue Management:* Hearing Before the S. Subcomm. on Aviation, Operations, Safety and Security of the S. Comm. on Commerce, Science and Transportation, 114th Cong. (2009) (statement of Basil Barimo, Vice President, Operations and Safety, Air Transport Association).

is constantly evolving, however, and the regulatory framework should evolve accordingly to ensure adequate rest for crewmembers. The foundation for such measures must always be scientific principles supported by data and operational experience.

Because ATA and its members recognize the fundamental importance of mitigating the risk of pilot fatigue and are committed to participating in FAA safety programs, we were active participants in the FAA's Flight and Duty Time Limitations and Rest Requirements Aviation Rulemaking Committee (the "ARC"). The FAA established the ARC on July 15, 2009 to recommend revisions to the agency's flight and duty time rule under an unusually tight schedule. During the ARC, stakeholders discussed a regulatory methodology that, for the first time in the U.S., would incorporate academic and research findings on the subject of sleep and fatigue, taking into account sleep time, circadian rhythms, time awake, time on duty, and time zone changes. Although scientific findings about these subjects are not always precise, when combined with operational experience, they offer guidelines for scheduling and operational practices that can help manage the risks associated with the effects of pilot fatigue. The airlines that participated in the ARC supported the incorporation of these principles into FAA regulations. Administrator Babbitt directed the ARC to consider as a model the regulatory scheme known as "CAP-371," which provides the flight and duty regulations that have been in effect in Great Britain since 1995, and are generally regarded as among the most restrictive regulations in the world. The Administrator also ordered that other international standards to be benchmarked.

The airline technical experts participating in the ARC recommended adoption of the best elements of CAP-371 that are consistent with the most recent sleep and fatigue research findings. ATA, the Cargo Airline Association ("CAA") and the Regional Airline Association ("RAA") submitted joint recommendations to the FAA for its consideration in the development of an expected notice of proposed rulemaking. These recommendations reflected the diverse operations and experience of mainline, all-cargo, and regional airlines and supported a science-based duty-day regulation. Our recommendations were generally more restrictive than current FAA regulations and many duty-limit and rest regulations around the world. They were intended to mitigate fatigue risk by reducing the pilot duty time while also expanding time for scheduled rest opportunities.

Appropriate duty limit and rest requirements must be the product of scientific research and operational experience, must be demonstrably effective, reflect the specific operational environment of each carrier and produce tangible results to enhance safety. They should not include extraneous rules unnecessary to achieving the appropriate regulatory goal of aviation safety. They must combine data-driven and evidence-based approaches and make sense from scientific, operational and public-interest perspectives. The ATA/CAA/RAA recommendations did just that; unfortunately, the FAA's Flightcrew Member Duty and Rest Requirements Notice of Proposed Rulemaking NPRM (the "NPRM" or "Proposal") does not meet that standard. It was with considerable disappointment that our close review of the NPRM revealed that, although the Proposal adopts some progressive elements of CAP-371, it also retains the most regressive vestiges of the Part 121 regulations and other subjective items of unknown origin.

The Proposal does not merely contain a handful of new rules. Rather, it amounts to a complex and comprehensive scheme that is a dramatic, wholesale replacement of the current rules pertaining to flight time, duty time, and rest. It represents a sea change in the U.S. approach to regulation of the aviation industry. As such, one would expect it to be the result of a meticulous process that fully complies with the Administrative Procedure Act and embodies the culmination of a searching, rigorous endeavor to take into account the best available knowledge derived from operational experience and science. Unfortunately, this is not the case. Important aspects of the NPRM are not based on science or supporting data, and the Proposal suffers from numerous other defects that are discussed throughout these Comments. If these non-validated provisions of the Proposal are adopted, they will unnecessarily saddle U.S. airlines with one of the most restrictive and costly flight and duty regulatory regimes in the world without the commensurate level of demonstrated safety benefits. As a result, the Proposal jeopardizes U.S. competitiveness, possibly leading to the loss of U.S. jobs and investment. The Proposal will likely lead to such consequences even though substantial portions lack the requisite scientific and data-driven basis to demonstrate that they will significantly enhance safety or even enhance safety at all.

ATA and its members support the aspects of the Proposal that are based on the best available science and which are effective at risk reduction. These elements include the basic philosophy of daily flight duty period ("FDP") limitations that take into account time of day as proposed in Tables B and C of the NPRM, but not with the reductions proposed for night operations below other international standards. We also support reasonable cumulative FDP limits and minimum rest requirements. These three mitigations—daily FDP limits, cumulative FDP limits, and minimum rest requirements—were the building blocks of the ARC recommendations. We also support several other concepts in the NPRM, including: application of flight and duty rest rules to certificate-holder Part 91 flights; the concepts of in-flight rest and split duty; and an available carrier-created, Administrator-approved Fatigue Risk Management System ("FRMS"). A successful model is the AQP program, providing carrier-proposed initiatives, reviewed and approved by the agency. We believe that, taken together, these steps represent a positive, science-based approach to fatigue mitigation that is reasonable, provides predictability, and significantly enhances safety.

Somewhere between the end of the ARC process and the publication of the NPRM, the FAA decided to propose a myriad of additional regulations that lack scientific or operational support and are unnecessary or overly restrictive for mitigating fatigue. These measures include rigid daily flight time limits, the "once in 168 hours" restriction on extensions to the scheduled

FDP, classification of short call reserve as "duty" and the "schedule reliability" concept-measures that do not provide additional safety benefits beyond those that flow from the three principal mitigations discussed above but do impose significant operational burdens on the industry. The net effect of this approach is a Proposal overloaded with duplicative rules that subject the U.S. industry, passengers, and shippers to unjustified economic burdens and adverse service consequences. The FAA itself readily acknowledges that many aspects of the Proposal are not based on science, let alone the best available science on the issue of fatigue. Assuming that all pilots are equally susceptible to fatigue regardless of the type of company they work for, the Proposal adopts a "one size fits all" approach that arbitrarily ignores the fact that a truly effective fatigue mitigation strategy must vary depending on the type of business model being regulated. Such strategies include a variety of well tested and FAA-approved air carrier operations and the different, but equivalent, fatigue mitigations successfully implemented into each type of operation. Many provisions in the NPRM would also impose unprecedented costs and undue burdens on the industry without providing any incremental safety benefits beyond those in the core proposals with which ATA members agree.

This result is not surprising because the Proposal is the product of an abbreviated process that did not allow the affected parties sufficient time to fully analyze its many complex provisions or perfect their own alternatives. Although the FAA has been attempting for decades to revise its pilot duty and rest rules, it denied stakeholders a meaningful chance to fully and effectively participate in this rulemaking proceeding. The ARC convened on an unprecedented, compressed schedule that did not afford its members a reasonable opportunity to reach consensus on key issues.[3] Compounding this problem, the NPRM contains many new proposals that the ARC did not have an opportunity to consider. Thus, the highly compressed ARC process

[3] The ARC reached consensus on only two issues, and the FAA ultimately rejected the ARC's agreed position on one of those issues.

prevented the FAA from thoroughly considering alternatives to the current Proposal and engaging in the thoughtful, discerning process mandated by the applicable authorities and necessary, as a practical matter, to successfully accomplish a rulemaking of such broad scope and impact.

Moreover, the NPRM as written is an incomplete and ambiguous document, containing a laundry list of questions from the FAA, many on foundational points that need to be resolved before parties can meaningfully comment on the Proposal.[4] When stakeholders sought a short extension of the original 60-day comment period and submitted detailed requests for clarification, the FAA responded by denying the extension requests, and with fewer than 30 days remaining in the comment period, issuing a so-called clarification that avoided answering many of their questions. We note that in the last regulatory effort in 1995, in a rulemaking action that did not include extraneous provisions such as schedule reliability, the FAA extended the comment period noting, "The extension of the comment period is warranted because of the scope and complexity of the proposal and the need to allow time for commenters to consider the agency's response to the above questions."[5] Additionally, the rushed rulemaking here stands in contrast to the measured DOT Federal Motor Carrier Safety Administration process to establish rules on hours of service for commercial motor vehicles, which permitted an extension in the comment period and featured several meetings open to the public at various locations, as well as the benefit of a regulatory impact analysis submitted and peer-reviewed by three Ph.D. and M.D. sleep experts. While we take no position on that rule, the process stands in stark contrast to the FAA's record in the present rulemaking.

---

[4] It is also possible that the FAA intends to impose the Proposal largely as is, and then attempt to resolve its substantial open questions through interpretation. Putting aside the serious legal issues this would raise, such an approach would almost certainly result in a quagmire of disputes, conflicting interpretations, and inconsistent enforcement.

[5] 61 Fed. Reg. 11492 (March 20, 1996).

Although ATA and its members support the general objective of the Proposal to mitigate the impact on pilots from a variety of factors that can affect their performance and judgment, we oppose the non-science based aspects of the NPRM and doubt that the Proposal can survive a legal challenge on procedural and other grounds if the FAA finalizes the Proposal without substantial revision. Among the glaring flaws in the Proposal are the following:

--*Many aspects of the Proposal are not science-based.* Although Congress directed the FAA to use the best available scientific information in developing the NPRM,[6] the FAA ignored science and instead based significant aspects of the Proposal on considerations of convenience, personal anecdotes, conjecture, labor, and political concerns. For example, the following high-impact aspects of the NPRM have no basis in science: (i) the imposition of hard daily flight time limits in addition to daily scheduled FDP limits; (ii) restricting extensions to the FDP to once in seven days; (iii) treating short call reserve as "duty"; (iv) requiring a minimum four-hour rest opportunity before allowing any credit for that opportunity as rest during a split duty period; and (v) requiring carriers to adjust their schedules to ensure that actual FDPs meet scheduled FDPs at least 95% of the time.

To provide the FAA with a scientific assessment of several NPRM provisions, some of which we oppose, ATA submits the report of two of the most distinguished scientists in the area of sleep science, fatigue, and human performance. They are Dr. Gregory Belenky, M.D., Director of the Sleep and Performance Research Center of Washington State University, and Dr. R. Curtis Graeber, Ph.D., leader of ICAO's Fatigue Risk Management Task Force.[7] Their report presents an independent, critical review of elements of the Proposal that should compel a

---

[6] *See* Airline Safety & Federal Aviation Administration Extension Act of 2010, Pub. L. No. 111-216, 124 Stat. 2348 (2010).

[7] The report prepared for the ATA by these experts is attached as Attachment 1, and includes biographical material about each author. The NPRM recognizes Dr. Belenky as an expert on sleep, fatigue and human performance. Flightcrew Member Duty and Rest Requirements, 75 Fed. Reg. at 55852-01, 55854 (Sept. 14, 2010) (to be codified at 14 C.F.R. pts. 117, 121).

reevaluation by the FAA of the purported scientific premises of the NPRM. Among other things, their report demonstrates that science does not support: imposing daily flight time limits in addition to daily FDP limits; restricting carriers to one 30-minute FDP extension in each 168-hour period; classifying short call reserve as duty; requiring a minimum of four hours rest for credit during a split duty period; restricting consecutive nighttime operations to three nights where crewmembers receive sufficient rest during such operations; or imposing a requirement that carriers evaluate pilots in real time to determine if they are "too fatigued" to fly.

--*The Proposal inappropriately adopts a one-size fits all approach to safety.* Flight and duty regulations are "hours of service" work rules that have evolved into elaborate and complex scheduling practices that comply with current FAA regulations and are compatible with the needs of both the individual carrier and its crewmembers. ATA members and their crews have developed detailed scheduling systems that respond to the specific operational and personnel requirements of each set of stakeholders. The Proposal would unnecessarily eliminate many of the benefits the current scheduling system provides to both carriers and crews, while adding *multiple* duplicative prescriptive requirements that the FAA has not shown will provide an additional margin of safety over core aspects of FDP limits, cumulative FDP limits and minimum rest requirements with which ATA members agree. Because ATA members employ over 50,000 flight crewmembers and, with their affiliates, account for more than 90% of domestic passenger and cargo traffic, the public interest is greatly affected, and indeed well-served, by the existing scheduling systems and related fatigue countermeasures developed by stakeholders.

In stark contrast to the existing system, the Proposal in its present form fails to adequately acknowledge the unique characteristics of different types of operations (*e.g.*, passenger, cargo operations, short-haul, long-haul, unscheduled). The Proposal's "one size fits all" approach rests on the erroneous assumption that the entire industry is operationally homogenous. In our membership alone, we have major international passenger carriers, major international cargo carriers, domestic passenger carriers and international cargo/passenger supplemental carriers. Each group operates under a significantly different business model. For instance:

- International all cargo carriers operate significant nighttime operations;
- Passenger carriers conduct some daytime some night operations;
- Some domestic passenger carriers operate mostly between 6:00 am and 10:00 pm; and
- Supplemental carriers operate mostly on demand.

Rules that affect the scheduling and operations of carriers must take into account the differences in their operations in order to be effective and rational.[8]

The Proposal also disregards the positive effect on safety resulting from carrier policies and work rules tailored to particular operations, and the efforts already undertaken by ATA members and their crewmembers to achieve the present high level of aviation safety. In fact, it will adversely affect carriers that have voluntarily instituted effective fatigue mitigation strategies that will be incompatible or of limited use with this Proposal as well as carriers whose CBA includes restrictions that exceed current rules. Nothing in fatigue and sleep research supports imposition of a one-size-fits-all regulation. Science teaches us that physiological needs for rest can be met in different ways depending on the differing operational models that exist within air commerce. Science recognizes that individual differences and operational contexts affect performance and it is unrealistic to expect that a one-size-fits-all policy will address all

[8] For example, one important difference between scheduled passenger carrier operations and cargo operations is the ability of cargo operators to accommodate the fluctuations in freight volumes on any given night. This manifests itself in additional landings and schedule changes compared to regularly scheduled duty periods. Use of sweep aircraft (aircraft specially designated to pick-up stranded freight in another city), standby periods, and rerouting allow cargo operators to accommodate customers. As such, cargo pilots realize and prepare for the flexibility required to operate to the maximum allowable flight duty period.

aspects of managing fatigue.[9] One only needs to look at the Department's own approach to fatigue management for validation of this point. The FMCSA hours of service rules for drivers differ greatly from current and proposed rules for flight crews in terms of rest, hours of duty, and hours on task and other dimensions. These rules demonstrate that the Department itself has or proposes to regulate fatigue management in very different ways. Moreover, the informal and formal rules and practices that govern a myriad of other critical safety-related professions, such as doctors, nurses, police officers, and fire department personnel who also operate around the clock highlight that successful fatigue management takes diverse forms. Nor is there any basis for the FAA's conclusion that "the proposal is sufficiently flexible to accommodate the vast majority of operations conducted today without imposing unreasonable costs."[10] In fact, the Proposal is highly inflexible and its costs would far exceed the FAA's estimates.

As discussed in this Comment, the Proposal's "one size fits all" approach will result in unjustified burdens to industry without corresponding safety benefits. Indeed, FAA Administrator Randy Babbitt warned about the dangers of a "one size fits all" approach when discussing this very rulemaking in connection with the ARC process: "In rulemaking, not only does one size not fit all, *but it's unsafe to think that it can."*[11]

--The Proposal will inhibit the carriers' ability to respond to operational disruptions, to the detriment of the general public. Air carrier service is the product of a finely synchronized system that relies on precisely timed operations and a predictable, flexible, and readily available workforce. Flight and duty limitations as well as reserve scheduling and rest requirements are fundamental to the manner in which this system functions. The integrity of air carrier service

---

9 Rosekind, MR. *From Laboratory to Flightdeck: Promoting Operational Alertness*, In Fatigue and Duty Time Limitations – An International Review, pages 7.6-7.7. (1997).

10 75 Fed. Reg. at 55857.

11 *We Can't Regulate Professionalism,* Speech of FAA Administrator J. Randolph Babbitt to the ALPA Air Safety Forum, August 5, 2009 (emphasis added).

schedules, whether passenger or cargo, depends upon the effectiveness of the system and its ability to respond to change. When an air carrier builds a schedule and schedules crewmembers, months or years in advance of an actual flight, it cannot predict what disruptions may affect that specific flight. Major disruptions, especially weather, are constantly unfolding and the system has to react to them in real time in order to meet customers' (both passenger and cargo) needs. Although weather reports can indicate problems in certain geographic areas, it is not until a disruptive event occurs that its true magnitude and effects are known. Likewise, mechanical problems, flightcrew member illness, and unpredictable air traffic control delays can and do occur on a daily basis, and when any disruption occurs, it has the potential to cause a "domino effect" affecting not just a single aircraft, crew or carrier, but operations across the entire system. The Proposal would make it substantially more difficult for a carrier to respond to entirely common, but unpredictable schedule disruptions. This, in turn, would result in more delayed or cancelled flights, an outcome contrary to the Department's passenger protection goals. The proposed inflexible daily flight time limitation, as well as the limitation on extensions of the flight duty period to once in every 168 hours (that is not based on the maximum values, but rather scheduled FDPs), and short call reserve as duty, would, in some instances, so delay carriers from recovering their normal schedules that the traveling and shipping public would be adversely affected. Additional flights would have to be cancelled due to the logistical inability of the carrier to provide relief crews to take over affected flights. This issue is not merely one of convenience. Carriers routinely transport individuals in urgent need of medical treatment and time-sensitive items such as human organs, pharmaceuticals, and machinery, the timely delivery of which is critical to human life and U.S. commerce.

--*The Proposal would impose compliance requirements that are extremely difficult to meet and impose unjustifiable operational and economic burdens.* ATA's members object to the Proposal's restrictions on scheduling practices that have nothing to do with fatigue mitigation but that will severely harm the traveling public, carrier operations, and crewmembers. This aspect of the proposal would require a carrier to adjust its FDPs so that, system-wide, all actual duty periods equal scheduled FDPs 95% of the time. This change alone will force increases in scheduled flight times across an airline's system in order to achieve this goal, causing many flights to arrive early. This, in turn, will drive up costs for airlines making routes economically unviable and leading carriers to reduce service. Operationally it will be extremely difficult for carriers to comply with this proposal. In fact, when attempting to quantify the financial impact, ATA's financial consultants, who are acknowledged experts in the field, had to develop three different methodologies to reflect operational reality in their attempt to derive credible costs to the industry. These costs and operational challenges will harm the U.S. economy and the flying public without improving fatigue management.

According to the FAA, the actual FDP would be compared to the initial bid package schedule to include all schedule changes that occur from publication of the original bid package to the end of duty day. This measuring stick would apply even if a FDP were changed to a duration well below a limit in Table B. The NPRM does not make clear why the FAA or any other agency would be interested in whether a FDP of four hours (scheduled months ago) results in a FDP of six hours when the science based regulatory limit could be 13 hours. Preventing schedule changes that have nothing to do with fatigue ignores the dynamic operating schedule that carriers must constantly adjust in order to serve the public, ignores the required period of rest that crewmembers must receive even if the original schedule is not met, and represents an unacceptable level of regulatory intrusion with zero effect on the goal of safe pilot performance. It is the kind of rigid regulation that Administrator Babbitt cautioned against.

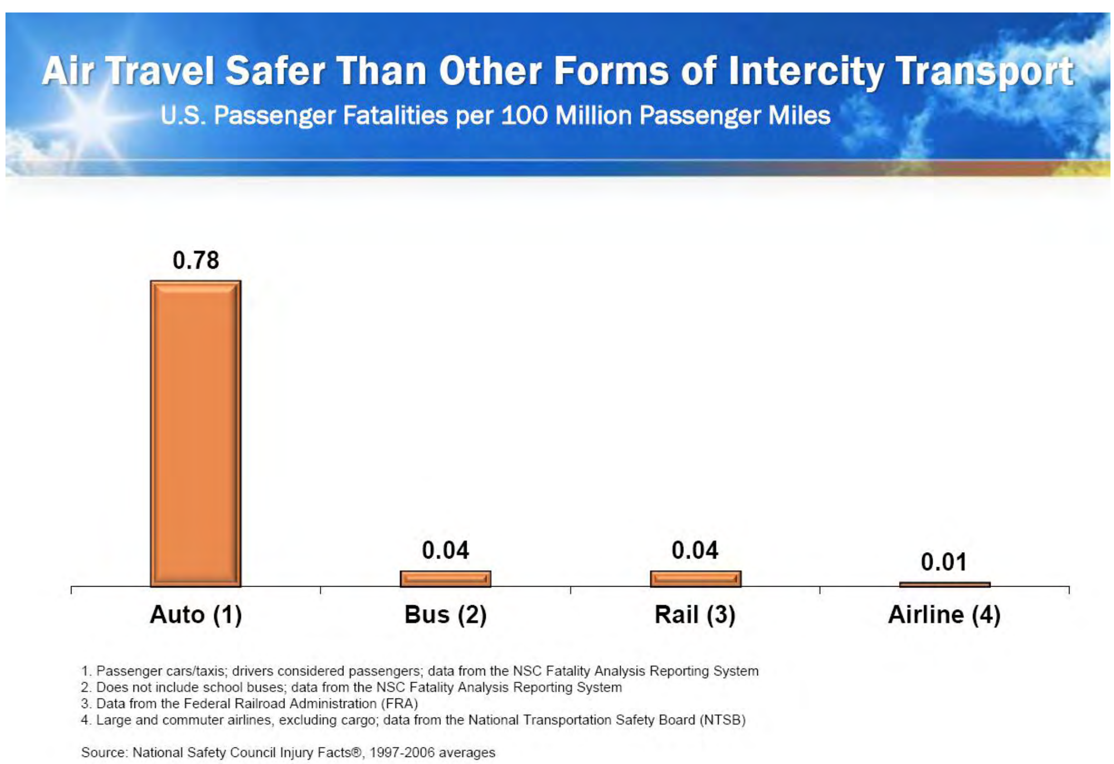
Equally unrealistic is the proposed rule that a carrier must evaluate, report, and (in the case of a negative report) immediately investigate, before a flight, whether a crew member is "*too fatigued*" to perform his or her duties. As the report from ATA's fatigue experts discusses, no scientifically validated test or measures exist that would allow carriers to reliably perform this type of evaluation.[12] Currently, it is nearly impossible to delegate a fitness for duty evaluation to anyone but each individual crewmember.

In addition, the FAA has proposed to greatly expand the definition of "duty," which, when combined with the cumulative duty limits, would require carriers to keep track of time spent by crew members performing administrative duties such as work email from home or work-related phone calls from around the globe, union activities and even studying during their time off-clearly an impossible task. Yet limiting these activities done at the discretion of managers, union representatives and crew members has little if any effect on mitigating fatigue.

--*The Proposal's cost-benefit analysis is flawed.* The FAA's Regulatory Impact Analysis (RIA) is fundamentally flawed. The potential "benefits" credited to the Proposal are exaggerated. The starting point is the U.S. commercial aviation industry's remarkable and unparalleled record:

[12] *See* Gregory Belenky, M.D. and R. Curtis Graeber, Ph.D., *Scientific Issues Regarding NPRM* (November 2010) ("Dr. Belenky and Dr. Graeber Opinion"), pages 4-5.

This is so even in relation to other modes of transportation in the U.S.:



This record is a reflection of the critical safety programs that both industry and government are committed to and in which airlines have heavily invested time and resources, including the 52 safety enhancements the Commercial Aviation Safety Team (CAST) has recommended and completed since its inception in 1998.[13] It is, therefore, disappointing that FAA's analysis of historical accidents in the NPRM is analytically flawed and contains weak and questionable conclusions. FAA's projection of future accidents that the Proposal would ostensibly mitigate fails to take into account the CAST-completed safety initiatives over the past 12 years, the resulting increased safety record, and how the operational environment has evolved since the cited accidents occurred. Simply put, the reports of many of the historical accidents relied on by FAA cite likely causes other than fatigue, and safety enhancements already in place would prevent some such accidents today. Even for the very few accidents that NTSB considered fatigue-related, this proposal fails to address the specific causes of those accidents. Thus, the FAA’s benefits analysis is inflated.

The methodology and conclusions in the "costs" portion of FAA's analysis are also defective. FAA grossly underestimated costs to the industry as a whole, especially in the areas of flight time limits, flight duty periods, schedule reliability, and schedule reprogramming costs. This is especially true because the RIA completely ignored the compounding effect of implementing this rule on top of incompatible provisions contained within existing collective bargaining agreements. In addition, consistent with its "one-size-fits-all" approach, FAA also failed to take into account the different economic impacts of the Proposal on diverse types of operators. ATA includes as Attachment 2 a detailed Economic Impact Analysis prepared by an independent consultant, Oliver Wyman (the "Economic Impact Analysis"). This analysis

[13] *See* CAST Aviation Summit Briefing, Sao Paulo, Brazil (April 19-22, 2010), http://www.mexico.icao.int/summit/Day%201%20-%20Monday/(19,%201100)%20CAST%20PA%20Summit%20Brief%20Mr.%20Kyle%20Olsen.pdf

thoroughly examined the costs and benefits attributable to the NPRM and shows why FAA's methodology and data assumptions must be rejected. Using a more exacting methodology, the Economic Impact Analysis estimates nominal costs to the industry for key provisions of the NPRM to be $19.641billion over a ten-year period.[14] This compares to the FAA's total estimated cost of the NPRM as $1.254 billion in nominal costs over a ten-year period. The Economic Impact Analysis did not attempt to estimate costs of all aspects of the entire NPRM but only specific key provisions of it. As shown by this analysis, the imposition of the Proposal would result in exorbitant costs to the air carriers—more than *fifteen times* greater than those projected by the FAA.

For example, one key provision of the NPRM, the classification of short call reserve as "duty," will result in an estimated nominal cost to carriers of $83 million per year.[15] This will be true even though, for the reasons discussed below, the classification is redundant to other mitigations contained in the NPRM and will not, as a practical or scientific matter, reduce crewmember fatigue. Tellingly, the RIA performed by the FAA did not even attempt to estimate the costs of this classification in its economic analysis. Consequently, the RIA as drafted does not satisfy the standards set forth in Executive Order 12866 and is otherwise insufficient to inform the public about the costs and benefits of the proposed rule.

--*The Proposal is inconsistent with leading international standards.* Although FAA claims it considered leading international standards governing crew duty and rest, such as the United Kingdom's CAP-371 and European Union ("EU") Subpart Q, what FAA actually did was selectively adopt concepts from those standards and then add its own prescriptive requirements—over and above those in the international standards—without justifying those

---

[14] *See* Oliver Wyman, *Economic Impact Analysis of Flightcrew Member Duty and Rest Requirements* (November 2010), page ES-1.

[15] *See* Economic Impact Analysis page 56.

additional requirements by reference to incremental expected benefits. For example, CAP-371 and EU Subpart Q, like the Proposal, contain daily FDP limitations. Unlike the Proposal, however, neither regulation contains daily flight time limitations. This is for good reason: existing science does not support the imposition of daily flight time limits in a FDP-based regulatory scheme. Imposing such limits, as the FAA proposes to do here, is unreasonable and analytically unsound, as discussed below.

--*The Proposal is contrary to the purpose of airline deregulation.* Congress passed the Airline Deregulation Act of 1978 with a clear directive to airlines and entrepreneurs to innovate and devise new business and operational models for air transportation for the benefit of the public. They responded, and the decades since deregulation have been marked by the creation of entirely new enterprises offering low cost passenger airlines, large international passenger network airlines, regional passenger airlines, small package carriers, cargo and supply chain management operators, on-call passenger and cargo operators, and civilian military airlift operators. During this period, by any metric, the U.S. aviation safety record consistently and dramatically improved. This commercial accomplishment required the investment of billions of dollars, most injected directly into the U.S. economy, to purchase and upgrade airplanes, facilities, and to hire and train hundreds of thousands of employees.

The NPRM seeks to turn back time by ignoring the diverse and vibrant operations of U.S. carriers. If imposed, the NPRM will burden various types of operators, penalizing them substantially for having different business models and putting the U.S. industry as a whole at a competitive disadvantage with the rest of the world without improving upon the safety standards we all consider our top priority.

--*The Proposal puts U.S. carriers at a substantial competitive disadvantage compared to foreign carriers without adding to safety.* Aspects of the Proposal will put U.S. carriers at a competitive disadvantage by subjecting them to restrictions that the FAA has not shown to advance safety or are overly restrictive and which foreign carriers do not have to meet. One example of such a restriction is the proposed daily flight time limit imposed on U.S. carriers in addition to daily FDP limits. Approximately 54.3% of the revenue passenger miles operated between the U.S. and foreign destinations are conducted by non-U.S. operators that are not subject to daily flight time limits. Carriers not subject to the Proposal and its unwarranted provisions such as the daily flight time limit would have a substantial competitive advantage over U.S. carriers, an outcome wholly at odds with the Administration's aim of U.S. export growth directed at international aviation, one of the few areas of the U.S. economy that at least today enjoys a trade surplus. The FAA should not impose a more restrictive regime on U.S. carriers than applies to foreign carriers, especially where, as here, the FAA has failed to substantiate various highly restrictive aspects of the Proposal, such as daily flight time limits, with science or a credible cost-benefit analysis.

In addition, the NPRM disregards the vast differences between cargo and passenger operations outside of the U.S. stemming from open skies agreements and unique fifth and seventh freedom traffic rights that the U.S. Departments of Transportation and State fought for years to obtain. The Proposal would nullify these rights by crippling many fifth and seventh freedom operations, which are a growth area for U.S. carriers.[16] In short, the Proposal substantially harms the competitive interests of U.S. carriers and, therefore, the public interest as a whole. It does so by imposing unduly burdensome requirements on U.S. carriers that the FAA has not shown will have any fatigue mitigation benefits beyond its core FDP, cumulative FDP and minimum rest requirement proposals.

[16] The "fifth freedom" of the air is "[t]he right to *enplane traffic at one foreign point and deplane it in another foreign point as part of continuous operation also serving the airline's homeland*." "Seventh freedom" of the air refers to "airlines *operating turn around service and carrying traffic between points in two foreign countries without serving its home country.*" U.S. Department of Transportation, *Freedom Rights*, http://ostpxweb.dot.gov/aviation/Data/freedoms.htm (emphasis in original).

--*The Proposal imposes unsupported prescriptive measures rather than focusing on the goal of fatigue mitigation.* The present Proposal is overly intrusive in areas typically handled through the collective bargaining process. For example, the NPRM's definition of "duty" as including short call reserve is both counter-intuitive and not central to the goal of fatigue management against the backdrop of core proposals. As explained above, ATA carriers and their crewmembers have worked for years in the context of collective bargaining and developed complex scheduling systems and fatigue mitigation strategies that successfully accommodate both operational requirements and favorable work rules, yielding the safest aviation system in the world. Short call reserve as duty has never been a component used in any of these systems. Without any supporting science or data, the FAA now proposes unsupported prescriptive measures that will not increase safety.

--*The net effect of the Proposal is redundancy and overregulation.* The NPRM proposes multiple redundant measures that are unjustified and unduly burdensome. The centerpiece of the Proposal's approach to fatigue mitigation is daily and cumulative FDP limits combined with robust rest requirements, central concepts with which ATA members agree. If these measures are adopted, additional measures such as daily flight time limits, restrictions on the number of permissible exceptions to the scheduled flight duty period, treating short call reserve as "duty" for purposes of cumulative duty limitations, and schedule reliability limits based on scheduled (not maximum) FDPs will not enhance fatigue management and thus are redundant. The law does not countenance informal rulemaking where, as here, an agency disregards fundamental tenets of procedure.

* * * *

Working under a tightly compressed schedule resulting from the FAA's unreasonable refusal to grant an extension of the comment period for a Proposal of this magnitude, ATA and its member carriers have devoted substantial time and resources to reviewing the NPRM and its effects on the commercial aviation industry. The unavoidable conclusion is that the NPRM is riddled with substantive, analytical flaws, departs from science-based principles and imposes substantial costs on air carriers, their employees and shareholders, as well as the traveling and shipping public. Many of its proposals have no safety benefit. The FAA should issue a Supplemental Notice of Proposed Rulemaking eliminating those items not scientifically based and a new RIA, and allow interested parties a meaningful opportunity to comment on both.

II. The FAA's Analysis is Flawed and Does Not Support Imposing Provisions That Will Not Positively Impact Fatigue Mitigation Strategies

As a preliminary matter, it is important to note that the basic premises underpinning the Proposal are flawed. In its "Statement of the Problem," the FAA asserts that current regulations do not adequately address fatigue. It then references, as support for this Proposal, the NTSB Most Wanted List of Transportation Safety Improvements, two NTSB accident investigations, and a series of scientific reports that the agency claims support the Proposal's rules regarding rest, consecutive nighttime operations, and cumulative duty limits. ATA does not disagree that the current regulations can be improved. However, the sum of these sources and the FAA's analysis of them does not support or justify this Proposal. In fact, a number of highly prescriptive aspects of the NPRM bear no relation to the NTSB recommendations or studies cited by FAA.

A. NTSB Recommendations

As a basis for the Proposal, the FAA cites the NTSB Most Wanted List for Aviation, which lists three objectives:

- Set working hour limits for flight crews, aviation mechanics, and air traffic controllers based on fatigue research, circadian rhythms, and sleep and rest requirements;
- Develop a fatigue awareness and countermeasures training program for controllers and those who schedule them for duty; and

- Develop guidance for operators to establish fatigue management systems, including a methodology that will continually assess the effectiveness of these systems.

Of these objectives, the second is not relevant to the Proposal and the third relates generally to the concept of FRMS, which ATA members support in principle. The first objective listed appears to be directly on point with core aspects of the Proposal. This objective asks the FAA to base working hour limits on *fatigue research*. Thus, to the extent that the NPRM is not based on fatigue research—and important parts of it are not, as discussed extensively below—the FAA has departed from this objective.

The agency also relies on two Safety Recommendations contained on the NTSB Most Wanted List. Examination of the accidents that lead to these recommendations reveals that the FAA's reliance on these recommendations as bases for the Proposal is highly problematic and unreasonable. The first recommendation, A-06-10 (FAA), states:

> Modify and simplify the flight crew hours-of-service regulations to take into consideration 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.

(Emphasis added.) This recommendation stems from a 2004 accident in Kirksville, Missouri. The NTSB found that the primary cause of this accident was:

> [T]he pilots' *failure to follow established procedures and properly conduct a nonprecision instrument approach at night in IMC*, including their descent below the minimum descent altitude (MDA) before required visual cues were available (which continued unmoderated until the airplane struck the trees) and *their failure to adhere to the established division of duties* between the flying and nonflying (monitoring) pilot.

(Emphasis added.) Thus, the NTSB did not find fatigue to be a primary cause of the accident. The aircraft involved was equipped with a Ground Proximity Warning System, which provided a "sink rate" warning about 3 seconds before initial impact. The NTSB observed that, had an

Enhanced Ground Proximity Warning System (EGPWS) been installed in the aircraft, it would have provided a “too low terrain” alert about ten seconds before impact and would have repeated this alert every three seconds until the descent profile was corrected. The NTSB concluded that "an EGPWS (required by Federal regulation since March 29, 2005), would have provided the pilots with a 'too low terrain' alert in sufficient time to avoid collision with the trees."

In reviewing the facts of this accident, it is clear that, had the aircraft been equipped with the latest ground proximity warning equipment, this accident would not have happened. The FAA now requires EGPWS to be installed on such aircraft. Accordingly, it is inappropriate and unreasonable to rely on this accident to justify new prescriptive rules governing pilot flight and duty time.

The second recommendation FAA cites is A-95-113 (FAA), which states:

> Finalize the review of current flight and duty time regulations and revise the regulations, as necessary, within 1 year to ensure that flight and duty time limitations *take into consideration research findings in fatigue and sleep issues*. The new regulations should prohibit air carriers from assigning flight crews to flights conducted under 14 CFR Part 91 unless the flight crews meet the flight and duty time limitations of 14 CFR Part 121 or other appropriate regulations.

(Emphasis added.) This recommendation comes from a 1995 accident in Kansas City, Missouri. While the NTSB found several probable causes for this accident, including fatigue, this was a part 91 flight. As stated earlier ATA members support application of flight and duty time limits to certificate holder part 91 flights. We also note the NTSB recommends that finalized flight and duty regulations take into account research findings in fatigue and sleep issues.

Thus, neither of the FAA-cited accidents were primarily caused by fatigue. One would have been prevented by current equipment requirements and the second would be prevented by application of flight and duty rules to part 91 flights, which we support.

B. Research Findings and Scientific Studies

In addition to the NTSB recommendations discussed above, as support for the Proposal the FAA has referenced general fatigue philosophies for basic propositions. The agency has failed to provide any nexus between these general points and the very specific and prescriptive provisions in the NPRM. The FAA cites scientific studies in a few areas to support very general points. These points include:

- On average a person needs additional sleep to recover from a sleep debt;[17]
- Several factors can affect sleep;[18]
- Daytime sleeping is not ideal;[19] and
- Additional rest will be needed for long trips crossing many time zones;[20]

These basic points are highly generalized. Extracting specific rules from them to govern human behavior by highly trained professionals, such as setting forth the discrete quantum of time required for sleep or determining the optimum physical characteristics of a rest facility, then placing further restrictions on them by mandating use of "scheduled" rather than "maximum" numbers is not defendable.

Nevertheless, the FAA relies on these general points as a basis for the NPRM. Although it relies on them, the FAA does not attempt to explain how these non-specific principles relate to the very specific and prescriptive provisions in the Proposal. The FAA cites no scientific studies in its description of Flight Duty Period limits (including schedule reliability), Acclimating to a New Time Zone, Daily Flight Time Restrictions, Reserve Duty, Fatigue Risk Management Systems, Commuting, or Exceptions for Emergency and Government Sponsored Operations.

---

[17] 75 Fed. Reg. at 55855, n.13; 75 Fed. Reg. at 55871, n.42.

[18] *Id.* at n.14.

[19] *Id.* at n.34.

[20] *Id.* at n.44-49.

And, even where scientific studies are cited in other sections of the NPRM, they are used to support the very general points described above, not the very specific provisions in the Proposal.

This lack of analytical rigor is troubling. Even the FAA states in the RIA that it is based "on the FAA safety effectiveness assessment for this proposed rule to prevent pilot fatigue accidents . . . ."[21] The RIA baldly states that the FAA's "rule requirements began with the recommendation from labor and industry and we then applied fatigue science to maximize benefits relative to costs."[22] However, the FAA makes no attempt in the RIA or elsewhere in the Proposal to tie each regulatory proposal to specific recommendations. The FAA has failed to justify the very specific provisions of the NPRM. The agency's reliance on very general concepts with additional restrictions that are insufficient to support the Proposal is unreasonable and legally deficient.

III. ATA's Members Object to the Many Aspects of the Proposal that are Arbitrary, Not Science-Based, Operationally Unsound, or Otherwise Defective

A. Inflexible Daily Flight Time Restrictions [Section 117.13]

ATA members strongly object to the proposal that would preclude a crewmember from accepting or continuing a flight if the total flight time would exceed an inflexible daily limit. The FAA has stated that the limits set forth in Table A of the NPRM "are intended to be firm limits that will not be exceeded except in emergency circumstances."[23] No scientific or safety basis exists for these restrictions and they are inconsistent with safe industry experience. Imposing hard daily flight time limits results in an unjustifiable burden with no added safety

[21] FAA, *Regulatory Impact Analysis, Flightcrew Member Duty and Rest Requirements, Docket No. FAA-2009-1093*, at p. 1 (Sept. 3, 2010) ("RIA").

[22] *Id.*

[23] FAA, *Response to Clarifying Questions, 14 C.F.R. parts 117 and 121, Flightcrew Member and Duty Rest Requirements; Proposed Rule, Docket No. FAA-2009-1093*, at p. 10 (Oct. 22, 2010) ("Response to Clarifying Questions").

benefit in light of the NPRM's other provisions. The proposal is arbitrary, inconsistent with leading international standards, operationally unwieldy, unduly burdensome to carriers, and against the public interest.

Restricting daily flight time in addition to FDP and rest requirements is redundant and antithetical to the NPRM's FDP-based scheme. The FDP limits and rest requirements alone are sufficient to mitigate fatigue. By taking into account circadian rhythms and time on task, the FDP tables reflect a science-based strategy for fatigue mitigation. In contrast, daily flight time limits, especially layered on FDP and a host of other rest requirements, are a throwback to legacy rules and reflect unwarranted political considerations. The FDP encompasses flight time, and, therefore, flight time will be limited through the FDP restrictions. Daily flight time will also be limited indirectly through the NPRM's rest requirements because, before starting a flight duty period, crewmembers will be required to have a rest opportunity during which they will not be flying.

By definition, the FDP assumes that crew members will spend a portion of the FDP engaged in non-flying activities necessary to preparing for a flight. As the FAA notes, flight time would be effectively limited to approximately two hours less than the FDP.[24] As a result, an examination of the values in Table B of the NPRM reveals that, under the Proposal, for some FDPs the total flight time will end up being somewhat less than the maximum allowed today, while for other FDPs, the total flight time could be somewhat more. Fatigue mitigation for such trips would be sufficiently addressed by the daily FDP limit and the requirement that crewmembers be rested before beginning the FDP.

Indeed, in contrast with the current regulatory scheme, under the Proposal crew members will spend *less* time on duty. Under the current rules, a pilot can spend up to sixteen hours on

[24] *See* 75 Fed. Reg. at 55862.

duty in any twenty-four hour period. The maximum daily FDP limits for unaugmented operations are all less than sixteen hours, some substantially less, as are the FDP limits for most augmented operations. During night hours, the FDP limits are even lower than the most restrictive international standards, which again is not based on science. As discussed in the report from ATA's fatigue experts, reported scientific analysis does not support the idea that flight time should be treated differently from duty time, except perhaps with respect to workload.[25] In the commercial aviation context, workload is thought of primarily in terms of the number of segments flown. Because FDP limits take into account the number of segments flown, as well as circadian timing, no science-based rationale supports imposing daily limits on flight time in addition to the Table B or Table C FDP limits in the NPRM.

The FAA has not provided a reasonable explanation or credible quantification of the incremental benefits of its proposal to impose daily flight time restrictions in addition to FDP and other provisions of the NPRM. Instead, without reference to any scientific study analysis, the FAA states that it decided to "propose a variation" of the "more conservative" flight time limits suggested by the labor representatives to the ARC.[26] This is not a reasonable science-based justification; it is political posturing. The FAA noted that it has a limited ability to evaluate the impact of longer flight time limits and that it may be possible to demonstrate that longer flight time limits would not adversely affect safety.[27] These statements disregard the scientific information presented by experts during the ARC process, as well as the fact that carriers operating under CAP-371 and EU-OPS Subpart Q demonstrate thousands of times each day that flights are completed safely without the need for daily flight time limits.

---

[25] *See* Dr. Belenky and Dr. Graeber Opinion page 6.

[26] 75 Fed. Reg. at 55863.

[27] *Id.*

The Proposal stands in direct contrast to international regulations based on daily FDP restrictions. As the FAA itself admits, "[o]ther jurisdictions have largely eliminated the concept of a uniform flight time in favor of a variable FDP that encompasses flight time but also includes other duties directly related to flight."[28] The UK's CAP-371, first published in April 1975 and most recently amended in 2004, implements a maximum FDP of 13 hours without a daily limitation on flight time.[29] Similarly, EU-OPS Subpart Q imposes a maximum daily flight duty period of 13 hours without restricting daily flight time.[30] These standards demonstrate that daily flight time restrictions are not necessary to mitigate fatigue in a regulatory framework centered on FDP limitations. Moreover, carriers subject to these standards will have a competitive advantage over U.S. carriers if the NPRM is imposed, with no safety benefit to justify this result.[31]

The FAA has not articulated what value an inflexible daily flight time restriction adds to the core FDP standard, cumulative FDP limits and minimum rest requirements-measures with which ATA members agree, but it is clear that the adverse consequences of the daily flight time restriction aspect of the proposal are substantial. First, it gives rise to serious practical scheduling problems for carriers on a daily basis because it *allows no exceedances of any kind, of however small duration, from the daily limits* except in the event of an emergency. Therefore, if this aspect of the Proposal is made final, carriers will be unable to schedule crews to the maximum limits in Table A to the NPRM. Instead, carriers will be forced to add substantial buffers to each schedule, as well as extra crew members on reserve or as relief pilots, in order to ensure their operations will continue to function in compliance with the inflexible daily limits.

---

[28] 75 Fed. Reg. at 55859.

[29] United Kingdom Civil Aviation Authority, The Avoidance of Fatigue in Aircrews: Guide to Requirements (CAP 371), at 8-9 (Jan. 2004).

[30] Council Regulation (EC) No. 1899/2006 of 12 December 2006, Annex III, Subpart Q, 2006 O.J. (L377) 163.

[31] *See infra* Section III(F)

This necessary operational adjustment will add inefficiency and unjustified costs to the carriers' operations merely to meet regulatory requirements without a genuine safety justification.

In addition, even with such buffers built into schedules, the likelihood that trips will be cancelled will increase under a regime with hard daily flight time limits as compared to one without them. Under the proposal, if any unforeseen event takes place—including one as seemingly benign as unexpected headwinds encountered on one leg —a crew could be placed in jeopardy of timing out, being unable to fly an additional leg, and thereafter leaving aircraft, passengers, and cargo stranded. Downline passengers and shippers who depend on the availability of that aircraft and/or crew also would be caught up in this disruption. In addition, during unforeseen events, carriers will not have notice sufficient to preposition relief crewmembers or the time or ability to fly in crews to continue a flight. The result will be more flight cancellations, a result at odds with DOT's goal to minimize such cancellations. Ground and ATC delays would similarly cause more cancellations than exist today were this aspect of the Proposal made final.

This aspect of the Proposal would also substantially interfere with carriers' ability to recover from unscheduled disruptive events. If a long-haul flight is required to divert, or a serious weather event takes place, the proposal's inflexible daily flight time restriction will be a substantial hindrance to the completion of the flight or resuming normal scheduled operations. A hypothetical example is a flight from DUB to JFK that has to divert to Allentown, PA (ABE) after holding for two hours. ABE would have limited ability to handle international passengers. Under the proposal, the pilots most likely would exceed the flight time limits on ground at ABE and would not be able to depart. It will take 3-4 hours minimum to drive a crew to ABE to fly the airplane to JFK. Such results are not in the public interest. The U.S. public interest will be doubly harmed where, in the aftermath of an unforeseeable event, such as a snowstorm, non-U.S.

carriers subject to regulations like CAP-371 will be able to resume operations while U.S. carriers remain grounded due to the proposal's inflexible flight time limits.

The Economic Impact Analysis submitted by ATA quantifies the substantial cost impacts to its members of the proposed daily flight time limits. It examines the costs that will result from the proposed rule in connection with building buffers into schedules, adding crew members, and of recovering from operational disruptions. The analysis shows that the FAA's methodology in estimating costs was materially flawed in at least two respects: it grossly underestimated hourly pilot costs and did not take into account any potential flight cancellations. Applying a methodology more exacting than that applied by the FAA, the Economic Impact Analysis concludes that the total annual cost to the industry of complying with the flight time limit is $428 million.[32] These impacts, although expressed as costs to air carriers, will largely be borne by members of the public in terms of flight delays and cancellations, resulting in lost time to passengers, reduction in the quantity and variety of service and higher fares. Indeed, the Oliver Wyman analysis estimates that the direct annual cost of this proposal to passengers is $153 million.[33]

For the reasons discussed above, the proposal is inflexible, inconsistent with the purpose and effect of a FDP-based scheme, not supported by leading international standards and would cause substantial burdens on the industry and the public. As leading experts state, limitations on maximum FDP and minimum rest requirements work hand-in-hand to fully address the causes of pilot fatigue, and no need exists to promulgate limitations on the amount of flight time within the prescribed FDP. The FAA should eliminate this provision. If the FAA nevertheless includes daily flight time limits in the final rule, then ATA and its members, without waiving their rights

[32] See Economic Impact Analysis page 37.

[33] *Id*.

to challenge the final rule, recommend that the FAA allow for a minimum degree of operational flexibility by making the flight time limit a scheduling restriction only. If carriers were allowed to schedule to the flight time limits but then exceed them due to circumstances beyond their control, then some, but not all, of the burdens and costs flowing from the rule would be reduced. The other provisions of Part 117, including the caps on daily FDP, rest requirements, training, and augmentation rules, would more than suffice to address crewmember fatigue if this change were made.

B. Limitations On Extensions Of The Flight Duty Period [Sections 117.15(c)(2) and 117.19(f)(2)]

ATA members object to various proposed limitations on extensions to the flight duty period. The NPRM limits extensions to FDP available beyond scheduled FDP, even where actual FDP does not exceed the maximums set forth in Tables B and C.[34] The comparison of actual versus scheduled FDP is immaterial for purposes of fatigue mitigation or safety. The Proposal's limitation on FDP extensions beyond scheduled times is unreasonable. It also deviates from international standards such as CAP-371 and EU Subpart Q, which evaluate FDP extensions in relation to maximum limits, not the scheduled FDP. These and other aspects of the proposed limitations on FDP extensions are arbitrary and would result in substantial unjustified burdens to carriers.

The NPRM limits FDP extensions exceeding thirty minutes to once in any consecutive 168 hour period, based on what the flightcrew member was scheduled, even though that FDP may be substantially below the Table B or C limits. ATA members strongly object to this limitation because it is overly restrictive, not supported by science, and will result in undue burden and cost. 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

[34] *See* FAA Response to Clarifying Questions page 13.

impacts. Moreover, as discussed in the report submitted by ATA's fatigue experts, no scientific evidence supports restricting extensions of greater than thirty minutes to once in 168 hours.[35]

If fatigue is deemed sufficiently mitigated by a maximum FDP, then it is sufficiently mitigated, regardless of whether the FDP was originally scheduled to the maximum or ended up reaching that maximum as a result of rescheduling. The ARC never discussed the concept of an exceedance of actual over scheduled FDP counting as an "extension" where the daily FDP maximum is not met. This was for good reason, because restricting exceedances of actual over scheduled FDP does not make sense from a fatigue mitigation standpoint. Indeed, the absence of similar requirements in FDP-based regulations from the UK and EU will place U.S. carriers at a competitive disadvantage compared to carriers subject to those rules as a result of higher costs to U.S. carriers arising from the need to buffer their schedules as well as potentially poor customer service due to cancellations. This proposal is unduly burdensome because, as the FAA knows, the rescheduling of crewmembers is commonplace. Under these provisions, carriers would be penalized for routine rescheduling that has little to no adverse impact on a pilot's fitness for duty. This proposal will result in substantial unjustified costs to carriers, as described in ATA's accompanying Economic Impact Analysis. In its Response to Clarifying Questions, the FAA admitted that it did not consider this circumstance and "seeks input on whether that should be allowed, and if so, with how much advance notice."[36] ATA members strongly object to restrictions of any kind on extensions of the scheduled FDP that would not exceed the applicable FDP limits.

The proposal will also lead to nonsensical results. For example, at the conclusion of an extended FDP a crewmember could have numerous days off. If the crewmember returns to work

---

[35] *See* Dr. Belenky and Dr. Graeber Opinion page 2.

[36] *See* Response to Clarifying Questions Page 13.

within seven days of the conclusion of the previous FDP, that crewmember will be unable to work another FDP that is extended by more than thirty minutes, even if he or she spent the bulk of the previous five days resting.[37]

That such a restrictive version of extensions is not founded in science is clear, as DOT FMCSA rules permit significantly more generous duty time extensions based on weather and emergencies for truck drivers.

The proposed limitations on extensions also disregard operational reality. To achieve a minimum degree of operational robustness, it is essential that carriers be permitted to extend the FDP more than once every seven days, and that those extensions be defined as exceedances to the maximum FDP limits of Tables B and C, and not the scheduled FDP. Such extensions would be especially necessary for recovery purposes during major disruptions from occurrences such as weather events, as well as more unusual situations such as volcanic activity, ATC strikes (internationally), and national crises (such as restoring air transportation after the September 11, 2001 attacks). If imposed, the proposal would reduce the availability of crew members to complete flights during the recovery period. Substantial delays in the resumption of normal service after such an event would result, to the detriment of the public interest.

ATA members also object because the NPRM does not permit extensions of greater than thirty minutes to the scheduled FDP for unaugmented operations on consecutive days in certain circumstances. Like the "once in 168 hours" rule, this proposal does not take into account operational reality. Rational carrier response to this aspect of the Proposal would include cancelling flights to comply with the rule, which in turn leads to downline cancellations. During a pairing assignment, flight crews are typically in spoke stations (or, for some carriers, overseas)

---

[37] The NPRM contains three instances where a limitation within a 168-hour period yields nonsensical results where a crewmember receives sufficient rest during the 168-hour period. These are the limitations on extensions to FDP (§117.15(c)(2) and §117.19(f)(2)); the reduction in rest period (§117.25(c)); and the shifting of reserve availability period (§117.21(e)(4)).

and geographically distant from the possibility of a reserve assignment. Application of this rule, if made final in its current form, within a single pairing would leave carriers little choice but to cancel flights. These cancellations could become all too common, and will directly harm the flying public. The following is an example of how a seemingly innocuous series of circumstances would result in adverse consequences to the public:

> A crew is scheduled for a 10:00 FDP, DFW-SEA-DFW (two 4:00 legs with an hour on the ground in SEA and a one hour sign-in). The First Officer has had one previous extension of FDP by more than 30 minutes this week, a 6:00 FDP extended to 6:45; he has had three days off since then. Due to ATC delays in SEA, the first leg gets in 25 minutes late. The start time of the return flight is pushed back 25 minutes. The aircraft is loaded and pushes off the gate. But, ground delays on taxiing out have added 10 minutes to the expected arrival time in DFW. The First Officer is now illegal to go on because the flight would result in a second FDP extension beyond 30 minutes in the past 168 hours. The aircraft must return to the gate. Because there are no reserves in SEA, the flight has to be cancelled and the unhappy passengers have to be put up in a hotel for the night.

Complying with the rule over the course of multiple pairings during the proposed 168 hours would impose an overwhelming financial burden on U.S. carriers. If the 30 minutes were impinged on the first pairing, air carriers would naturally be reluctant to maintain that flight crewmember's assignment over the balance of the 168 hours, and of course the FAA proposes to prohibit such extensions on consecutive days, both leading to devastating scheduling impacts.

Limitations on extension of the flight duty period would also severely hamper the ability of carriers to recover from major service disruptions. This limitation in conjunction with other parts of the NPRM also has the potential to cause unintended consequences with substantial adverse impacts. The following is an example of a commonly occurring situation in which such unintended and costly impacts may take place:

> A flight crew on a multi-day trip encounters an ATC delay on Day One, and uses their FDP extension to make service. Because the last flight of the first day arrives late, the crew is late in arriving at their hotel. To ensure the crew get sufficient rest, their report time

> for Day Two is changed. If this change puts the crew into a band of the FDP table with a maximum FDP that is lower than that for which they were originally scheduled, the crew would not be able to fly their entire Day Two FDP. Because no consecutive extensions would be allowed, the last leg of the day would cancel, even though the crew had sufficient rest before starting the Day Two FDP.[38]

Due to the dynamic nature of how FDP periods may vary based on report time, which itself can vary based on rest opportunity, extensions are necessary for maintaining operational robustness. As the fatigue scientists stated, there is no scientific basis for 1 extension per 168 hours, therefore carriers should be allowed to use three extensions to the maximum FDP limits per 168 hours on nonconsecutive days. We also urge the FAA to clarify that "consecutive days" does not include a scenario described above, where the crewmember has at least 30 consecutive hours free from all duty between FDPs.[39] In other words, a pilot that has an extension over 30 minutes on Monday but then does not start a FDP until Thursday could have an extension on Thursday without it being considered an extension on "consecutive days."

ATA members also object to the FAA's vague and ambiguous construction of the term "unforeseen circumstances" in connection with limits on FDP extensions. Even assuming that the FAA intended to use the term "unforeseen operational circumstance," which is defined in the Proposal, instead of the undefined term "unforeseen circumstances," which is used in the text of Sections 117.15(c) and 117.19(f), the FAA's vague use of the term raises concerns. The Preamble states that the Proposal's extensions to the FDP

> [A]re intended to address unforeseeable circumstances beyond the carrier's control. Such circumstances should be of sufficiently short duration that the carrier could not reasonably make schedule adjustments. Thus, while the FAA contemplates that adverse

[38] We also note this scenario would negatively impact a carrier's "schedule reliability" with *no impact* on the pilot's fatigue or safety.

[39] We note that FAA uses 30 hours as the standard for minimum weekly rest requirements. If a pilot is receiving enough rest to fulfill weekly requirements at one time, that should eliminate any concerns with consecutive extensions.

> weather could fit within the criteria because it is beyond the control of the certificate holder, it would not always be considered unforeseeable. Carriers should anticipate thunderstorms in many parts of the United States during summer months.[[40]]

Based on this construction, the FAA considers some weather events to be foreseeable and some unforeseeable, but provides no guidance for determining which is which for purposes of legally extending the FDP. This construction is vague and ambiguous because it does not provide carriers with any meaningful guidance for complying with the NPRM. As such, the proposal opens the door to arbitrary enforcement and a likely plethora of interpretations in the future.

It is also unrealistic and operationally unworkable. A carrier cannot reasonably predict in advance the magnitude of impact that a weather event or other circumstance will have on a specific scheduled flight. This is true even where a carrier may generally be able to anticipate that a flight might encounter thunderstorms, ATC delays or other generally foreseeable events that nevertheless cannot be predicted for particular flights, days, or times of day. Thus, the extent to which schedule adjustments to specific flights will be necessary will almost always be unforeseeable. The only logical meaning of the term "unforeseen circumstances" with respect to FDP extensions is "circumstances beyond the control of the carrier." ATA therefore recommends that the final rule include this definition.[41]

ATA members also object to the authority the proposal confers upon the PIC to determine whether to extend the FDP. Other parts of FARs and NPRM require crew members, including the PIC, to report when they are not fit to fly and forbid a flight from continuing if a crew member has reported that he or she is too fatigued to fly. The PIC also has emergency

[40] 75 Fed. Reg. at 55860.

[41] Moreover, the fact that the proposal limits extensions to the FDP makes its additional restriction to extensions only for "unforeseen circumstances" redundant and illogical. If the limit on extensions of the FDP fosters fatigue mitigation, then the *reason* an extension is required is irrelevant. If the FAA intends to cap FDP extensions then it should remove the "unforeseen circumstances" caveat and permit extensions up to the cap for any reason.

authority to take action in response to a safety issue.[42] This proposal is, therefore, redundant. This is true even though, in its Response to Clarifying Questions, the FAA suggests that "safety of flight must be the primary consideration" in making such decisions.[43] Because the PIC already has authority to stand down for safety reasons, this proposal is unnecessary.

ATA's expert, Oliver Wyman, analyzed the economic impacts of the Proposal's limitations on FDP extensions and concluded that limiting the number of extensions *as proposed by the NPRM* results in an estimated cost to the industry of $1.174 billion per year and to the public of $1.151 billion per year over and above a scenario where unlimited, but nonconsecutive, extensions are allowed.[44] This estimate does not include the cost to the public for cargo cancellations. Oliver Wyman also analyzed alternative scenarios where (i) two nonconsecutive extensions beyond thirty minutes are allowed and (ii) unlimited extensions are permitted. Each scenario results in a substantial reduction in flight cancellations as compared to the Proposal, along with associated cost benefits.[45]

C. Short Call Reserve as "Duty" [Section 117.21(c)]

ATA members strongly object to the Proposal's classification of short call reserve as "duty." We view this classification as inappropriate and overly restrictive. It arbitrarily disregards the reality of what short call reserve is, is not supported by science, imposes a redundant regulation unnecessary to mitigate fatigue, and would result in unjustified burdens to carriers.

Short call reserve refers to a period of time in which a crewmember does not receive a full required rest period before reporting for a flight duty period. Although the crewmember may

[42] See 121.557(a).

[43] Response to Clarifying Questions, p. 12.

[44] *See* Economic Impact Analysis page 50.

[45] As a result of the magnitude of data that must be processed in order to quantify the multifaceted impacts of this aspect of the Proposal, ATA and/or some of its members may provide additional analysis to the FAA at a later date.

not receive the minimum required rest, he or she is experiencing a normal day at home or at a hotel, similar to a lineholder. The crewmember is provided a meaningful break prior to beginning short call and sufficient notice to allow him or her to properly prepare for eligible duty. The only task a pilot has on short call reserve is to answer the phone. Otherwise, the pilot is free to do what he or she wants, and plan the day to take advantage of rest opportunities as he or she desires, just as a lineholder would. The reserve system adequately addresses fatigue mitigation for short calls through the use of reserve availability periods ("RAPs"), reserve duty periods ("RDPs") and predictability. Short call as duty is redundant and places a heavy burden on the industry with no benefit for fatigue mitigation or safety. If FAA is concerned about limiting the time a pilot spends on short call, there are ways to accomplish this without the burden of making it count toward cumulative duty limits.

The short call reserve proposal is also contrary to science. The ATA's fatigue scientists concluded that being on short call reserve is not equivalent to duty because it does not entail any significant work load.[46] A pilot on short call reserve has the same, predictable rest and sleep opportunities as a regularly scheduled lineholder. A pilot on short call reserve would be just as likely to take advantage of those opportunities and receive rest. Therefore, according to the fatigue experts, no scientific support exists for treating short call reserve equivalent to duty in terms of fatigue.

The fatigue scientists also noted a conflict between the treatment of deadheading crewmembers and those on short call reserve. The scientists note: "For deadheading pilots with adequate on board sleeping accommodations, the NPRM allows extending the cumulative duty period limitations by up to 10 hours. In contrast, short-call reserve pilots who also have adequate

---

[46] *See* Dr. Belenky and Dr. Graeber Opinion page 2.

sleep accommodations (home or hotel) are not allowed a similar extension."[47] We agree this inconsistent treatment between similarly situated crewmembers does not make sense and is another reason why the FAA should not count short call reserve as duty.

This classification is redundant due to other provisions of the NPRM, including the reserve rules agreed upon by the ARC that specifically address concerns of fatigue relating to short call reserve. Once a crewmember's stint on short call reserve begins, *i.e.*, as soon as the pilot has an obligation to answer the telephone, a clock starts running that limits the total amount of time the pilot can remain on duty: the NPRM limits the RAP to a maximum of fourteen hours.[48] In addition, a crewmember on short call reserve may not accept assignment of a FDP unless given a minimum of *fourteen hours'* rest.[49] Further, the reserve rules proposed by the ARC have the net effect of affording pilots with a large amount of predictability, thereby making it easy for them to adjust their personal activities to manage fatigue. Because these provisions are more than sufficient to mitigate fatigue, the classification of short call reserve as duty serves no safety purpose yet adds significant costs to the airlines and our customers.

The Preamble suggests that the FAA intended to address aberrant reserve policies by "some portions of the industry."[50] These types of outlying issues are more appropriately addressed through enforcement rather than burdensome rules on the industry as a whole especially where, as here, other proposals in the NPRM are sufficient to mitigate fatigue without the addition of this classification. The ARC did not recommend that short call reserve be classified as duty. In fact, the ARC did not discuss this issue at all. It appears that the FAA

---

[47] *Id*. at page 3.

[48] Proposed §117.21(c)(2), 75 Fed. Reg. at 55887.

[49] Proposed §117.21(c)(3), 75 Fed. Reg. at 55887.

[50] *Id.* n.41.

decided to propose this classification without consideration of science, the effects of other mitigations contained in the NPRM, or the costs it would impose on the industry.

The adverse impact on carriers is demonstrated by the following example. Under the portion of the proposal not agreed to by the ARC, a crewmember could spend several consecutive days at home on short call reserve. The pilot would go about his or her normal routine, sleep at night in his or her own bed, and not ever be tasked by the carrier. Nevertheless, by operation of the cumulative duty limits in proposed § 117.23, 75 Fed. Reg. at 55887, the crewmember would be required to receive additional time off before being allowed to start a FDP. As a result, the carrier would be obliged to assign the FDP that the—now very well-rested—crewmember would normally receive to another crewmember. Extrapolate this scenario across the totality of a carrier's crew and operations and the result will be substantial unjustified costs arising from the need to hire many more pilots to cover flights, all with zero effect on fatigue.

The analysis performed by Oliver Wyman demonstrates the magnitude by which this proposal will lead to increased costs. The Economic Impact Analysis examined the impacts of the classification in two respects: (i) impacts arising from reduced operational flexibility, the addition of new pilots, and increased costs of operational pairings; and (ii) impact arising from short call time being counted toward the NPRM's cumulative duty limits. The total estimated annual carrier cost arising from both categories of impacts is $83 million.[51] These substantial costs are driven by the FAA's unjustified classification of short call reserve as duty. We urge the FAA to withdraw this aspect of the Proposal.[52]

---

[51] *See* Economic Impact Analysis page 56.

[52] The impact resulting from the need for carriers to hire more pilots to comply with this and other aspects of the Proposal should not be underestimated. Not only will the substantially increased headcounts necessitated by the Proposal result in substantially increased costs for salary and benefits for flight crew, other impacts include the

(continued…)

The FAA also added a proposal to the rules governing short call reserve that the ARC never discussed, but which represents a significant material deviation from the ARC recommendation. Specifically, the FAA inserted proposed §117.21(c)(4)(ii), 75 Fed. Reg. at 55887, which adds the assigned FDP as an alternative for determining the maximum allowed reserve duty period. Section 117(c)(4) states that the maximum reserve duty period shall be the lesser of the alternatives listed. Because this new provision is the most limiting of the alternatives set forth in proposed §117.21(c)(4), 75 Fed. Reg. at 55887, it results in a restriction that the ARC never considered or recommended. Moreover, 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.[53] ATA asked for clarification on this section during the question period and did not receive an answer. For these reasons and because the FAA does not attempt to justify it, §117.21(c)(4)(ii), should not be adopted.

D. Schedule Reliability [Section 117.9]

The NPRM's "schedule reliability" requirements for FDP monitoring, schedule adjustment and reporting are unrelated to fatigue mitigation and will impose substantial unjustified costs on carriers. ATA's members strongly object to this proposal.

Neither the proposed requirement that system-wide actual FDPs meet scheduled FDPs 95% of the time nor the proposed 80% reliability requirement for each specific FDP would do anything to mitigate transient, cumulative or chronic fatigue. This is because, against the backdrop of other limitations in FDP and rest rules, the extent of any deviation between actual and scheduled FDP is irrelevant to pilot fatigue. No reason exists to anticipate that a

(continued…)

difficulty in finding sufficient pilots to hire from a limited pool of applicants, and the costs of providing training and retraining as appropriate.

[53] *See* proposed §117.3, 75 Fed. Reg. at 55884.

crewmember will experience added fatigue so long as the daily FDP limit is not exceeded, even if the schedule is not accurate. In other words, even if a flight arrives later than the scheduled time, so long as the pilot does not exceed the FDP limit for the day (and received required rest before starting the next FDP), then how closely the actual FDP corresponds to the scheduled FDP is immaterial to whether the pilot will be fatigued.

The existing mitigations in the NPRM, particularly the daily FDP limits and the restriction on FDP extensions to no greater than two hours, are sufficient to address any legitimate fatigue-based concern that underpins the "schedule reliability" proposal. Were the NPRM to be imposed, carriers would adjust pairings as a matter of course to ensure that they do not violate the daily FDP maximums and limits on FDP extensions. Carriers would also ensure that each pilot receives the required rest opportunity as proposed. Therefore, none of the requirements in proposed Section 117.9 are necessary for fatigue mitigation. Assuming that the FAA's proposed maximum FDP limits are accurate barometers for fatigue, the only metric that could arguably relate to fatigue, and thereby be of potential value, is a comparison of scheduled FDP with maximum FDP plus permitted extensions. The proposed "schedule reliability" rule is another example of the redundant overregulation that is in the NPRM.[54] The schedule reliability proposal also disregards how the industry functions. Carriers do not have incentives to miss their schedules. Quite the opposite is true. For example, ATA estimates direct aircraft operating costs for scheduled U.S. passenger airlines in 2009 was nearly $6.1 billion, which is based on more than 100 million system delay minutes.[55] The cost of aircraft block (taxi plus airborne) time

[54] It also has the unintended consequence of increasing the potential for pilot fatigue. This is because carriers will have to schedule longer FDPs to ensure that they will meet the 95% reliability requirement. The longer FDPs will, in some cases, cause crew members to have less time in which they are free from duty.

[55] This estimate does not include additional costs. Delayed aircraft also drive the need for extra gates and ground personnel and impose costs on airline customers (including shippers) in the form of lost productivity, wages and goodwill. Assuming $37.56 per hour as the average value of a passenger's time, 2009 delays are estimated to have cost air travelers over $3.3 billion.

was $60.99 per minute, [56] which includes fuel costs of $24.90 per minute, crew costs of $14.60 per minute, followed by maintenance and aircraft ownership ($10.82 and $8.23, respectively) and all other costs ($2.44):

Calendar Year 2009	Direct Aircraft Operating Cost per Block Minute	2009 Delay Costs ($ millions)
Fuel	$24.90	$2,501
Crew - Pilots/Flight Attendants	14.60	1,467
Maintenance	10.82	1,087
Aircraft Ownership	8.23	827
Other	2.44	245
Total DOCs	**$60.99**	**$6,126**

However, the nature of the business is such that carriers cannot predict with perfect accuracy when flights will arrive due to dynamic factors, most beyond the carrier's control, that affect each flight. Some factors, like ATC delays, are largely in FAA's control. The proposal also disregards the nature of operations. Carriers currently do not schedule at a reliability level of 95%. To achieve that level of reliability would be extremely difficult and expensive, and would lead to a variety of unintended consequences, including those stemming from extremely early arrivals of a large majority of flights. By ignoring operational reality, the proposal is another example of the FAA's intrinsically flawed one-size-fits-all approach to this NPRM.

In the absence of a clear connection between the stated schedule reliability standards and fatigue mitigation, we are forced to conclude that the FAA is availing itself of the opening presented by this rulemaking to pursue unrelated goals such as gaining control of scheduling reminiscent of the era before deregulation or incentivizing carriers to lengthen schedules. In addition to the host of legal and practical arguments against the schedule reliability proposal, ATA adds that other existing and contemplated regulations address scheduling, notably reporting

[56] Costs based on DOT Form 41 data for U.S. scheduled passenger airlines with annual revenues ≥ $100 million.

requirements and the recently-concluded and current DOT consumer protection rulemakings that set out specific metrics for schedule reliability both in terms of delay and cancellation statistics.[57]

Given regulation of scheduling practices as they affect consumers, the schedule reliability aspect of the Proposal sets standards that are impossible for the ATA's members to meet without (i) making extraordinary increases in scheduled block time; (ii) routinely cancelling a large number of flights in real time; or (iii) both. As discussed below and in the detailed Oliver Wyman analysis, complying with these unnecessary and arbitrary schedule reliability goals will result in significant costs to the industry and deprive the traveling public of service due to inevitable schedule reductions that would flow from this aspect of the Proposal. The "schedule reliability" rule is also unreasonably inflexible. The proposal contains no *de minimis* exception for an actual FDP that exceeds scheduled FDP. As a result, an actual FDP that exceeds scheduled FDP by one minute will count against schedule reliability. This inflexibility will force carriers to take drastically conservative measures to avoid exceeding scheduled FDPs. In addition, the sixty-day time period allowed in the proposal for adjusting schedules is simply not workable, especially considering the schedule restrictions that exist with landing slot times at airports with slot time restrictions.[58]

The FAA admits that "the point of a schedule reliability requirement is to assure the integrity of schedules, not simply to assure that the time frames listed in the tables are not exceeded."[59] But the "integrity of schedules," a matter addressed both by mandatory flight performance reporting and in the DOT passenger protection rulemakings, has no relationship to

---

[57] Among the reasons why "schedule reliability" proposal is redundant is the fact that the Department of Transportation already regulates and gathers data about on-time performance. The Department's Bureau of Transportation Statistics tracks the on-time performance of domestic flights operated by large air carriers. It issues periodic directives to the industry concerning data about on-time performance that it requires carriers to provide.

[58] Moreover, international carriers will be unable to readjust their scheduled within the time frame contemplated by the proposal because international slots at airports are allocated only twice per year.

[59] Response to Clarifying Questions, p.7.

mitigating fatigue—that is the purpose of the FDP tables and rest requirements in the NPRM. In fact, for decades the FAA has been attempting to impose such schedule "integrity" requirements for reasons wholly unrelated to fatigue. The FAA has long been an advocate for what it calls “realistic” scheduling practices. Since 1958, the FAA has issued at least six legal interpretations cautioning carriers against “unrealistic” scheduling:

- 1958 – In response to a carrier’s stated position that a pilot who is properly scheduled may exceed flight time limitations, the Civil Aeronautics Administration introduced the following methodology to promote schedule reliability: “If it is determined over a period of 90 days or more that the flight schedule over a particular route cannot be completed by the pilots within the period of the scheduled flight time by more than 50 percent of the flights flown, then such schedules cannot be considered to adequately reflect the actual time required for flights over such route, and the carrier will be required to take corrective action.” *Letter to J.P. O’Brien from G.S. Moore, Acting Chief, Air Carrier Safety Division* (Oct. 21, 1958);

- 1990 – FAA regulatory counsel states: “The flight time regulations have a premise that each certificate holder is scheduling realistically” and “constant deviations from the flight and duty time limitations of Part 121 based upon [delays beyond the control of the air carrier] are not acceptable if the certificate holder is not scheduling realistically.” *Legal Interpretation to Bernard Geier from Donald P. Byrne, Assistant Chief Counsel, Regulations and Enforcement Division* (Feb. 8, 1990);

- 1991 – FAA regulatory counsel issues a reminder that “schedules must be realistic” and refers to a discussion in a 1985 Amendment to FAR 121.541 in which FAA explained that “. . . compliance with the flight scheduling rules requires each carrier to schedule realistically . . . . If actual flight time is consistently higher than the scheduled flight time allowed, the schedule should be adjusted.” *Legal Interpretation to E.E. Sowell from Donald P. Byrne, Assistant Chief Counsel, Regulations and Enforcement Division* (June 20, 1991); and

- 2006 – Citing two previous FAA Chief Counsel Interpretations, Nos. 1990-25 and 1991-8, to support the proposition that “the determination of whether a schedule is realistic depends upon an examination of all the facts and circumstances of a particular case” and that “the original scheduling must be realistic and represent a normal occurrence in the flight operations conducted by the carrier,” the FAA Assistant Chief Counsel for Regulations affirmed that FAA FSDOs have the authority to conduct reviews of a carrier’s scheduling data to determine compliance with section 121.503 scheduled flight times.

Legal Interpretation to Patrick Ryan from Rebecca B. MacPherson, Assistant Chief Counsel, Regulations Division (Feb. 23, 2006).

These interpretations demonstrate the FAA's extensive historical efforts to assure the accuracy of carriers' scheduling practices, whether referred to as "realistic scheduling," "schedule integrity," or "schedule reliability."

By proposing in the NPRM to measure actual FDP versus scheduled FDP, a metric that bears no relation to the regulatory objective of mitigating pilot fatigue, it seems that the FAA is intending to tighten carriers' scheduling practices rather than mitigate fatigue. In our opinion the schedule reliability proposal amounts to an unjustified attempt to achieve a longstanding agency objective unrelated to fatigue management by inserting requirements for "realistic" scheduling into the NPRM. This rulemaking, however, is not the appropriate vehicle for so doing. The proposal is by definition arbitrary and capricious. There is simply no rational basis for requiring carriers to furnish information to the FAA pursuant to a metric that offers no safety enhancing or fatigue mitigating value to the agency and is already addressed by DOT in regulation, enforcement and reporting requirements.

Unfortunately for the U.S. economy and the traveling public, as well as U.S. air carriers and their employees, if made final as proposed, the schedule reliability proposal will result in substantial unjustified costs. In order to comply with the proposal, carriers will have to adjust schedules across the board by building in substantial buffers to limit potential deviations. Thus, the FAA's effort to achieve "realistic" scheduling will cause highly unrealistic scheduling. As a result, network connectivity will deteriorate, notably as a large share of flights will arrive early given the need for buffers; aircraft and other resource utilization will be degraded; general efficiency will drop; and costs will rise—with *no impact* on fatigue or safety. Carriers will have to increase crewmember headcounts to accommodate the longer scheduled FDPs, thereby incurring substantial additional costs. Moreover, because most carriers pay pilots for the greater of their actual or scheduled time pursuant to most collective bargaining agreements, the longer scheduled FDPs will drive up costs for this reason as well. The analysis performed by Oliver Wyman reveals that the added costs to for compliance with "schedule reliability" requirements are extremely high. According to this analysis, the estimated cost to the industry of requiring airlines to achieve schedule reliability of 95% is $967 million per year as a result of the additional flight crew required to provide necessary buffers.[60] The FAA's RIA failed to consider the cost of buffering, thereby substantially understating the economic impact of the proposed 95% schedule reliability rule.

The FAA's "schedule reliability" proposal underscores the extent to which the agency's process in issuing the NPRM was flawed. The proposal is unnecessary, disregards operational reality, is impossible to comply with, and amounts to a backdoor attempt to accomplish an objective unrelated to fatigue, and will, if imposed, result in substantial unjustified costs to the U.S. economy, the traveling public and carriers.

ATA also urges the FAA to examine the impact of the unnecessary schedule reliability proposal on high density airports. Flight time variability for flights originating in or destined to these airports is principally a function of the volume of flight activity. For each of these, the only mechanism of which we are aware to reach the thresholds proposed in the NPRM would be for the FAA to unnecessarily curtail operations. The negative effect on travelers, airports, and affected communities should be obvious. Additionally, should the FAA finalize some aspect of the schedule reliability proposal, ATA would seek consultations with the agency regarding the time period over which such “reliability” would be reported and evaluated and other definitions. Among other examples, seasonal weather or other short-term factors that would not suggest a

[60] *See* Economic Impact Analysis page 44.

rationale for modifying scheduling practices could easily make system-wide duty periods or pairing-specific reliability fall outside the proposed standards.

E. Split Duty [Section 117.17]

ATA's members object to the proposed four-hour minimum for a rest opportunity to be credited during split duty. We agree with the FAA that science and operational experience supports the concept that a crewmember can recuperate because of the opportunity to sleep during a period of their FDP. This sleep opportunity can be especially effective if it takes place when a crewmember would normally be sleeping. We also agree with the concept of expanding the duty period in proportion to the length of the rest opportunity. As the FAA acknowledges in the preamble, split duty is an area in which carriers have heavily invested and developed over and above regulatory requirements because it helps fight fatigue and is in the best interest of safety. The experience gained from this investment should not be discarded in favor of the FAA's arbitrarily proposed four hour standard. The four hour minimum required for credit is not science-based. It is arbitrary, counter-intuitive, and operationally unsound.

As discussed in the fatigue scientists' report, any sleep longer than twenty minutes provides benefit. Assuming that normal adult sleep latency at night is between five and ten minutes, then time behind the door of more than thirty minutes would provide recuperative value. Moreover, no basis in science exists for scaling the extension by 50% of the rest opportunity. According to the fatigue experts, any sleep longer than twenty minutes provides recuperative value on a full minute-by-minute basis.[61] The methodology FAA seems to have employed is premised on the idea that a four hour sleep opportunity may net only two hours of actual sleep.[62] This might be an adequate estimation for rest in some facilities on board an

[61] *See* Dr. Belenky and Dr. Graeber Opinion pages 3-4.

[62] *See* 75 Fed. Reg. at 55866.

aircraft but it is overly conservative for a quality sleep facility located on the ground that doesn't have the rest-inhibiting factors of turbulence, transient noise, and other airborne challenges.

Indeed, the proposal defies logic and operational experience. According to the NPRM, in some cases rest on the ground is worth less than rest in the air. The credit the NPRM affords to rest on some augmented flights is more generous than that for split duty, with a sleep opportunity in a ground rest facility. The FAA also seems to believe that rest during split duty "multiplies" the "overhead" involved in getting to sleep, even though no basis for this conclusion may be found in science or operational experience.[63]

The four hour minimum is also operationally unsound. Because split duty is calculated dynamically in real time, based upon the actual amount of rest opportunity afforded, building a schedule around the four-hour minimum is very difficult. For example, split duty rest periods may occur during breaks at a hub while cargo is loaded on an aircraft. Crewmembers receive rest in ground facilities during the aircraft loading process. There is no rational reason to give credit for a four hour period when science dictates shorter periods of time provide recuperative benefits and the loading process may take a shorter period of time. Shorter periods of sleep opportunity are in place now and operational experience shows this as a valid fatigue mitigation strategy. The proposal would have an even greater impact on carriers that have already voluntarily invested substantial resources to build rest facilities that would be of limited use if the proposal goes into effect.

Science supports credit for a split duty rest opportunity of as little as thirty minutes. We therefore recommend that the FAA change the proposal to allow credit with a minimum thirty minute rest opportunity. The credit should work on a sliding scale that acknowledges that a longer rest opportunity results in greater fatigue mitigation. Thus, the credit allowed should

---

[63] *See id.* The ARC never discussed a four-hour minimum for credit, and the four-hour number contained in the proposal appears to be entirely arbitrary.

increase as a crew member receives more rest especially if the sleep opportunity is during a time the pilot would normally be sleeping. Moreover, by application of science, and the principles employed in the NPRM for credit for augmented operations, the FAA should allow FDPs to be expanded beyond the currently proposed limits to account for rest received during split duty.

The costs that carriers will be forced to bear if this proposal is imposed will be substantial, as the analysis from Oliver Wyman demonstrates. In its Economic Impact Analysis, Oliver Wyman compared the cost difference between implementing the proposed rules with an alternative that decreases the minimum rest time to ninety minutes and permits an increase in maximum FDP arising from split duty rest to up to sixteen hours. This analysis shows that the proposal in the NPRM will cost the carriers at least $7.4 million per year.[64]

F. Rest Period [Section 117.25(d)]

ATA members support the concept of providing crewmembers with an eight hour rest opportunity. Nonetheless, our members object to the scheme proposed in Section 117.25(d), which places the responsibility on carriers to ensure that each crewmember receives nine hours at a rest facility. This proposal is both legally objectionable and practicably and practically impossible.

The proposal is yet another example of the overregulation that permeates the NPRM. It is unnecessary in light of other mitigation measures contained in the NPRM and existing practices currently employed by air carriers and their flight crews. If implemented, this proposal would create a great deal of uncertainty around time free of duty and scheduling of crews and aircraft.

Carriers cannot control variables such as time in transit to rest facilities, vehicular break downs, accidents or unexpectedly heavy traffic, and lost or overbooked facility reservations.

[64] *See* Economic Impact Analysis page 61.

Yet, the Proposal requires that the carriers be responsible for all of them, which is neither practical nor feasible. If any one or more of these contingencies occur, schedule reliability and operational dependability (particular concerns of all stakeholders including the FAA) will be harmed due to the daily uncertainty of literally hundreds of occurrences outside of the control of carriers. A high frequency of dropped flights could result if time of arrival at the rest facility shifts by only a few minutes. Carriers, crewmembers, and the traveling public and shippers depend on robust and reliable operations, both of which will be harmed if this part of the Proposal is implemented. Carriers, passengers, and shippers will be faced with unmanageable, unacceptable delays and the requirement to reconfigure pilot schedules and call in reserve crews as pilots report that they did not receive the minimum rest opportunity. A viable alternative would be to allow a carrier to choose between the NPRM proposed methodology or the 10 hour-from-release methodology suggested by the ARC.

The FAA in the NPRM has defined rest as a period "during which the crewmember is free from all restraint by the certificate holder." Even if the carriers could obtain time of check-in records from hotels and other facilities used for rest, a specific check-out time from a hotel, usually does not exist where the hotel bills are slid under the door and neither the facility nor anyone else knows when the occupant actually departs, or whether they actually occupied the room. We also anticipate situations when, due to the choice of the pilot, layovers occur in a location other than the one provided by the carrier. How is rest measured in that instance? In addition, the term "other suitable accommodation" is vague and ambiguous, and its use in the proposal is problematic. A carrier cannot guarantee that an accommodation will be "suitable," whatever that means. This is especially clear in instances where a crewmember is not in the middle of a trip and staying at a crew hotel but instead is laying over at home or wherever else the crewmember chooses to stay.

The proposal puts both carriers and crewmembers in an untenable, unmanageable position when the crewmember wants to step out for a meal down the street or wants to stop to eat on the way before checking in to a rest facility. Carriers will never be able to account for crewmembers' whereabouts throughout a rest period, nor should they need to. A carrier can control the scheduling of a rest opportunity between flights. It cannot control an individual pilot's private life and activities when he or she is off duty. This is why showing up for work "fit for duty" has been, and must remain, the responsibility of the individual crewmember.[65] This part of the Proposal should be withdrawn, reevaluated, and republished for comment.

We recommend that the FAA adopt a rule that sets the required rest period at "10 hours from release of a crewmember from duty" for operations in a theater, and "12 hours from release of a crewmember from duty" for operations into a new theater. The term "theater" would have the same definition afforded to it by the Proposal.[66] Once a crewmember becomes acclimated in a new theater, the required rest period would revert to 10 hours.[67] The 10 hour or 12 hour opportunity to rest would include an automatic two hour buffer for local transit and other activities to provide pilots an adequate opportunity to rest for eight hours. Such a rule would be simple to apply. It would also relieve the carriers of responsibility for variables over which they have no control, as discussed above, and in many cases would provide flightcrew members an additional margin of time in which to get rest. In the event of an unforeseen disruption in the

---

65 As the Administrator has stated: "We cannot regulate professionalism. No matter how many rules, regulations, advisories, mandatory training sessions, voluntary training sessions — pull them all together, and it still comes down to us — and by us, I mean every pilot." *We Can't Regulate Professionalism*, Speech of FAA Administrator J. Randolph Babbitt to the ALPA Air Safety Forum, August 5, 2009.

66 The benefit of using the term "theater" instead of distinguishing between domestic and international operations in this context is that the domestic/international distinction is of no relevance here, as the FAA has recognized by proposing to eliminate the distinction. *See* 75 Fed. Reg. at 55854. For example, science and common sense tell us 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.

67 Under our proposal, what is now NPRM §117.27(e) would be revised to provide that the applicable rest period (10 or 12 hours) would be reduced by one hour for unforeseen circumstances.

rest opportunity, any crewmember would still be able to notify the carrier if there are delays in getting to the rest facility. ATA members strongly encourage consideration of this alternative and again urge the FAA to withdraw the pending proposal by itself as operationally deficient or consider offering both options.

G. Flight Duty Period for Unaugmented Operations [Section 117.15 and Table B]

ATA's members agree with the concept of FDP limits that take into account time of day the duty departure and are expressed in a tabular format. We disagree and object to two aspects of the Proposal's treatment of FDP limits as expressed in Table B of the NPRM.

First, some of the specific FDP limits in Table B are unreasonable and overly restrictive. Although scientists agree on general principles for scheduling pilots, such as the impact of the WOCL and the importance of rest, it became clear during the ARC that the current state of fatigue science makes it challenging to define precise values for FDP limits. Although specific numbers were discussed during the ARC, the values eventually derived did not spring from purely scientific concerns, but from an attempt to balance science with operational experience. An example of the challenge of applying "one size fits all" to FDP limits, operators that regularly operate robust operations during the time periods where the nine-hour FDP limits are expressed on Table B provide mitigations to their crews that should enable them to fly beyond these 9 hour limits.. Additionally, we do not support maximum daily FDP limits less than those established by CAP-371, which is the most restrictive international standard.

Because the specific numbers on Table B are not fully science based, particular care should be given to practical considerations and the costs of imposing these limits on the industry. The limits for the 0500-0559 and 0600-0659 blocks are particularly unreasonable and operational experience validates longer FDP during these time periods. In these blocks, a crewmember will obtain a significant amount of sleep during the WOCL and the vast majority of flying will take place during daylight hours. These crewmembers will also receive full rest periods before departure. The combination of a full rest period, beneficial sleep during the WOCL, and flight duty in daylight hours is conducive to enhanced alertness, as studies have shown.[68]

As described in the accompanying Economic Impact Analysis, the imposition of the more restrictive FDP limits recommended by labor representatives to the ARC, will cost carriers $20 million annually more than the less restrictive limits recommended by some members of the ARC.[69] These costs cannot be justified, especially in light of the fact that the FAA cannot demonstrate a scientific basis for the specific values in Table B and operational experience validates these current practices are safe today.

Second, ATA's members object to reductions in maximum FDP based on the number of segments flown. Science does not support such wholesale reductions, which are, therefore, arbitrary.

As the FAA readily admits, "[t]here is no evidence that flying multiple segments is more fatiguing than flying one or two segments per duty period."[70] The FAA also admits that the issue is "not addressed by sleep studies," and that "[m]uch of the available science is based on laboratory studies, with exceptionally limited validation in the aviation context . . . ."[71] Because the FAA found no science available to support reducing FDP based on flight segments, the agency relied instead on anecdotal statements as the basis for this proposal. This is another example of arbitrary and capricious rulemaking by the FAA.

---

[68] Rosekind, MR. From Laboratory to Flightdeck: Promoting Operational Alertness, In Fatigue and Duty Time Limitations – An International Review, pages 7.6-7.7 (1997).

[69] *See* Economic Impact Analysis page 64.

[70] 75 Fed. Reg. at 55858.

[71] *Id*. at 55860.

H. Flight Duty Period - Augmented Crew [Section 117.19 and Table C]

ATA's members agree that providing meaningful rest opportunities and limiting time on task are important in augmented operations. The proposal embodied in Table C of the NPRM is, however, highly prescriptive and could unnecessarily restrict certain operations. Like the values in Table B for unaugmented operations, the values in Table C did not arise from purely scientific concerns and current operational experience also validates longer time periods as safe. ATA's members object to aspects of the proposal governing FDP limits for augmented operations that are arbitrary, unreasonable, not science-based, and/or operationally unsound. We believe that adding additional flexibility to the proposal will be reasonable and operationally effective while not increasing fatigue, especially in light of the other mitigations contained in the NPRM.

First, the 4-pilot augmented FDP limits set forth in Table C to the NPRM seem counterintuitive and not in accord with known science. They reduce the maximum FDP for crews that do not land in their WOCL compared to those that land in the WOCL, which are allowed a longer FDP. All flightcrews will also be subject to cumulative limits and receive the opportunity to rest. For example, a 4-member crew that starts between 0700-1259 would be allowed an 18 hour FDP, while a 4-member crew that starts between 1700-2359 would be allowed a 16 hour FDP. Both crews will have equal opportunities to mitigate fatigue with sleep opportunities on board the aircraft. The crew starting between 1700-2359 will be afforded an inflight sleep opportunity through their WOCL. This sleep opportunity through the WOCL will mitigate fatigue by providing a sleep opportunity at a time the pilot would normally be sleeping. Because of this it is unnecessary to reduce this crew's maximum FDP. Since both crews have equal opportunities to mitigate fatigue on board the aircraft, their available FDPs should not be lower. As discussed in the accompanying report by ATA's fatigue experts, science does not support this reduction either.[72] Moreover, carriers that undertake the substantial expense of investing in four pilot operations with on board rest facilities should be allowed to take full advantage of existing fatigue mitigation strategies. Accordingly, we suggest that the FDP limits for four pilot operations in Table C be adjusted to uniformly reflect the maximum values currently set forth in the table, in accordance with international standards, like CAP-371

Second, the requirement in Section 117.19(c)(3) that a crewmember manipulating the controls during landing receive two consecutive hours of rest during the last flight segment is arbitrary, operationally unworkable, and unnecessarily restrictive. Because the proposal would require a final segment lasting at least 3.5 hours, some current operations with short final legs would not qualify even though they are safely operated today. Moreover, 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.[73]

Not only is this proposal operationally unsound, it is not supported by science. As discussed in the accompanying expert report, the time when a pilot is most likely to sleep may not necessarily be the last available rest period or take place during the last segment of a multi-segment flight. Any sleep longer than 20 minutes has the same minute-by-minute recuperative value as longer naps and main sleep periods.[74] Because the recuperative effect of sleep is cumulative across sleep periods, a significant rest opportunity within the last six hours of duty will mitigate fatigue that the pilot may experience during the landing phase of the final segment.[75]

---

[72] *See* Dr. Belenky and Dr. Graeber Opinion pages 5-6.

[73] Highlighting the premature nature of this rulemaking process, the FAA admits that it "did not consider any circumstances under which a certificate holder's customer demands less than a 2-hour final segment. Nor did the FAA consider situations when both crewmembers are manipulating the controls, but only a single 2-hour rest opportunity is available." Response to Clarifying Questions, p. 15.

[74] *See* Dr. Belenky and Dr. Graeber Opinion page 3.

[75] *See* Dr. Belenky and Dr. Graeber Opinion page 5.

We suggest that Section 117.19(c)(3) be revised to allow the two-hour break to take place anytime during the last six hours of the FDP. This would allow the landing pilot to receive a meaningful break and reduction in time on task that would, consistent with science, sufficiently mitigate fatigue and recognize operationally validated final legs.

We also suggest 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. The FAA appears to support this standard in its Clarifying Answers, which state "Provided the proposed rest requirements for augmentation are met, the proposal contemplates domestic augmentation. There is no reason that both domestic and international augmentation could not be allowed on a series of FDPs."[76] In order to avoid additional legal interpretations and allow for carrier planning, the FAA should include this concept in any final rule.

I. Crew Rest Infrastructure for Augmented Operations [Section 117.19]

ATA's members support the concept of providing credit for rest received in flight. The Proposal is, however, overly restrictive with respect to the facilities it deems sufficient for conferring credit for in-flight rest. As a result, it will cause substantial and unreasonable impacts on carriers.

The proposed criteria for in-flight rest facilities are based entirely on one study conducted under contract by the Dutch government.[77] The standards described by the TNO Report that the FAA proposes to adopt are extremely narrow and restrictive. The report studied whether flight duty periods should be extended based on aircraft rest facilities and augmentation of flight crewmembers. The TNO report reviewed the very limited national and international literature on

[76] Response to Clarifying Questions page 16.

[77] *See generally* discussion at 75 Fed. Reg. at 55864.

crew rest facilities to reach its conclusions. The report concluded that short in-flight sleep periods are an effective measure in maintaining alertness and performance throughout a long haul flight and alertness and performance are better maintained after sleep periods of longer duration. The principal factors influencing the efficiency of in-flight sleep are the time of day and the length of rest period and the duty start time and the duration of prior wakefulness. Finally, the report defined four classes of rest facilities and recommended flight duty period extensions depending on the type of facility. As demonstrated by industry experience from the use of rest facilities, including those that conform with AC 121-31, the more constraining TNO criteria are overly restrictive. It is unreasonable for the FAA to rely on a single foreign study as the sole basis for its new rules, especially in light of the fact that they are a significant departure from current requirements and not a single regulatory body in the world has ever adopted these criteria. The FAA's wholesale and uncritical adoption of the criteria from the TNO Report is particularly troublesome because of the substantial adverse impacts on U.S. carriers that this will cause. Use of the TNO Report also does not meet the Information Quality Act standards discussed in Section IV(W).

The proposal among other things abandons the less restrictive criteria set forth in AC 121-31. The FAA has deemed this AC's guidance to be adequate in the past and has not provided sufficient justification for its decision to abandon it now. Numerous aircraft were configured in accordance with the criteria set forth in AC 121-31 and have operationally validated rest facilities. It is arbitrary and unreasonable for the FAA to ignore the fact that it has certified these aircraft and allowed credit for their rest facilities. Additionally, many carriers have voluntarily provided rest facilities for operations where they were not required by regulation. If the proposal is imposed it will substantially change the nature of operations of carriers that have invested in aircraft with rest seats that could not be used for credit under the proposal. For example, longstanding practice shows that existing business class seats provide adequate capability for fatigue mitigation on routes that are 8-12 hours scheduled block time flown with 3 pilots. Additionally, some carriers do not operate aircraft with passenger seats and/or are otherwise unable to add rest facilities that comply with the TNO Report's criteria. They do, however, have aircraft with facilities that provide a horizontal sleep opportunity in accordance with the criteria of AC 121-31.

The FAA has grossly underestimated costs arising from the proposed crew rest infrastructure requirements. These include costs of adding rest facilities, lost revenue during installation, lost revenue from the loss of passenger or cargo space, and fuel costs from the weight of carrying Class 1 facilities on board. The Oliver Wyman report concludes that the total one-time cost to the carriers for providing new or upgraded rest facilities that conform to the standards set forth in the proposal is $461 million. This amount far exceeds the FAA's estimate of $67.5 million, which grossly underestimates costs as a result of numerous simplifying assumptions in the RIA that fail to take into account operational realities.[78]

The proposal's criteria for crew rest infrastructure is overly restrictive and will result in unjustified cost burdens. The proposal should be withdrawn pending further study and analysis to develop sound standards. We recommend that, before proceeding, the FAA commission a study to examine and evaluate the parameters for various types of in-flight crew rest facilities. At 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. This would strike a balance recognizing current operational experience, allow a U.S. study to go forward and impose new standards on new aircraft.

---

[78] *See* Economic Impact Analysis page 68.

J. Limit On Consecutive Nighttime Operations [Section 117.27]

ATA's members object to the Proposal's three night limit on consecutive FDPs because it is unreasonable and disregards operational experience. The 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. The proposal also fails to take into account mitigations such as sleep room facilities for rest of less than four hours for carriers that have made substantial investments in those ground-based facilities. These mitigations have been shown to sustain performance for more than three nights in a row. The proposal is also unreasonable because it applies the limit to augmented operations. Because crewmembers receive a required rest opportunity before starting duty and significant opportunities for inflight and split duty rest during augmented operations limits on consecutive nights are redundant.

The proposed three-consecutive-night limit is not supported by science. As discussed in the accompanying report by ATA's fatigue experts, sleep obtained by workers assigned to night duty can sustain performance across greater than three consecutive nights[79]. A recent study comparing the sleep of physicians working night and day shifts found that they received equivalent amounts of sleep when working either type of shift.[80] The NASA study of night cargo operations revealed that crews obtained five hours of sleep each day after duty. Scientific evidence shows that sleep obtained by night workers, even if broken into two shorter periods, can sustain performance over multiple nights.[81] Even the analysis by Dr. Hursh concluded that, given a sufficient sleep opportunity, "a person can sustain his or her performance at acceptable

---

[79] *See* Dr. Belenky and Dr. Graeber Opinion page 4.

[80] *Id.*

[81] *Id.*

levels for five consecutive nights."[82] The proposed three night limit is arbitrary because it disregards the best available science, operational experience and current mitigation strategies for consecutive night duty.

A three night limit may well also lead to increased crewmember fatigue. Industry experience shows that the first night flight in sequence tends to be more fatiguing than the night flights that follow it because, during the first flight, pilots are readjusting to night duty. This element of the proposal will likely result in substantially more first night flights than compared to today, where crewmembers commonly work more than three consecutive nights in a row. This is because under the proposal crewmembers will end up being scheduled for more overall shorter multiple-night pairings in a given time period (*i.e.*, monthly). In addition to resulting in more first-night flights, the proposal will likely lead to more frequent crewmember transitional schedules in which pilots alternate between day and night duty. If the proposal is adopted, carriers will have no choice but to build such schedules replacing the efficiency and operational robustness of longer consecutive nights that carriers schedule now. Even the FAA expressed a concern that a departure from "longstanding industry practice" to fly more than three consecutive nights could "lead to adverse safety impacts in the real world."[83] Nevertheless, despite these FAA concerns this proposal will likely lead to more first nights being scheduled.

Additionally, an unintended consequence of this proposal would be to unnecessarily limit simulator training to three consecutive nights. Because simulator time would now be defined as FDP, the three consecutive nights limit would apply. Because public safety is not affected by simulator operations, application of the proposal would provide absolutely no safety enhancement, even though it would add unnecessary burdens to the certificate holder and

[82] 75 Fed. Reg. at 55867.

[83] 75 Fed. Reg. at 55867.

crewmembers by delaying the amount of time it takes a flightcrew member to complete training. This application would also fail to recognize that crewmembers would receive full rest opportunities.

As discussed in the accompanying report by Oliver Wyman, the proposal will impose substantial costs on operators. The cost burden will be especially high on carriers with business models built for robust night operations. ATA's Economic Impact Analysis estimates that the limitation on nighttime duty to three consecutive nights results in a cost to the industry of $3.8 million[84] per year, 90% of which will be borne by cargo carriers.[85] The FAA should not adopt a regulation lacking scientific support while the cost of imposing it will be excessively high. This is especially true where, as here, operational experience validates that more than three consecutive nights is safe and the proposal could result in increased fatigue levels.

K. Issues Arising From Definitions [Section 117.3]

ATA members object to a number of definitions in the NPRM that are arbitrary, not science based, and/or would result to unjustified burdens and costs, including the following:

a. "Deadhead transportation"

As drafted, the definition of "deadhead transportation" is unduly restrictive. It should be revised to remove the word "passenger" in the phrase "Deadhead transportation means transportation of a crewmember as a passenger . . . ." There is no reason to assume deadhead transportation should be limited to crewmembers characterized as “passengers” when not all carriers carry passengers.

b. "Duty"

---

[84] *See* Economic Impact Analysis page 76.

[85] This estimate applies the definition of "nighttime duties" provided by the FAA in its Response to Clarifying Questions. Any change of the definition of "nighttime" as used in interpreting this proposal is likely to have a major cost impact, especially on cargo carriers.

ATA's members strongly object to the NPRM's definition of "duty" as vague, overly encompassing, unduly restrictive, and operationally unworkable. The highly problematic inclusion of short call reserve in the definition is discussed above, and the definition has other major flaws.

First, the definition disregards the fact that an operator cannot control the time, place, and manner in which crewmembers perform discretionary tasks or how they choose to manage their personal life. A professional pilot must routinely perform tasks such as refreshing outdated publications, watching videos for recurrent training, and reading and responding to e-mails. A crewmember may perform these tasks at a time and place of his or her choosing. The carrier has no way of knowing or controlling when or where a pilot does these things.[86] This has nothing to do with fatigue mitigation.

The definition is overbroad and unreasonable because it classifies "any task" performed by a crewmember "on behalf of the certificate holder" as duty. It is fundamentally unmanageable and over restrictive because it makes carriers responsible for tracking and controlling the cumulative time pilots spend on "duty," while allowing pilots unfettered discretion to perform "any task" that amounts to duty any time that they wish. The definition also gives rise to the potential for substantial abuse. A carrier would not have any way to track or validate these tasks

Discretionary tasks that a carrier has no means of controlling or tracking should not be counted as "duty." We recommend that the FAA make clear that it will only consider "duty" to include activities that an operator specifically directs and controls (*i.e*. report for ground training at a certain time and on a certain date) performed on company property. ATA therefore

[86] Carriers have no desire to monitor or control the conduct of crewmembers during their time off. Crewmembers should be allowed to decide how they spend their down time, including when and will they perform the various discretionary functions that are inherent to being a crewmember.

recommends replacing the phrase "on behalf of the certificate holder" in the definition with "directed by a certificate holder on company property."

Second, the inclusion of "administrative work" in the definition of “duty” is vague, overbroad, and unduly burdensome. The FAA appears to believe that the ARC reached a consensus on a definition of "duty" that includes administrative work.[87] This is not correct. In a summary of ARC meetings on Aug. 11-13, the FAA notes that, after review of the meeting summary notes, ARC members called into question whether administrative work should be included in the definition of "duty."[88]

Management pilots and certain union pilots routinely perform administrative tasks such as paperwork, going to meetings, and making phone calls. Sometimes such activities are directed to be done at a place of work. Other times these tasks are performed at the discretion of the pilot at a time and place of his or her choosing. A management or union pilot could be performing "administrative work" while sitting at home sending emails. It is impossible for a carrier to accurately track the time that pilots spend on such tasks. Additionally, work performed at the pilot's discretion and chosen time and place falls into the category of personal responsibility, to be managed by that individual pilot. Moreover, the inclusion of administrative but not labor-related work in this definition does not make sense. No material distinction exists between administrative tasks performed on behalf of management and administrative tasks performed on behalf of labor. If the FAA intends to keep "administrative work" in the definition of "duty,” then the FAA should make clear that the definition treats management and labor-related administrative work in exactly the same way. Moreover, with respect to administrative work performed on behalf of management or labor, only administrative functions directed by the

---

[87] *See* 75 Fed. Reg. at 55871 ("The ARC defined duty as 'any task that crewmembers are required by the certificate holder to perform including, but not limited to . . . administrative work . . . .")

[88] *See* ARC Report, p. 299 (Pilot Flight and Duty Time Limitations and Rest Requirements, Aviation Rulemaking Committee, Record of Meeting, Aug. 11, 12 and 13 (2009), Docket FAA-2009-1093-0005, at 8).

operator or union official and performed on company or union property should be classified as "duty."

c. "Fatigue"

As discussed in the accompanying report of ATA's fatigue scientists, the NPRM's definition of "fatigue" is inconsistent with ICAO's proposed definition: "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."[89] The ICAO definition captures the fatigue-inducing effects of the interaction of sleep loss, circadian phase, and workload, and also provides a scientific basis for fatigue risk management. We support conforming the Final Rule's definition of "fatigue" to ICAO's.

d. "Flight duty period"

ATA's members object to the inclusion of training conducted in a flight simulator or with a flight training device in the definition of "flight duty period." No scientific or safety basis exists for the FAA's determination that "[a]ll training conducted on the flight simulator or flight training device would be considered part of a FDP regardless of when it occurs."[90] Training conducted on its own, and not in connection with a flight or that takes place after a flight, should not count as part of a FDP. No public safety is involved with stand-alone simulator training. FDP is also overly restrictive in that it includes other items such as travel to a training site as well. There is no basis for including travel FDP unless it occurs before flight time. The counting of all simulator time as FDP results in an additional consequence which, if imposed, will cause a substantial and costly change to current operating practices.

---

89 *See* Dr. Belenky and Dr. Graeber Opinion page 2.

90 Response to Clarifying Questions, p. 3.

The FAA has failed to articulate why training that takes place with an intervening rest period before flight duty should be included in FDP. In fact, the definition of FDP recognizes a distinction between deadhead transportation that takes place before a flight without an intervening rest period—which counts as duty—and other deadhead transportation that does not. Paradoxically, the FAA does not recognize that this distinction should apply to training in simulators and flight training devices. We strongly urge the FAA to rewrite this definition to provide that only training and flight simulator time conducted before a flight without an intervening rest period is counted as part of a FDP.

We also recommend that the FAA make a change with respect to how it treats time a crewmember spends deadheading before a flight segment without an intervening required rest period. The NPRM includes this time in the definition of FDP. If a crewmember deadheads in a rest facility that would otherwise qualify for credit allowing for an extension of the FDP for augmented operations, then credit should also be extended for deadheading as well. It is illogical to treat a deadheading crewmember as if he or she is at the controls if the pilot is deadheading in a qualifying rest facility and getting the same rest the pilot would receive during augmented operations. Therefore, if the FAA is going to include deadheading before flight in the definition of FDP, then the maximum FDP for a crewmember deadheading in an approved rest facility should be extended and consistent with the rules for augmented operations. Deadheading pilots should be treated the same as a flying pilot for FDP limits, as long as the deadheading pilot is traveling in a rest facility. Section 117.29(b) of the NPRM should also be changed accordingly.

e. Nighttime Operations

The FAA should add a new definition of "nighttime operations" for purposes of part 117 to be consistent with the response to Clarifying questions. The definition should include operations "that commence between 10:00 p.m. and 5:00 a.m."

f. "Rest facility"

For the reasons discussed in Section III(I) above, ATA's members object to the unreasonably narrow criteria the Proposal would impose for rest facilities. Although we support the concept of credit for in-flight rest, we do not support rest facility criteria derived from the TNO Report. 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 crewmembers. 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.

L. **Cumulative Duty Limitations** [Section 117.23]

ATA's members object to certain aspects of the cumulative limitations on duty proposed in Section 117.23 of the NPRM.

Several limitations are unnecessary in light of the other mitigations contained in the NPRM. The FAA admits that it decided to take a "conservative approach" to cumulative limitations "[d]espite the lack of validated data."[91] Including these unnecessary restrictions without a scientific basis is not "conservative" but is arbitrary and does not reflect a reasoned decision.[92] It is also redundant because the cumulative FDP limits and minimum rest requirements in the NPRM are sufficient and operationally validated to address fatigue. Indeed, imposing three different sets of cumulative limits—for flight time, FDP, and duty—amounts to overregulation. As discussed in Section III(A), there is no reason to impose flight time limits of any kind in an FDP-based scheme and is counter to international FDT schemes in place today. The net effect of the Proposal's overbroad definition of "duty" and the cumulative duty limits in

---

[91] 75 Fed. Reg. at 55871.

[92] *See* discussion in Section IV below regarding Executive Order 12866 requirements; *See also* discussion below regarding how the NPRM fails to meet the standards mandated by the Information Quality Act of 2000 and the Department's Information Dissemination Quality Guidelines.

Section 117.23(d) is an unduly burdensome and unworkable regime that will impose substantial unjustified burdens on carriers, with operationally adverse effects on passengers, shippers and the U.S. economy. As discussed above, the classification of short call reserve as duty leads to the illogical result that a reserve pilot could spend several days at home and thereby exceed cumulative duty limits. While this redefinition of short call reserve as duty would not promote fatigue mitigation, it would unnecessarily impact operators. It is essential that carriers be allowed to assign pilots to short call reserve without counting it as cumulative duty.[93] The cumulative duty limitations also penalize carriers in instances where "duty" time is expanded due to circumstances beyond the carriers' control such as, for example, random drug tests.[94]

If imposed, the proposed cumulative duty limitations will adversely affect operational robustness and, thereby, result in flight cancellations that harm the general public, as demonstrated by the following example:

> A Captain has 49 FDP hours in the first five of the last six days, 14 of which were his annual two day continuing qualification in the simulator with a 3 hour flight to the simulator location on Day 1. Day 6 was a duty free period. Day 7 is a 2 segment turn flown out of his domicile which takes him to 58 FDP hours scheduled in the previous 168 consecutive hours. None of the crewmembers on his flight have had an FDP extension over 30 minutes in the past 168 hours. His inbound flight arrives on time. During the return flight, he has a medical emergency and has to divert to an off line airport short of his destination. The offload of the passenger, fueling of the aircraft and coordination with dispatch adds two hours to his FDP. He can no longer finish the return leg because it would put him over the 60-hour cumulative FDP limit in the past 168 hours. Because there are no reserves at the location where the aircraft is

93 For the reasons set forth in these Comments, we strongly oppose the classification of short call reserve as duty. Without waiving our objection to this classification, in response to the question posed by the FAA on page 18 of its Response to Clarifying Questions, we conclude that "over-*scheduling*" of reserve or other duty as long as actual duty limits are not exceeded has no safety impact of any kind.

94 The FAA seems to recognize that the proposed cumulative duty limits are unworkable as a practical matter. The agency asks for comment on "whether some allowance should be made for a flightcrew member at the end of his or her cumulative duty limit, but the certificate holder cannot allow the individual to be free from duty because of circumstances beyond its control." Response to Clarifying Questions, at 18. If the agency includes cumulative duty limits in the final rule, then an allowance should be made for instances where cumulative limits would otherwise be exceeded through no fault of the carrier.

> diverted to, the flight must be cancelled and the passengers put up overnight in a hotel.

Additionally, the proposal in §117.23(d)(3) to provide additional credit for transportation of a crew member on a suitable business or first-class seat is unjustified. A carrier cannot guarantee a "suitable business or first class seat" accommodation for a deadheading crewmember on flights operated by other airlines. This proposal also penalizes carriers that do not operate aircraft with first or business class cabins, but that do provide rest facilities for crewmembers. Specifying the specific type of seat to be provided a deadheading crewmember is another example of arbitrary overregulation.

M. Fitness for Duty Requirement [Section 117.5]

ATA's members object to the fitness for duty obligations that the FAA proposes to impose on carriers. These proposed standards are not based on science and are vague, ambiguous, and unworkable. ATA's members agree that mitigating fatigue is a shared responsibility. Operators are responsible for compliant scheduling that allows for adequate fatigue mitigation and pilots are responsible for reporting fit for duty. As proposed, compliance with the proposal is impossible.

This proposal fails outright because no valid scientific tool exists for evaluating whether a pilot is "too fatigued" for duty. As discussed in the accompanying report from fatigue experts, no test is available that would provide an observation that can be used to determine whether a pilot is "too fatigued."[95] The FAA itself acknowledges that "[i]t is difficult to detect fatigue in operational settings because there are no biomarkers for fatigue, or simple tests of how an individual will respond to sleep loss."[96] Indeed, the FAA provides no guidance whatsoever about what it means by the vague term "too fatigued." The agency states that it will approve a

[95] *See* Dr. Belenky and Dr. Graeber Opinion pages 4, 5.

[96] FAA, *Fatigue Risk Management Systems for Aviation Safety,* AC 120-103 at 4 (FAA Aug. 3, 2010), http://www.faa.gov/documentLibrary/media/Advisory_Circular/AC%20120-103.pdf.

training curriculum that can be used to make fitness for duty determinations.[97] According to the FAA, "[n]o other specialized training, or use of specific medical equipment or personnel is contemplated" for performing the evaluation.[98] Because no scientific basis is presently known for making objective, real time, determinations of actual and prospective pilot fatigue, it will be impossible for the FAA to approve a testing standard or curriculum at this time.

Among other things, the NPRM imposes responsibility on carriers for evaluating the physical condition of a pilot when he or she reports for duty. Section 117.5(b) would not permit a certificate holder to assign a FDP if the carrier "believes" that a crewmember is "too fatigued" to safely perform his or her assigned duties. ATA is unaware of any other government regulations in any field that make the employer responsible for assessing the fatigue state of the employee, and seeking to so regulate here imposes an unprecedented undefined standard, impossible for carriers to implement. "Belief" is a subjective standard that is impossible to apply with consistency, fairness or rigor.[99] Moreover, a pilot is the only person fully knowledgeable about his or her time off duty, and whether any activities during downtime will impact the pilot later in the FDP. The proposal also would impose a requirement that a crewmember will not be "too fatigued" for the entire FDP. It is, however, impossible for a carrier to ascertain whether a crewmember who appears not to be "too fatigued" to begin a FDP will not be "too fatigued" (an undefined term) by the end of the FDP. This concept also conflicts with the mitigating practices of inflight rest and split duty.

---

[97] *See* Responses to Clarifying Questions, p. 6.

[98] *Id.*

[99] The proposal is also silent as to which employee of the carrier will be required to apply this "belief" standard. Will it be the scheduler who assigns the FDP, who 99.99% of the time never meets the pilot in person before a flight? Alternatively, especially in line stations with few if any company employees, if the assessment is meant to be made in person, would it be a customer service representative?

The NPRM states that “any person" who "suspects" that a flight crew member is "too fatigued" for duty "must immediately report” that information "to the "certificate holder."[100] This proposal is also ambiguous and unworkable. Unlike the "belief" standard in Section 117.5(b), it appears to apply an even vaguer and less rigorous "suspicion" standard. By referring to "any person," the standard would contradict FAA statements regarding training and would require persons with no training of any kind to report crewmembers based on a purely subjective "suspicion."[101] Even well-intentioned persons could provide erroneous or uninformed reports that would cause major operational disruptions for no good reason. And persons harboring ill will could easily interfere with a pilot's duties or with a carrier's operations.[102]

Section 117.5(e) of the NPRM requires an operator to perform an "evaluation" once notified of "possible" crewmember fatigue. Which carrier personnel will be required to perform the evaluation, and on what basis, is left open to speculation. Although the proposal states that the evaluator must be trained in accordance with § 117.11, this provides no concrete guidance because *no scientifically validated test exists for performing these evaluations.*[103] The proposal also does not take into account the fact that a carrier cannot produce personnel in a timely manner that have undergone specialized training at every distant station on the network each time there is a report of "possible" fatigue at any time. For example, what is expected of a carrier if a flight diverts to an airport where a carrier has no employees? Under the proposal, it is possible that operations would have to cease until a rested substitute pilot or qualified individual

[100] Proposed § 117.5(d), 75 Fed. Reg. at 55885.

[101] *See* Response to Clarifying Questions pages 5-6, implying that employees that are trained will make fitness determinations not “any person”: “The NPRM states that the FAA will approve the fatigue-based training curricula. The agency anticipates that this training will be used to make fitness for duty determinations based on possible fatigue.”

[102] The proposal could also potentially undermine a PIC’s authority by putting the power to potentially ground the PIC into the hands of a subordinate.

[103] *See* Dr. Belenky and Dr. Graeber Opinion pages 4, 5.

is flown in to evaluate the pilot. Would the "fatigued pilot" be ok to continue the operation after a legal rest period? This fitness for duty proposal is unworkable, impossible to implement, not scientifically based, premature and would also impose initial and ongoing training costs for tens of thousands of employees arising from proposed Section 117.11for employees who have no duties that implicate fatigue mitigation.[104]

The audit requirement in §117.5(g) is also ambiguous. The FAA provides no guidance about how a carrier is supposed to "monitor" whether crewmembers are reporting fit for duty. It also leaves unclear what "deficiencies" the program is supposed to correct, or how a carrier is supposed to correct them.[105] This proposal should be withdrawn until the FAA develops science-based standards.

In addition, this proposal will cause an unjustified shift in potential liability to carriers as a result of the requirement that they evaluate pilots for fatigue. It will also result in substantial compliance costs. These costs include the cost for training and annually retraining potentially tens of thousands of employees. Additional costs will also result from ensuring compliance with fatigue evaluation requirements at stations that are not part of routine scheduled operations.[106]

The accompanying Advisory Circular, AC 120-FIT only raises additional questions. It requires carriers to develop a commuting policy, but provides no guidance on an acceptable

---

[104] The proposal also fails to specify which employee of the certificate holder must receive the report required by §117.5(d). If a crewmember mentions in passing to a baggage handler that a fellow pilot looks tired, and the baggage handler does nothing with this information, will the certificate holder be in violation of the §117.5(e) if it does not perform an on-the-spot fatigue evaluation of the pilot?

[105] In addition, the attestation requirement in §117.5(f) adds unduly burdensome administrative overhead. In typical operations the captain signs the paperwork necessary for flight release. Requiring the first officer to sign a separate individual attestation will complicate the departure process for most flights. The first officer will have to exit the aircraft to sign a form, and additional paperwork will have to be generated and managed. The FAA has not explained why it now believes requiring individual crewmembers to sign attestations to be a meritorious exercise when the agency has never deemed this necessary in connection with issues such as drug and alcohol use.

[106] In fact, the multitude of locations that the fitness evaluation could conceivably be made makes full compliance impossible for many carriers. For example, what would happen if an aircraft lands at airport where no trained carrier personnel are available? Or in an unsafe area? Who will make the "too fatigued" determination there? Will the carrier be obliged to assume the expense of flying a trained person to a diversion airport in order to perform the evaluation before a flight? The FAA's answers to these and other similar questions cannot presently be found.

policy. Indeed, it appears that nobody can currently define what a rational and effective commuting policy is. As directed by Congress, the National Research Council began a study in September 2010 to review the effects of commuting on pilot fatigue. Based on the study, it intends to define commuting in the context of pilot fatigue, discuss the relationship between available science and fatigue issues, discuss regulatory issues that affect pilot commuting, discuss commuting policies of commercial air carriers, and "outline potential next steps, including to the extent possible, recommendations for regulatory or administrative actions, or further research, by the Federal Aviation Administration (FAA)."[107] According to the website for the project, an interim report will be issued early next year and a final report is expected by the summer of 2011.

This study in progress will likely guide the FAA and industry's understanding of commuting. Therefore, the proposed AC 120-FIT is premature and not ripe for comments at this time. There is no point to finalizing AC 120-FIT until the NRC study is completed and all interested stakeholders have had an opportunity to review and analyze its results. We recommend that the FAA defer issuing the Advisory Circular until the study results are available. Thereafter, the agency should afford stakeholders an appropriate opportunity to comment.

N. Fatigue Risk Management System [Section 117.7]

As a general matter, ATA members support the concept of FRMS and the work that is progressing on this topic at the international level.[108] Properly implementing a Fatigue Risk Management System ("FRMS") could allow a carrier to continue to mitigate fatigue as it has done for some time in a manner tailored to its operations while allowing it to avoid operational restrictions that would otherwise result from the Proposal. The use of FRMS as a regulatory

[107] National Research Council, Project Information Summary, *available at* http://www8.nationalacademies.org/cp/.

[108] We also support the concept of a non-punitive reporting system that would encourage the reporting of fatigue events as part of the overall safety system.

alternative for enhancing safety is consistent with the well-established concept of "equivalent level of safety" that has proven successful in other contexts. It is not a means for avoiding regulation, but rather an alternative intended to result in a level of safety equivalent to regulatory requirements while taking into account case-by-case operational circumstances. As the FAA has stated:

> FRMS permits an operator to adapt policies, procedures and practices to the specific conditions that create fatigue in a particular aviation setting. Operators may tailor their FRMS to unique operational demands and focus on mitigations of fatigue that are practical within the specific operational environment.[[109]]

At the present time, however, the FAA's FRMS process is so unclear that it is vague and ambiguous. Neither the NPRM nor AC 120-103 sheds concrete light on what specific criteria the FAA will use in determining whether to approve a carrier's FRMS. In fact, no such criteria exist today. No country has adopted FRMS and ICAO is in the process of developing standards.[110] The FAA should commit to compliance with international standards in any final rule. Without this commitment the FAA program has the potential to raise unrealized expectations. If the FAA decides to issue a final rule that closely tracks the NPRM, without changing the Proposal and doesn't take into account the numerous concerns raised in these Comments, then each carrier will have to rely on future FAA determinations and will be at a significant competitive disadvantage as carriers outside the U.S continue to gain capability using FRMS. In this context, it is concerning and a further source of ambiguity that the FAA has stated it believes that validating an FRMS will be costly and, as a result, FRMS will likely be used only on a "route specific" basis.[111] The FAA fails to explain the basis for this statement. The agency analogizes FRMS to the Advanced Qualification Program ("AQP"), which the FAA states

---

[109] *See* Fatigue Risk Management Systems for Aviation Safety, *supra*.

[110] *See* 75 Fed. Reg. at 55874.

[111] Response to Clarifying Questions, p. 7.

"incorporates many aspects of FRMS."[112] AQPs, however, are broad-based systems that apply universally to all training. It would seem logical and efficient for carriers to develop and implement FRMS in a similar fashion to AQP, applying for a FRMS system-wide, instead of repeated applications on a piecemeal basis. Nevertheless, the FAA suggests that FRMS will disfavor a system-wide approach.[113]

The manner by which the agency will approve specific FRMS plans is uncertain and potentially problematic. Using the AQP analogy, ATA strongly believes that the use of FRMS, like AQP, is a regulatory relationship between the carrier and the regulator. The FAA has stated that "FRMS provides an interactive and collaborative approach to operation performance and safety levels on a case-by-case basis."[114] "Collaborative" in this context should not mean "negotiated." As is the case with Safety Management Systems, FRMS should depend on information provided by crewmembers relevant to ongoing monitoring, assessment, and improvement of safety initiatives. FRMS is a regulatory issue that should be a carrier to FAA approval process, with no other parties involved. The timing for approval and implementation of FRMS is also of great concern. Various carriers intend to develop robust FRMS plans in order to continue operationally validated mitigation strategies as an alternative to certain elements of the NPRM. Industry experience with new concepts and international trials employing FRMS principles show greater implementation success using a phased approach. To facilitate this, it is essential that carriers begin the implementation process as soon as possible, not delayed until the day the new rules go into effect. Otherwise, carrier investments in training, equipment, and other improvements in fatigue mitigation and safety would be unnecessarily delayed or wasted. It

---

[112] 75 Fed. Reg. at 55874.

[113] Implementation of FRMS on only a route-specific basis would require unnecessary largely redundant applications for approval significantly delaying a means for obtaining relief.

[114] *See* Fatigue Risk Management Systems for Aviation Safety, *supra*.

would serve no one's interest for the FAA to require carriers that have developed robust FRMS in advance, to wait for approval until after the effective date of the new rules so that operationally validated safe operations would have to cease until a carrier receives FRMS approval. Doing so would unjustifiably penalize carriers that voluntarily invest in fatigue mitigation strategies used today. The FAA has stated that, although it "intends to have an FRMS approval process in place prior to any final rule effective date," the agency "likely will not implement any approvals until the rule takes effect, since there will be no requirement for carriers to have an FRMS, even as an alternative to the proposed prescriptive requirements."[115] Taken together, these statements are ambiguous at best as to whether the agency intends to approve FRMS before the prescriptive requirements go into effect. They leave open the possibility that carriers will be unable to have their FRMS plans approved and ready to go on day one. In order to ease the transition to the new rules, recognize operationally validated fatigue mitigation procedures, minimize costs, and simplify surveillance and compliance activities for all stakeholders, we urge the FAA to ensure that it will be able to approve FRMS applications so that carriers can implement FRMS on day one. Alternatively, the FAA could provide an exception for current operators that submit FRMS applications by the effective date of the rule, FAA makes a decision regarding an individual FRMS application. This should not be difficult for the agency to accomplish.

O. Fatigue Education and Training Program [Section 117.11]

ATA's members object to the prescriptive training time requirements set forth in Section 117.11(b) of the NPRM. The minimum programmed hour requirements—five hours for initial training and two hours for recurrent training are not consistent with modern AQP practices. These minimums have no basis in science. In addition, the concept of training time requirements

[115] Response to Clarifying Questions, p. 6.

is outdated. Industry and FAA experience through AQP programs has shown that systematic training targeted at proficiency objectives is superior, effective, and efficient. State of the art training in the aviation industry is driven by content and meeting of proficiency objectives, not prescriptive training hour requirements. The FAA has acknowledged that a qualified AQP could be used as an alternative means of compliance.[116] This is a good step, but we urge the FAA to do away with minimum time requirements. The proposal's text should be changed to remove the specific time requirements and, instead, indicate that the time for such training shall be "as determined by the Administrator" to allow content-based training programs to be developed. The FAA could provide carriers with objectives and allow carriers to develop training content. As is the case today, a carrier could build a training program and provide it to the FAA for approval. The proposal is also ambiguous with respect to the personnel covered by the regulatory text. By "individuals involved in operational control," the proposal is vague as to which "individuals" the FAA has in mind. The CEO of an airline is "involved" in operational control. Would he or she have to receive training as well? Moreover, the proposal does not specify whether, in the case of an employee that changes employers, training received at a prior employer would count. Because the mandatory training subject areas are generic and untethered to a specific airline's operations, we see no sound reason for imposing redundant training requirements where an employee has received the training from a prior employer. For similar reasons, we believe the FAA should credit fatigue training that takes place under a FRMP.

P. Operations Into Unsafe Areas [Section 117.31]

The proposed requirements regarding operations into "unsafe areas" are ambiguous, and made even more so by the FAA's Responses to Clarifying Questions. The proposal could result in arbitrary and inconsistent enforcement due to the fact that the FAA has provided no concrete

---

[116] Response to Clarifying Questions, p. 9.

standards to guide compliance. The FAA admits that it not possible "to define what constitutes an 'unsafe area' with any specificity."[117] According to the FAA, a carrier is supposed to "use its best judgment in determining whether the area is sufficiently safe to allow for crew rest."[118] This "best judgment" standard is vague and unworkable. As functioning business entities charged with safeguarding passengers and cargo, carriers will always strive to use their best judgment. What constitutes "best judgment" at the time—especially under exigent circumstances—could, with the benefit of hindsight, be questioned. For example, the carrier's best judgment could be questioned if the carrier received incorrect information from other sources.

It is also unclear why the FAA believes that no extensions of the cumulative duty limitations in § 117.23 should be permitted.[119] The proposal purports to address a scenario where, because a flight crew is unable to layover in an unsafe area, the crew can continue to a place where they can safely be relieved and/or receive required rest, even if this would exceed "the maximum applicable flight duty periods."[120] However, under this scenario, the flight out of the unsafe area could cause a crewmember to exceed his or her *cumulative* limitations. According to proposed 117.31(d), the assignment of such a flight would not be allowed. Because there is no limiting language in proposed 117.31(b), we must presume the FAA means exceeding any one of the three cumulative limitations is forbidden. Therefore, there is an internal conflict in proposed section 117.31; crewmembers are permitted on the one hand to continue out of an unsafe area if they will exceed their flight duty period in Table B but if the outbound flight would exceed the crewmember's maximum duty, flight time, or flight duty period cumulative limits, the crewmembers must stay in the unsafe area? This result contradicts

---

[117] Response to Clarifying Questions, p. 24.

[118] *Id.*

[119] *Id.* p. 25.

[120] Proposed 117.31(b).

the purpose of the proposal as stated by the agency, and could put crewmembers' lives in jeopardy.

In addition, ATA's members object to the use of the term "unsafe areas" because it falsely implies that a carrier would intentionally operate in an area that is unsafe. This term is also inconsistent with the intent of proposed 117.23. We suggest that, instead of the term "unsafe areas," the proposal use the more accurate term "Areas Not Suitable for Rest."

IV. The Proposed Rules are Fatally Flawed under Applicable Legal Standards

A. FAA's Proposal Does Not Satisfy the Requirements of Executive Order 12866

Executive Order 12866[121] requires an agency to assess both the costs and benefits of intended regulations, and propose a new regulation only after a reasoned determination that the benefits warrant the costs. E.O. 12866 at § 1(b)(6). As the FAA recognizes here, "[E.O.] 12866 directs that each Federal Agency shall propose or adopt a regulation *only* upon a reasoned determination that the benefits of the intended regulation justify its costs." 75 Fed. Reg. at 55876 (emphasis added). Executive Order 12866 also requires the agency specifically to determine whether adoption of a regulation is the best available method for achieving the regulatory objective and, so, the agency must design its regulation in the most cost effective manner (E.O. 12866 at § 1(b)(5)) and "rely on the best reasonably obtainable scientific, technical, or economic data [under the circumstances] and [t]he data should be assembled and analyzed objectively, without preconceived notions of the outcome." Report on Executive Order No. 12866, Regulatory Planning and Review, 59 Fed. Reg. at 24276-01, 24280 (May 10, 1994); *See* E.O. 12866 at § 1(b)(7).

Review of the NPRM and Regulatory Impact Analysis ("RIA") show that the FAA has failed to meet the requirements set forth of E.O. 12866 in multiple respects, as discussed below.

[121] Exec. Order No. 12,866, 58 Fed. Reg. 51735 (Sept. 30, 1993) ("E.O. 12866").

1. The Benefits of FAA's Proposals Do Not Justify their Costs

a. Benefits Analysis

As shown in detail in the accompanying Economic Impact Analysis prepared on behalf of ATA by Oliver Wyman, the Proposal is based on a faulty analysis of historical aircraft accidents. Of the 43 supposedly fatigue-related aircraft accidents considered by the FAA in concluding that its Proposal will substantially reduce the number of fatigue-related accidents, almost half (47%) are improperly classified, which means that the FAA has substantially overstated benefit value. *See* Economic Impact Analysis at ES-1. As discussed in the Economic Impact Analysis, the flaws in the FAA's benefits analysis include the following:

- The FAA classified eight out of the data set of 43 accidents and three out of the set of 22 accidents as caused by fatigue, even though the NTSB found no evidence of crew fatigue in those accidents. *Id.* at 8.
- The FAA substituted its judgment that fatigue caused or contributed to at least one flight, when other major overriding factors were found. *Id.*
- Two out of five flights categorized as late night duty fatigue are mischaracterized as such by the FAA, which used the wrong flight reference time in its analysis. *Id.* at 9.
- Six accidents involved operations non-representative of present day Part 121 flights, including Part 135 flights, single pilot Part 135 flights, and pre-1997 Part 135 flights conducting under substantially different flight time rules than required by the present Part 121. *Id.* at 9-10.
- Eight flights involved 3-person crews, which involve different fatigue risks than 2-person crews which operate a large majority of present day Part 121 flights. *Id.* at 10.[122]

Although the FAA's analysis cannot be duplicated, tested, or confirmed, what can be confirmed is that almost half of the accidents on which the FAA based its benefits analysis were misclassified. Therefore, the estimated benefit value of the Proposal is grossly overstated and

[122] The Economic Impact Analysis details other anomalies that are apparent from examining the cut of 43 accidents initially reviewed down to 22 for final benefit analysis. The FAA started from a database of 250 accidents over a 20- year period, and indicates that it reduced that number to 43 accidents, including only those where sufficient data existed to permit further analysis. However, among the "short list" of 22 accidents on which the RIA focuses, three accidents are in the original 250 database but not in the first cut of 43. *Id.* at 11.

must be reduced. *See id.* at 12-13. This does not include further analysis of whether particular sections of this proposal are related to past accidents or would prevent future accidents. This further analysis would likely reduce the benefit determination *substantially*. Because of the lack of transparency in the FAA's calculations, it was not possible for Oliver Wyman to duplicate the FAA's methodology in order to re-project NPRM benefits using corrected accident categorizations. Nevertheless, Oliver Wyman was able to estimate that correcting the FAA's erroneous accident categorizations would reduce the accident avoidance benefit by at least 40%. *Id.* at 14. This would reduce the FAA's projected benefit value of $659.4 million to a maximum of $395.6 million in current dollars. *Id.* Based on the more accurate benefit and cost numbers provided in the Economic Impact Analysis, the actual ratio of costs to benefits for the NPRM is at least 50-to-1. *Id.* at 15.

b. Cost Analysis

ATA's Economic Impact Analysis also shows that the methodology used in the RIA to assess the cost of implementing the Proposal rests on faulty assumptions and cost inputs. *Id.* at 27. Unsupportable assumptions include, but are not limited to:

- Absenteeism reductions assumed to result from fatigue management;
- Collective bargaining agreement adjustments to comply with Proposal assumed to have no cost; and
- Ability of carriers to optimize their results to reduce cost assumed without factual bases or modeling.

Id. at 27-29.

Examples of faulty cost inputs include, but are not limited to:

- Flight crew costs which are not current and do not include payroll taxes, pensions, benefits, and other significant cost elements; and
- No consideration of cancellation costs for either carriers or passengers.

Id. at 29-30. Moreover, the RIA specifically excludes the impact of cumulative limits, which have a substantial cost. *Id.* at 29.

Oliver Wyman devotes a full chapter of its report to each of the following aspects of the Proposal that the FAA has either substantially underestimated costs or ignored resultant costs all together:

- Flight time limits (Chapter 5);
- Schedule reliability (Chapter 6);
- Flight duty period extensions (Chapter 7);
- Day of operation reserve (Chapter 8);
- Cumulative duty time from short-call reserve (Chapter 9);
- Split duty (Chapter 10);
- Proposal duty tables A1 v. A2 (Chapter 11);
- Crew rest infrastructure (Chapter 12);
- Proposal implementation (Chapter 13);
- Three consecutive duty night duty limit (Chapter 14)*;* and
- Interaction of Proposal with collective bargaining agreements (Chapter 15).

The Economic Impact Analysis demonstrates that the Proposal fails to account for operational reality in the air transportation system (as also discussed in detail earlier in these Comments), ignores obvious quantifiable costs, and underestimates other substantial cost drivers associated with implementation of the NPRM. For example, the average per hour flight crew cost for commercial passenger carriers, based on DOT Form 41 data, is $297. Nevertheless, the FAA assumes that it is only $129. *Id.* at 30. The disparity between the FAA's assumed crew costs and DOT published costs for all other types of carriers is equally great. The FAA included no potential flight cancellations or associated costs from implementation in its RIA, notwithstanding the fact that such cost data is readily available in the DOT's own Final Regulatory Impact Analysis of Rulemaking on Enhanced Airline Passenger Protections, dated December 17, 2009. *Id.* at 30. Examples of faulty estimates and cost inputs can be found in all parts of the RIA. For instance, the RIA's estimate of the cost to install a class 1 rest facility in an aircraft is less than half of the actual cost, and the number aircraft requiring modification to accommodate rest facilities is actually over 500, some five times the number estimated by the FAA. *Id.* at 65-66.

Although the FAA estimated the nominal cost of its Proposal over a ten-year period at $1.254 billion, the Economic Impact Analysis reveals that the cost is actually over *fifteen times* more at $19.641 billion.[123] Even then, the Economic Impact Analysis only examined costs associated with a few key aspects of the NPRM; a complete analysis of the cost impacts of all aspects of the Proposal was not possible given the time constraints imposed by the FAA. We believe that, had time been available to perform such an analysis, the total estimated cost to industry would have been substantially higher. This would have resulted not only from analysis of all aspects of the NPRM, but because of the cumulative cost-multiplying effects of overregulation through the NPRM's often redundant prescriptive rules. The numerous substantial defects in the FAA's comparison of benefits and costs are fatal to the NPRM and compel withdrawal of the Proposal.

As the Economic Impact Analysis points out, even more detailed analysis could have been performed if the FAA had granted the extensions requested by ATA and others. Given the abbreviated comment period established by the FAA, certain modeling that Oliver Wyman and the carriers are capable of doing simply could not be performed on time. *Id.* at 2. Rather than granting the request of ATA and others for a brief extension of time to more fully analyze and

[123] *Id.* at 91.

comment on this complex and important Proposal, interested parties were forced to submit written questions in the docket for the FAA's consideration during the original, insufficient comment period. The sheer number of questions posted by many different stakeholders (including carriers and labor) demonstrates the grossly insufficient notice provided by the Proposal and the RIA. The FAA's responses, including clarification of topics which are direct cost drivers for ATA members, were posted in the docket on October 22, 2010, with express reference to the Flight and Rest Time Safety and Cost Analysis (Phase 3) by GRA, Incorporated (Docket ID # FAA-2009-1093-0369), which was posted simultaneously. That stale document contains information regarding pilot scheduling, accidents, and costs which might have been relevant to an FAA proposal made ten years ago when the GRA document was published, but the GRA document is now stale, given the evolution and transformation the industry has undergone in the past decade. The FAA's apparent reliance on such obviously out-dated data confirms that its Proposal is not a "reasoned determination" under Executive Order 12866, does not "rely on the best (or even relevant) reasonably obtainable scientific, technical or economic data," and is not founded upon fact and science.

Not only is the GRA document stale, it contemplates a flight and duty time regulation substantially different than the Proposal and ignores obvious costs. This is particularly problematic given that more current cost data was readily available to the FAA. Nowhere in the document does GRA consider a combination of regulations in any way comparable to the current Proposal (hard flight time limits plus Flight Duty Periods plus robust rest requirements).[124] Thus, the document, even if it were based on current data, does not appear to be instructive or useful for current purposes. The cost analysis in the document is brief (five pages), outdated, and incomplete. For example, GRA states,

---

[124] *See GRA, Inc., Flight and Rest Time Safety and Cost Analyses (Phase 3)* (2000) at Table ES-1, 1.

> Faced with any particular rulemaking scenario, individual carriers would determine their own flight crewmember hiring needs by including the rulemaking scenario as a new constraint in existing flight crewmember schedule optimization algorithms. This schedule optimization software would also contain constraints derived from existing labor agreements, aircraft fleet, and other factors affecting the carrier's operations. There is no feasible way for GRA to model each of these individual carrier scheduling parameter sets to estimate new flight crewmember requirements on a carrier-by-carrier basis.

Id. at 44. Notwithstanding the acknowledgement that new algorithms and software will be necessary with new flight and duty time rules, the GRA analysis goes on to attribute no cost at all to that requirement. *Id.* at 45-47. The document allocates no costs to any of the other drivers highlighted above, as analyzed in the Economic Impact Analysis. The salary and benefits data contained in the GRA report are from 1994 and 1995, respectively; thus, the FAA relied on 15 and 16-year old data in a 10-year old report in order to promulgate the Proposal.

The FAA could have relied on slightly more current, although still stale, data if it had relied on another GRA document commissioned by the agency: GRA, Inc., Economic Values For FAA Investment and Regulatory Decisions, A Guide (2005). Reliance on the second GRA report would have enabled the agency to attribute at least some costs to elements of the Proposal. The RIA allocates no cost at all to cancelled flights, either to the carriers or to their passengers and shippers. Yet, the second GRA report devotes a section to the value of passenger time in air travel. *Id.* at 1-1. Another section observes that the "utilization of available capacity affects the benefits and costs that accrue directly to aircraft operators and indirectly to users and society," and goes on to analyze capacity by load factor, block time, airborne time, and cargo tonnage. *Id.* at 3-1. Regardless of the perspective from which the matter is viewed, time is money, and a cancelled flight costs carriers, shippers, and passengers, but the RIA fails to acknowledge that fact.

2. The FAA Concedes Its Proposal Is Not Based on Scientific, Technical, or Other Information

The FAA admits that "sleep science has not been validated in the aviation context" (75 Fed. Reg. at 55861), and, many of the FAA's proposals in this rulemaking lack scientific, technical or other support. For example, as the FAA recognizes "there is no evidence that flying multiple segments is more fatiguing than flying one or two segments per duty period" and "[m]uch of the available science about [whether multiple takeoffs and landings are more fatiguing] is based on laboratory studies, with exceptionally limited validation in the aviation context." 75 Fed. Reg. at 55858, 55860. Moreover, the FAA adopted a conservative approach to FDP limits "because [FAA] has little experience with this type of regulatory regime." *Id*. at 55860. Similarly, the FAA took a conservative approach with respect to cumulative duty periods while recognizing that "Some conclusions are based on experiments in sleep labs, and there is limited data either supporting or refuting that the amount of cumulative duty has a direct effect on cumulative fatigue." *Id*. at 55871.

3. The FAA Has Not Assessed Alternatives

The FAA's rejection of the alternatives it "considered" in the Proposal contravenes the regulatory philosophy articulated in E.O. 12866:

> In deciding whether and how to regulate, agencies should 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. Further, in choosing among alternative regulatory approaches, agencies should select those approaches that maximize net benefits (including potential economic, environmental, public health and safety, and other advantages; distributive impacts; and equity), unless a statute requires another regulatory approach.[125]

[125] E.O. 12866 at § 1.

The FAA has failed to comply with any of these principles. The agency's "one-size fits all" proposal does not consider other approaches or the unique needs of individual carriers or types of operations. Nor has it properly evaluated alternatives to the proposed regulations.

4. The Proposed Rule Is Unduly Burdensome

Failure to identify and assess available alternatives also violates the mandate of E.O. 12866 at § 1(b)(3), as well as the Regulatory Flexibility Act, which is discussed below. Additionally, FAA's failure to tailor the proposals here so that they impose the least burden on society, including passengers, businesses of differing sizes, and other entities, consistent with obtaining the regulatory objectives, runs counter to E.O. 12866 at § 1(b)(11). As explained in Section I, the FAA's "one-size fits all" approach, 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. The FAA has also failed to consider in each case alternative means of regulation, including the option of not regulating.

In sum, the Proposal does not meet the requirements of E.O. 12866 and should not be finalized. At a minimum, the FAA must withdraw the current rule and rewrite the RIA with a view to restarting the notice and comment period on a regulatory analysis that meets the standards of E.O. 12866.

B. The Proposed Rule is Arbitrary and Capricious

Pursuant to the Administrative Procedure Act ("APA"), "The reviewing court shall . . . . hold unlawful and set aside agency action, findings, and conclusions" if they are "arbitrary, capricious, an abuse of discretion, or otherwise not in accordance with law." 5 U.S.C. § 706(2)(A) (2010). The FAA's proposal is arbitrary and capricious on numerous grounds and would not survive scrutiny under this standard.

When the Supreme Court ruled that the National Highway Traffic Safety Administration's rescission of a passive restraint requirement for automobiles was "arbitrary and capricious," the Court explained:

> [T]he agency must examine the relevant data and articulate a satisfactory explanation for its action including a "rational connection between the facts found and the choice made." *Burlington Truck Lines v. United States*, 371 U.S. 156, 168, 83 S.Ct. 239, 245-246, 9 L.Ed.2d 207 (1962) . In reviewing that explanation, we must "consider whether the decision was based on a consideration of the relevant factors and whether there has been a clear error of judgment." *Bowman Transp. Inc. v. Arkansas-Best Freight System, supra,* 419 U.S., at 285, 95 S.Ct., at 442; *Citizens to Preserve Overton Park v. Volpe, supra,* 401 U.S., at 416, 91 S.Ct., at 823. Normally, an agency rule would be arbitrary and capricious if the agency has relied on factors which Congress has not intended it to consider, entirely failed to consider an important aspect of the problem, offered an explanation for its decision that runs counter to the evidence before the agency, or is so implausible that it could not be ascribed to a difference in view or the product of agency expertise.

Motor Vehicle Mfrs. Ass'n v. State Farm Auto. Ins., 463 U.S. 29, 43 (1983). Other courts have reversed FAA actions taken on asserted safety grounds under this standard. *E.g., Safe Extensions, Inc. v. FAA*, 509 F.3d 593, 606 (D.C. Cir. 2007) (reversing FAA's decision under the agency's authority in 49 U.S.C. § 44701(a) to treat fixed and adjustable products differently as "arbitrary and capricious" where the decision "finds no support in the evidence the agency considered"); *Nat'l Parks & Conservation Ass'n v. FAA*, 998 F.2d 1523, 1532 (10th Cir. 1993) (reversing the FAA's determination on "no significant impact on the recreational use of the area" where the agency acknowledged "[n]ot much research has been conducted" and "substituted its subjective evaluation for that of recreational users instead of attempting to ascertain the actual impact on the users themselves"); *Rocky Mountain Helicopters v. FAA*, 975 F.2d 736 (10th Cir. 1992) (reversing the FAA decision that removal and replacement of oxygen cylinders could only be performed by certified mechanics as arbitrary and capricious where "the record contains no adequate explanation for" such a requirement).

A final rule based on the proposal here would fail the applicable "arbitrary and capricious test" and would likely be reversed by a reviewing court on multiple grounds. Many sections of the NPRM contain prescriptive requirements that are redundant and unjustified in light of the other mitigations contained in the proposal. The result is costly overregulation with no discernable benefit, which is, therefore, arbitrary and capricious. Moreover, many sections of the NPRM fail because they are illogical, not based in science, are unreasonable and/or vague and ambiguous on their face, and disregard operational reality. Such proposals include, for example and without limitation, the following:

- The FAA provides no explanation or justification for why flight time limits are necessary when flight duty period and rest schemes are in place. There *is* no rational basis for the proposed flight time limits in Section 117.13, and no international or other precedent for imposing daily flight time limits coupled with a Flight Duty Period and required rest schemes. Indeed the FAA proposal selectively includes the most restrictive FDP standard in CAP 371 (the United Kingdom standard) and then adds inflexible daily flight time limits without citing any scientific evidence supporting such an extreme measure. *See* Section III(A) above.

- The inflexible daily flight time limits by themselves are operationally unsound and inconsistent with international standards adopted by the United Kingdom and the European Union. The daily flight time limits in Table A of the NPRM are also incompatible with the stated Flight Duty Periods. Such inflexible daily flight time limits would require air carriers to build in "buffers" that nullify Table A times, drastically increase U.S. carrier costs and put U.S. carriers at a competitive disadvantage with foreign carriers. *See* Section E below.

- Such inflexible flight time limits would cause significant scheduling problems for carriers on a daily basis. To the extent crews exceeded those limits during their otherwise legal Flight Duty Period, carriers would have to find other available flight crews to operate as substitutes on the next leg or return trip, either by bringing in new pilots from other bases or having them pre-positioned around their route system to cover such contingencies. In addition to further increasing U.S. carrier costs, daily flight time limits would greatly inconvenience passengers who would be delayed or stranded while substitute crews are assembled and moved into place. *See* Section III(A) above.

- The Proposal's limitations on extensions of daily FDPs are operationally unsound, without scientific support, or other FAA justification would result in substantial delays, cancellations, and problems related to recovery, and are is contrary to several ARC recommendations. They would also result in substantial unjustified costs to the carriers and are unnecessary in light of the other mitigations contained in the NPRM.

The sole permissible circumstance that the NPRM identifies for FDP extensions, "unforeseen circumstances," is vague and ambiguous.

- The FAA provided no justification or analysis and no rational basis exists for the classification of "short call reserve" as duty, which is arbitrary, capricious, unsupported by science, inconsistent with FAA's own proposed treatment of rest for deadhead, and overly restrictive. *See* Section III(C) above.

- FAA's proposal to limit credit for a rest opportunity during a split duty period only when the crewmember receives a minimum of 4 hours rest is contrary to science. It is also arbitrary, counter-intuitive and operationally unsound and not justified or explained in the Proposal. Equally unsound, counter-intuitive, and contrary to operational experience is FAA's apparent conclusion that rest received on the ground is less valuable than that obtained in the air. It cannot be squared with the FAA's requirement that a required "rest period" may only be spent in a "suitable accommodation" and not in an aircraft, leading to the inescapable conclusion that rest on the ground is more valuable than that obtained in the air. *See* Section III(E) above.

- FDP limits for unaugmented operations in Table B of the proposal are not based in science and are problematic and unreasonable. *See* Section III(G) above.

- The "three consecutive night" duty limit in Section 117.27 is also vague and ambiguous, operationally unsound, and ignores industry experience, acknowledged by the FAA, showing an adverse safety impact from adding more first night flights that would necessarily result from this aspect of the Proposal. *See* Section III(J) above.

- The FAA's requirement that actual FDPs meet scheduled FDPs 95% of the time has no connection to fatigue or safety, and inclusion of this unsound requirement is an arbitrary and disingenuous attempt to accomplish unrelated objectives already regulated elsewhere by DOT. *See* Section III(D) above.

- The "fitness for duty" requirement in Section 117.5 seeks to force carriers to perform "on the spot" tests at stations around the world that currently do not exist. It is unworkable and problematic, because it requires operational personnel to make judgments apparently requiring medical or paramedical training.

- The FAA failed to sufficiently consider less burdensome alternatives.

As a result, proposed rule would likely be overturned by a reviewing court unless it is revised consistent with ATA recommendations in these Comments.

C. The Proposed Rule Is An Abuse of Discretion And Exceeds The FAA's Authority

Under the APA, "The reviewing court shall . . . hold unlawful and set aside agency action . . . found to be . . . in excess of statutory jurisdiction, authority, or limitations." 5 U.S.C. § 706.

In this NPRM, the FAA invokes its authority under 49 U.S.C. § 44701, 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."[126] (emphasis added). More specifically, 49 U.S.C. § 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 . . . ." (emphasis added). Section 212 of the Airline Safety and Federal Aviation Extension Act also directs the FAA to issue regulations "that are based on the best science." As shown throughout these comments, however, FAA's Proposal includes requirements that lack scientific support and will not enhance either safety or national security. Thus, adopting invalidated measures in the name of safety is beyond the scope of the FAA's safety authority, and is another reason the pending proposal would likely be overturned by a reviewing court unless it is significantly revised. *See generally, Transohio Sav. Bank v. Director, Office of Thrift Supervision*, 967 F.2d 598, 621 (D.C. Cir. 1992) ("[a]gency actions beyond delegated authority are 'ultra vires' and courts must invalidate them"). In *Asiana Airlines v. FAA*, for example, the court found that the FAA exceeded its authority to collect overflight fees by basing fees on value to recipient of services provided rather than costs. *Asiana Airlines v. FAA*, 134 F.3d 393 (D.C. Cir. 1998).[127]

The FAA has failed to provide any record justification for the numerous propositions outlined above and contained elsewhere in the Proposal. The FAA has simply assumed or concluded that its proposals are required to enhance safety, but simply saying it does not make it so. Similarly, simply throwing the "cloak of safety" over a concept in the absence of supporting data or science does not meet the requirements of the law and will not survive judicial scrutiny.

[126] 75 Fed. Reg. at 55852.

[127] *Cf. Southwest Airlines, Co. v. TSA*, 554 F.3d 1065 (D.C. Cir. 2009) (TSA had authority to impose aviation and security infrastructure fee ("ASIF") amounts but violated the plain meaning of the Aviation and Transportation Security Act's overall limits by including costs for screening non-passengers in its estimated costs).

The FAA has a duty to examine the relevant data and articulate a satisfactory explanation for its proposed action demonstrating a rational connection between the facts found and the choice made. It has not done so; and, too, the FAA has overlooked or chosen to ignore well-established countervailing science and data (as discussed herein).

As a result, the FAA has exceeded the limits of its discretion to address aviation safety. It has not provided any factual or scientific basis for many of its proposals, and it has failed to adequately explain how it arrived at its conclusions. Interested parties must guess at the FAA's reasoning or supporting data, if any. As Mr. Justice Black recognized, "[u]nless we make the requirements for administrative action strict and demanding, expertise, the strength of modern government, can become a monster which rules with no practical limits on its discretion…" *New York v. United States,* 342 U.S. 882, 884 (1951) (Black, J., dissenting). Moreover, to survive an abuse of discretion challenge, a federal agency must "disclose the basis of its order" and "give clear indication that it has exercised the discretion with which Congress has empowered it." *Burlington Truck Lines v. United States,* 371 U.S. 156, 167-168 (1962), *citing Phelps Dodge Corp. v. Labor Board,* 313 U.S. 177, 197 (1941). "The agency must make findings that support its decision, and those findings must be supported by substantial evidence." *Id*. at 168, *citing Interstate Commerce Comm'n v. J-T Transport Co.*, 368 U.S. 81, 93 (1961).

Having failed in this fundamental regard, the FAA should withdraw or at the very least substantially revise the Proposal to comport with the requirements of law and reissue it for comment.

ATA's members support continued vigilance by the government and improvement by the industry with respect to pilot performance and well-crafted, data-driven, science-based rules directed at mitigating fatigue. Indeed, ATA members have for many years voluntarily instituted measures that far exceed regulatory requirements, often at substantial expense, to address pilot fatigue. What ATA members do not support, however, is a fundamentally flawed proposal imposed after a hasty and politically charged process that disregards even the basic tenets of administrative procedure. Without science to support it, thorough consideration of all issues and a full and fair opportunity for stakeholders to comment, the new regulation should not be imposed.

D. The FAA Has Not Provided a Meaningful Opportunity for Stakeholders to Comment on Its Proposed Rule

1. The FAA Failed to Provide Sufficient Time for Comments on Its Complex Proposal

By limiting the amount of time provided to comment on this complex rulemaking to 60 days from issuance of the NPRM, denying stakeholder requests for a 30-day extension of the comment period, providing only a partial response to stakeholder requests for clarification and then less than 30 days before the comment due date, the FAA has denied interested parties a meaningful opportunity to comment on its complex proposals, in violation of fundamental principles of agency rulemaking. *See* 5 U.S.C. § 553, 706(2)(D) (2010). The agency's notice denying requests of seven industry stakeholders indicates that the FAA's decision to deny those requests was, in light of the Airline Safety and Federal Aviation Administration Extension Act of 2010, "that the FAA issue a final rule on pilot fatigue by August 1, 2011." Response to requests for a comment period extension, 75 Fed. Reg. 63424-01, 63425 (Oct. 15, 2010).

Sixty days from issuing its proposed rule and only 24 days after providing an incomplete clarification does not provide sufficient time to for stakeholders to digest and comment on the proposed rule in this proceeding. Indeed, it took the FAA itself almost 20 years to develop the proposed rules, given the complexity of the issues. As ATA explained in its request for an extension:

> The NPRM and associated regulatory documents are extensive and complex. . . . The NPRM is 145 pages and amounts to a complete rewrite of existing FAA regulations and legal interpretations on flight crew member duty and rest. The Regulatory Impact Analysis (RIA) is another 145 pages, including a vast number of assumptions that all parties will have to closely scrutinize to ensure that FAA

> captures the costs and benefits of this proposal. The FAA also issued three draft Advisory Circulars for comment that are integral to an overall flight crew duty and rest system. This does not include a number of documents the FAA relied on in formulating this NPRM, such as the ARC recommendations, foreign government regulatory schemes such as the United Kingdom's "CAP 371" and the European Union's "Subpart Q" and a Dutch study on flight duty periods."[128]

Contrary to the FAA's conclusion, the existence of the rushed ARC (see 75 Fed. Reg. at 63425) does not justify the denial of the extension requests. Participation through the ARC was limited and far shorter than most ARCs established by the agency,[129] not to mention the fact that the NPRM contains provisions related to subjects not considered by the ARC, including provisions related to short call reserve status and limits on FDP extensions that the ARC did not even discuss.

Furthermore, as indicated by the numerous requests for clarification, the Proposal contains key provisions that are unclear, inconsistent or require additional FAA information and explanation before interested parties can complete their analysis and comment fully on the NPRM. It was not until October 22, 2010 that the FAA provided a response to industry questions, and that response failed to address most of the questions posed that are essential to stakeholders providing meaningful comments on the impact of this proposal.

---

[128] Request To Extend Public Comment Period, Docket No. FAA-2009-1093, filed by ATA, Air Carrier Association of America and Regional Airline Association (Sept. 29, 2010).

[129] As the FAA notes in the NPRM, "FAA began considering changing its existing flight, duty and rest regulations in *June 1992*, when it announced the tasking of the Aviation Rulemaking Advisory Committee (ARAC) Flightcrew Member Flight/Duty Rest Requirements working group [which] submitted a final report in *June 1994*." 75 Fed. Reg. at 55853 (emphasis added). In 2007, the FAA formed a two-year ARC to examine Operations Specifications applicable to foreign carriers operating in the U.S. and determine if regulatory amendments are necessary. See FAA Order 1110.146, March 5, 2007. Also in 2007, the FAA chartered a two-year Takeoff/Landing Performance Assessment ARC. *See* FAA Order 1110.149, October 12, 2007. In 2006, the FAA established a two-year ARC examining Amateur Built Aircraft and subsequently reconvened the ARC for an additional 6 months. *See* FAA Orders 1110.143, 1110.143A.

In short, the FAA has failed to provide the opportunity for comment on its proposal that is fundamental under the APA, and any final rule based on that Proposal will be fatally defective on due process grounds.[130]

2. The Rulemaking Record Is Fatally Flawed

Just as interested parties have been deprived a meaningful opportunity to comment by a comment period that is too short, the FAA's failure to provide the public with access to certain materials it has relied on has also made meaningful comment on the proposal impossible. "Among the information that must be revealed for public evaluation are the 'technical studies and data' upon which the agency [relies in its rulemaking]."[131] For example, as discussed in the Oliver Wyman report, the RIA failed to include an analysis of how the FAA made the determination to include accidents as relevant to this rulemaking, including any explanation of how the specific items proposed in this NPRM would address or prevent prior accidents. As Oliver Wyman notes, there are four distinct categories of accidents in the RIA, which are in some instances overlapping, in others completely separate. Without further information from the FAA on how and why it included certain accidents in its analysis, it is extremely difficult to determine the benefits of this rulemaking.

E. The Proposed Rules Violate the Department's Policy of Strengthening the Competitive Position of U.S. Air Carriers and Assuring Parity with Foreign Air Carriers

By deviating from existing international standards and imposing requirements on U.S. air carriers that increase their costs, the FAA runs afoul of several fundamental aviation policies.

---

130 As *Florida Power & Light v. United States*, 846 F.2d 765, 771 (D.C. Cir. 1988) explains, "notice must not only give adequate time for comments, but also must provide sufficient factual detail and rationale for the rule to permit interested parties to comment meaningfully" (citing *Connecticut Light & Power Co. v. NRC*, 673 F.2d 525, 530-31 (D.C. Cir. 1982), *cert. denied*, 459 U.S. 835, 103 S.Ct. 79, 74 L.Ed.2d 76 (1982); *Home Box Office, Inc. v. FCC*, 567 F.2d 9, 35 (D.C. Cir. 1977), *cert. denied*, 434 U.S. 829, 98 S.Ct. 111, 54 L.Ed.2d 89 (1977)).

131 *See, e.g.*, *American Radio Relay League, Inc. v. FCC*, 524 F.3d 227, 236 (D.C. Cir. 2008) *(citing Chamber of Commerce v. SEC*, 443 F.2d 890, 899 (D.C. Cir. 2006).

Finalizing the proposed rules as written would undermine the ability of U.S. carriers to compete on equal terms with foreign carriers, contrary to longstanding policy objectives under the aviation statute with no demonstrable safety benefit.

The Secretary of Transportation has a statutory mandate to consider "as being in the public interest . . . strengthening the competitive position of air carriers to at least ensure equality with foreign air carriers, including the attainment of the opportunity for air carriers to maintain and increase their profitability in foreign air transportation." 49 U.S.C. § 40101(a)(15). The importance of this goal is underscored by the corresponding statutory mandate that the Secretaries of Transportation and State develop a negotiating policy aimed at "strengthening the competitive position of air carriers to ensure at least equality with foreign air carriers, including the attainment of the opportunity for air carriers to maintain and increase their profit ability in foreign air transportation." 49 U.S.C.§ 40101(e)(1) (2010).

As the FAA stated recently in the context of the slot program:

> Congress did not exclude the Administrator from considering the "public interest to include factors beyond "safety," "national defense" and "security." Rather, Congress expressly directed the Administrator to consider those matters "among others." . . .The "public interest" includes policies furthering airline competition, as provided in 49 U.S.C. 40101(a)(4), (6), (9), (10), (12)-(13) and (d). These goals have been public policy since at least the time of adoption of the Airline Deregulation Act of 1978 . . . , and they include (among others) maximizing reliance on competitive market forces; avoiding unreasonable industry concentration and excessive market domination; and encouraging entry into air transportation markets by new carriers.

Notice on Petition for Waiver of the Terms of the Order Limiting Scheduled Operations at LaGuardia Airport, 75 Fed. Reg. 26322-01, 26325 (May 11, 2010).

Here the hard daily flight time limits and the inability to reschedule a flightcrew member beyond their original schedule in the Proposal apply only to U.S. carriers. Those limits do not apply to foreign air carriers and are not encompassed in either United Kingdom or EU standards. As shown above, these flight time limits will drastically increase costs for U.S. carriers without increasing safety. As a result, the Proposal would create a tilted playing field, undermining the ability of U.S. carriers to compete on equal terms with foreign flag carriers who would not incur the same costs and burdens of the NPRM, all for no safety benefit. Such a result would be bad for U.S. carriers employees, communities, and the U.S. economy. Numerous and varied stakeholders benefit from a financially viable, competitive U.S. airline industry, including airline and aerospace workers, hub cities, spoke communities, small businesses, corporate America, aviation suppliers, air travelers and shippers, U.S. travel and tourism, and the national defense.

Consistent with Federal aviation policy, the FAA has a legal duty to give U.S. carriers a level playing field with their foreign competitors and not – as with FAA's proposal here – stack the deck against U.S. carriers (and the U.S. economy) without any safety benefit. For this in addition to the other reasons cited, the proposal should be withdrawn.

F. The Proposal Disregards the Trade Agreements Act of 1979 and OMB Circular A-119

Just as the FAA's proposed rule is antithetical to longstanding aviation policy, it also violates the Trade Agreements Act of 1979 and disregards directives in OMB Circular A-119.

1. Imposition of Flight Time Limits Is Inconsistent with International Standards

As the FAA recognizes in the preamble of the proposed rule, "the Trade Agreements Act . . . *prohibits* agencies from setting standards that create unnecessary obstacles to the foreign commerce of the United States" and "*requires* agencies to consider international standards and, where appropriate, that they be the basis of U.S. standards." 75 Fed. Reg. at 55876 (emphasis added). Similarly, OMB Circular A-119, which is not mentioned in the preamble, directs FAA to "consider international standards in procurement and regulatory applications." OMB Circular A-119 § h and i. Inclusion of flight time limits in the Proposal violates both the Trade Agreements Act and OMB Circular A-119.

As discussed, most modern aviation authorities (*e.g.*, EU Subpart Q and CAP-371) impose daily flight duty period limits without imposing daily flight time (block time) limits. FDP limits are based on a crewmember's Circadian rhythm, time zone and number of legs. By deviating from these existing international standards and imposing additional hard daily flight time limits as well, the FAA's proposal violates principles of the Trade Agreements Act of 1979[132] and directives of OMB Circular A-119, in addition to the aviation policies outlined above in Section III(F). The daily flight time limits included in the Proposal impose high costs on U.S. air carriers without any scientific or other justification and should be removed from the Proposal.

2. The FAA Should Have Relied on Voluntary Consensus Standards

OMB Circular 119-A also requires federal agencies such as the FAA to use voluntary consensus standards in lieu of government-unique standards except where law or otherwise impractical.[133] By imposing FAA standards rather than those developed through industry consensus, the FAA runs further afoul of OMB Circular 119-A.

By its own admission, the FAA has been "considering changing its existing flight, duty and rest regulations [since] June 1992." 75 Fed. Reg. at 55853. It was not until almost 20 years later, in June 2009, that the FAA chartered the ARC "to develop recommendations for an FAA rule based on current fatigue science and a thorough review of international approaches to the issue." *Id*. The ARC met only over a 6-week period and FAA emphasized to ARC members that the agency would ultimately "evaluate any proposals and independently determine how best

[132] Trade Agreement Act of 1979, Pub. L. No. 96-39, 93 Stat. 144 (1979) (codified at 19 U.S.C. §§ 2531-2533).

[133] All federal agencies must use voluntary consensus standards in lieu of government-unique standards in their procurement and regulatory activities, except where inconsistent with law or otherwise impractical. In these circumstances, you agency must submit a report describing the reason(s) for its use of government-unique standards in lieu of voluntary consensus standards to the Office of Management and Budget (OMB) through the National Institute of Standards and Technology.

to amend the existing regulations." *Id.* The ARC's 6-week tenure was insufficient to address the complex issues covered in this rulemaking and inconsistent with the time FAA has given other working groups to reach consensus.

G. The NPRM Fails to Meet the Standards Mandated by the Information Quality Act as Implemented by DOT

The FAA's failure to disseminate useful and objective scientific evidence in support of the Proposal is a substantial deviation from the data quality standards mandated by the Information Quality Act of 2000 (the "IQA")[134] and the Department of Transportation's ("DOT's) Information Dissemination Quality Guidelines (the "Guidelines")[135] implementing the IQA. Both the IQA and the Guidelines emphasize, in no uncertain terms, that information disseminated by Federal agencies must meet defined standards of quality, objectivity, utility and integrity. Particularly in a rulemaking with the complexity and tremendous economic impacts of the present NPRM, which proposes to dismantle the existing scheduling practices of every major U.S. airline, the quality of the information disseminated and relied upon by the government is a critical consideration.[136] Despite 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 crewmember flight and duty time limitations and rest requirements. Had the FAA weighed the quality of the information it disseminated in the NPRM

---

[134] Consolidated Appropriations – FY 2001, Pub. L. No. 106-554, § 515(a), 114 Stat. 2763 (2000). Section 515, known as the Information Quality Act, required the Office of Management and Budget to promulgate guidance to agencies ensuring the quality, objectivity, utility, and integrity of information (including statistical information) disseminated by Federal agencies. OMB's Guidelines for Ensuring and Maximizing the Quality, Objectivity, Utility, and Integrity of Information Disseminated by Federal Agencies were finalized in 2002. *See* Guidelines for Ensuring and Maximizing the Quality, Objectivity, Utility, and Integrity of Information Disseminated by Federal Agencies; Republication, 67 Fed. Reg. at8452-01 (Feb. 22, 2002). Section 515 also required Federal agencies to publish their own agency specific guidelines no later than one year after OMB's guidelines.

[135] *See* 67 Fed. Reg. at 61719 (Oct. 1, 2002).

[136] The U.S. Court of Appeals for the District of Columbia Circuit recently acknowledged the general applicability of the Information Quality Act in *Prime Time Intern. Co. v. Vilsack*, 599 F.3d 678 (D.C. Cir. 2010).

against the standards contained in DOT's Guidelines,[137] it would have concluded that the information does not justify the Proposal and its corresponding impact on the airline industry with no safety benefit.

The substantive requirements of the Guidelines, which "apply to information in rulemakings just as they do to other information,"[138] derive from DOT's overarching mandate to "[ensure] the quality of disseminated information."[139] The operative term is "quality" which, according to the Guidelines, includes utility, objectivity and integrity.[140] The Guidelines characterize utility as the "usefulness" of the information; objectivity as the extent to which the information is "accurate, clear, complete, and unbiased" as to substance and presentation; and, integrity as the extent to which the information is "protected from unauthorized access, corruption, or revision."[141]

The scientific information disseminated and relied upon by the FAA is woefully inadequate, particularly as measured against the Department's heightened standards for influential scientific information. The DOT Guidelines advise that influential scientific information disseminated as part of an analysis of the risks to human health, safety, and the environment – which would clearly encompass an analysis of the effects of pilot fatigue on the safety of the U.S. traveling public – should:

---

[137] The Guidelines list the FAA as one of the many modal agencies to which the Department's guidelines apply. *See* Guidelines at 12.

[138] The Guidelines apply not only to information that the Department generates, but also to information that other parties provide to the Department, if the other parties seek to have the Department rely upon or disseminate this information. Specifically, the Guidelines clarify that "the substantive requirements of the guidelines (objectivity, integrity, etc.) apply to information in rulemakings just as they do to other information" and "…what we have adopted in these final guidelines, is a provision that does apply the guidelines to docketed material, if and when the Department uses and disseminates the material." Guidelines at 4-5.

[139] *Id*. at 1.

[140] *Id*. at 15.

[141] *Id*. at 15-17.

- Use the best available science and supporting studies conducted in accordance with sound and objective scientific practices, including peer-reviewed studies where available.

- Use data collected by accepted methods or best available methods (if the reliability of the method and the nature of the decision justifies the use of the data).

- In the dissemination of influential scientific information about risks, ensure that the presentation of information is comprehensive, informative, and understandable. In a document made available to the public, specify, to the extent practicable:

    - Each population addressed by any estimate of applicable effects.

    - The expected risk or central estimate of risk for the specific populations affected.

    - Each appropriate upper bound or lower-bound estimate of risk.

    - Each significant uncertainty identified in the process of the risk assessment and studies that would assist in reducing the uncertainty.

    - Any additional studies, including peer-reviewed studies, known to the agency that support, are directly relevant to, or fail to support the findings of the assessment and the methodology used to reconcile inconsistencies in the scientific data.

The information evaluated and disseminated in the NPRM fails to meet this standard. Nor could it, since, as the FAA itself concedes, "sleep science has not been validated in the aviation context," 75 Fed. Reg. at 55861. Rather than basing its proposed rules on the best available science, the FAA has presented a Proposal that is based on very little to no science.

Although the Guidelines are not themselves binding regulations, they establish authoritative data quality standards against which information disseminated and relied upon must be measured. By contrast, the information disseminated and relied upon by the FAA in this proposed rulemaking is woefully incomplete, vague, inaccurate, subjective and biased; it is unworthy as the basis for agency action per se, much less for a rulemaking of such critical significance to aviation safety and the continued viability of the domestic aviation industry. Therefore, the NPRM should be withdrawn.

H. The NPRM Violates the Regulatory Flexibility Act

The inadequacy of FAA's regulatory review is highlighted by the preamble's discussion of potential alternatives considered "to mitigate or eliminate significant economic impacts on small entities" pursuant to the mandate of the Regulatory Flexibility Act ("RFA"). *Id*. at 55882. The RFA requires Federal agencies to prepare and make available for public comment an initial regulatory flexibility analysis and assessment of the impact of a proposed rule on small business entities and emphasizes responsible, targeted and less onerous agency rulemaking. The FAA considered only three alternatives for RFA purposes: (1) maintaining the status quo, which was rejected solely because it was thought to result in an "unacceptably high aviation accident risk;" (2) extending the compliance time, which was rejected because it "extends this [perceived] risk;" and (3) expanding the proposal to include Part 135 operators, rejected because the agency wants to study the effects on small entities further before doing so. *Id*. at 55882. These alternatives are given such short shrift in the preamble that it is clear they did not receive serious consideration. In one sentence that cites no statistics or science, the FAA rejected maintaining the status quo because is "subjects the society to an unacceptably high aviation accident risk." *Id*. Likewise the second or "extension" alternative is not a true alternative, since it would simply delay the implementation date; and once again, this so-called alternative is summarily rejected without science, statistics or an evaluation of the benefits versus costs; finally the third alternative, which the FAA still might adopt, is neither less burdensome nor a meaningful alternative to FAA's proposal.

I. The Proposal is Contrary to the Public Interest

As shown above, the FAA Proposal is contrary to the public interest and will not only adversely affect U.S. airlines and the travelers and shippers that depend on them but – more fundamentally – will also harm the U.S. economy and threaten U.S. national security without increasing safety. For example and without limitation, the Proposal will:

-- *Lead to Loss of Jobs Without Increasing Safety*. According to FAA figures, commercial aviation drives nearly 11 million U.S. jobs.[142] A strong, competitive U.S. airline industry fuels U.S. jobs and growth. By significantly harming the financial position of U.S. airlines and reducing their ability to compete with foreign airlines, the Proposal puts millions of U.S. jobs at risk when the country can least afford it without increasing safety

--*Harm the U.S. Economy Without Increasing Safety.* The excessive costs imposed on airlines by the Proposal will translate into higher airline fares, higher shipping costs and increases in the costs the U.S. public must pay for U.S.-produced products without increasing safety.

--*Harm Air Passengers and the National Air Transportation System Without Increasing Safety.* Insufficiently evaluated in this proposal is the loss of air passenger time that the proposal implies. Increased flight time to meet performance standards; flight cancellations on short notice; disruption of network efficiencies and consequent longer travel time for one or more stop itineraries; suboptimal flight timings arising from service reduction to meet performance standards; downstream effects on passengers whose travel plans are cancelled or delayed by delay; or cancellation of a crew's previous leg all imply massive costs of lost time to hundreds of millions of U.S. passengers annually. The Department has shown itself to be highly sensitive to passengers' time, notably in its general monitoring of flight performance statistics, cancellations and tarmac delay. The present proposal, however, threatens to undermine passenger service. DHS in various rulemakings has quantified the value of passenger time imposed by its regulations; the FAA must do the same here.

--*Prevent U.S. Airlines from Meeting Critical Service Demands Without Increasing Safety.* The loss of operational robustness and delay of flights caused by the proposed

---

[142] FAA, "The Economic Impact of Civil Aviation on the U.S. Economy," 21 (Dec. 2009), http://www.faa.gov/air_traffic/publications/media/FAA_Economic_Impact_Rpt_2009.pdf.

regulations will prevent U.S. airlines from meeting critical delivery requirements of life-saving shipments and potentially lead to the destruction of perishable shipments without increasing safety. Further, ours is now a "just in time delivery" and "supply chain management" economy. Businesses of all kinds avoid the unnecessary costs associated with storage and management of huge inventories of supplies, parts, and goods of all types. Raw materials, parts, and assemblies move constantly and repeatedly before the end product is finished. Manufacturers and end users alike rely on a precise choreography among all transportation modes running on synchronized schedules to ensure final delivery on time and on budget. All of this will be adversely impacted by the Proposal without any discernible safety benefit in return.

--*Disrupt the U.S. Air Transportation System Without Increasing Safety*. Inflexible daily flight limits and other features of the Proposal threaten to disrupt the U.S. air transportation system without increasing safety. As discussed in detail elsewhere herein, the Proposal evidences a profound lack of understanding of the operational requirements of moving passengers and goods around the system on schedule. The inflexibility of the Proposal will certainly result in delayed and cancelled flights, passengers, and shipments without increasing safety. It likely will cause domino-effect repercussions throughout the air transportation system and the U.S. economy as a whole. Delays and cancellations are bad for the traveling public, bad for business, and bad for the economy overall. Time is money, and the costs associated with this Proposal's inflexible daily flight limits will be substantial, with no demonstrable safety benefit.

Even more fundamentally, the flawed process pursuant to which this Proposal has been developed has yielded a result unsupported by the best available data or science. The public depends on its government to follow existing law and regulations in developing new ones, and the government owes them that duty. In this instance, however, many aspects of the Proposal are not backed by any science or data, let alone the best available. As discussed above, the process was rushed to begin with and multiple requests for an extension of time to provide substantive comments were denied. Interested parties were not permitted sufficient time to fully analyze the Proposal's many complex provisions or perfect their own alternatives. On its face, the Proposal is incomplete and ambiguous, asking at least as many fundamental questions as the number of conclusions it draws. It is not surprising then that the Proposal contains competing mandates that cannot be reconciled with real-world operations as well as requirements that impede, rather than improve, safety. Costs will be substantial. The benefit to safety, if any there may be, will be tiny by comparison. It is thus clear that the public interest has not been served procedurally, nor will it be served substantively if this Proposal is implemented as presented.

In view of these grave and pervasive negative consequences, and in the absence of science supporting the FAA Proposal, the NPRM should be withdrawn.

V. CONCLUSION

For all of the reasons discussed above, the NPRM should be withdrawn and revised. Once revised, FAA should publish a Supplemental Notice of Proposed Rulemaking and a new Regulatory Impact Analysis, and allow interested parties a meaningful opportunity to comment on both.

Respectfully submitted,

AIR TRANSPORT ASSOCIATION OF AMERICA, INC.

David A. Berg
Vice President & General Counsel
dberg@airlines.org

Douglas K. Mullen
Senior Attorney
dmullen@airlines.org

November 15, 2010

Attachment 1

Scientific Issues Regarding NPRM

Gregory Belenky, M.D. and R. Curtis Graeber, Ph.D.
November 5, 2010

General Comments:

While the principles of sleep science are generally well understood and accepted, their practical application to any operational environment, including aviation, is very much a work in progress. The reason is that such environments typically involve extended work hours, work through the circadian trough, and/or 24x7 operations. Because fatigue is the result of the interaction of sleep/wake history, circadian rhythm, and workload as well as individual factors, the precision of any predictions for a specific scheduled or non-scheduled operation is challenging and limited in accuracy.

The interaction of these three variables is complex. For example, in the first 24 hours of an operation where no sleep is possible the circadian rhythm in alertness and performance is dominant. With time awake extending beyond 24 hours, the homeostatic drive for sleep (the effect of sleep/wake history) gradually becomes more dominant displacing the importance of the circadian rhythm. Both homeostatic sleep drive, increasing with time awake, and circadian rhythm, waxing and waning in a 24 hour cycle, modulate performance and amplify the effect of workload (time on task) which can vary in intensity and complexity based on a number of operational factors. Thus, fatigue is not simply the result of sleep loss but rather the interaction of sleep loss, time of day and workload. For these reasons, the specific application of sleep science in aviation is far from settled.

This is not to say that a limited number of very practical, scientifically robust, studies have been carried out in commercial flight operations by NASA and other laboratories. These studies have enabled some application of sleep science principles to specific industry uses. However, there are a significant number of practical fatigue related questions for which the science is currently limited to extrapolations and application of general sleep science principles based primarily on non-aviation research. A good example of this is the current attempt to develop mathematical models to predict performance from the three interacting factors that underlie fatigue. Integration of such models into today's "industrial strength" rostering and scheduling software will likely enable turn-key fatigue risk management as they are validated by actual flight crew data in the future.

The operational environment is one in which the performance of the human in the loop is critical. Adequate sleep, working at a favorable circadian phase and bearing a reasonable workload will sustain nominal performance. We know that fatigue degrades performance and (in the words of the USAF fighter pilot, John Boyd) the operator's ability to "observe, orient, decide, and act." The goal of the NPRM is to put together a system of regulations or, alternatively, a framework to enable the implementation of an FRMS, to manage the complex interaction between sleep loss, circadian rhythm phase, and workload in order to reduce fatigue risk by preventing error, incident, or accident. The complex interaction of three factors causing fatigue is not easily captured in a set of prescriptive rules and is in our opinion much more amenable to management by an FRMS.

In this regard it is important to note that the NPRM's definition of Fatigue is inconsistent with ICAO's proposed definition: "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." The ICAO definition captures the fatigue inducing effects of the interaction of sleep loss, circadian phase and workload and provides the scientific basis for FRM. Managing the interactive effects of sleep loss, circadian phase, and workload in commercial aviation is the purpose of the NPRM.

Comments on Specific Provisions of the NPRM:

1. FDP Extension 117.15(c)(2) restricts carriers to only one extension of 30 minutes or more in each 168 hour period.

Comment: There is clear scientific evidence that extended work hours over consecutive work days reduces the opportunity for sleep and can lead to cumulative sleep loss and fatigue. However, there is no clear scientific evidence to support restricting an extension of greater than 30 minutes and less than or equal to 2 hours to once in 7 days. A more sensible rule would be to ban extensions over consecutive duty days in order to allow recovery from a prior extension and to not allow more than two extensions within any one 168 consecutive hour period. It is our understanding that this is similar to the recommendation of the ARC.

2. Short Call 117.21(c) & 117.23(d)

Comment: Being on short-call reserve is not being on duty. Short-call reserve does not entail any significant work load. The only task the pilot has while on short-call reserve is to answer the phone and acknowledge information. Further, a short-call reserve pilot has the same, predictable rest and sleep opportunities as a regularly scheduled pilot. A short-call reserve pilot, even if he or she thought a call unlikely, would take advantage of these opportunities. Even if called while sleeping, we expect that all but the most inexperienced would fall right back to sleep as is the case in other professionals, e.g., physicians, who are on call and are called without the immediate need to do something beyond acknowledging receipt of information.

The effect of anticipating a phone call in creating anxiety and disturbing sleep we expect would be minimal. Actually receiving a call would reduce to zero any uncertainty ensuring a rapid return to good sleep subsequent to the call. By declaring being on short-call reserve as being on duty, the FAA is effectively claiming that being on short-call reserve, i.e., being available at home or in a hotel to answer the phone, is as fatiguing as flying an airplane. There is no scientific much less operational support for the claim that flight duty and short-call reserve are equivalent in terms of fatigue. In addition, there appears to be an inconsistency between the NPRM position on deadheading pilots and its position on short-call reserve pilots. For deadheading pilots with adequate on board sleeping accommodations, the NPRM allows extending the cumulative duty period limitations by up to 10 hours. In contrast, short-call reserve pilots who also have adequate sleep accommodations (home or hotel) are not allowed a similar extension.

3. Split Duty 117.17 –

Comment: In actuality the science suggests that any sleep longer than 20 min provides full minute-by-minute recuperative value (Bonnet and Arand, 2003); see Figure 2). For napping during night operations, assuming the normal adult sleep latency for that time of day of between 5 and 10 minutes, any time behind the door of more than 30 minutes would have recuperative value. The requirement that the sleep opportunity must be at least 4 hours in duration before granting an extension of duty of 50% of the time spent behind the door is not supported by the science. Any time behind the door beyond 30 min should be given the time behind the door extension credit. The 50% of the time behind the door extension credit is especially conservative for sleep obtained in a suitable rest facility on the ground during usual bedtime hours but may be warranted for split duties that require daytime sleep.

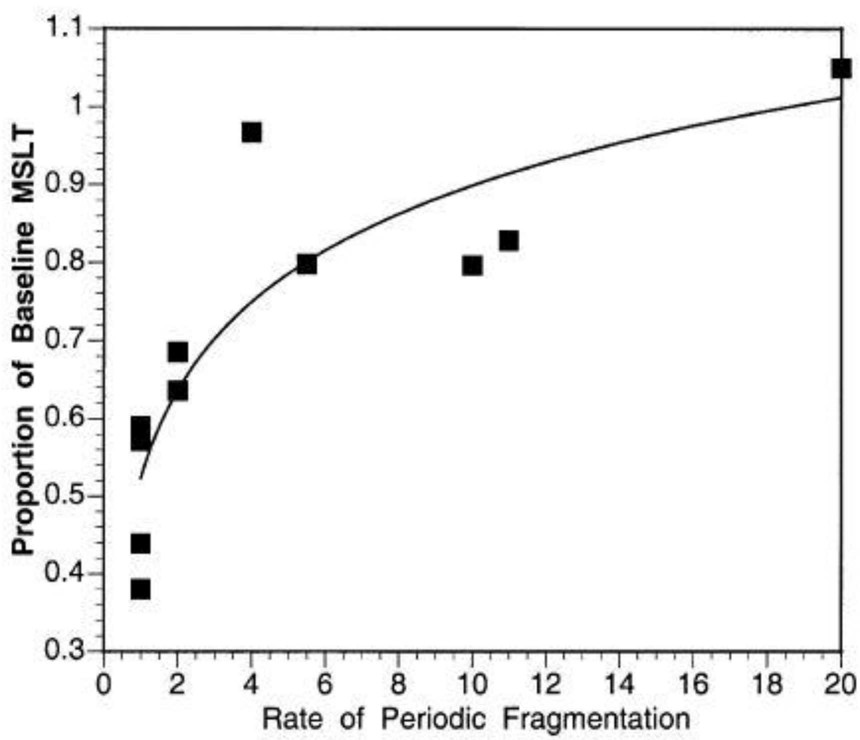


Figure 2 – Proportion of baseline multiple sleep latency test (MSLT) representing the minute-by-minute recuperative value of sleep (the higher the proportion the more recuperative value per minute of sleep) plotted as a function of rate of sleep fragmentation (the interval of time between awakenings or partial awakenings during the night). The shorter the interval between

sleep fragmenting events, the less the recuperative value. When sleep is fragmented at one minute intervals the proportion and hence recuperative value is near zero. When sleep is fragmented every 20 minutes the proportion is near 1 to 1 indicating full minute-by-minute recuperative value with sleep broken every 20 minutes when compared to normal, continuous, unbroken sleep. Adapted from Bonnet and Arand (2003).

4. Consecutive Nighttime Operations 117.27 - 17)

Comment: Assuming the goal of the NPRM is to assure 7-8 hours of sleep per 24 hours, the issue of consecutive night duties is critically tied to the ability of the split duty rest periods to provide sufficient sleep. In a recent study comparing the sleep of physicians working night shifts and day shifts (McDonald et al., 2010), it was found that they got equivalent amounts of sleep (i.e., approximately 7 hrs) when working either type of shift. When working days their sleep was consolidated into a single 7 hr sleep period at night. When working nights they split their sleep averaging 4 hrs of sleep off duty during the day and 3 hours of sleep on duty at night. Performance tested when going on and off shift was equivalent for day and night shifts.

It is therefore important to realize that the NASA study of night cargo operations showed that crews obtained 5 hrs sleep during each day after duty. This is similar to other studies on shift workers (Akerstedt, 2003) that found that they also slept five hours during the daylight hours. Obtaining another 2 hrs of sleep during split night duty should sustain performance across more than 3 consecutive nights. This is supported by Mollicone et al's laboratory studies (2007, 2008) that showed that following restricted sleep for the same total sleep time performance was the same whether the sleep was consolidated into a single sleep period or split into two sleep periods.

5. Fitness for duty 117.5(e) –

Comment: The state-of-the-art of fatigue science today cannot provide an objective standard to identify fitness for duty for compliance with this section. Even if a tool such as the PVT could be used as a basis for such assessments there would be several major obstacles to overcome: (1) each pilot would need to be tested to establish his or her own well rested norm, (2) even with a norm, the airline and the FAA would have to determine the % deviation from the baseline defining unfitness to perform, and (3) in making that decision circadian phase effects would have to be considered because despite being well rested a pilot could "fail" at one phase and "pass" at another.

More important are the general difficulties from a scientific viewpoint posed by paragraphs (d) and (e) of this section. It is not at all clear whether the NPRM literally means "any person" "must immediately report". Such persons could range from passengers, ground workers, and security to cabin crew and other pilots. While the latter two groups may be assumed to have some working experience with tired crews, there is little reason to believe that the general public or non-flying aviation personnel could make an informed judgment. Regarding para (e), despite the claims of draft AC 120-FIT para 8 (b), a person trained in accordance with 117.11

would be unable to make such an assessment in a reliable manner. There is no evidence that even a certified aeromedical specialist could make a reliable assessment in this situation unless the level of fatigue was obviously debilitating. At a minimum an accurate sleep-wake history is required to begin the task. This of course would raise significant privacy issues. All this begs the question of how the FAA is going determine how such assessments should be carried out.

6. Flight Duty Period: Augmented Crew 117.19 (c) (1)(2)(3) -

Comment: In order to assure that the landing pilot has adequate rest he or she should time the in-flight rest opportunity to coincide with time that he or she is most likely to sleep. In the case of a single long-haul flight, this requirement should be readily satisfied. The requirement becomes an issue when a short flight (<4 hrs) occurs within the augmented flight duty. The time when the pilot is most likely to sleep may not necessary be the last available rest period or occur during the last segment of a multi-segment flight. Similarly such a last segment may too short to encompass a 2-hr sleep period in which case the rest period may need to occur in the previous segment.

The science would also support an additional rest shorter than 2 hrs before top of descent since the data suggest that any sleep longer than 20 min provides full minute-by-minute recuperative value (Bonnet and Arand, 2003). This value was dramatically demonstrated in NASA's study of the effectiveness of controlled rest on the flight deck where the pilot's rest was not obtained in a bunk but rather in his assigned duty seat (Rosekind et al., 1994) NASA Technical Memorandum 108839, 1994). Short naps (including controlled napping on the flight deck) are an effective fatigue mitigation to sustain pilot performance during critical phases of flight (Graeber, et al., 1990). Since naps longer than 30 min have the same minute-by-minute recuperative value as longer naps and main sleep periods and the recuperative effect of sleep is cumulative across sleep periods, it is also possible that the 2 hr sleep opportunity could be broken up and distributed over more than one segment.

Furthermore, if the short segment was the final segment, and the required rest were allowed to occur during the last 6 hrs of duty, then it may be appropriate to reduce the manipulating pilot's workload by limiting the pilot to only one landing after his or her rest. Conversely, we also point out that a short flight segment could be at the start of a multi-segment duty period where the NPRM would limit the length of such flights to greater than 4 hours and prohibit an operator from capitalizing on a well rested crew at the beginning of the flight duty period.

7. Tables B & C -

Comment: It is interesting to note that the longest duty times are allowed for the 0700-1259 start times in both Tables B and C. This is presumably because crews are assumed to have gotten a full night's sleep and, in accordance with the scientific evidence, are therefore fully rested at the start. That said, there is no scientific basis for the different hours assigned as limits for different departure times.

In reality modern onboard crew rest facilities are designed to enable the crew to manage their alertness throughout the flight and especially that of the landing crew. Unpublished 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. In other words, a sufficient on-board rest prior to top of descent may mitigate landing crew fatigue sufficiently to obviate the need different duty limits for fully augmented crews based on departure time. Studies of sleep and performance in ultra-long range and long range flights are underway to test this.

8. Limiting flight time in addition to duty time –

Comment: There are no scientific papers supporting the idea that flight time should be treated differently from duty time except perhaps in so far as they involve differences in workload. Workload in the commercial aviation context is thought of primarily in terms of number of segments, specifically number of take offs and landings. Since both number of segments and circadian timing are taken care of in the duty time limits there is no rationale for putting further limits on flight time.

References:

Akerstedt, T. (2003) Shift work and disturbed sleep/wakefulness. Occup. Med., 55, pp. 89-94.

Bonnet, M.H. and Arand, D.L. (2002) Clinical effects of sleep fragmentation versus sleep deprivation. Sleep Medicine Reviews, 7, no. 4 pp. 297-310.

Gander, P.H., Gregory, K.B., Connell, L.J., Miller, D.L., Graeber, R.C., and Rosekind, M.R. (1996) Crew Factors in Flight Operations VII: Psychophysiological responses to overnight cargo operations. NASA Technical Memorandum 110380.

Graeber, R.C., Rosekind, M.R., Connell, L.J., and Dinges, D.F. (1990) Cockpit napping. The ICAO Journal, 45, pp. 6-10.

Rosekind, M.R., Graeber, R.C., Connell, L.J., Dinges, D.F., Rountree, M.S., Spinweber, C.L., and Gillen, K.A. (1994) Crew Factors in Flight Operations IX: Effects of preplanned cockpit rest on crew performances and alertness in long-haul operations. NASA Technical Memorandum 108839.

McDonald, J.L., Tompkins, L.A., Lillis, T.A., Bowen, A.K., Grant D.A., Van Dongen, H.P.A., and Belenky, G. (2009) Work hours, sleep, and performance in medical residents working night float vs. day shift. Sleep, 32, pp. A394.

Mollicone, D.J., Van Dongen, H.P.A., and Dinges, D.F. (2007) Optimizing sleep/wake schedules in space: Sleep during chronic nocturnal sleep restriction with and without diurnal naps. Acta Astronautica, 60, no. 4-7, pp. 354-361.

Mollicone, D.J., Van Dongen, H.P.A., Rogers, N.L., and Dinges, D.F. (2008) Response surface mapping of neurobehavioral performance: Testing the feasibility of split sleep schedules for space operations. Acta Astronautica, 63, no. 7-10, pp. 833-840.

Wesensten, N.J., Belenky, G., Thorne, D.R., Kautz, M.A., and Balkin, T.J. (2004) Modafinil versus caffeine: Effects on fatigue during sleep deprivation. Aviat. Space Environ. Med., 75, pp. 520-525.

Curriculum Vitae
Gregory Lucas Belenky, M.D.

Research Professor & Director
Sleep and Performance Research Center
Washington State University Spokane
P.O. Box 1495
Spokane, WA 99210-1495

Tel: 509-358-7738
Fax: 509-358-7810
Cell: 509-953-6035
Email: belenky@wsu.edu
Web: http://www.wsu.edu/sprc

Colonel, Medical Corps, U.S. Army (Retired)

Education

B.A.	Psychology, Yale University, New Haven, CT	1966
M.D.	Stanford University School of Medicine, Palo Alto, CA	1971

Research and Professional Experience

1966-1968	Research Assistant, Sleep Research Laboratory (Dr. William Dement), Stanford University School of Medicine, Stanford, CA
1971-1972	Intern (Internal Medicine), School of Medicine, University of Utah, Salt Lake City, UT
1972-1975	Resident (Psychiatry), School of Medicine, Yale University, New Haven, CT
1975-1984	Research Psychiatrist, Department of Medical Neurosciences, Division of Neuropsychiatry, Walter Reed Army Institute of Research (WRAIR), Washington, D.C.
1976-1978	Instructor, Department of Psychiatry, School of Medicine, Uniformed Services University of the Health Sciences (USUHS), Bethesda, MD
1977-2004	Emergency Service Psychiatrist (part-time), Woodburn Center for Community Mental Health, Annandale, VA
1978-1980	Assistant Professor, Department of Psychiatry, School of Medicine, USUHS, Bethesda, MD
1980-1996	Associate Professor, Department of Psychiatry, School of Medicine, USUHS, Bethesda, MD

1984-1995	Chief, Department of Behavioral Biology, Division of Neuropsychiatry, WRAIR, Washington, D.C.
Jan-Apr 1991	Chief, Mental Health Team, Medical Troop, Regimental Support Squadron, Second Armored Cavalry Regiment, Operation Desert Storm, Saudi Arabia, Kuwait, and Iraq
1995-2003	Director, Division of Neuropsychiatry, WRAIR
1996-2004	Professor, Department of Psychiatry, School of Medicine, USUHS
Jun-Aug 2003	Division Psychiatrist, Second Infantry Division, Camp Casey, South Korea
2003-2004	Director, Division of Neuroscience, WRAIR
2004-pres.	Research Professor and Director, Sleep and Performance Research Center, Washington State University Spokane

Military Service

1975-2004 Active Duty, U.S. Army; retired as a Colonel

Professional Organizations

American Psychiatric Association	Member Fellow Distinguished Fellow	1975 - 1984 1984 - 2002 2003 - present
American Academy of Sleep Medicine	Member	2000 - present
Sleep Research Society	Member	2000 - present
European Sleep Research Society	Member	2000 - present

Other Organizational Affiliations

Sleep Disorders Research Advisory Board National Heart, Lung & Blood Institute	Ex-Officio Member	1998 - 2004
Board of Directors National Sleep Foundation	Member	2000 - 2008

Board Certification

American Board of Psychiatry & Neurology June 1978

Medical Licenses

Commonwealth of Virginia # 0101030411

State of Washington # MD00047310

Hospital Privileges – none at present

Ongoing Research Support

W81XWH05-1-0099 Belenky (PI) 04/15/04 – 04/14/10
U.S. Army Medical Research and Materiel Command
Laboratory and Field Studies of Sleep and Performance
This project will conduct a series of laboratory and field studies in the Sleep and Performance Research Center investigating the effects of restricted sleep on human performance.
Role: PI

Number N/A Belenky (PI) 01/01/07 – 12/31/10
W.M. Keck Foundation
New Theoretical, Technical and Experimental Approaches to Brain Organization of Sleep and Performance.
This project will conduct a series of laboratory studies in humans and animals to test the theory that sleep is a use-dependent, local phenomenon of cortical columns and other neuronal assemblies.
Role: PI

DTMC75-07-D-00006 Task Order #5 Belenky (PI) 04/04/08 – 08/10/2011
Federal Motor Carrier Safety Administration
Investigation of Split Sleep Schedules on Commercial Vehicles Driver Safety and Health
This project will investigate the effects of split vs. consolidated sleep on performance and health-related parameters, including glucose regulation and inflammation.
Role: PI

DTMC75-07-D-00006 Task Order #7 Belenky (PI) 05/02/08 – 08/10/11
Federal Motor Carrier Safety Administration
Motorcoach Driver Fatigue
This project will investigate the effects of split vs. consolidated sleep on performance and health-related parameters, including glucose regulation and inflammation.
Role: PI

T8200-066506/001/MTB Mallis (PI) 09/02/08 – 03/01/10
Transport Canada
Investigation of Effective Recovery and Napping Strategies for Commercial Motor Vehicle Drivers
This field study with within-subject design examines the effects of different nap and recovery sleep amounts on driving performance in commercial motor vehicle drivers
Role: Co-I

Number N/A Belenky (PI) 03/15/07 – 04/30/11
Continental Airlines
Field Studies of Ultra Long-Range Flights
This project will compare the objectively measures sleep (using actigraphy) and performance (using Palm OS Psychomotor Vigilance Test) of flight crew (pilots) flying ultra-long range (>16 hours) vs. long range (>7 hours < 16 hours) flights.
Role: PI

Number N/A Vila (PI) 02/01/09–07/31/10
Defense Advanced Research Projects Agency
Accelerating Realistic Deadly-Force Judgment and Decision Making Training

This subcontract involves the development of methodology for controlled simulator studies of deadly force decision making and training thereof.
Role: Co-I

Selected Completed Research Support

R01-HL70154 Van Dongen (PI) 04/01/02–03/31/07
NIH / NHLBI
Individual Differences in Response to Sleep Deprivation
This investigation was the first to establish individual differences in the neurobehavioral and recovery sleep responses to sleep deprivation as human phenotypes.
Role: Co-I

Number N/A Belenky (PI) 03/08/07 – 03/31/07
Airline Pilots Association (ALPA)
Fatigue Analysis of Comair Flight 3191
This project will apply the SAFTE/FAST sleep/performance prediction model to the reconstructed sleep/wake histories of the Captain, First Officer, and Air Traffic Controller involved in the crash of Comair Flight 3191
Role: PI

Number N/A Belenky (PI) 07/01/07-12/15/07
American Trucking Association
Modeling Divided vs. Consolidated Sleep
This project will use a mathematical sleep performance prediction model to predict the relative efficacy in sustaining performance of consolidated vs. split sleep.
Role: PI

Number N/A Belenky (PI) 04/15/06 – 04/14/07
DURIP
U.S. Air Force, Office of Scientific Research
Sleep and Performance Research Center Equipment
This DURIP is to equip the Sleep and Performance with high sampling rate polysomnographic (PSG) recording systems and near-infrared optical topography systems.
Role: PI

DURIP No. N000149810802 Vila (PI) 05/01/08-07/30/09
U.S. Navy, Office of Naval Research
Critical Job Task Simulation Laboratory, Expansion for the WSU Sleep and Performance Research Center
This DURIP is to equip the Sleep and Performance Research Center with an integrated system of high fidelity simulators and measurement devices that enable the replication of a sleep/wake/work environment in which to conduct long-term (days/weeks) residential laboratory studies of the impact of sleep deprivation on performance of critical job tasks. Target occupational groups for initial studies include police officers, soldiers in counter-insurgency and peacekeeping operations and drivers/engineers/pilots in trucking, rail, air, and sea operations.
Role: Co-I

Patents:

Patent No. US 6,241,686 – System and method for predicting human cognitive performance using data from an actigraph.
Patent No. US 6,419,629 – Method for predicting human cognitive performance.
Patent No. US 6,527,715 – System and method for predicting human cognitive performance using data from an actigraph.
Patent No. US 6,530,884 – Method and system for predicting human cognitive performance.
Patent Pending (US and International) – Computer implemented scheduling systems and associated methods

Editorial Board

Aviation, Space and Environmental Medicine – 2006–present

Editor

Section on Occupational Sleep Medicine, In Kryger, M., Roth, T., and Dement, W.C. Principles and Practice of Sleep Medicine, 5th Edition, in press. The section on Occupational Sleep Medicine consists of 11 chapters, 3 co-authored by me (see Book Chapters under Publications).

Course Chair

WWAMI Spokane, First Year Medical School Curriculum, Nervous System Course – 2008–present

Reviewer

Accident Analysis and Prevention
Aviation, Space, and Environmental Medicine
Behavior Research Methods
Behavioral Sleep Medicine
Journal of Sleep Research
Psychopharmacology
Sleep
Sleep Medicine Reviews

Grant Reviewer

NASA

NIH

DOJ

Consultant

Qantas Airlines/University of South Australia (Drew Dawson) - Fatigue Management Research Study (FMRS) – actigraph/palm pilot PVT sleep and performance study of pilots flying international routes – 2002-2006

The Boeing Corporation – Effect of oxygen supplementation during sleep at altitude on subsequent waking performance – 2004–2009

Continental Airlines – Flight and cabin crew sleep and performance during ultra-long-range flight operations – 2007–present

FedEx – Flight crew sleep and performance in short-haul, frequent take off and landing, backside of the clock operations – 2008–present

Air Transport Association – Fatigue due to sleep loss, circadian rhythm phase, and workload effect on pilot performance in commercial aviation – 2009–present

Military Training:

Air Assault School (rappelling from helicopters), Fort Campbell, KY, 1981

Airborne School (parachuting), Fort Lee, VA, 1982

Wartime Service:

Chief, Mental Health Team, Medical Troop, Regimental Support Squadron, Second Armored Cavalry Regiment, Operation Desert Storm, Saudi Arabia, Kuwait, and Iraq, January-April 1991

Awards:

Angier Prize for Best Undergraduate Research in Psychology
High Honors in Psychology
Yale University, New Haven, CT, June 1966

The Alvin Thompson Award, Northwest Association for Biological Research
Seattle, WA, May 2006

Publications

1) Cole, M., **Belenky, G.L.,** Boucher, R., Fernandez, R., Myers, D. (1965) Probability learning to escape from shock. *Psychonomic Science, 3,* 127-129.

2) **Belenky, G.L.,** Cole, M. (1968) The role of test trials in paired-associate verbal learning. *Psychonomic Science, 10,* 201-203.

3) Ferguson, J., Henriksen, S., McGarr, K., **Belenky, G.L.,** Gonda, W., Cohen, H., Dement, W.C. (1968) Phasic event deprivation in the cat. *Psychophysiology, 5,* 238-39.

4) **Belenky, G.L.,** Henriksen, S., McGarr, K., Ferguson, J., Cohen, H., Dement, W.C. (1968) Effect of anticholinesterase (DFP) on the sleep-wakefulness cycle of the cat. *Psychophysiology, 5,* 243.

5) **Belenky, G.L.** Unusual visual experiences reported by subjects in the British Army study of sustained operations, Exercise Early Call. (1979) *Military Medicine, 144,* 695-696.

6) **Belenky, G.L.**, Holaday, J.W. (1979) The opiate antagonist naloxone modifies the effects of electroconvulsive shock (ECS) on respiration, blood pressure, & heart rate. *Brain Research, 177,* 414-417.

7) Holaday, J.W., **Belenky, G.L.** (1980) Opiate-like effects of electroconvulsive shock in rats: a differential effect of naloxone on nociceptive measures. *Life Sciences, 27,* 1929-1938.

8) Belenky, G.L. & Holaday, J.W. (1981) Repeated electroconvulsive shock (ECS) & morphine tolerance: demonstration of cross sensitivity in the rats. *Life Sciences, 29,* 553-563.

9) Tortella, F.C., Cowan, A., **Belenky, G.L.,** & Holaday, J.W. (1981) Opiate-like electroencephalographic & behavioral effects of electroconvulsive shock in rats. *European Journal of Pharmacology, 76,* 121-128.

10) **Belenky, G.L.,** Newhouse, P., & Jones, F.D. (1982) Prevention & treatment of psychiatric casualties in the event of a war in Europe. *Revue Internationale des Services de Sante, 55,* 303-307.

11) Holaday, J.W., Hitzemann, R.J., Curell, J., Tortella, F.C., **Belenky, G.L.** (1982) Repeated electroconvulsive shock or chronic morphine treatment increases the number of 3H-D-Ala2, D-Leu5-enkephalin binding sites in rat brain membranes. *Life Sciences, 31,* 2359-2362.

12) **Belenky, G.L.,** Kaufman, L.W. (1983) Cohesion & rigorous training: observations of the air assault school. *Military Review, 63,* 24-34.

13) **Belenky, G.L.** Gelinas-Sorell, Kenner, J.R., Holaday, J.W. (1983) Evidence for delta-receptor involvement in the post-ictal antinociceptive responses to electroconvulsive shock in rats. *Life Sciences, 33,* Supplement I 583-585.

14) Kaufman, L.W., **Belenky, G.L.** (1984) Staying alive: Knowing what to do until the medic arrives. *Military Review, 64,* 28-33.

15) **Belenky, G.L.,** Noy, S., & Solomon, Z. (1985) Battle stress: The Israeli experience. *Military Review, 65*, 28-37.

16) Deeken, M.G., Newhouse, P.A., **Belenky, G.L.,** Eshelman, S.D., Parker, M.T., Jones F.D. (1985) Division psychiatrists in peacetime. *Military Medicine, 150,* 455-457.

17) **Belenky, G.L.,** Noy, S., Solomon, Z., & Jones, F.D. (1985) Contemporary Israeli studies in combat psychiatry. *Annales Medicinae Militaris Fenniae, 60,* 105-110.

18) Holaday, J.W., Tortella, F.C., Meyerhoff, J.L., **Belenky, G.L.**, Hitzemann, R.J. (1986) Electroconvulsive shock activates endogenous opioid systems: Behavioral & biochemical correlates. *Annals of the New York Academy of Sciences, 467,* 249-255.

19) Holaday, J.W., Tortella, F.C., Long, J.B., **Belenky, G.L.,** Hitzemann, R.J. (1986) Endogenous opioids & their receptors: Evidence for involvement in the post-ictal effects of electroconvulsive shock. *Annals of the New York Academy of Sciences, 462,* 124-139.

20) **Belenky, G.L.** (1987) Varieties of reaction & adaptation to combat experience. *Bulletin of the Menninger Clinic, 51,* 64-79.

21) Hitzemann, R.J., Hitzemann, B., Blatt, S., Tortella, F.C., Kenner, J.R., **Belenky, G.L.**, Holaday, J.W. (1987) Repeated electroconvulsive shock: Effect on sodium dependency & regional distribution of opioid-binding sites. *Molecular Pharmacology, 31*, 562-566.

22) **Belenky, G.L.** Psychiatric casualties: The Israeli experience. (1987) *Psychiatric Annals, 17,* 528-31.

23) O'Donnell, V.M., Balkin, T.J., Andrade, J.R., Simon, L.M., Kamimori, G.H., Redmond, D.P., **Belenky, G.** (1988) Effects of triazolam on performance & sleep in a model of transient insomnia. *Human Performance, 1,* 145-160.

24) Penetar, D., Redmond, D., & **Belenky, G.** (1989) Effects of triazolam on sleep & memory during long range deployments by air. *Aviation, Aerospace & Environmental Medicine 60,* 594-98.

25) Balkin, T.J., O'Donnell, V.M., Kamimori, G.H., Redmond, D.P., & **Belenky, G.** (1989) Sleep inertia following triazolam-induced recovery sleep. *Human Psychopharmacology 4,* 291-296.

26) Balkin, T.J., O'Donnell, V.M., Kamimori, G.H., Redmond, D.P., & **Belenky, G.** (1989) Administration of triazolam prior to recovery sleep: Effects on sleep architecture, subsequent alertness and performance. *Psychopharmacology 99,* 526-531.

27) Newhouse, P.A., **Belenky, G.,** Thomas, M., Thorne, D., Sing, H.C. & Fertig, J. (1989) The effects of d-amphetamine on arousal, cognition, and mood after prolonged total sleep deprivation. *Neuropsychopharmacology 2,* 153-164.

28) Ursano, R.J., Holloway, H.C., Jones, D.R., Rodriquez, A.R., and **Belenky, G.L.** (1989) Psychiatric care in the military community: family and military stressors. Hospital & *Community Psychiatry 40,* 1284-1289.

29) Pleban, R.J., Valentine, P.J., Penetar, D.M., Redmond, D.P., and **Belenky, G.** (1990) Characterization of sleep and body composition changes during ranger training. *Military Psychology 2*, 145-56.

30) McCann, U.D., Penetar, D.M., and **Belenky, G.** (1990) Acute dystonic reaction in normal humans caused by catecholamine depletion. *Clinical Neuropharmacology 13,* 565-568.

31) Kamimori, G.H., Smallridge, R.C., Redmond, D.P., **Belenky, G.L.,** and Fein, H.G. (1990) The effect of exercise on atropine pharmacokinetics. *European Journal of Clinical Pharmacology 39*, 395-397.

32) Penetar, D.M., Sing, H.C., Thorne, D.R., Thomas, M.L., Fertig, J.B., Schelling, A.S.D., Sealock, J.C., Newhouse, P.A., and **Belenky, G.** (1991) Amphetamine effects on recovery sleep following total sleep deprivation. *Human Psychopharmacology 6,* 319-323.

33) Balkin, T.J., O'Donnell, V.M., Wesensten, N., McCann, U., and **Belenky, G.** (1992) Comparison of the daytime sleep and performance effects of zolpidem versus triazolam. *Psychopharmacology 107,* 83-88.

34) McCann, U.D., Penetar, D.M., Shaham, Y., Thorne, D.R., Gillin, J.C., Sing, H., Thomas, M. & **Belenky, G.** (1992) Sleep deprivation and impaired cognition: The role of catecholamines. *Biological Psychiatry 31*, 1082-97.

35) Newhouse, P.A., Penetar, D.M., Fertig, J., Thorne, D.R., Sing, M., Thomas, M., Cochran, J. & **Belenky, G.** (1992) Stimulant drug effects on performance and behavior after prolonged sleep deprivation: A comparison of amphetamine, nicotine, and deprenyl. *Military Psychology 4,* 207-233.

36) Wesensten, N.J., Crowley, J., Balkin, T., Kamimori, G., Iwanyk, E., Pearson, N., Devine, J., **Belenky, G.** & Cymerman A. (1993) Effects of simulated high altitude exposure on long-latency event-related brain potentials and performance. *Aviation, Space and Environmental Medicine 64,* 30-36.

37) McCann, U.D., Penetar, D.M., Shaham, Y., Thorne, D.R., Sing, H.C., Thomas, M.L., Gillin, J.C., & **Belenky, G.** (1993) Effects of catecholamine depletion on alertness and mood in rested and sleep deprived normal volunteers. *Neuropsychopharmacolgy 8,* 345-356.

38) Penetar, D., McCann, U., Thorne, D., Kamimori, G., Galinski, C., Sing, H., Thomas, M. & **Belenky, G.** (1993) Caffeine reversal of sleep deprivation effects on alertness and mood. *Psychopharmacology 112*, 359-365.

39) Wesensten, N.J., Balkin, T.J., Kamimori, G.H., Crowley, J.S., Iwanyk, E., Kaufman, D., Pearson, N., Amoroso, P., **Belenky, G.,** & Cymerman, A. (1993) Effects of simulated high altituted exposure on long-latency ERPs and performance. *Aviation, Space and Environmental Medicine 64,* 30-36.

40) Wesensten, N.J., Balkin, T.J., & **Belenky, G.** (1995) Effects of daytime administration of zolpidem versus triazolam on memory. *European Journal of Pharmacology 48,* 115-122.

41) Wesensten, N.J., Balkin, T.J., Davis, H.Q., and **Belenky, G.** (1995) Reversal of triazolam and zolpidem-induced memory impairment by flumazenil. *Psychopharmacology 121*, 242-249.

42) McCann, U., Hall, T., Thorne, D., Thomas, M., Sing, H., Popp, K., & **Belenky, G.** (1995) The effects of l-dihydroxyphenylalanine on alertness and mood in alpha-methyl-para-tyrosine treated normal volunteers: Further evidence of the role of cathecholamines in arousal and anxiety. *Neuropsychopharmacology 13(1),* 41-52.

43) Wesensten, N.J., Balkin, T.J., & **Belenky, G.** (1995) Effects of daytime administration of zolpidem and triazolam on performance. *Aviation, Space, and Environmental Medicine 67,* 115-120.

44) Braun, A. R., Balkin, T. J., Wesensten, N. J., Carson, R. E., Varga, M., Baldwin, P., Selbie, S., **Belenky, G.** & Herscovitch, P. (1997) Regional cerebral blood flow throughout the sleep-wake cycle. An H215O PET study. *Brain 120,* 1173-1197.

45) Braun, A. R., Balkin, T. J., Wesensten, N. J., Gwardry, F., Carson, R. E., Varga, M., Baldwin, P., **Belenky, G.** & Herscovitch, P. (1998) Dissociated pattern of activity in visual cortices and their projections during human rapid eye movement sleep. *Science 279(5347),* 91-5.

46) Wesensten, N.J., Balkin, T.J., and **Belenky G.L** (1999) Does sleep deprivation impact recuperation? A review and reanalysis. *Journal of Sleep Research, 8* 237-245.

47) Thomas, M L., Sing, H.C., **Belenky, G.,** Holcomb, H.H., Mayberg, H.S., Dannals, R.F., Wagner, Jr., H.N., Thorne, D.R. Popp, K.A., Rowland, L.M., Welsh, A.B., Balwinski, S.M. and Redmond, D.P. (2000) Neural basis of alertness and cognitive performance impairments during sleepiness. I. Effects of 24 h of sleep deprivation on waking human regional brain activity. *J. Sleep Research, 9* 335-352.

48) Kamimori G.H., Penetar, D.M., Headley, D., Thorne, D.R., Otterstetter, R., and **Belenky, G.** (2000) Effect of three caffeine doses on plasma catecholamines and alertness during prolonged wakefulness. *Eur. J. Clin Pharmacol 56,* 537-544.

49) Kamimori, G.H., Karyekar, C.S., Otterstetter, R., Cox, DS, Balkin, T.J., **Belenky, G.L.,** and Eddington, N.D. (2002) The rate of absorption and bioavailability of caffeine administered in chewing gum versus capsules to normal healthy volunteers. *Int. J. Pharm. 234,* 159-167.

50) Balkin, T.J., Braun, A.R., Wesensten, N.J., Jeffries, K., Varga, M., Baldwin, P., **Belenky, G.,** and Herscovitch, P. (2002) The process of awakening: A PET study of regional brain activity patterns mediating the reestablishment of alertness and consciousness. *Brain, 125,* 2308-2319.

51) Wesensten, N.J., **Belenky, G.,** Kautz, M.A., Thorne, D.R., Reichardt, R.M., and Balkin, T.J. (2002) Maintaining alertness and performance during sleep deprivation: modafinil versus caffeine. *Psychopharmacology (Berl.) 159,* 238-47.

52) **Belenky, G.,** Wesensten, N.J., Thorne, D.R., Thomas, M.L., Sing, H.C., Redmond, D.P., Russo, B.M., Balkin, T.J (2003) Patterns of performance degradation and restoration during sleep restriction and subsequent recovery: a sleep dose-response study. *J. Sleep Res. 12,* 1-13.

53) Thomas, M.L., Sing, H.C., **Belenky, G.,** Holcomb, H.H., Mayberg, H.S., Dannals, R.F., Wagner, H.N., Thorne, D.R., Popp, K.A., Rowland, L.M., Welsh, A.B., Balwinksi, S.M., Redmond, D.P. (2003) Neural basis of alertness and cognitive performance impairments during sleepiness II. Effects of 48 and 72 h of sleep deprivation on waking human regional brain activity. *Thalamus & Related Systems 2,* 199-229.

54) Hursh, S.R., Redmond, D.P., Johnson, M.L., Thorne, D.R. **Belenky, G.,** Balkin, T.J., Miller, J.C., Eddy, D.R. (2004) Fatigue models for applied research in warfighting. *Aviation, Space and Environmental Medicine 75,* Supplement A44-A53.

55) Johnson, M.L., **Belenky, G.,** Redmond, D.P., Thorne, D.R., Williams, J.D., Hursh, S.R., and Balkin, T.J. (2004) Modulating the homeostatic process to predict performance during chronic sleep restriction. *Aviation, Space and Environmental Medicine, 75,* Supplement A141-A146.

56) Balkin, T.J., Kamimori, G.H., Redmond, D.P., Vigneulle, R.M., Thorne, D.R., **Belenky, G.** and Wesensten, N.J. (2004) On the Importance of Countermeasures in Sleep and Performance Models. *Aviation, Space, and Environmental Medicine, 75,* Supplement A155-A157

57) Wesensten, N.J., **Belenky, G.**, Thorne, D.R., Kautz, M.A., and Balkin, T.J. (2004) Modafinil versus Caffeine: Effects on Fatigue during Sleep Deprivation. *Aviat Space Environ Med, 75,* 520-525

58) Balkin T.J., Bliese P.D., **Belenky, G.**, Sing H., Thorne D.R., Thomas M., Redmond D.P., Russo, M., Wesensten, N.J. (2004) Comparative Utility of Instruments for Monitoring Sleepiness-Related Performance Decrements in the Operational Environment. *Journal of Sleep Research, 13,* 219-227

59) McLellan T.M., Kamimori G.H., Bell D.G., Smith I.F., Johnson D., **Belenky G.** (2005) Caffeine Maintains Vigilance and Marksmanship in Simulated Urban Operations with Sleep Deprivation. *Aviat Space Environ Med 76,* 39-45.

60) LaJambe, C.M., Kamimori, G.H., **Belenky, G.**, Balkin, T. (2005) Caffeine Effects on Recovery Sleep Following 27 Hours Total Sleep Deprivation. *Aviation, Space, Environ Med 76,* 108-113.

61) Wesensten N.J., Balkin T.J., Reichardt R.M., Kautz M.A., Saviolakis G.A., **Belenky G.** (2005) Daytime sleep and performance following a zolpidem and melatonin cocktail. *Sleep 28(1),* 93-103.

62) Wesensten, N.J., **Belenky, G.** & Balkin, T.J. (2005) Cognitive readiness in network centric operations. *Parameters: U.S. Army War College Quarterly, 35 (1),* 94-105.

63) Thorne, D.R., Johnson, D.E., Redmond, D.P., Sing, H.C., **Belenky, G.** and Shapiro, J.M. (2005) The Walter Reed palm-held psychomotor vigilance test. *Behavior Research Methods, Instruments, & Computer, 37(1),* 111-118.

64) McLellan, TM, Kamimori, G.H. Bell, D.G. Smith, I.F. Johnson, D., **Belenky**, **G.** (2005) Caffeine Maintains Vigilance and Marksmanship in Simulated Urban Operations with Sleep Deprivation. *Aviat Space Environ Med 76,* 39-45.

65) Kamimori G.H., Johnson D, Thorne D, **Belenky G.L**. (2005) Multiple Caffeine Doses Maintain Vigilance During Early Morning Operations. *Aviat Space Environ Med 76,* 1046-1050.

66) Webber SR, Sherman MR, Tucker AM, Belenky G, Van Dongen HPA. Introversion, Type A personality, and resilience to cognitive impairment from sleep loss. *Sleep-Wake Research in The Netherlands* 2007; 18: 131–134.

67) Bender AM, Tucker AM, Knittle KA, Belenky G, Van Dongen HPA. Slow wave activity in the first NREM episode is a trait marker in addition to a homeostatic state marker. Sleep-Wake Research in The Netherlands 2007; 18: 33–36.

68) Oonk M, Tucker AM, **Belenky G**, Van Dongen HPA. Excessive sleepiness: determinants, outcomes, and context. *International Journal of Sleep and Wakefulness 2008*; 1(4): 141–147.

69) Luik AI, Tucker AM, Whitney P, Hinson JM, Belenky G, Van Dongen HPA. Inter-individual differences in performance on a letter verbal fluency task during sleep deprivation. *Sleep-Wake Research in The Netherlands* 2008; 19: 105–108.

70) Luik AI, Bender AM, Tucker AM, Belenky G, Van Dongen HPA. Systematic inter-individual differences in polysomnographic sleep variables. *Sleep-Wake Research in The Netherlands* 2008; 19: 109–112.

71) Krueger JM, Rector DM, Roy S, Van Dongen HPA, **Belenky G**, Panksepp J. Sleep as a fundamental property of neuronal assemblies. *Nature Reviews Neuroscience* 2008; 9: 910–919.

72) Smith AD, Genz A, Freiberger DM, **Belenky G**, Van Dongen HPA. Efficient computation of confidence intervals for Bayesian model predictions based on multidimensional parameter space. *Methods in Enzymology* 2009; 454: 213–231.

73) McCauley P, Kalachev LV, Smith AD, **Belenky G**, Dinges DF, Van Dongen HPA. A new mathematical model for the homeostatic effects of sleep loss on neurobehavioral performance. Journal of Theoretical Biology 2009; 256: 227–239.

74) McCauley P, Kalachev LV, Smith AD, **Belenky G**, Dinges DF, Van Dongen HPA. A new mathematical model for the homeostatic effects of sleep loss on neurobehavioral performance. *Journal of Theoretical Biology* 2009; 256: 227–239.

75) Van Dongen HPA, **Belenky G**. Individual differences in vulnerability to sleep loss in the work environment. *Industrial Health* 2009; 47(5): 518–526.

76) Smith AD, Genz A, Freiberger DM, **Belenky G**, Van Dongen HPA. Efficient computation of confidence intervals for Bayesian model predictions based on multidimensional parameter space. *Methods in Enzymology* 2009; 454: 213–231.

77) Rector DM, Schei JL, Van Dongen HPA, **Belenky G**, Krueger JM. Physiological markers of local sleep. *European Journal of Neuroscience* 2009; 29: 1771–1778.

78) Pruchnicki S., Wu L, Van Dongen, H.P.A., and **Belenky G**. Comair 5191: A fatigue analysis. In preparation.

Books:

1) **Belenky, G.** (Ed.) (1987) Contemporary Studies in Combat Psychiatry, Greenwood Press, Westport, CT.

2) Martin, J.A., Sparacino, L. & **Belenky, G.** (Eds.) (1966) The Gulf War and Mental Health: A Comprehensive Guide. Praeger, Westport, CT.

3) **Belenky G.** and Kryger, M. (Eds.) Textbook of Occupational Sleep Medicine, in preparation.

Technical Reports:

1) Balkin, T., Thorne, D., Sing, H., Thomas, M., Redmond, D., Williams, J., Hall, S., and **Belenky, G.** Effects of Sleep Schedules on Commercial Vehicle Driver Performance. Washington, DC, U.S. Department of Transportation, Report No. DOT-MC-00-133; 2000.

2) **Belenky G**, Hursh SR, Fitzpatrick J, Van Dongen HPA. Split sleeper berth use and driver performance: A review of the literature and application of a mathematical model predicting performance from sleep/wake history and circadian phase. *American Trucking Associations Technical Report*, Washington State University, Spokane, Washington; 2008

Book Chapters and Papers in Proceedings:

1) **Belenky, G.L.** & Holaday, J.W. Possible functions of b-endorphin. In B. Saletu et al (Eds.) Neuro-Psychopharmacology, Pergamon Press, Oxford (1979)503-514.

2) **Belenky, G.L.** & Holaday, J.W. Electroconvulsive shock (ECS) in rats: Naloxone modification of post-ECS behaviors provides evidence for functional endorphin release. In E.L. Way (Ed.) Endogenous & Exogenous Opiate Agonists & Antagonists, Pergamon Press, New York (1979)487-490.

3) Holaday, J.W., Tortella, F.C., & **Belenky, G.L.** Electroconvulsive shock results in a functional activation of endorphin systems. In H. Emrich (Ed.) Modern Problems in Pharmacopsychiatry, Vol 17: The Role of Endorphin in Neuropsychiatry, Karger, Basel, (1981)142-157.

4) **Belenky, G.L.** Training in military & combat psychiatry in the United States Army. In O. Adelaja & F.D. Jones (Eds.) War & Its Aftermath, John West Publishers, Lagos, (1983)129-135.

5) **Belenky, G.L.,** Tortella, F.C., Hitzemann, R.J. & Holaday, J.W. The role of endorphin systems in the effects ECS. In B. Lerer, R.D. Weiner, & R.H. Belmaker (Eds.), ECT: Basic Mechanisms, John Libbey & Company, Ltd., London, (1984)89-97; republished American Psychiatric Press, Inc., Washington, D.C., (1986)89-97.

6) **Belenky, G.L.,** Noy, S., Solomon, Z., & Jones, F.D. Psychiatric casualties (battle shock) in Israeli Defense Forces in the war in Lebanon, June-September 1982. In P. Pichot, P. Berner, R. Wolf, & K. Thau (Eds.), Psychiatry: The State of the Art, Volume 6: Drug Dependence & Alcoholism, Forensic Psychiatry, Military Psychiatry, Plenum Publishers, New York, (1985) pp479-484.

7) Crocq, L., Crocq, M.A., Barrois, C., **Belenky, G.L.,** & Jones, F.D. Low intensity combat psychiatric casualties. In P. Pichot, P. Berner, R. Wolf, & K. Thau (Eds.), Psychiatry: The State of the Art, Volume 6: Drug Dependence & Alcoholism, Forensic Psychiatry, Military Psychiatry, Plenum Publishers, New York, (1985) pp545-550.

8) Jones, F.D., Crocq, L., Adelaja, O. Rahe, R., Rock, N., Mansour, F., Collazo, C., & **Belenky, G.L.** Psychiatric casualties in modern warfare, I: Evolution of treatment. In P. Pichot, P. Berner, R. Wolf, & K. Thau (Eds.), Psychiatry: The State of the Art, Volume 6:

Drug Dependence & Alcoholism, Forensic Psychiatry, Military Psychiatry, Plenum Publishers, New York, (1985) pp459-463.

9) Crocq, L., Jones, F.D., Adelaja, O., Rahe, R., Collazo, C., Mansour, F., & **Belenky, G.L.** Psychiatric casualties in modern warfare, II. In P. Pichot, P. Berner, R. Wolf, & K. Thau (Eds.), Psychiatry: The State of the Art, Volume 6: Drug Dependence & Alcoholism, Forensic Psychiatry, Military Psychiatry, Plenum Publishers, New York, (1985).

10) Jones, F.D. & **Belenky, G.L.** Warfare & the U.S. military family. In P. Pichot, P. Berner, R. Wolf, & K. Thau (Eds.), Psychiatry: The State of the Art, Volume 6: Drug Dependence & Alcoholism, Forensic Psychiatry, Military Psychiatry, Plenum Publishers, New York, (1985) pp527-531.

11) Jones, F.D., Stokes, J.W., Newhouse, P.A., **Belenky, G.L.,** & Crocq, L. Neuropsychiatric casualties in chemical, biological & nuclear warfare. In P. Pichot, P. Berner, R. Wolf, & K. Thau (Eds.), Psychiatry: The State of the Art, Volume 6: Drug Dependence & Alcoholism, Forensic Psychiatry, Military Psychiatry, Plenum Publishers, New York, (1985).

12) **Belenky, G.L.** Military psychiatry in the Israeli Defence Force. In R.A. Gabriel (Ed.) Military Psychiatry: A Comparative Perspective. Greenwood Press, Westport, CT, (1986) pp147-180.

13) **Belenky, G.,** Balkin, T., Krueger, G.P., Headley, D., Solick, R. (1986). Effects of continuous operations (CONOPS) on soldier and unit performance; Phase I: Review of the literature. Joint WRAIR/ARI report for TRADOC CONOPS Staff Study. Washington, D.C.: Walter Reed Army Institute of Research. Also, In: U.S. Army Combined Arms Combat Development Activity (1987). Continuous Operations (CONOPS) Final Report. (ACN 073194). Fort Leavenworth, KS: Headquarters, U.S. Army Training and Doctrine Command and U.S. Army Combined Arms Center.

14) **Belenky, G.L.** & Jones, F.D. Combat psychiatry: An evolving field. In **Belenky, G.L.** (Ed.) Contemporary Studies in Combat Psychiatry. Greenwood Press, Westport, CT, 1987.

15) **Belenky, G.L.,** Noy, S. & Solomon, Z. Battle stress, morale, cohesion, combat effectiveness, heroism, & psychiatric casualties: The Israeli experience. In **Belenky, G.L.** (Ed.) Contemporary Studies in Combat Psychiatry. Greenwood Press, Westport, CT, 1987.

16) **Belenky, G.L.** The future of combat psychiatry. In **Belenky, G.L.** (Ed.) Contemporary Studies in Combat Psychiatry. Greenwood Press, Westport, CT, 1987.

17) **Belenky, G.,** Penetar, D.M., Thorne, D.R., Popp, K., Leu, J., Thomas, M., Sing, H., Balkin, T.J., Wesensten, N.J., & Redmond, D.P. The effects of sleep deprivation on performance during continuous combat operations. In B.M. Marriott (Ed.), Food Components to Enhance Performance, National Academy Press, Washington, DC, (1994) pp 127-135.

18) Penetar, D.M., McCann, U., Thorne, D., Schelling, A., Galinski, C., Sing, H., Thomas, M., & **Belenky, G.** Effects of caffeine on cognitive performance, mood, and alertness in sleep-deprived humans. In B.M. Marriott (Ed.), Food Components to Enhance Performance, National Academy Press, Washington, DC, (1994) pp 407-431.

19) **Belenky, G.,** Sing, H., Thomas, M., Shaham, Y., Balwinski, S., Thorne, D., Redmond, D., & Balkin, T. Discrimination of rested from sleep-deprived EEG in awake normal subjects. In Proceedings of the IEEE International Conference on Neural Networks, IEEE, Piscataway, NJ, (1994) pp 3521-3524.

20) **Belenky, G.,** Marcy, S.C., & Martin, J.A. Debriefings and battle reconstructions following combat. In Martin, J.A., Sparacino, L. & **Belenky, G.** (Eds.) The Gulf War and Mental Health: A Comprehensive Guide, Praeger, Westport, CT, 1996.

21) **Belenky, G.** & Martin, J.A. Practicing combat psychiatry. In Martin, J.A., Sparacino, L. & **Belenky, G.** (Eds.) The Gulf War and Mental Health: A Comprehensive Guide, Praeger, Westport, CT, 1996.

22) McCarroll, E. & **Belenky, G.** Debriefings after return to the United States. In Martin, J.A., Sparacino, L. & **Belenky, G.** (Eds.) The Gulf War and Mental Health: A Comprehensive Guide, Praeger, Westport, CT, 1996.

23) **Belenky, G.,** Balkin, T.J., Redmond, D.P., Sing, H.C., Thomas, M.L., Thorne, D.R., Wesensten, N.J., and Hursh, S.R. Sustaining performance during continuous operations: The U.S. Army's Sleep Management System. In Proceedings of the Army Science Conference, Norfolk, Virginia, June 1996.

24) **Belenky, G.,** Balkin, T.J., Redmond, D.P., Sing, H.C., Thomas, M.L., Thorne, D.R., Wesensten, N.J., and Hursh, S.R. Sustaining performance during continuous operations: The U.S. Army's Sleep Management System. In Friedl, K., Lieberman, H., Ryan, D.H., and Bray, G.A. (Eds.) Pennington Center Functional Nutrition Series: Vol. 10, Countermeasures for Battlefield Stressors. Baton Rouge, LA: Louisiana State University Press, (2000) pp. 197-205.

25) Wesensten, N.J., Balkin, T.J., **Belenky, G.** Sleep sustains individual and organizational effectiveness. In WF Barko, MA Vaitkus (eds.), US Army War College Guide to Executive Health and Fitness. Carlisle, PA. Army Physical Fitness Research Institute, (2000) pp. 97-118.

26) Wesensten N.J., Comperatore, C.C., Balkin T.J., **Belenky, G.** Jet lag and sleep deprivation. In Kelley P.W., (Ed). Military Preventive Medicine: Mobilization and Deployment. In: Textbook of Military Medicine. Washington, DC: Office of the Surgeon General at TMM Publications, (2003) pp. 287-300.

27) Balkin T.J., Wesensten N.J., **Belenky G.** A system for monitoring operational effectiveness as a function of alertness. In: Hockey, Gaillard and Burov (Eds.) Operator Functional State: The Assessment and Prediction of Human Performance Degradation in Complex Tasks. Amsterdam: IOS Press (2003) pp. 121-130.

28) **Belenky, G.,** Balkin, T.J., Wesensten, N.J. Military operational effectiveness. In Kushida, C.A. (Ed.) Sleep Deprivation: Clinical Issues, Pharmacology, and Sleep Loss Effects. New York: Marcel Dekker (2005) pp. 289-312.

29) A. M. Bender, A. M. Tucker, K. A. Knittle, **G. Belenky**, H. P. A. Van Dongen (2007). Slow wave activity in the first NREM episode is a trait marker in addition to a homeostatic state

marker. In Ruigt, G. S. F., DeBoer, T., Van Kasteel, V., Van Luijtelaar, G., Overeem, S. (Eds.). Sleep-Wake Research in the Netherlands, vol. 18. Dutch Society for Sleep-Wake Research, pp. 33-36.

30) S. R. Webber, M. R. Sherman, A. M. Tucker, **G. Belenky**, H. P. A. Van Dongen (2007). Introversion, Type A personality, and resilience to cognitive impairment from sleep loss. In Ruigt, G. S. F., DeBoer, T., Van Kasteel, V., Van Luijtelaar, G., Overeem, S. (Eds.). Sleep-Wake Research in the Netherlands, vol. 18. Dutch Society for Sleep-Wake Research, pp. 131-134.

31) M. Oonk, A. M. Tucker, **G. Belenky**, H. P. A. Van Dongen (2008). Excessive sleepiness: determinants, outcomes, and context. The International Journal of Sleep and Wakefulness, in press.

32) Van Dongen HPA, **Belenky G.** Alertness level. In Binder MD, Hirokawa N, Windhorst U (Eds.), Encyclopedia of Neuroscience, Springer, Berlin, Germany; 2008: 75–77.

33) Van Dongen HPA, Rector DM, **Belenky G**, Krueger JM. Sleep, a localized phenomenon of the brain. In Kryger MH (Ed.), *Atlas of Clinical Sleep Medicine*, Elsevier Saunders, Philadelphia, Pennsylvania; 2010: 27–29.

34) King AC, **Belenky G**, Van Dongen HPA. Performance impairment consequent to sleep loss: determinants of resistance and susceptibility. *Current Opinion in Pulmonary Medicine* 2009; 15: 559–564.

35) Van Dongen HPA, **Belenky G**. Alertness level. In Binder MD, Hirokawa N, Windhorst U (Eds.), *Encyclopedia of Neuroscience*, Springer, Berlin, Germany; 2008: 75–77.

36) **Belenky, G.** & Akerstedt, T., Introduction to occupational sleep medicine. In Kryger, M., Roth, T. and Dement, W.C. (Eds.) Principles and Practice of Sleep Medicine, 5th Edition; in press.

37) Gander, P.H, Graeber, R.C., and **Belenky, G.** Fatigue Risk Management. In Kryger, M., Roth, T. and Dement, W.C. (Eds.) Principles and Practice of Sleep Medicine, 5th Edition, in preparation; in press.

38) McDonald, J., Patel, D., **Belenky, G.** Monitoring Sleep and Performance in the Workplace. In Kryger, M., Roth, T. and Dement, W.C. (Eds.) Principles and Practice of Sleep Medicine, 5th Edition; in press.

39) Van Dongen HPA, **Belenky G**, Krueger JM. Investigating the temporal dynamics and underlying mechanisms of cognitive fatigue. In Ackerman P (Ed.), *Proceedings of the Cognitive Fatigue Conference*, American Psychological Association, Washington, D.C.; in press.

40) Van Dongen HPA, **Belenky G**, Krueger JM. Investigating the temporal dynamics and underlying mechanisms of cognitive fatigue. In Ackerman P (Ed.), *Proceedings of the*

Cognitive Fatigue Conference, American Psychological Association, Washington, D.C.; in press.

Recent Abstracts (2006- present)

1) W. C. Clegern, H. Van Dongen, T. J. Balkin, N. J. Wesensten, **G. Belenky** (2006). Time on task effect of chronic sleep restriction. Sleep 29: A134.

2) H. Van Dongen, **G. Belenky** (2006). Replicability of the time-on-task effect during sleep deprivation. Sleep 29: A371.

3) **G. Belenky**, D. Thorne, N. Wesensten, H. Van Dongen, T. Balkin (2007). Sleep restriction degrades performance in a driving simulator in a sleep-dose dependent manner. Sleep 30: A143.

4) Bender, A. Tucker, K. Knittle, **G. Belenky**, D. Dinges, H. Van Dongen (2007). Slow wave activity in the first NREM episode is a trait marker in addition to a state marker. Sleep 30: A38.

5) P. McCauley, A. Smith, **G. Belenky**, H. Van Dongen (2007). Adapting to sleep loss: Dynamic properties of cognitive performance predictions based on the two-process model. Sleep 30: A123.

6) M. Sherman, S. Webber, A. Tucker, **G. Belenky**, H. Van Dongen (2007). Type A personality and resilience to neurobehavioral impairment from sleep loss. Sleep 30: A379.

7) Smith, P. McCauley, **G. Belenky**, H. Van Dongen (2007). Efficient computational procedure for individualization of sleep/wake model parameters. Sleep 30: A352.

8) L. Tompkins, A. Tucker, **G. Belenky**, H. Van Dongen (2007). Follicle stimulating hormone and sleep continuity in healthy women and men. Sleep 30: A37-A38.

9) S. Webber, M. Sherman, A. Tucker, **G. Belenky**, H. Van Dongen (2007). Does introversion/extraversion predict resilience to cognitive impairment from sleep loss? Sleep 30: A380.

10) A. Bender, K. Knittle, A. M. Tucker, **G. Belenky**, H. Van Dongen (2008). The range of trait individual differences exceeds the average effect of 36 hours of total sleep deprivation on total sleep time. Sleep 31, A27.

11) D. A. Grant, D. M. Rector, R. Short, H. Van Dongen, **G. Belenky** (2008). Correlation of psychomotor vigilance task performance with prefrontal BOLD signal measured by near-infrared optical topography. Sleep 31, A374-375.

12) J. L. McDonald, T. A. Lillis, L. A. Tompkins, H. Van Dongen, **G. Belenky** (2008). Effects of extended work hours on objectively measured sleep and performance in industrial employees. Sleep 31, A374.

13) A.D. Smith, A. C. Genz, **G. Belenky**, H. Van Dongen (2008). An efficient procedure for finding the 95% confidence interval of performance predictions based on the Two-Process Model. Sleep 31, A338.

14) L. A. Tompkins, A. M. Tucker, **G. Belenky**, D. F. Dinges, H. Van Dongen (2008). Generalizability of the relationship between follicle stimulating hormone and sleep discontinuity in healthy adults. Sleep 31, A24.

15) A. M. Tucker, P. Whitney, **G. Belenky**, J. M. Hinson, H. Van Dongen (2008). Performance on a letter verbal fluency task is better, not worse, after sleep deprivation. Sleep 31, A367.

16) H. Van Dongen, D. A. Grant, **G. Belenky** (2008). Systematic individual differences in circadian contribution to neurobehavioral impairment during sleep deprivation. Sleep 31, A43.

17) D.A. Grant, D.M. Rector, H.P.A. Van Dongen, **G. Belenky** (2009). Prefrontal hemodynamic signals measured by near-infrared optical topography are correlated with attentional lapses on a psychomotor vigilance test. Sleep 32, A24.

18) L. Swanson, J Arnedt, R. Rosa, M. Rosekind, **G. Belenky**, C. Drake (2009). Sleep, health, and work outcomes for shift workers: Results from the 2008 Sleep in America Poll. Sleep 32, A58.

19) P. McCauley, L.V. Kalachev, **G. Belenky**, D.F. Dinges, H.P.A. Van Dongen (2009). Cognitive performance predictions from a new biomathematical model of sleep/wake homeostasis. Sleep 32, A131.

20) A.C. King, **G. Belenky**, H.P.A. Van Dongen (2009). Homeostatic and circadian processes contribute jointly to the magnitude of systematic individual differences in performance impairment during sleep deprivation. Sleep 32, A145.

21) H.P.A. Van Dongen, P. McCauley, L.V. Kalachev, **G. Belenky** (2009). Modeling recovery after chronic sleep restriction: Sleep extension can provide recuperation of performance buy may me neither necessary nor sufficient. Sleep 32, A146.

22) A.K. Bowen, D. Patel, L.J. Wu, **G. Belenky** (2009). The effect of in-flight sleep on fatigue-risk in ultra-long-range (ULR) flight – comparison of 4-pilot ULR to 4-pilot non-ULR flights. Sleep 32, A155.

23) D. Patel, A.K. Bowen, L.J. Wu, **G. Belenky** (2009). The effect of in-flight sleep on estimated fatigue-risk in ultra-long-range (ULR) flight – comparison of 4-pilot with 2 to 3 pilot non-ULR flights. Sleep 32, A156.

24) A.M. Bender, A.M. Tucker, **G. Belenky**, H.P.A. Van Dongen (2009). General intellectual functioning does not predict performance impairment on the psychomotor vigilance test during total sleep deprivation. Sleep 32, A160.

25) J.M. Moore, H.P.A. Van Dongen, **G. Belenky**, C.G. Mott, L. Huang, B. Vila (2009). Use of a driving simulator to assess fuel inefficiency as a downstream effect of driver sleepiness in controlled laboratory experiments. Sleep 32, A387.

26) J.L. McDonald, L.A. Tompkins, T.A. Lillis, A.K. Bowen, D.A. Grant, H.P.A. Van Dongen, **G. Belenky** (2009). Work hours, sleep, and performance in medical residents working night float vs. day shift. Sleep 32, A394.

27) H.P.A. Van Dongen, R. Childers, **G. Belenky**, R. Ratcliff (2009). Sleep deprivation affects multiple distinct components of cognitive processing. Sleep 32, A406.

28) L.J. Wu, J.M. Hinson, A.M. Tucker, **G. Belenky**, P. Whitney, H.P.A. Van Dongen (2009). No significant effect of sleep deprivation on impulsivity in a delay discounting task. Sleep 32, A426.

CURRICULUM VITAE – GRAEBER, Raymond Curtis
October 2010

EDUCATION

1963-65 Canisius College, Buffalo, NY
1965-67 SUNY at Binghamton, NY; B.A. magna cum laude, Mathematics & Science (Psychology)
1967-70 University of Virginia, Charlottesville, VA; M.A. (Experimental Psychology)
1970-72 University of Virginia, Charlottesville, VA; Ph.D. (Neuro Psychology)

PROFESSIONAL EXPERIENCE

2009 - present: President, The Graeber Group, Ltd., human performance and aviation safety consultants with a global focus. Past or current clients include:
International Civil Aviation Organization, Montreal, Canada
Air New Zealand, Auckland, NZ
Air France, Roissy, FR
Cargo Airline Association, Washington, DC
National Air Carrier Association, Washington, DC

1990-2008: Boeing Commercial Airplanes, Seattle, WA (retired Dec. 31, 2008)
Senior Technical Fellow, 2003-2008 (Corporate STF Leadership Team 2005-2008)
Director, Regional Safety Programs, 2006-08.
Chief Engineer, Human Factors, 1997-2008
Chief, Crew Operations, 737-600/700/800 Program Engineering, 1994-97
Chief, Human Factors Engineering, 1993-94
Manager, Flight Deck Research, Avionics and Flight Systems, 1990-93

1981-90: Aerospace Human Factors Division, NASA Ames Research Center, Moffett Field, CA.
Chief, Flight Human Factors Branch (formerly Aviation Systems Research Branch) 1989-90;
Principal Scientist, Aviation Systems Research Branch, 1988-89;
Research Psychologist/Project Officer, Aeronautical Human Factors Research Office, 1981-87.

1986: Human Factors Specialist, Investigation Staff, The Presidential Commission on the Space Shuttle Challenger Accident, Washington, D.C.

1977-81: Research Psychologist, Department of Military Medical Psychophysiology, Neuropsychiatry Division, Walter Reed Army Institute of Research, Washington, D.C. 1980-81: Deputy Chief.

1972-76: Research Psychologist, Behavioral Science Division, Food Sciences Laboratory, U.S. Army Natick Research and Development Command, Natick, MA.

1970-71: Visiting Scientist, Lerner Marine Laboratory, American Museum of Natural History, Bimini Island, Bahamas.

INDUSTRY ACTIVITIES AND PROFESSIONAL SOCIETIES

Government Support

U.S. Federal Aviation Administration:
U.S. Industry Co-Chair, FAA-JAA ARAC Harmonization Working Group, Flight Crew Error & Performance in the Flight Deck Certification Process, FAR/JAR 25-1302, 1999-2005.
Co-Chair, FAA Certification Process Study, Phase II, Human Factors Team, Sept. 2002-04.
FAA Research, Development, and Engineering Human Factors Subcommittee, 1997-2004.
Co-Chair, Working Group 2 (Human Factors), RTCA Certification Task Force, 1998-99.

Chair, FAA ARAC Working Group for Controlled Rest on the Flight Deck, 1991-93.
Scientific Task Planning Group (cockpit) to develop Aviation Human Factors National Plan, 1990.

European Joint Airworthiness Authorities (JAA) and EASA Human Factors Steering Group, 1995-2008.

International Civil Aviation Organization (ICAO):
Leader, Fatigue Risk Management Task Force, 2009-10.
Flight Operations Panel – standards development: Chair, Fatigue Risk Management Subteam, 2005 - 2008. Chair, Flight Time Limitations Subteam, 2004-05.
Member, Industry Safety Strategy Group, co-author of Global Aviation Safety Roadmap, 2005- 2008.

U.S. National Aeronautics and Space Administration:
Airspace Systems Program Subcommittee, Aeronautics Research Advisory Committee, 2005.
Aeronautics Goals Subcommittee, Aero-Space Technology Advisory Committee, 1999-2001.
Human Factors Subcommittee, Aero-Space Technology Advisory Committee, 1996-2001.
NATO AGARD Advisory Panel on Aerospace Medicine (NASA representative), 1989-90.
Investigation Staff, The Presidential Commission on the Space Shuttle Challenger Accident, 1986.

U.S. Congress:
House Subcommittee on Aviation of the Committee on Public Works and Transportation:
Testified at June 2009 hearing on Regional Air Carriers and Pilot Workforce Issues.
Testified at May 1990 hearing on Language Issues in ATM Communication.
Office of Technology Assessment, Washington, DC. Human Factors in Aviation Safety Working Group, May 1987; Shift Work and Extended Duty Hours Workshop, May 1990.

U.S. National Transportation Safety Board:
NTSB Human Performance Seminar, Washington, DC, June 1987.

DOD Human Factors Engineering TAG, SUB TAG on Sustained/Continuous Operations, 1985-1990.

National Research Council Committee on Military Nutrition Research Workshop on Cognitive Testing Methodology, Washington, DC, June 1984.

Nuclear Regulatory Commission Shift Work Scheduling Project, Washington, DC, April 1984.

Department of State, Medical Department, 1981.

Office of Naval Research, Oceanic Biology Program, 1974 –79.

U.S. Department of Agriculture (Food for Peace Program), 1973.

Industry Activities and Professional Societies:

Air France, Chair, Independent Safety Review Team, 2009-10.

Flight Safety Foundation (FSF):
Chair, Icarus Committee ("think tank"), 2003-08, member since 2001.
Board of Governors and Executive Committee, 2003-08 (Ex Officio)
Organizer and Co-Chair, International Ultra Long-Range Crew Alertness Project, June 2001-05.

National Sleep Foundation, Board of Directors, 2008 – present.

Air New Zealand, Independent Alertness Advisory Panel, Chair 2006 – present, member since 1996.

Royal Aeronautical Society, Fellow 1997- present.
External Affairs Board, 2001- 2008;

The Boeing Company Technical Focal, 2001-08.
Founding Member, Seattle Chapter Executive Committee, 2000-09, Vice-Chair, 2003-06.

QANTAS/Civil Aviation Safety Authority/ AIPA: Fatigue Risk Management Steering Committee, 2000 - 2007. Chair, Scientific Review Committee, 2000-06.

Joint United Airlines/ALPA Working Group on Long-Haul Crew Scheduling, Chicago, IL, 1988-2001.

LOSA (Line Operational Safety Audit) International Advisory Board, 2003-07.

International Air Transport Association, Human Factors Working Group, 1995-2005.
Air Transport Association (U.S.A.), Human Factors Task Force, 1988-1995.

Editorial Board, *Cognition, Technology and Work Journal,* Springer Publishing, 2002- present.

Associate Editor (N. America), *Human Factors and Aerospace Safety*, Ashgate Press, 1999- present.

Journal Manuscript Reviewer for: *International Journal of Cognition, Technology & Work; Work and Stress; Aerospace Safety &Human Factors; Sleep; Aviation, Space & Environ. Med.; J. Biol. Rhythms.*

Ohio State University, Institute for Ergonomics, Advisory Board, 1998-2002.
Aerospace Medical Association: Fellow 1990, member, 1981-95.
Human Factors and Ergonomics Society: member, 1991-2005.
International Society for Chronobiology: member, 1975-1992. Board of Directors, 1984-1992.
Sleep Research Society, member, 1986-1993, Governmental Affairs Committee, 1987-1992.
Society for Neuroscience: member, 1972-82.
American Psychological Association: member, 1972-75.

HONORS AND AWARDS

Elected Member, Washington State Academy of Science, 2010- present.

Fellow, Flight Safety Foundation, 2009.

Honorary Research Fellow, Massey University, Wellington, New Zealand, 2009-11.

International Council of Aeronautical Sciences (ICAS) Maurice Roy Medal for fostering international scientific cooperation in human factors, 2008.

Flight Safety Foundation – Airbus Human Factors in Aviation Safety Award, 2006.

Senior Technical Fellow, The Boeing Company, 2003.

Cumberbatch Trophy 2000, Guild of Aircraft Pilots and Air Navigators (GAPAN), for the Promotion of Flight Safety and Recognition as a World Authority in Aviation Human Factors, 2001.

Sir Frank Whittle Medal, International Federation of Airworthiness, MEDA Team Award, 2000.

1999 Aerospace Laurel Award, Commercial Air Transport, *Aviation Week and Space Technology.*

Fellow, Royal Aeronautical Society, 1997.

NASA Group Achievement Awards, 1986, 1994.

Fellow, Aerospace Medical Association, 1990.

The John Lane Visiting Lecturer, Aviation Medical Society of Australia and New Zealand, 1990.

Boothby-Edwards Memorial Award for Outstanding Research in Civil Aviation Medicine, Aerospace Medical Association, 1989.

Harold Ellingson Literary Award, Aerospace Medical Association, 1987.

Military Decorations:
- Legion of Merit, U.S. Army, 1989.
- U.S. Army Meritorious Service Medal, 1988.
- Department of Defense Meritorious Service Medal, 1986.
- U.S. Army Commendation medal, 1976, with oak leaf cluster, 1983.

Commander's Award in Science, U.S. Army Natick Research and Development Command, 1974.

National Defense Title IV Predoctoral Fellowship, University of Virginia, 1967-69

.

B. A. *magna cum laude*, SUNY Binghamton, 1967.

TEACHING:

Visiting Professor, Human Factors, College of Aeronautics, Cranfield University, UK, 2001- 2008.

Faculty, Aviation Safety and Security Management Certificate Program, The George Washington University Aviation Institute, Virginia Campus, 1998-2000.

Lecturer: Sleep Disorders Center, Stanford University School of Medicine, Stanford, CA. Course in Clinical Polysomnography, 1986-90. Physicians' Course in Sleep Disorders Medicine, 1988-89.

Lecturer: Trinity University, San Antonio, TX. Advanced Human Factors Short Course, 1986-90.

Lecturer: USAF School of Aerospace Medicine, Brooks, AFB, TX.
Basic Aerospace Physiology Course, 1986. Operational Problems in Aerospace Physiology, 1987.

Visiting Instructor, Psychology: Framingham State College, Framingham, MA, 1973-76; George Mason University, Graduate Div., Fairfax, VA, 1978; University of Maryland, College Park, MD, 1978-80.

MILITARY SERVICE

U.S. Army: Active duty, Medical Service Corps, July 1, 1969 to June 30, 1989.
Retirement Rank: Lieutenant Colonel

AERONAUTICAL RATINGS

Private pilot: airplane, single engine land (July 9, 1983).

CONSULTING:

Compa Corp., Nuclear Regulatory Commission Control Room Simulator Review Project, 1994.
Federal Highway Authority, Office of Motor Carrier Standards, U.S. Dept. Transportation, Sept. 1989.
SAE A-21 Aircraft Noise Committee (Interior Noise Subcommittee), San Antonio, TX, April 1989.
SAE G-10 Committee on Aerospace Behavioral Engineering Technology: consultant, 1985-1994.
Stanford Research Institute, Inc., Menlo Park, CA. 1986.
Westinghouse-Hanford Co., Fast Flux Test Facility, Hanford, WA. 1986-87.

DOD Uniform Services University of the Health Sciences: December 1986 & November 1987.
San Francisco "Forty-Niners" NFL Football Team, Redwood City, CA, 1986.
NATO AGARD Consultant Mission to FRG National delegation, DFVLR Institute of Aerospace Medicine, Cologne, W. Germany, May, 1985.

MEDIA INTERACTION:

"Cockpit Napping Endorsed", CNN TV News, November 9, 2009.

"Working Nights", Soundprint, Minnesota Public Radio/NPR, June 1997.

PBS "Discovery", Cockpit Technology and Automation, 1996.

Swissair Flight Crew Training video, Flight Deck Automation, 1995.

Segment on Cockpit Rest, Medical World News, CNN, International Syndication, Nov. 1990.

"Sleep Alert", PBS national syndication, March 1990.

"The Flying Computer Game", MTV Finland, Helsinki, Finland, fall 1989.

"Pilot Fatigue", eyewitness, LWT (London Weekend Television), London, England, May 1989.

"The Biological Clock", Innovation, WNET-TV (PBS national syndication), New York, NY, Jan. 1989

"The Twenty-Five Hour Day", Horizon, BBC2, London, U.K., Dec. 1986.

Landing of the "Voyager", CNN, human factors of the "Voyager" round-the-world flight, Dec. 23, 1986.

MacNeil-Lehrer News Hour, PBS, live discussion with Congressman W. Nelson on Human Factors Aspects of the Space Shuttle Challenger Accident, Aug. 6, 1986.

PUBLICATIONS

Books

Boy, G., C. Graeber, and J-M. Robert (Eds.): *Proceedings of the HCI-Aero '98 International Conference on Human-Computer Interaction in Aeronautics*. Montreal: Editions de l'Ecole Polytechnique de Montreal, 1998.

Graeber, R.C. (Ed): Sleep and Wakefulness in International Aircrews. *Aviation Space, And Environmental Medicine*, Vol. 57, No. 12, Section II (Suppl.), 1986.

Brown, F. M. and R. C. Graeber (Eds): *Rhythmic Aspects of Behavior*. Hillsdale, N.J.: L. Erlbaum Associates, 1982.

Book Chapters

Balkin, T.J., Horrey, W.J., Graeber, R.C., Czeisler, C.A., and Dinges, D.F.: The Challenges and Opportunities of Technological Approaches to Fatigue Management. In: *Proceedings of Liberty Mutual Hopkinton Conference on Future Directions in Fatigue and Safety Research*, in press.

Gander, P., Graeber, R.C., and Belenky, G.: Fatigue Risk Management. In: M. Kryger**,** T. Roth, and W. C. Dement (Eds.), *Principles and Practice in Sleep Medicine*, 5th Edition, Elsevier, 2010, pp. 760-768.

Applegate, J.D., and Graeber, R.C.: Integrated safety system design and human factors considerations for jet transport aeroplanes. In D. Harris and H.C. Muir (Eds.), *Contemporary Issues in Human Factors and Aviation Safety.* Aldershot, Ashgate: 2005, pp. 3-23.

Graeber, R.C., and Mumaw, R.J.: Realizing the benefits of cognitive engineering in commercial aviation. 3rd International Conference on Engineering Psychology and Cognitive Ergonomics, Oxford, England, Oct. 1998. In D. Harris (Ed.), *Engineering Psychology and Cognitive Ergonomics, Vol. 3.* Aldershot, Ashgate: 1999, pp. 3-26.

Kovarik, L.E., Graeber, R.C., and Mitchell, P.R.: Human factors considerations in aircraft cabin design. In D. Garland, J. Wise, and V.D. Hopkin (Eds.), *Handbook of Aviation Human Factors*. Malwah, NJ, Lawrence Erlbaum Associates, 1999, pp. 389-403.

Graeber, R. C.: Integrating human factors and safety into airplane design and operations. In B.J. Hayward and A.R. Lowe, (Eds), *Applied Aviation Psychology: Achievement, Change, and Challenge*. Aldershot, UK, Avebury Aviation, 1996, pp. 27-38.

Marx, D. M., and Graeber, R. C.: Human error in aircraft maintenance. In N. McDonald, N. Johnston, and R. Fuller (Eds), *Aviation Psychology in Practice*. Aldershot UK, Ashgate Press, 1994, pp. 87-104.

Connell, L. J., and Graeber, R. C.: Ambulatory monitoring in the aviation environment. In L. Miles and R. Broughton (Eds), *Clinical Evaluation and Physiological Monitoring in the Home and Work Environment*. New York, Raven Press, 1989, pp. 175-185.

Graeber, R.C.: Long-range operations in the glass cockpit: Vigilance, boredom, and sleepless nights. In A. Coblentz (Ed), *Vigilance and Performance in Automatized Systems*. NATO Advanced Science Institutes Series. Dordrecht: Kluwer Academic Publ., 1989, pp. 67-76.

Graeber, R.C.: Jet lag and sleep disruption. In M. H. Kryger, T. Roth, and W. C. Dement (Eds): *Principles and Practice in Sleep medicine*. New York, W. B. Saunders, 1989, pp. 324-331. Also 2nd edition, 1994, pp. 463-470.

Graeber, R.C.: Aircrew fatigue and circadian rhythmicity. In E. L. Wiener and D. C. Nagel (Eds): *Human Factors in Aviation*. New York, Academic Press, 1988, pp. 305-343.

Appendix G: Human Factors Analysis. In Volume II, *Report of the Presidential Commission on the Space Shuttle Challenger Accident*. Washington, D.C., 1986, pp. G1-6.

Graeber, R.C., Foushee, H.C. and Lauber, J.K.: Dimensions of flight crew performance decrements: Methodological implications for field research. In J. Cullen, J. Siegrist, and H. M. Wegmann (Eds): *Break down in Human Adaptation to Stress, vol. 1*. The Hague, M. Nijhoff Publ., 1984, pp. 584-605.

Graeber, R.C.: Alterations in performance following rapid transmeridian flight. In F.M. Brown and R. C. Graeber (Eds), *Rhythmic Aspects of Behavior*. Hillsdale, L. Erlbaum Associates, 1982, pp. 173-212.

Graeber, R.C., H.C. Sing, and B.N. Cuthbert: The impact of rapid transmeridian flight on deploying Soldiers. In L. Johnson, D. Tepas, W. P. Colquhoun, and M. J. Colligan (Eds), *Biological Rhythms, Sleep, and Shift Work. Advances in Sleep Research, vol. 7*. New York, Spectrum, 1981, pp. 513-537.

Graeber, R.C.: Recent studies relative to the airlifting of military units across time zones. In L. Scheving and F. Halberg (Eds), *Chronobiology: Principles and Applications to Shifts in Schedules*. Alphen aan den Rijn, Sijthoff & Noordhoff, 1980, pp. 353-369.

Graeber, R.C.: Behavioral correlates of tectal function in elasmobranchs. In H. Venegas (Ed.), *Comparative Neurology of the Optic Tectum.* New York, Plenum Press, 1984, pp. 69-92.

Graeber, R.C.: Telencephalic function in elasmobranchs: A behavioral perspective. In S.O.E. Ebbesson (Ed.), *Comparative Neurology of the Telencephalon*. New York, Plenum Press, 1980, pp. 17-39.

Graeber, R.C.: Behavioral studies correlated with central nervous system integration of vision in sharks. In E.S. Hodgson and R.F. Mathewson (Eds.), *Sensory Biology of Sharks, Skates and Rays.* Arlington, VA, Office of Naval Research, 1978, pp. 195-225.

RESEARCH TECHNICAL REPORTS

Dinges, D.F., Graeber, R.C., Rosekind, M. R., Samel, A., and Wegmann, H.M.: Principles and Guidelines for Duty and Rest Scheduling in Commercial Aviation. NASA Technical Memorandum 110404, May 1996.

Gander, P.H., Gregory, K.B., Connell, L.J., Miller, D.L., Graeber, R.C., and Rosekind, M.R.: Crew Factors in Flight Operations VII: Psychophysiological responses to overnight cargo operations. NASA Technical Memorandum 110380 , 1996.

Gander, P.H., Graeber, R. C., Foushee, H. C., Lauber, J. K., and Connell, L. J.: Crew Factors in Flight Operations: II. Psychophysiological Responses to Short-Haul Air Transport Operations. NASA Technical Memorandum 108856, 1994.

Rosekind, M. R., Graeber, R.C., Connell, L. J., Dinges, D. F., Rountree, M. S., Spinweber, C.L., and Gillen, K. A.: Crew Factors in Flight Operations IX: Effects of preplanned cockpit rest on crew performances and alertness in long-haul operations. NASA Technical Memorandum 108839, 1994.

Gander, P. H., Barnes, R. M., Gregory, K. B., Connell, L. J., Miller, D. M., and Graeber, R. C.: Crew Factors in Flight Operations VI: Psychophysiological Responses to Helicopter Operations. NASA Technical Memorandum 108838, 1994.

Gander, P.H., Graeber, R.C., Connell, L. J., and Gregory, K. B.: Crew Factors in Flight Operations: VIII. Factors Influencing Sleep Timing and Subjective Sleep Quality in Commercial Long-Haul Flight Crews. NASA Technical Memorandum 103852, 1991.

Graeber, R. C. (Ed): Crew Factors in Flight Operations: IV. Sleep and Wakefulness in International Aircrews, NASA Technical Memorandum 88231, March 1986.

Gander, P. H., G. Myhre, R. C. Graeber, H. T. Anderson, and J. K. Lauber: Crew Factors in Flight Operations: I. Effects of 9-Hour Time-Zone Changes on Fatigue and Circadian Rhythms of Sleep/Wake and Core Temperature. NASA Technical Memorandum 88197, December 1985.

Graeber, R.C., Cuthbert, B.N., Sing, H.C., Schneider, R.J., Sessions, G.R.: Rapid Transmeridian Deployment: Cognitive Performance and Chronobiologic Prophylaxis for Circadian Dyschronism. Walter Reed Army Institute of Research, Washington, D.C., 15 pages. DTIC Accession No. ADA090393, June 1980.

Graeber, R.C., Gatty, R., Halberg, F.,and Levine, H.: Human Eating Behavior: Preferences. Consumption Patterns, and Biorhythms. U.S. Army Natick Laboratories Technical Report, 279 pages. DTIC Accession No. ADA073571, June 1978.

Siebold, J.R., Symington, L. E., Maas, D L , and Graeber, R.C.: Consumer and Worker Evaluation of Cash Food Systems: Loring Air Force Base (Part II Long Term Findings). U.S. Army Natick Laboratories Technical Report, 47 pages. DTIC Accession No. ADA032468, August 1976.

Siebold, J.R., Symington, L. E., Graeber, R.C., and Maas, D L.: Consumer and Worker Evaluation of Cash Food Systems: Loring Air Force Base Part I. U.S. Army Natick Laboratories Technical Report, 279 pages. DTIC Accession No. ADA022121, November 1975.

Rodier, Jr., W.I., Wetsel, W.C., Jacobs, H.L., Graeber, R.C., Moskowitz, H.R., Reed, T.J., and Waterman, D.: The Acceptability of Whey-Soy Mix as a Supplementary Food for Pre-School Children in Developing Countries. U.S. Army Natick Laboratories Technical Report, 21 pages. DTIC Accession No. AD0772930, December 1973.

PAPERS

Graeber, R.C.: SMS in the Global Aviation Safety Roadmap. The Inaugural South Pacific Aviation Safety Management Systems Symposium, Auckland, NZ, March 21, 2009.

Graeber, R.C.: Fatigue Risk Management. IFALPA Annual Conference, Auckland, NZ, March 20. 2009.

Graeber, R.C.: The Global Aviation Safety Roadmap: Regional Implementation Update. FSF, IFA, and IATA 61st Annual International Air Safety Seminar, Honolulu, Hawaii, October 27, 2008.

Graeber, R.C.: Fatigue Risk Management Systems within SMS. FAA Aviation Fatigue Management Symposium: Partnerships for Solutions, Tysons Corner, VA, June 17-19, 2008.

Graeber. R.C.: Managing Fatigue Risk in Commercial Air Transport. Royal Aeronautical Society NZ Division Symposium, Auckland, NZ, March 19, 2008.

Graeber, R.C.: Implementing the Global Safety Roadmap in Africa. AU/ATAG/ICAO/World Bank Air Transport Development Forum, African Union Headquarters, Addis Ababa, Ethiopia, 23-25 April 2007.

Graeber, R.C.: The safety benefits of LOSA: A manufacturer's perspective. International LOSA and TEM Workshop, Toulouse, France, Nov. 15-16, 2006.

Graeber, R.C.: The Global Safety Roadmap. 59th Annual FSF-IATA-IFA International Air Safety Seminar, Paris, France, Oct. 23-26, 2006.

Graeber, R.C.: Aviation Safety Trends: A Regional Perspective. Assoc. of Asia-Pacific Airlines Safety Symposium, Kuala Lumpur, Oct. 10, 2006.

Graeber, R.C.: LOSA as a collaborative safety tool. International LOSA and TEM Workshop, Rio de Janeiro, Brazil, June 23, 2005.

Graeber, R.C.: LOSA and the value of collaboration. 2nd ICAO-IATO Line Operational Safety Audit /Threat and Error Management Conference, Seattle, WA, Nov. 3-4, 2004.

Graeber, R.C.: Addressing crew alertness in ultra long-range operations. Association of Asia Pacific Airlines Air Safety Seminar, Kuala Lumpur, Malaysia, April 27-28, 2004.

Graeber, R.C.: Setting the standards for flight deck design: The next generation. 6th International Aviation Psychology Symposium, Sydney, Australia, Dec. 1-5, 2003.

Graeber, R.C.: The Boeing safety approach: The value of collaboration. 1st ICAO-IATA LOSA-TEM Conference, Dublin, Ireland, Nov. 5-7, 2003.

Graeber, R.C.: Crew alertness in ultra long-range operations. SAE-Flight Safety Foundation, N. American Aviation Safety Conference, Atlanta, GA, Feb. 4-6, 2003; and 56th FSF-IATA-IFA International Air Safety Seminar, Washington, DC, Nov. 10-13, 2003.

Graeber, R.C: The value of LOSA collaboration: Boeing UT/TLC. ICAO-Emirates 3rd LOSA Week Conference, Dubai, UAE, Oct. 14-16, 2002.

Castano, D.J. and Graeber, R.C.: Aviation safety collaboration: LOSA and Boeing, a manufacturer's perspective. *ICAO Journal*, *57 (4)*, Pp. 10-11, 27-28, August 2002.

Applegate, J.D., and Graeber, R.C.: Integrated safety systems design and human factors considerations for jet transport airplanes. *Human Factors and Aerospace Safety*, 1(3), 201-221, 2001.

Graeber, R.C.: The role of human factors in improving aviation safety. Boeing *Aero* magazine, October 1999 (No.8), Pp. 23-28.

Graeber, R.C.: Tools developed by aircraft builder designed to help airlines manage human error. *ICAO Journal*, *54* (5), Pp. 11-14, June 1999.

Graeber, R.C.: Design, human performance, and safety: The opportunities. Invited keynote, ICAO 4th Global Safety and Human Factors Symposium, Santiago, Chile, April 12-15, 1999. (*ICAO Journal*, 54: 11-14, June 1999.)

Graeber, R.C.: Airplanes, safety, and culture: A manufacturer's perspective. Paper presented at the ICAO 1st Regional Seminar on Cross-Cultural Issues in Aviation Safety, Bangkok, Thailand, August 12-14, 1998.

Graeber. R.C., and Moodi, M.M.: Understanding flight crew adherence to procedures: The procedural event analysis tool (PEAT). Paper presented at the Flight Safety Foundation/International Federation of Airworthiness, International Air Safety Seminar, Capetown, So. Africa, Nov. 17-19, 1998.

Gander, P.H., Gregory, K.B, Miller, D.L., Graeber, R.C., Connell, L.J., and Rosekind, M.R.: Flight crew fatigue V: Long-haul air transport operations. *Aviation, Space & Environ. Med., 69*, (9, Section II, Suppl.), B37-B48, 1998.

Gander, P.H., Gregory, K.B, Connell, L.J., Graeber, R.C., Miller, D.L., and Rosekind, M.R.: Flight crew fatigue IV: Overnight cargo operations. *Aviation, Space & Environ. Med., 69*, (9, Section II, Suppl.), B26-B36, 1998.

Gander, P.H., Barnes, K.B., Gregory, K.B, Graeber, R.C., Connell, L.J., and Rosekind, M.R.: Flight crew fatigue III: North sea helicopter air transport operations. *Aviation, Space & Environ. Med., 69*, (9, Section II, Suppl.), B16-B25, 1998.

Gander, P.H., Gregory, K.B, Graeber, R.C., Connell, L.J., Miller, D.L., and Rosekind, M.R.: Flight crew fatigue II: Short-haul fixed-wing air transport operations. *Aviation, Space & Environ. Med., 69*, (9, Section II, Suppl.), B8-B15, 1998.

Gander, P.H., Graeber, R.C., Connell, L.J., Gregory, K.B., Miller, D.L., and Rosekind, M.R.: Flight crew fatigue I: Objectives and methods. *Aviation, Space & Environ. Med., 69*, (9, Section II, Suppl.), B1-B7, 1998.

Graeber, R.C.: Applying human factors to airplane maintenance operations. Paper presented at the Tunisian Ministry of Transport Aviation Human Factors Conference, Tunis, Tunisia, March 3-5, 1997.

Graeber, R.C.: Human factors challenges: The key to safe flight in the 21st century. Paper presented at the Tunisian Ministry of Transport Aviation Human Factors Conference, Tunis, Tunisia, March 3-5, 1997.

Graeber, R.C.: Enhancing aviation system safety through improved human factors. White House International Conference on Aviation Safety and Security in the 21st Century. Washington, DC, Jan. 13-15, 1997.

Graeber, R.C.: Accident prevention strategies. Invited paper presented at the IATA Human Factors in Aviation Seminar, Warsaw, Poland, Oct. 1996.

Graeber, R.C.: The value of human factors for airline management. Invited paper presented at the Royal Aeronautical Society Conference, Human Factors for Aerospace Leaders, London, England, May 1996.

Graeber, R.C.: Integrating human factors and safety into airplane design and operations. Invited paper presented at the 3rd Australian Aviation Psychology Symposium, Sydney, Australia, Nov. 1995.

Graeber, R.C.: Human factors challenges: The key to safe flight in the 21st Century. Invited paper presented at the Registro Aeronautico Italiano Int'l. Conference on "The Human Factor in Civil Aviation," Rome, Sept. 1995.

Graeber, R.C.: Flight crew accident and incident human factors. Proceedings of the FAA Office of System Safety Workshop on Flight Crew Accident and Incident Human Factors, pp. A64-67, June 21-23, 1995.

Gander, P.H., Gregory, K.B., Miller, D.L., Connell, L.J., Graeber, R.C., and Rosekind, M.R.: Flight crew sleep and circadian rhythms during overnight cargo operations. Paper presented at the Annual Meeting of the Aerospace Medical Assoc., Anaheim, CA, May 1995.

Graeber, R.C.: Accident prevention strategies. Invited paper presented at the IATA Human Factors in Aviation Seminar & Workshops, Bahrain, March 1995.

Graeber, R.C.: Mutual assurance: Technological opportunity and human responsibility. Invited paper presented at the ANAE/Flight Safety Foundation International Symposium, The Air Transport System: Aircrew and Air Traffic Management Integration, Toulouse, France, Nov. 1994.

Graeber, R.C.: Integrating human factors knowledge into advanced flight deck design. Paper presented at the 6th Regional ICAO Flight Safety & Human Factors Seminar, Amsterdam, Netherlands, May 1994.

Graeber, R.C., and Marx, D.A.: Reducing human error in aircraft maintenance operations. Paper presented at the Flight Safety Foundation 46th Annual International Air Safety Seminar, Kuala Lumpur, Malaysia, Nov. 1993.

Graeber, R.C.: Safer skies for tomorrow: A manufacturer's perspective on future aviation safety improvements. Invited paper presented at the Scandinavian Safety Symposium, Oslo, Norway, Feb. 1993.

Sasaki, M., Kurosaki, Y.S., Spinweber, C.S., Graeber, R.C., and Takahashi, T.: Flight crew sleep during multiple layover polar flights. *Aviat., Space, & Environ. Med*., *64*:641-647, 1993.

Graeber, R.C.: Design challenges for 21st century flight decks: Human factors implications. Invited paper presented at the Australian Aviation Psychology Symposium, Sydney, Australia, Nov. 1992. (In B.J. Hayward and A.R. Lowe (Eds.), *Towards 2000: Future directions and new solutions*. Albert Park: Australian Aviation Psychology Assoc., 1993, pp. 153-163.)

Kelly, B.K., Graeber, R.C., and Fadden, D.M.: Applying crew-centered concepts to flight deck technology: The Boeing 777. Paper presented to the Flight Safety Foundation 45th International Air Safety Seminar, Long Beach, CA., Nov. 1992.

Graeber, R.C.: Defining 21st Century transport flight decks: A human-centered approach. Invited paper presented to 3rd Seminar in Transportation Ergonomics: The Pilot/Aircraft System. Montreal, Canada, Oct. 1992.

Braune, R.J., and Graeber, R.C.: Human-centered designs in commercial air transport aircraft. Paper presented at the Annual Meeting of the Human Factors and Ergonomic Society, Oct. 1992, Atlanta, GA.

Graeber, R.C.: Defining 21st Century transport flight decks: Revolution or evolution? Invited paper presented to Guild of Airline Pilots and Air Navigators. Royal Aeronautical Society, London, April 1992.

Rosekind, M.R., Connell, L.J., Dinges, D.F., and Graeber, R.C.: Preplanned cockpit rest: Effects on physiological alertness in long-haul flight crews. Paper presented at the Annual Meeting of the Aerospace Medical Assoc., Cincinnati, OH, May 1992. (Abstr.: *Avia., Space, Environ. Med*., 62:482, 1991).

Graeber, R.C., Hudson, D., and Kohn, G.: The jet lag dilemma, Part II. *Airline Pilot*, Feb. 1991, pp. 23-25, 50.

Graeber, R.C.: The jet lag dilemma, Part I. *Airline Pilot*, Jan. 1991, pp. 18-22.

Samel, A.L., Gander, P.H., Graeber, R.C., and Wegmann, H.M.: Response of the circadian system to shifted sleep-wake cycles and bright light exposure during head-down tilt (HDT). Paper presented at the Annual Meeting of the Aerospace Medical Assoc., Cincinnati, OH, May 1992. (Abstr.: *Avia., Space, Environ. Med*., 62:476, 1991).

Connell, L.C., Samel, A.L., and Graeber, R.C.: The impact of eastbound flight on sleep and circadian rhythms in military transport crews. Paper presented at the Annual Mtg. of the Aerospace Med. Assoc., Cincinnati, OH, May 1992. (Abstr.: *Avia., Space, Environ. Med*., 62:455, 1991).

Dinges, D.F., Connell, L.J., Rosekind, M.R. and Graeber, R.C.: Preplanned cockpit rest: Effects on vigilance performance in long-haul flight crews. Paper presented at the Annual meeting of the Aerospace Medical Assoc., Cincinnati, OH, MA 1992. (Abstr.: *Avia., Space, Environ. Med*., 62:451, 1991).

Graeber, R.C.: Fatigue and the body clock in long-haul operations. Paper presented at "Managing the Modern Cockpit", 3rd SAE-AREF Human Error Avoidance Techniques Conference, Dallas, TX, Dec. 1990.

Graeber, R.C.: Fatigue in long-haul operations: Sources and solution. Paper presented at the 43rd FSF International Air Safety Seminar, Rome, Italy, Nov. 1990.

Graeber, R.C.: Sleep loss and jet leg: Implications for cabin crew health and performance. Assoc. of Flight Attendants Conference on Flight Attendant Occupational Health, Washington, D.C., Nov. 1990.

Graeber, R.C.: Fatigue in long-haul operations: Sources and solutions. Proc. 43rd Annual International Air Safety Seminar, Arlington: Flight Safety Foundation, 1990, pp. 246-257.

Graeber, R.C., Rosekind, M.R., Connell, L.J., and Dinges, D.F.: Cockpit napping. *The ICAO Journal*, 45, 6-10, Oct. 1990.

Graeber, R.C.: NASA's sleep/fatigue study: Alertness management of the flight deck. Invited paper presented at the Triennial Boeing 747 Flight Operations Symposium, Seattle, WA, Oct. 1990.

Gander, P.H., and Graeber, R.C.: Factors controlling sleep timing and subjective sleep quality in long-haul flight crews. Paper presented at the 38th Int'l. Congress of Aviation and Space Med., Paris, France, Sept. 1990.

Graeber, R.C.: Improved alertness through preplanned cockpit rest in long-haul operations. Invited paper presented at the Triennial Combined Conference of the Aviation Medical Society of Australia and New Zealand, Auckland, NZ, Sept. 1990.

Graeber, R.C.: Circadian rhythms and sleep loss in transmeridian flight. Invited paper presented at the Triennial Combined Conference of the Aviation Medical Society of Australia and New Zealand, Auckland, NZ, Sept. 1990.

Graeber, R.C.: Long-range flying and flight crew performance factors. Invited paper presented to the Japan Aircraft Pilot Association, Tokyo, Japan, July 1990.

Moline, M.L., Pollak, C., Wagner, D.R., Zendell, S.M., Monk, T.H., Graeber, R.C., Lester, L.S., Salter, C.A., and Hirsch, E: Effects of age on the ability to sleep following an acute phase advance. Paper presented at the Annual Meeting of the Assoc. of Professional Sleep Societies, Minneapolis, MN, June 1990. (Abstr.: *Sleep Research*, 19:400, 1990).

Rosekind, M.R., Townsend, B.T., Rountree, M., Connell, L.J., Yost, D., Graeber, R.C., Spinweber, C.S., Dinges, D.F., and Dement, W.D.: Modification of the Medilog 9000-II recorder to reduce 400 Hz noise in the cockpit environment. Paper presented at the Annual Meeting of the Assoc. of Professional Sleep Societies, Minneapolis, MN, June 1990. (Abstr.: *Sleep Research*, 19:403, 1990).

Dinges, D.F., Graeber, R.C., Connell, L.J., Rosekind, M.R., and Powell, J.W.: Fatigue-related reaction time performance in long-haul flight crews. Paper presented at the Annual Meeting of the Assoc. of Professional Sleep Societies, Minneapolis, MN, June 1990. (Abstr.: *Sleep Research*, 19:117, 1990).

Graeber, R.C.: Pilot/Air Traffic Controllers Communications Issues. Testimony to Subcommittee on Aviation of the Committee on Public Works and Transportation, U.S. Congress, May 24, 1990. (Congressional Record, 101-77, 1991, pp. 16-19, 50-52)

Connell, L.J., Graeber, R.C., and Schreiber, H.G.: Overnight cargo operations: aircrew sleep, fatigue, and circadian rhythmicity. Paper presented at the Annual meeting of the Aerospace Medical Assoc., New Orleans, LA, May 1990.

Gander, P.H., and Graeber, R.C.: Circadian timing of sleep in long-haul flight crews. Paper presented at the 2nd Annual Meeting of the Society for Research on Biological Rhythms, Amelia Is., FL, May 1990.

Graeber, R.C.: Research on the flight deck - - lessons in fatigue. Panel presentation at the Annual Meeting of the Aerospace Med. Assoc., New Orleans, LA, May 1990.

Graeber, R.C., and Dinges, D.F.: Flight crew fatigue: underlying causes and operational factors. Invited paper presented at the Royal Jordanian/Flight Safety Foundation 1st Arab Regional Aviation Safety Conference, Amman, Jordan, March 1990. (Proceedings., pp. 161-174.)

Graeber, R.C.: Integration of field, simulator, and laboratory approaches to crew fatigue. Paper presented at "Challenges in Aviation Human Factors: The National Plan", AIAA/NASA/FAA/HFS Conference, Washington, DC, Jan. 1990.

Moline, M.L., Pollak, C.P., Wagner, D.R., Zendell, S.M., Monk, T.H., Graeber, R.C., Lester, L.S., Salter, C.A., and Hirsch, E. Age differences in the ability to adjust to simulated jet lag. *J. Biol. Rhythms*, 1990.

Graeber, R.C.: Multinational studies – lessons from flight crew field research. Invited paper presented at the Royal Aeronatical Society's Conference on Flight Time Limitations: A Review of the Current Situation, London, U.K., November 1989.

Dinges, D., and Graeber, R.C.: Flight crew fatigue monitoring,. *Flight Safety Digest*, 8:65-75, 1989

Dinges, D., Graeber, R.C., Carskadon, M.A., Czeisler, C.A., and Dement, W.C.: Attending to Inattention (Letter). *Science*, 245: 342, 1989

Connell, L. J., and Graeber, R.C.: Aircrew scheduling on transmeridian flights. Invited paper presented at Symposium on Circadian Rhythmicity, XXXI Int'l. Congress of Physiological Sciences, Helsinki, Finland, July 1989.

Gander, P.H., Myhre, G., Graeber, R.C., Andersen, H.T., and Lauber, J.K.: Adjustment of sleep and the circadian temperature rhythm after flights across nine time zones. *Aviation, Space, & Envir. Med., 60*, pp. 733-743, 1989.

Sasaki, M, Kurosaki, Y., Onda, M., Yamaguchi, O., Nishimura, H., Kashimura, K., and Graeber. R.C.: Effects of bright light on circadian rhythmicity and sleep after transmeridian flight. Paper presented at the Annual Meeting of the Assoc. of Professional Sleep Societies, Washington, D.C., June 1989. (Abstr.: *Sleep Research*, 18:442, 1989).

Kurosaki, Y., Sasaki, M., Tamira, M., Masumo, H., Sugiura, K., Kabashima, T., Nonaka, K., and Graeber, R.C.: Mood changes of flight crew during multiple layover polar flights. Paper presented at the Annual Meeting of the Assoc. of Professional Sleep Societies, Washington, D.C., June 1989. (Abstr.: *Sleep Research*, 18:426, 1989).

Glotzbach, S.F., Rowlett, E.A., Connell, L. J., Graeber, R.C., and Ariagno, R.L.: Biological rhythmicity in preterm infants prior to hospital discharge. Paper presented at Annual Mtg, Assoc. of Professional Sleep Societies, Washington, D.C., June 1989. (Abstr.: *Sleep Research*, 18:420, 1989).

Graeber, R.C.: Sleep and circadian rhythmicity after transmeridian flight. Invited paper presented via satellite at Annual Meeting on the Japanese Sleep Research Society, Tokyo, Japan, June 1989.

Connell, L. J., Graeber, R.C., and Barnes, R.M.: Fixed-wing vs. Rotary-wing operations: Comparisons of sleep and fatigue among pilots. Paper presented at Annual Mtg, Aerospace Medical Assoc., Washington, D.C., May 1989. (Abstr.: *Avia., Space, Environ. Med*., 60:496, 1989).

Graeber, R.C., Schreiber, H.G., and Connell, L. J.: Sleep in aircrew flying sequential transatlantic crossings. Paper presented at Annual Mtg. Aerospace Medical Assoc., Washington, D.C., May 1989. (Abstr.: *Avia., Space, Environ. Med*., 60:496, 1989).

Graeber, R.C.: Translocation: Movement to Europe. Invited plenary paper presented at the 40th Annual Military Medical Surgical Clinical Congress, Garmisch, W. Germany, May 1989.

Graeber, R.C.: Sleep in the long-range environment. Invited paper presented at the International Operators Committee Conference, National Business Aircraft Assoc., Washington, D.C., March 1989.

Dinges, D., and Graeber, R.C.: Flight crew fatigue monitoring. Invited paper presented at the Crew Performance Monitoring and Training Regional Safety Workshop, Flight Safety Foundation, Taipei, Taiwan, Republic of China, March 1989.

Graeber, R.C.: Cockpit automation and fatigue. Invited paper presented at Symposium on “Fitness for Duty”. SAE Aerotech ’88, Anaheim, CA, Oct. 1988.

Graeber, R.C.: The management of sleep/wakefulness in airline transport long-haul operations: The sleep research perspective. Invited paper presented at the XXXVI International Congress of Aviation & Space Medicine, Brisbane, Australia, Oct. 1988.

Graeber, R.C.: Long-range operations in the glass cockpit: Vigilance, boredom, and sleepless nights. Invited paper presented at NATO Advanced Research Workshop on Vigilance and Performance in Automatized Systems, Universite Rene Descartes, Paris, France, Sept. 19-23, 1988.

Graeber, R.C.: Flight crew fatigue research. Invited paper presented at the SAE and Aviation Research & Education Foundation's Conference on Human Error Avoidance Techniques, Herndon, VA, Sept. 1988.

Schreiber, H.G., Graeber, R.C., and Connell, L. J.: Flight crew sleep during repeated transatlantic crossings. Presented at Annual Mtg. Assoc. of Professional Sleep Societies, San Diego, CA, June 1988. (Abstr.: *Sleep Research*, 17:397, 1988).

Connell, L.J., Graeber, R.C., and Schreiber, H.G.: Sleep and fatigue among commercial north sea helicopter pilots. Presented at Annual Mtg. Assoc. of Professional Sleep Societies, San Diego, CA, June 1988. (Abstr.: *Sleep Research*, 17:365, 1988).

Barnes, R.M., and Graeber, R.C.: Flight deck environment and working North Sea helicopter operations. Presented at the Annual meeting of the Aerospace Medical Association, New Orleans, LA, May 1988. (Abstr.: *Avia., Space, Environ. Med*., 59:483, 1988).

Graeber, R.C.: The Challenger accident: The human element in decision making. Invited seminar presented at the Center for International Security and Arms Control, Stanford University, CA, April 1988.

Mitler,M.M., Carskadon,M.A., Czeisler, C.A., Dement, W.C., Dinges, D.F., and Graeber, R.C.: Catastrophes, Sleep, and Public Policy: Consensus Report**,** *Sleep* 11(1): 100–109, February 1988.

Graeber, R.C.: Aircrew sleep and fatigue in long-haul flight operations. Presented at the 40th Flight Safety Foundation International Air Safety Seminar, Tokyo, Japan, October, 1987.

Graeber, R.C.: Fatigue sleep loss and the body clock. Invited address presented at the CMPATWING TEN Safety Symposium, Moffett Field NAS CA, September, 1987. Also presented at the U.S. Coast Guard Air Station (Sacramento) Safety Symposium, Oct. 1987, and at the USCG Air Station (San Diego) Jan. 1988.

Sasaki, M., Kurosaki, Y., Takahashi, Tl, Mori, A., Spinweber, C.S., and Graeber, R.C.: Flight crew sleep after multiple layover polar flights Presented at 5th International Congress of Sleep Research, Copenhagen, Denmark, July 1987. (Abstr.: *Sleep Research*, 16:637, 1987)

Graeber, R.C.: External factors affecting pilot decisions. Invited paper presented at the Orient Airlines Association's 9th flight Safety Seminar, Manila, Philippines, May 1987.

Hudson, D.E., Graeber, R.C., Schreiber, H.G., Connell, L. J. And Demitry, P.P.: Circadian rhythms, sleep and fatigue in strategic airlift: Pacific theater. Presented at 58th annual Meeting, Aerospace Medical Association, Las Vegas, NV, May 1987. (Abstr.: *Avia., Space, Environ. Med*., 58:512, 1987).

Graeber, R.C.: The space shuttle Challenger accident: Human factors and training and implications. Invited address presented at the Committee on Safety of Nuclear Installations' International Specialist Meeting on Training of Nuclear Reactor Personnel, Orlando, FL, April 1987.

Graeber, R.C.: Sleep in space. Invited paper presented at the NATO DRG Seminar "Sleep and Its Application for the Military", Ecole du Service de Sante des Armees, Lyon, France, March 1987.

Graeber, R.C.: Sleep and fatigue in international flight operations. Invited paper presented at the National Business Aircraft Association's 14th Annual International Operators Seminar, San Diego, CA, Feb. 1987.

Graeber, R.C.: Behavioral responses of commercial aircrew to short-haul flying. Invited paper presented at 2nd CEC Workshop on Irregular and Abnormal Hours of Work, University of Sussex, Brighton, UK, January 1987.

Graeber, R.C.: Management of fatigue and sleep deprivation. Invited paper presented at Symposium on "Fitness for Duty". SAE Aerotech '86, Long Beach, CA, October 1986.

Graeber, R.C.: Human factors aspects of the space shuttle Challenger accident. Invited address presented at the Electricite de France and Institute of Nuclear Power Operations' Human Performance Workshop, Lyon, France, September 1986.

Graeber, R.C., Lauber, J.K., Connell, L.J., and Gander, P.H.: International aircrew sleep and wakefulness after multiple time zone flights: A cooperative study. Presented at Annual Meeting, Assoc. Prof. Sleep Societies, Columbus, OH, June 1986. (Abstr.: *Sleep Research*, 15:273, 1986)

Monk, T.G., Moline, M., and Graeber, R.C.: The effect of a brief post-lunch nap on circadian adjustment to a 6-hour phase advance in routine. Presented at the Annual Meeting, Association of Professional Sleep Societies, Columbus, OH, June 1986. (Abstr.: *Sleep Research*, 15:278, 1986)

Graeber, R.C.: Field studies of sleep and circadian rhythms in flight crews. Presented at Annual Meeting, Assoc. Professional Sleep Societies, Columbus, OH, June 1986.

Dement, W.C., Siedel, W.F., Cohen, S.A., Bliwise, N.G., Graeber, R.C., Carskadon, M.A., and Connell, L.J.: Sleep and wakefulness in aircrew operating eastward or westward transoceanic flights. Presented at Annual meeting, Assoc. Prof. Sleep Societies, Columbus, OH, June 1996. (Abstr.: *Sleep Research*, 15:269, 1986)

Graeber, R.C., Gander, P.H., Foushee, H.C. and Lauber, J.K.: Sleep and fatigue in short-haul commercial flight crews. Presented at Annual Meeting, Assoc. Prof. Sleep Societies, Columbus, OH, June 1986. (Abstr.: *Sleep Research*, 15:272, 1986)

Gander, P.H., G. Myhre, R. C. Graeber, H.T. Andersen, and J. K. Lauber: Effects of 9-hour time zone changes on fatigue and the circadian rhythms of sleep/wake and core temperature. Presented at 57th Annual Meeting, Aerospace Medical Association, Nashville, TN, April 1986. (Abstr.: *Avia., Space, Environ. Med*., 57:504, 1986).

Monk, T.H., M. Moline, R.C. Graeber, J. Lauber and P. Gander: Jet lag: Changes in sleep, mood and performance after a 6-hour advance shift in routine. Presented at 57th Annual Meeting, Aerospace Medical Association, Nashville, TN, April 1986. (Abstr.: *Avia., Space, Environ. Med*., 57:504, 1986).

Graeber, R.C.: International aircrew sleep and wakefulness after multiple time zone flights: A cooperative study. Presented at 57th Annual Meeting, Aerospace Medical Association, Nashville, TN, April 1986.

Graeber, R.C., P.H. Gander and J.K. Lauber: Sleep and fatigue in short-haul flight operations. Presented at 57th Annual Meeting, Aerospace Medical Association, Nashville, TN, April 1986. (Abstr.: *Avia., Space, Environ. Med*., 57:504, 1986).

Connell, L.J., R. C. Graeber, and P.H. Gander: Morning and evening administration of theophylline: Effects on circadian temperature, sleep-wake, and cognitive performance in man. Presented at 57th Annual Meeting, Aerospace Medical Association, Nashville, TN, April 1986. (Abstr.: *Avia., Space, Environ. Med*., 57:504, 1986).

Gander, P.H., Connell, L.J., and Graeber, R.C.: Masking of the Circadian Rhythms of Heart Rate and Core Temperature by the Rest-Activity Cycle in Man. *Journal of Biological Rhythms,* 1:2, 119-135 (1986)

Graeber, R.C.: Sleep and fatigue in short-haul flight operations. Presented at 38th International Air Safety Seminar, Flight Safety Foundation, Boston, MA, November, 1985.

Gander, P.H., Graeber, R.C., and Kronauer, R.E.: Phase shifting two coupled circadian pacemakers: implications for jet lag. Presented at IEEE Annual Meeting, Chicago, IL, September 1985. (also *Amer. J.Physiology, 249*:R704-R719, 1985)

Graeber, R. C., Foushee, H. C., Gander, P.H., and Noga, G. W.: Circadian rhythmicity and fatigue in flight operations. Invited paper presented at 4th UOEH International Symposium on Occupational Health in Aviation and Space Work, Kitakyushu-shi, Japan, October 1984. (*J. of UOEH*, 7 (Suppl):122-130, 1985)

Graeber, R.C., Foushee, H.C., and Lauber, J.K.: Dimensions of flight crew performance decrements; Methodological implications for field research. Invited paper presented at the CEC-Workshop on Human Performance in Transport Operations, DFVLR Institute for Flight Medicine, Cologne, FRG, January 1983.

Graeber, R.C.: Altered sleep-wake schedules associated with transmeridian flight. Invited paper presented at Annual meeting of Association of Psychophysiological Study of Sleep, Satellite Symposium "Chronobiology: Physiology and Pathology", San Antonio, TX, June 16, 1982.

Graeber, R.C.: When to teach what to whom. *Today's Education*, 71:3, 35-37, 1982.

Graeber, R.C., Schroeder, D.M., Jane, J.A., and Ebbesson, S.O.E.: Visual discrimination following partial telencephalic ablations in nurse sharks (Ginglymostoma cirratum). *The Journal of Comparative Neurology*, 180:2, 325-344, 1978.

Tisinger, J.L. and Graeber, R.C.: Use of oral antibiotics in studies of ingestive behavior in rats. *Physiology & Behavior*, 17:5, 861-864, 1976.

Graeber, R.C.: Food Intake Patterns in Captive Juvenile Lemon Sharks, *Negaprion brevirostris*. *Copeia*, Vol. 1974, No. 2 (Jun. 13, 1974), pp. 554-556.

Graeber, R.C., Ebbesson, S.O.E., and Jane, J.A.: Visual Discrimination in Sharks without Optic Tectum. *Science*, *180*:4084, 413-415, 1973.

Graeber, R.C., and Ebbesson, S.O.E: Retinal Projections in the Lemon Shark (*Negaprion brevirostris*). *Brain, Behavior, and Evolution*, *5*:461, 1972.

Graeber, R.C., and Ebbesson, S.O.E: Visual discrimination learning in normal and tectal-ablated nurse sharks (*Ginglymostoma cirratum). Comparative Biochemistry and Physiology, 42A*: 131, 1972.

Graeber, R.C., Schroeder, D.M., Jane, J.A., and Ebbesson, S.O.E.: The importance of telencephalic structures in visual discrimination learning in nurse sharks. *Proc. Society of Neuroscience 2nd Annual Mtg*,, pg. 100, 1972

Attachment 2

November 2010

Economic Impact Analysis of
Flightcrew Member Duty and Rest Requirements

Federal Aviation Administration Notice of Proposed Rulemaking
Published September 14, 2010

OLIVER WYMAN

TABLE OF CONTENTS

EXECUTIVE SUMMARY

The *Flightcrew Member Duty and Rest Requirements* NPRM published by the FAA on September 14, 2010 (the NPRM) proposes a complex set of new rules which amount to a wholesale replacement of the current rules on flight and duty time limits. This Report analyzes the benefits and costs of the NPRM. Our analysis shows that the FAA has substantially overstated the benefits of the NPRM and understated its costs. Based on our analysis, the costs of the NPRM as written, which total $19.6 billion over a ten-year period, are 50 times higher than its benefits.[1] The costs and benefits estimated by the FAA are compared with those substantiated in this Report in the table below.

Figure ES.1 – Comparison of FAA and Oliver Wyman Cost Estimates

	10-year Nominal Cost ($ millions)	
	FAA Regulatory Impact Analysis	**Oliver Wyman Analysis***
Benefits	$659.4	$395.6
Costs	$1,254	$19,641
Cost/Benefit Ratio	1.9:1	49.6:1

* Oliver Wyman analysis includes mainline, LCC, and large cargo carriers only. FAA analysis includes all industry segments.

Benefits

In its Regulatory Impact Analysis (the "RIA"), the FAA has justified the proposed rules on the ground that they will substantially reduce the number of future fatigue-related accidents. However, the FAA's accident analysis in support of this position is seriously flawed. Of the 43 accidents identified by the FAA as caused at least in part by pilot fatigue, fully 47% should in fact be reclassified. For eight of those accidents, the NTSB stated there was no evidence of crew fatigue (nevertheless, the FAA classified them as caused by fatigue). For others, the FAA substituted its judgment that pilot fatigue was the contributing factor or primary cause of the accident despite evidence of other major overriding factors such as deicing procedures. Still other accidents involved single engine aircraft or aircraft operated under different and less restrictive flight duty rules than apply to modern commercial operations.

The FAA conducted additional analysis of a smaller group of 22 accidents, and similarly in this group approximately 40% of the accidents were improperly classified as caused by pilot fatigue. It is not possible to re-project NPRM benefits using our corrected accident classifications

[1] See Chapter 17 for NPV estimates based on FAA's assumed 7% discount rate.

because of multiple undisclosed fatigue causation factors used by the FAA. However, assuming that the accidents removed from the 22-accident data set because they were improperly classified had the same average accident causation factors as those that remain, the result of correcting the accident classifications is to reduce the accident avoidance benefit by approximately 40%. That would reduce the FAA's projected benefit number of $659.4 million in current dollars to $395.6 million. (The net present value of the corrected accident avoidance benefit is $278.3 million using the FAA's 7% discount rate assumption.)

Costs

With regard to the costs of the rule, the FAA underestimates the costs in a number of areas:

- 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.

- The FAA substantially underestimates crew costs by relying on basic historical salary costs–and excluding the costs of taxes, pensions and benefits.

- The FAA assumes 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's costs.

- The FAA simply ignores flight cancellation costs despite the fact that the NPRM will result in substantial increases in flight cancellations.

- 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 makes clear that its cost estimates only include costs relating to individual duty periods and do not include the substantial costs that will be incurred as a result of flight crews reaching their duty limits over longer periods of a week or a month.

- The FAA makes the optimistic assumption that the carriers will "optimize" their schedules to reduce FAA estimated costs by an average of 25%.

- The FAA omits key cost drivers in estimating the overall cost of the NPRM, e.g., lost revenue due to the loss of first class seating and out-of-service time required for crew rest infrastructure installation.

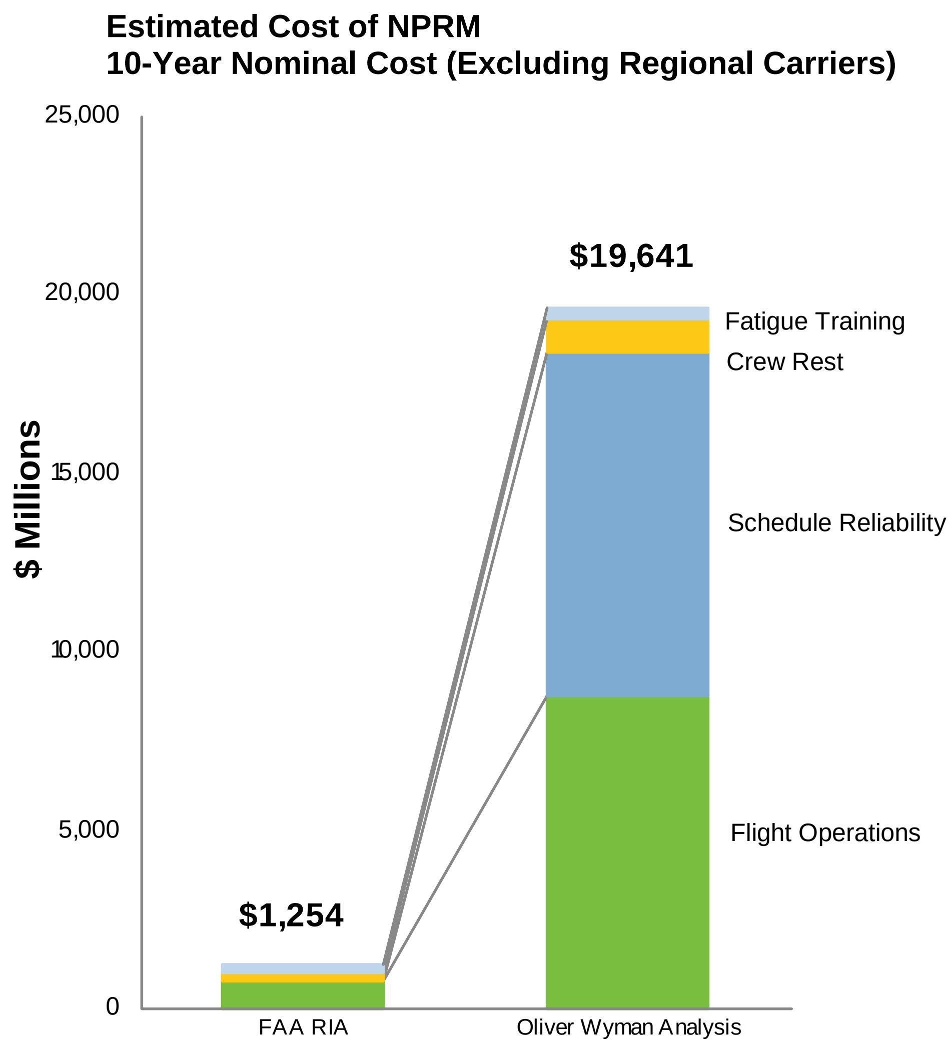
These and other unrealistic cost assumptions made by the FAA are discussed in the Report that follows.

In comparing this Report with the RIA, it is important to understand that this Report analyzes key provisions of the NPRM, but not all provisions. As a result, this Report does not capture all of the costs of the NPRM. Even so, the estimated cost of the specific NPRM provisions analyzed here exceeds the FAA's estimated *total cost* of the NPRM. The FAA's total estimated cost of the NPRM is $1.254 billion in nominal costs over a ten-year period. Oliver Wyman's estimated cost of specific key provisions of the NPRM is $19.641 billion in nominal costs over a ten-year period.

Note also that the FAA's cost estimate includes all seven air carrier groups identified in the RIA, while Oliver Wyman's costs include only three of the seven air carrier groups – mainline, LCC, and large cargo. Extrapolation of Oliver Wyman results to include regional carriers would increase the total cost of the specific key provisions to $21.628 billion over a ten-year period. The methodology used to extrapolate costs to include regional costs is discussed in Chapter 3.2, *Extrapolating to Include Regional Carriers.*

A summary of the total costs analyzed in this Report compared with total costs included in the RIA is provided in Figure ES.2 below. The costs represent a ten-year projected nominal cost, and incorporate the FAA's assumption that the carriers will "optimize" their schedules to reduce estimated costs by an average of 25%. Although that assumption is considered optimistic, we have applied it as well to the Oliver Wyman nominal costs for ease of comparison.

Figure ES.2 – Comparison of FAA Regulatory Impact Analysis (Entire Industry) and Oliver Wyman Economic Impact Analysis (Mainline, LCC, and Large Cargo only) – FAA 25% Optimization Assumption Applied to Both Estimates



	FAA RIA	Oliver Wyman Analysis
Fatigue Training	262	331
Crew Rest	227	928
Schedule Reliability	5	9,624
Flight Operations	760	8,758
Total	$1,254	$19,641

More detailed cost estimates of the specific individual provisions analyzed by Oliver Wyman are provided in Figure ES.3 below. These figures, which include mainline, LCC, and large cargo carriers only, are optimized using the same 25% optimization factor used by the FAA (see Section 4.3, *Optimization Assumptions).*

Figure ES.3 – Summary of Optimized Nominal Cost Estimates for Specific Individual Provisions

	Key Issue	**Oliver Wyman Methodology**	**Results / Findings Annual and 10 year or One-Time Costs**
Flight Time Limits (Block hour restrictions) within overall flight duty period (FDP)	Change to hard flight time limits requires the addition of buffer to scheduled flight times and increases the possibility of flight cancellations in the event of delay	1. Addition of at least 45 mins buffer to flight times in historical schedule 2. Evaluation of # flights that exceeded FTL due to delay, and assumed cancellation if occurred at a non-domicile station	Additional $428M in annual passenger and carrier costs ($4.28B over 10 years) If Schedule Reliability buffers are added, annual cost is $335M
Schedule Reliability	Carriers to maintain a reliability where scheduled FDP is less than or equal to actual FDP of 95% of the time system wide (80% for individual FDPs) which is far in excess of current operation at most carriers	Scheduled FDPs are buffered by an amount that would achieve 95% reliability, with costs based on additional crew required to avoid exceeding FDP limitations (daily, 7-day and 28-day) and additional pilot block hour pay	Additional $962M in annual costs due to additional crew costs ($9.62B over 10 years)
Flight Duty Period Extensions	Carriers are limited to a single extension over 30 minutes within a 168-hour period, where extensions are based on scheduled time rather than FDP limits published in table B	Individual FDPs that exceeded schedule more than once in 168 hrs were identified and assumed to cancel, as day on which extension is needed cannot be forecast	Additional $1.174B in annual costs to airlines and $1.151B in annual costs to the public, due to cancellations. If substantial buffers added under Schedule Reliability provisions, costs can be reduced to $161M and $161M, respectively. To avoid double counting, this lower figure is used for NPRM total cost estimate ($3.2B over 10 years)
Day of Operation Reserve	Redefining short call reserve as duty limits the usefulness of reserve flight crew by restricting options of assigned duties	Reserve duty periods (RDP) exceeding the maximum allowed RDP truncated, and truncated hours multiplied by a per Duty Hour cost	Additional $83M in annual costs to airlines ($826M over 10 years)

	Key Issue	Oliver Wyman Methodology	Results / Findings Annual and 10 year or One-Time Costs
Cumulative Duty Time from Short-Call Reserve	Redefining short call reserve as duty adds to a flight crew members cumulative duty time, which may exceed weekly or monthly limits	All cumulative duty times were compared with weekly and monthly limits. All duty hours that exceeded periodic limits were truncated. Truncated hours were multiplied by a per Duty Hour cost	Additional $14M in annual costs ($143M over 10 years)
Crew Rest Infrastructure	The FAA makes several assumptions about the cost of crew rest facilities that do not reflect the experience of carriers. In addition, they have excluded costs that should be included in the overall impact	Cost estimates were gathered from carriers and extrapolated to the entire industry	Estimated industry one-time costs of $461M Ongoing costs are $47M per year ($928M over 10 years)
NPRM Implementation	The FAA makes assumptions around programming costs per carrier that do not reflect estimates provided by carriers, and include simplifying assumptions that underestimate the requirements to implement the NPRM	Cost estimates were gathered from carriers and extrapolated to the entire industry	Estimated industry one-time costs of $1,696M and annual costs of $27M
Three Consecutive Nights	Carriers cannot assign flight crew to operate more than 3 consecutive night duties where night duties are defined as those starting between 22:00 and 05:00	Local start time based on domicile or acclimation rules was determined. Consecutive night duties were then counted. Where more than 3 consecutive night duties occurred, it was assumed that the 4th FDP was operated by a new flight crew member	Additional $3.8M in annual costs to industry for extra crew, almost exclusively impacting cargo carriers ($38M over 10 years) Analysis is highly sensitive to the definition of night and would increase substantially if the night parameters change

Oliver Wyman was also asked to analyze the cost difference between certain provisions of the NPRM and alternative provisions which the ATA believes, based on scientific evidence and operational experience, provide equal or greater levels of fatigue risk mitigation at a lower cost and with less operational disruption. The cost differences shown in the table below between these alternative provisions and the original provisions of the NPRM are independent of and not reflected in the total cost estimate provided in Figures ES.1 and ES.2 above. These figures are optimized using the same 25% optimization factor used by the FAA (see Section 4.3, *Optimization Assumptions).*

Figure ES.4 – Summary of Optimized Cost Estimates for Alternative Provisions

	Key Issue	**Oliver Wyman Methodology**	**Results / Findings Annual Costs**
Flight Duty Period Extension Alternatives	Carriers are limited to a single extension over 30 minutes within a 168-hour period, where extensions are based on scheduled time rather than FDP limits published in table B	The cost of the NPRM provisions is compared with alternative provisions that permit multiple extensions under some circumstances	Annual cost savings of $469M in cancellation cost to industry and $526M in costs to the public versus base provisions. ($9.95B over 10 years, but some trade-off with costs under Schedule Reliability provisions)
Split Duty	Maximum FDP limits have been reduced below current limits, and credit given for split rest is insufficient to allow many current duties to be conducted legally under the new proposal	Optimization runs have been used to compare the NPRM and an alternate set of regulations that reduce the minimum rest requirements and increase maximum FDP on split duties	Annual cost savings of $7.4M versus base provisions ($74M over 10 years)
A1 versus A2 Flight Duty Period Tables	FDP limits proposed in the NPRM are based on a recommendation generally reflecting labor interests. Table A2 represents the recommendation generally representing industry (excluding cargo carriers)	Optimization runs were used to compare the different costs of operating a historical schedule using flight duty limits from Tables A1 and A2	Annual cost savings of $20M versus base provisions ($204M over 10 years)

CHAPTER 1

INTRODUCTION

1.1 BACKGROUND

On September 14, 2010, the Federal Aviation Administration published a notice of proposed rulemaking entitled *Flightcrew Member Duty and Rest Requirements*, 75 Fed. Reg. 55852-55889 ("the NPRM"), in which it proposed to amend its existing flight, duty and rest requirements applicable to certificate holders and their flight crew members. The NPRM, which proposes a complex set of rules to replace those currently in place, is intended to address the risk of fatigue on the safety of flight.

The Air Transport Association of America, Inc. ("ATA") commissioned Oliver Wyman to conduct an independent economic analysis of the NPRM to evaluate the costs and benefits to the industry and flying public of the NPRM as written. In addition, ATA identified several proposed alternatives to certain provisions of the NPRM which it believes, based on scientific evidence and operational experience, provide equal or greater levels of fatigue risk mitigation at a lower cost to the industry and flying public and with less operational disruption. Oliver Wyman has also analyzed the economic impact of these alternative provisions.

The elements of the NPRM that are the subject of this analysis are clearly identified in this Report, and consist of the following:

- Specific provisions of the NPRM as written, as clarified by the FAA's "Response to Clarifying Questions," issued on October 22;
- Specific proposed alternative provisions, as proposed by ATA to meet the goals of the NPRM with less operational disruption and lower cost; and
- Specific elements of the *Regulatory Impact Analysis* by the FAA Office of Aviation Policy and Plans, dated September 3, 2010.

The NPRM proposes a complex set of new rules that amount to a wholesale replacement of the current rules on flight and duty time limits. The NPRM's requirement that new rules on flight time, flight duty period, duty period, and schedule reliability all must be met concurrently – in addition to restrictions imposed by collective bargaining agreements – means that the final, real world impacts of the NPRM may be far greater than apparent from analysis of the separate individual rules.

1.2 APPROACH

A comprehensive analysis of the NPRM would require full productivity/optimized roster runs for multiple carriers in which the impact of the changed work rules is analyzed. That type of analysis, which may take up to three months per airline, is not possible within the time frame permitted by the FAA for response. And, even given the much longer time frame available to the FAA for its own Regulatory Impact Analysis, the FAA did not employ that extremely time- and resource-intensive type of analysis. Instead, the FAA, in estimating the economic impact of various elements of the NPRM, addressed the economic and operational complexity of the new rules by making various simplifying assumptions.

The analysis conducted for this report uses multiple approaches, as follows:

(A) General Validation of FAA Assumptions

- The FAA has made general assumptions in a number of areas, including flight crew costs; collective bargaining agreement optimization; reductions in absenteeism resulting from fatigue reduction, etc. The Report analyzes some of these assumptions.

(B) Industry Modeling Using Carrier Pairing and Rostering Data

- For some categories of analysis, bottom-up modeling was conducted using historical pairing and rostering data. (A pairing is a flight duty period (FDP) or series of FDPs which originate or terminate at a flight crew member’s home base. A roster is the actual scheduled assignment of duties to specific crew members.) Since full productivity/optimization analysis of each carrier is not practical, representative airlines were selected for each of the following segments: (1) mainline hub and spoke carrier with significant international operations; (2) low cost carrier; and (3) cargo carrier. The representative airlines each provided scheduled and actual pairing/rostering data for a winter month and a summer month in 2009 ("the three-segment data").

- Various modeling approaches were employed, as further described in the analysis of the relevant rule provision. These included:
    - Analysis of additional costs incurred as a result of currently operated pairings/rosters that would not be permitted under the proposed rules
    - Potential cancellations that would be necessary based on applying historical delay data to the proposed rules
    - Assumptions regarding anticipated optimization in pairings/duty periods that could reduce the estimated additional costs/cancellations

- The results of the three-segment data analyses (mainline, low cost, cargo carrier) were aggregated to the overall industry level. Although the three-segment data does not include regional carriers, an overall industry aggregation is provided for the high level cost analyses with and without the inclusion of regional carriers.

- In some cases, where specifically described, the modeling results provided by additional individual carriers were added to that of the three-segment set.

(C) Aggregation of Individual Carrier Analyses in Combination with Selected Modeling

- For a number of provisions, the best analytic technique is to collect individual carrier results. An example of this is the estimated cost of rule implementation – including software, crew rest infrastructure, and training costs – where individual carriers have obtained separate vendor quotations and conducted other carrier-specific analysis. In those cases, the results have been aggregated.

- For other provisions, selective modeling or other quantitative analysis has been conducted, as described in the analysis of the relevant rule provision. These analyses may rely on other carrier-provided data and analysis outside of the three-segment data.

- In still other cases, where the airlines do not have the ability to estimate cost or operational impacts, the Report relies on qualitative assessments made on the basis of industry experience. For example, there are clear conflicts between the NPRM and certain provisions of individual carrier collective bargaining agreements. The Report points these out, but does not quantify them.

(D) Comparison of the Cost of Individual Rule Provisions with the Aggregate Cost Estimates Provided by the FAA

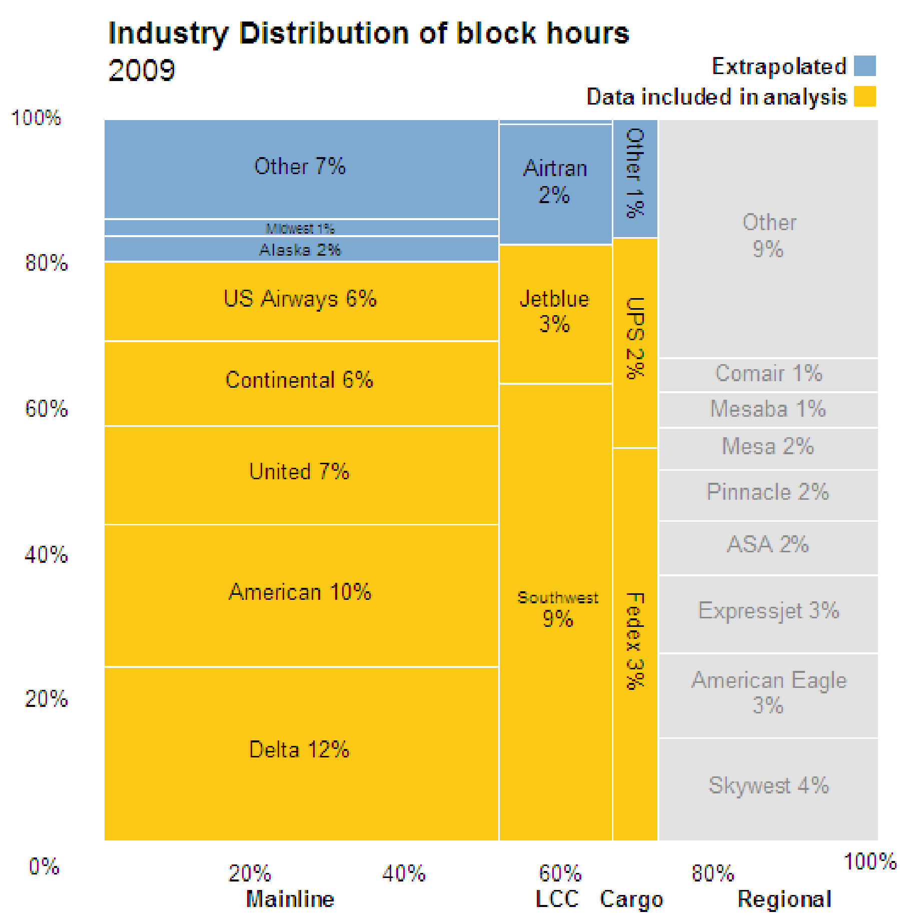
- As explained further in Chapter 3, the Report analyzes key provisions of the NPRM, but not all provisions. Therefore the Report does not capture the entire cost of the NPRM. For those specific provisions analyzed, the Report provides a more comprehensive analysis than does the RIA. The Report takes a different approach from the RIA in including the cost impact of the interaction of specific provisions of the proposed rules, and the Report also analyzes the cumulative impact of the flight duty period provisions, in contrast to the RIA analysis which specifically excludes any analysis of impacts over time.

(E) Comparison with Other International Flight, Duty Time and Rest Requirements

- The key differences between the NPRM and comparable international provisions are identified both to aid general analysis and to show where U.S. carriers may be operating under significant more or less restrictive provisions in comparison to international competitors.

The table below identifies the carriers that provided the data and analysis used in this Report. (Note that large cargo carriers are underrepresented in some respects when measured by this type of block hour table.) The table also shows how results are aggregated based on the industry distribution of block hours to produce estimates for the mainline industry. For some types of analysis, results are aggregated based on block hours, while for others, the number of flight crew, or other variables are used, as indicated. The methodology used to extrapolate costs to include the regional carriers is explained in Section 3.2.

Figure 1.1 – Industry Distribution of Block Hours and Carrier Data Included in Analysis



1.3 REPORT ORGANIZATION

The Report is organized as follows:

Chapter 2 reviews the information available regarding the causes for specific accidents which the FAA has cited, the conclusions that the FAA has drawn from the information, and modifications to those conclusions that should be made.

Chapter 3 compares the cost analyses performed in the Report with those in the RIA analysis.

Chapter 4 provides a review of some of the assumptions and methodology used by the FAA in estimating the costs of the rule—specifically, those regarding:

- The extent to which reduced absenteeism may result from the NPRM
- The interaction between existing collective bargaining agreements and the NPRM
- Cost impact optimization
- Cumulative impacts
- Flight crew costs
- Flight cancellation costs
- Cost savings from augmented operations

The majority of the Report, beginning with Chapter 5, is organized to address specific aspects of the NPRM and the proposed industry alternative provisions on a chapter-by-chapter basis. Each chapter describes the specific NPRM provision or proposed alternative provision to be analyzed, the methodology used to analyze the provision, and the results and conclusions. The Report is designed to provide as much transparency as possible without disclosing commercially sensitive individual carrier information.

CHAPTER 2

ACCIDENTS REPORTED AS CAUSED BY PILOT FATIGUE

2.1 BACKGROUND

The FAA's accident analysis is based on a review of NTSB accident reports that resulted in substantial aircraft damage, serious injury to passengers, or worse outcomes. The accidents in this data set, which primarily involve Part 121 operators, occurred from 1990 through 2009. For this 20-year period, the FAA identified 250 human factors related accidents. It then excluded those involving turbulence and also those without a 72-hour history of pilot activities before the accident.

The FAA reports on page 18 of the Regulatory Impact Analysis (RIA) that it found 43 accidents (33 passenger and 10 cargo) involving flight crew human factors issues where the necessary data was available for further analysis.

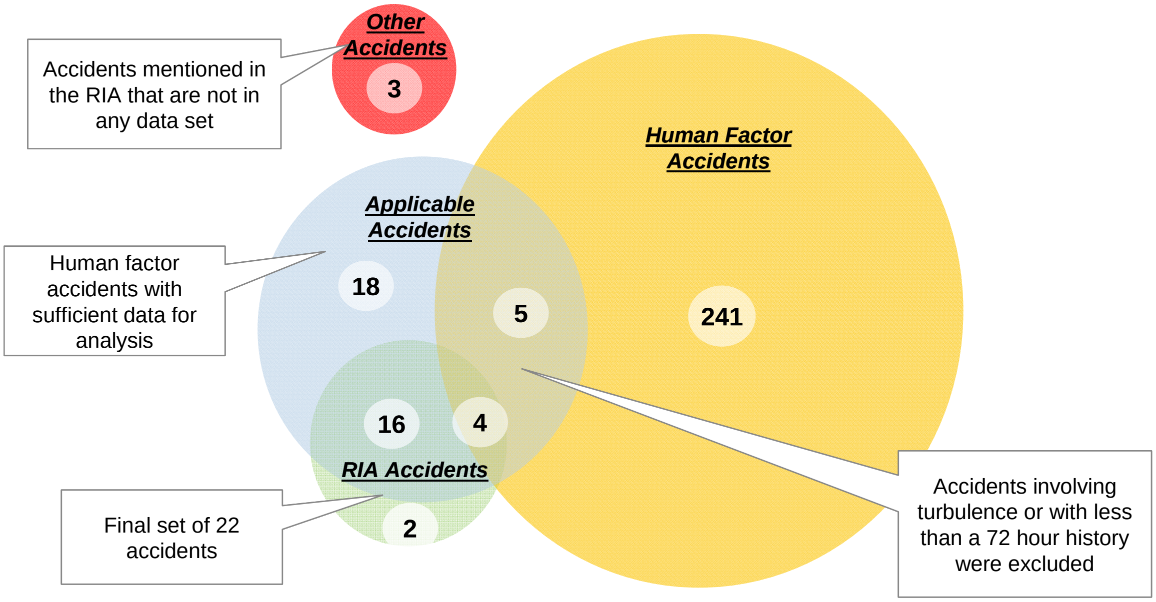
> "There were 43 accidents where the needed data were available (sometimes slightly more or fewer than 43 accidents depending on the schedule-related risk factor of interest). The FAA believes that these accidents are representative of all the major human factor-caused accidents that occurred during the period, including all accidents where fatigue was a factor."

The FAA further winnowed down this list to 22 accidents that it categorized in two ways—(1) by which of the five fatigue descriptions applied, and (2) by the six-segment NPRM effectiveness scale.

In reviewing the accidents identified by the FAA, it is not clear what criteria the FAA used to winnow the list to only the 22 accidents that are cited in the RIA. The set of 43 accidents, and the ultimate set of 22 accidents are not subsets of the larger set of 250 accidents, as would have been expected. See Figure 2.1 below. Moreover, the RIA text references and discusses other accidents that are in none of the three data sets.

The diagram below shows the multiple data sets used by the FAA, and the surprising conclusion that the FAA did not simply winnow down the number of accidents from an initial large data set, but instead created new and different data sets with each step of its analysis.

Figure 2.1 – FAA Accident Analysis Data Sets



See Figure 2.4, page 5 of 5, for details on overlap between data sets.

The FAA concluded that one of the following fatigue descriptions was a causal/contributing factor in each of the accidents in its set of 22 accidents:

- Adequate rest between duty periods
- Long duty period/duty time limits
- Time awake
- Chronic fatigue
- Late night duty fatigue

The individual accidents are reviewed in this Report and evaluated to determine if the facts match the fatigue descriptions that the FAA applied.

The NPRM effectiveness scale has six categories based on the FAA's assessment of whether the proposed rules would have prevented the accident. The categories range from 90% effectiveness, meaning that the NPRM would very likely prevent this type of accident in the future, to 0% effectiveness, meaning that the NPRM would not reduce this type of accident in the future. The categories applied in the RIA are 90%, 75%, 50%, 15%, and 0% effective.

There are inherent difficulties in conducting this type of post hoc accident causation analysis because when the original accident investigation reports were issued, the NTSB did not necessarily focus on pilot fatigue as a causal factor, often reaching the more general conclusion that an accident was caused by "pilot error" or "human factors." The FAA cites only five instances since 1990 where the NTSB identified lack of adequate sleep as a contributing factor to the accident. In addition, the NTSB did not attempt to use a percentage scale to attribute specific degrees of causation to pilot fatigue.

With these limitations in mind and recognizing that any post hoc analysis of causation must be subjective to some degree, it is nevertheless important to any objective analysis that a consistent approach be taken to evaluating each accident. Section 2.2 examines the accident causation conclusions drawn by the FAA.

2.2 METHODOLOGICAL INCONSISTENCIES IN THE REGULATORY IMPACT ANALYSIS

The FAA's categorization of accidents is inconsistent in multiple ways. More often than not, these inconsistencies point in the general direction of classifying accidents as fatigue-based in the absence of—and, in a number of accident cases, despite—evidence to the contrary.

A review of each of the 43 accidents identified by the FAA as caused at least in part by pilot fatigue shows the following types of methodological inconsistencies:

A. For eight out of the set of 43 accidents, and for three of the set of 22 accidents, the NTSB stated there was no evidence of crew fatigue; nevertheless, the FAA categorized these accidents as caused by fatigue. See Figure 2.1, page 5 of 5. Examples include:

Air Tahoma, Convair 580, CVG, cargo accident on 8/3/2004 (NTSB: DCA04MA068). There, the NTSB stated: "There is no evidence that crew fatigue was a factor in this accident." Yet the FAA categorized the accident as caused by fatigue and used it as a supporting case for one of its five pilot fatigue types.

American Airlines, MD83, BDL, passenger accident on 11/12/1995 (NTSB: DCA96MA008). There, the NTSB stated: "The flight crew … received the proper amount of crew rest before the accident flight…" Yet the FAA categorized the accident as caused by fatigue and used it as a supporting case for its late night fatigue type.

B. For at least one flight, the FAA substituted its judgment that pilot fatigue was the contributing factor or primary cause in the accident despite evidence of other major overriding factors. See the following example:

Ryan, DC9, CLE, 2/17/1991, NTSB: DCA91MA021, where the NTSB found that "pilot error", not pilot fatigue, was the probable cause for not detecting wing ice contamination. The NTSB also pointed out that the accident was largely the result of a lack of appropriate response by the FAA, Douglas Aircraft, and Ryan to the known critical effect of wing ice contamination. The NTSB considered fatigue, but decided that there was "insufficient evidence to reach a firm conclusion" that fatigue was a factor. The FAA classified this accident as caused by pilot fatigue; a fair reading of these conclusions does not necessarily lead to that categorization.

C. Two of the five accidents which the FAA categorized as caused by late night duty fatigue were improperly classified using local originating times during the 0:00-3:59 period. However, when the correct reference time for those flights (the pilot base time) was applied, these flights in fact originated during the prior period. This earlier period is a lower-risk period in terms of fatigue. Examples include:

FedEx, MD11, EWR, 7/31/97, NTSB: DCA97MA055 occurred at 01:30 local time but 21:30 crew base time (Anchorage), and therefore should be re-categorized in the 20:00-24:00 time period.

Air Tahoma, Convair 580, CVG, 8/3/2004 (NTSB: DCA04MA068) occurred at 00:49 local time but 23:49 crew base time (Memphis), and therefore should be re-categorized in the 20:00-24:00 time period.

This re-categorization by time significantly changes the results of the FAA's estimates of probable future accidents avoided during particular time periods.

D. Some accidents should have been excluded from the FAA's Part 121 fatigue analysis because they do not represent typical modern era Part 121 operations.

- FAA included in its list of 43 accidents six accidents involving Part 135 operators flying aircraft with fewer than 30 seats.

  Two of the six Part 135 accidents were based on a one-person crew flying the aircraft and should be excluded as involving different risks than a typical two- or three-person crew under a Part 121 operation in the modern era: (1) Hageland, Cessna 208B (Caravan), BRW, 11/9/07, ANC98MA008 and (2) Air Sunshine, Cessna 402C (Businessliner), STT, 2/8/97, MIA97FA082.

  The remaining four of the six Part 135 accidents happened during the period before spring 1997. These operators were flying under different flight time rules than applied to Part 121 operators and should be excluded. For example, the difference in annual flight time limit between FAR Part 135 and 121 is 200 block hours (1200bh versus 1000bh). Note, the NTSB did not mention pilot fatigue as a causal factor in any of these cases. In one of these cases involving deicing, the NTSB did not even list pilot error as the primary causal factor, and explicitly ruled out fatigue (" …the captain on the day of the accident, he appeared well rested…" and "The first officer's fiancée indicated that he was always well rested.") Yet the FAA has included these cases in their sample of 43 fatigue-related accidents.

- There are eight accidents among the FAA sample of 43, which are based on two pilots plus flight engineer.
  Kalitta Air, B747-200, BRU, 5/25/2008, NTSB: DCA08RA063
  FedEx, B727-200, TLH, 7/26/02, NTSB: DCA02MA054
  ATI, DC-8, TOL, 2/15/1992, NTSB: DCA92MA022
  American Airlines, DC-10, DFW, 4/14/93, NTSB: DCA93MA040
  AIR American International, DC-8, GAO, 8/18/93, NTSB: DCA93RA060
  Tower Air, B747-100, JFK, 12/20/95, NTSB: DCA96MA029
  FedEx, DC-10, SWF, 9/5/96, NTSB: DCA96MA079
  TWA, L10-11, JFK, 8/25/96, NTSB:NYC96FA174

  These flights/accidents should, at a minimum, be analyzed separately as they involve different fatigue risks than apply to the modern era in which nearly all flights are operated with 2-person crews.

E. Weaknesses in overall composition of the FAA sample of 43 accidents

- **Data sample skewed towards the past:** As stated in the RIA, the FAA is using pilot schedule data from 1999 (GRA study) and 2009. Splitting the sample of 43 accidents into 2 decades, 1990 – 1999 and 2000 – 2009, provides 28 accidents (i.e. 65%) in the first sample decade and only 15 accidents (i.e. 35%) in the more recent decade. Safety standards in the aviation industry have been significantly enhanced over recent years due to various efforts, e.g., mandatory TAWS and TCAS, FAA Advanced Qualification Program (AQP), constant descent approaches, introduction of glass cockpit, etc. Based on the significant safety differences between these decades, the data provided in Appendices A to C of the RIA should be separated between the two decades to permit a more accurate extrapolation of the accidents avoided.

- **No augmented flights in the FAA sample:** In the FAA sample of 43 fatigue-related accidents, there is not a single case of a fatigue-related accident occurring on a flight operated with an augmented crew. However, the NPRM flight time limits in Part 117 Table A and FDP limits in Part 117 Table B will require additional crew augmentation and increase the overall number of augmented flights, which will lead to airlines incurring additional costs. The absence of any fatigue-related accidents involving augmented crew suggests that additional regulation will provide no accident-prevention benefit.

F. Some accidents are cited in the Regulatory Impact Analysis narrative as caused by fatigue, but are not included in the FAA's list of 250 or 43 accidents.

As noted, it is not clear how the FAA actually selected the particular accidents to analyze. In the three examples below, the RIA discusses each as an example of a fatigue-caused accident, yet none of the three is included in the FAA's list of 43 accidents involving flight crews where the necessary data was available for further analysis.

- Example 1: The Continental Express accident, N24706, Embraer 120 RT, 4/29/1993, Pine Bluff, NTSB: FTW93MA143 is cited in the RIA on page 13 as an example of a fatigue-caused accident. However, despite being part of the FAA sample of 250 accident examples, it is not included in the list of 43 accidents involving flight crews where the necessary data was available for further analysis. Surprisingly, the accident again appears as part of the smaller list of 22 accidents that the FAA divided among five fatigue type categories.

- Example 2: The Air Transport International (ATI) accident, N782AL, DC-8-63, 2/16/1995, Kansas City, NTSB: DCA95MA020 is cited in the RIA on page 14 as an example of a fatigue-caused accident, but is listed in neither the FAA's list of 250 accidents that were human-factors related, nor the list of 43 accidents involving flight crews where the necessary data was available for further analysis. This flight was carried out under Part 91 which might explain its exclusion from the 43 accidents. However, it appears contradictory that the FAA has then included this accident in the effectiveness analysis of 22 airlines. In addition, the FAA's sample of 43 includes another Part 91 flight which would contradict the possible rationale for exclusion of this accident from the list of 43.

- Example 3: The FAA effectiveness analysis is based on 23 accidents, which include the 22 accidents the FAA has assigned to its five fatigue type categories. All of these should be part of the FAA sample of 43; however, both accident examples described above are not included in the sample of 43. In addition, the gap between the 22 accidents used for the fatigue types and the 23 accidents used in the effectiveness analysis was identified to be the following accident Comair, Bombardier CRJ-100, LEX, 08/27/2006, NTSB: DCA06MA064 which is included in the FAA's list of 250, but not in the FAA sample of 43.

- Besides the hit-or-miss approach to matching particular accidents to the FAA's different data samples, the FAA's definition of segments within the effectiveness analysis, as well as its allocation of accidents to these segments, appears subjective and arbitrary. For example, it is not clear, why the effectiveness segments have not been evenly distributed: 0% → 15% (+20PP) → 35% (+15PP) → 50% (+25PP) → 75% (+15PP).

G. Some RIA conclusions are simply not understandable.

For example, in a discussion about cargo airplane accidents, the RIA states (pg. 53): "Pilot fatigue was present in 5.8 (58.0 percent) of those accidents." It is not clear how pilot fatigue could be present in anything other than a whole number of accidents. The same paragraph continues: "There are, however, 39 additional pilot error accidents involving passenger airplanes where that information is not available." It is not clear whether the RIA is intentionally referring to passenger airplanes in its analysis of cargo accidents or actually intended to refer to cargo airplanes.

2.3 CONCLUSIONS REGARDING ACCIDENT AVOIDANCE BASED ON FAA ANALYSIS

As discussed, the Regulatory Impact Assessment does not provide a clear explanation of how the FAA selected the particular set of 22 accidents from which to extrapolate and project future results. Moreover, the larger set of 43 "Part 121" accidents provided by the FAA contains numerous inconsistencies, including the following:

- Accidents involving small single pilot aircraft
- Accidents involving aircraft operated under the less stringent rules of Part 135
- Eight accidents where the NTSB concluded that fatigue was not a factor
- Accidents where a fair reading of the NTSB findings leads to the conclusion that fatigue was not a factor or at best a very minor factor.

Equally confusing, the RIA narrative contains examples of accidents reportedly caused by pilot fatigue yet which are not included within the accident data sets.

In summary, the methodology used in the RIA to estimate the number of future accidents that would be avoided by adoption of the proposed rules does not meet basic requirements for transparency and cannot be replicated.

Based on the above, the FAA's estimate of the benefits of the NPRM in terms of future accidents avoided is substantially overstated.[2] The table below shows the number of accidents that the

[2] Note that the NTSB cited fatigue as a causal factor in only 12 of the set of 22 accidents, and therefore another approach would be to use only that set of accidents.

FAA misclassified in both the set of 43 accidents and the smaller set of 22 accidents.[3] As shown below, 47% of the set of 43 accidents should be excluded, as should 40% of the set of 22.

Figure 2.2 – Accidents that Should Be Excluded from Set of Part 121 Accidents Caused by Fatigue

FAA Accident Set		
Set of 43	**Set of 20(22)****	**Reason to Exclude**
8/4*	3/1*	NTSB determined fatigue not a factor
8/8*	5/5*	Two pilots plus flight engineer
2/2*	2/2*	Time difference: local versus base
6/6*	0/0*	Part 135 or single piloted aircraft accidents
20	**8**	**Total Accidents Excluded**
47%	**40%**	**% Excluded**

* The figure on the left of the / is the total number of accidents within this category. Because some accidents have been categorized in more than one way, the figure on the right is the number of accidents redistributed into single categories.
** See footnote 3 below.
.

Figure 2.3 below identifies the specific accidents that should be excluded from the FAA's set of Part 121 accidents caused by fatigue. More information about each accident is found in Figure 2.4, the five-page detailed table located at the end of this Chapter.

[3] The FAA refers to a set of 22, but included only 20 accidents within its data set. It discusses 3 other accidents in the narrative, but provides no data for them.

Figure 2.3 – Identification of Specific Accidents Excluded

# in Fig 2.4	NTSB ID #	Set of 43: Reason for Exclusion		Set of 20: Reason for Exclusion	
1	ANC98MA008	Part 135			
4	DCA02MA054	Crew size		Crew size	
5	DCA04MA011	**No Factor**			
7	DCA04MA068	**No Factor**	Base Time	**No Factor**	Base Time
10	DCA06MA009	**No Factor**			
13	DCA08RA063	Crew size			
18	DCA92MA022	Crew size		Crew size	
20	DCA93MA040	Crew size		Crew size	
21	DCA93RA060	Crew size		Crew size	
22	DCA94MA022	Part 135			
25	DCA95MA006	Part 136			
26	DCA96MA008	**No Factor**		**No Factor**	
27	DCA96MA029	Crew size			
28	DCA96MA079	**No Factor**	Crew size		
30	DCA97MA017	**No Factor**	Part 135		
31	DCA97MA055	**No Factor**	Base Time	**No Factor**	Base Time
37	MIA97FA082	Single Pilot			
38	NYC96FA174	Crew size		Crew size	
39	NYC97FA045	Part 135			
40	NYC97MA005	**No Factor**			
Total exclusions		**20**		**8**	

Key to Figure 2.3:

No Factor – NTSB found that fatigue was not a factor in the accident

Crew Size – Flight operated with 2 pilots plus flight engineer under substantially different circumstances than apply to modern Part 121 operations

Base Time – When time is adjusted to base time as required in the NPRM, the flight did not operate during the late night period indicated by the FAA

Part 135/Single Pilot – Flight operated under pre-1997 Part 135 rules or involved a single pilot aircraft

---

In estimating NPRM benefits, the FAA assigned different accident causation factors to the different fatigue types (adequate rest between duty periods, long duty period/duty time limits, etc.), but did not disclose those different factors. As a result, it is not possible to re-project NPRM benefits using our corrected accident categorizations. However, assuming that the accidents removed from the 22-accident data set because they were improperly categorized had the same average accident causation factors as those that remain, the result of correcting the accident categorizations is to reduce the accident avoidance benefit by approximately 40%. That would reduce the FAA's projected benefit number of $659.4 million in current dollars to $395.6 million. (The net present value of the corrected accident avoidance benefit is $278.3 million using the FAA's 7% discount rate assumption.)

Even before these corrections, the FAA's projected benefit of $659.4 million is far less than the FAA's projected cost of $1.254 billion. (On an NPV basis, the FAA's projected benefit is $463.8 million and cost is $803.5 million.) Based on the more accurate benefit and the cost numbers provided in this Report, the actual ratio of costs to benefits for this NPRM is approximately 50-to-1, with costs of approximately $19.641 billion[4] and benefits of approximately $395.6M. (On an NPV basis, the corrected benefit is $278.3 and cost is $14.439 billion.)

[4] As discussed elsewhere, this cost estimate does not include the cost incurred by regional carriers and is net of applying the FAA's optimistic 25% optimization assumption.

Figure 2.4 – Accident Summary – 43 Accidents Identified by the FAA as Involving Flight Crews Where the Necessary Data Was Available *(page 1 of 5, columns 1&2 repeat)*

		General					
#	NTSB ID #	A/C Registration	Type (Pax - Cargo)	Aircraft Make / Model	Date & Time	Airport	Operator
1	ANC98MA008	N750GC	Pax	Cessna 208B	11/9/07 0:00	BRW	Hageland
2	ATL96FA101	N53SW	Pax	B737-200	7/8/96 7:41	BNA	Southwest
3	DCA00MA030	N668SW	Pax	B737-300	3/5/00 18:11	BUR	Southwest
4	DCA02MA054	N497FE	Cargo	B727-200	7/26/02 5:37	TLH	FedEx
5	DCA04MA011	N364FE	Cargo	DC-10	12/18/03 12:26	MEM	FedEx
6	DCA04MA045	N438AT	Pax	ATR-72	5/9/04 14:00	SJU	Executive Airlines
7	DCA04MA068	N586P	Cargo	Convair 580	8/3/04 0:49	CVG	Air Tahoma
8	DCA05MA004	N875JX	Pax	BAE Jetstream	10/19/04 19:37	IRK	Corporate Airlines
9	DCA05WA019	N748CC	Cargo	Short Brothers SD3-60	12/10/04 22:00	YOO	Air Cargo
10	DCA06MA009	N471WN	Pax	B737-700	12/8/05 19:14	MDW	Southwest
11	DCA07FA037	N8905F	Pax	Bombardier CRJ CL-600	4/12/07 0:43	TVC	Pinnacle
12	DCA07MA072	N862RW	Pax	ERJ-170	2/18/07 15:06	CLE	Shuttle America
13	DCA08RA063	N704CK	Cargo	B747-200	5/25/08 11:31	BRU	Kalitta Air
14	DCA09MA027	N200WQ	Pax	DHC-8	2/12/09 22:17	BUF	Colgan
15	DCA90MA030	N670MA	Pax	B737-200	6/2/90 9:37	LAK	Markair
16	DCA91MA010	N3313L / N278US	Pax	B727/DC-9	12/3/90 13:46	DTW	Northwest
17	DCA91MA021	N565PC	Cargo	DC-9	2/17/91 0:19	CLE	Ryan International
18	DCA92MA022	N794AL	Cargo	DC-8	2/15/1992	TOL	ATI
19	DCA92MA025	N485US	Pax	Fokker F-28	3/22/1992 21:35	LGA	US Air
20	DCA93MA040	N139AA	Pax	DC-10	4/14/93 6:59	DFW	American Airlines
21	DCA93RA060	N814CK	Cargo	DC-8	8/18/93 16:56	GAO	American International
22	DCA94MA022	N334PX	Pax	BAE Jetstream	12/1/93 19:50	HIB	Express Airlines
23	DCA94MA038	N18835	Pax	MD-82	3/2/94 17:58	LGA	Continental Airlines
24	DCA94MA065	N954VJ	Pax	DC-9	7/2/94 18:51	CLT	US Air
25	DCA95MA006	N918AE	Pax	BAE Jetstream	12/13/94 18:34	RDU	Flagship/Aeagle
26	DCA96MA008	N566AA	Pax	MD-83	11/12/95 0:56	BDL	American Airlines
27	DCA96MA029	N605FF	Pax	B747-100	12/20/95 11:36	JFK	Tower Air
28	DCA96MA079	N68055	Cargo	DC-10	9/5/96 5:55	SWF	FedEx
29	DCA96RA020	N651AA	Pax	B757	12/20/95 21:42	CLO	American Airlines
30	DCA97MA017	N265CA	Pax	Emb-120	1/9/97 15:54	DTW	Comair
31	DCA97MA055	N611FE	Cargo	MD-11	7/31/97 1:31	EWR	FedEx
32	DCA98MA023	N845AA	Pax	B727-200	2/9/98 9:54	ORD	American Airlines
33	DCA99MA060	N215AA	Pax	MD-83	6/1/99 23:51	LIT	American Airlines
34	DEN07LA101	N2536L	Pax	Beech 1900D	6/20/07 16:20	LAR	Great Lakes Air
35	FTW03MA160	N343SW	Pax	B737-300	5/24/03 21:36	AMA	Southwest
36	FTW96FA118	N105576	Pax	DC-9	2/19/96 9:02	IAH	Continental Airlines
37	MIA97FA082	N318AB	Pax	Cessna 402C	2/8/97 19:30	STT	Air Sunshine
38	NYC96FA174	N31031	Pax	L-1011	8/25/96 7:10	JFK	TWA
39	NYC97FA045	N139VZ	Pax	Beech 1900D	1/10/97 9:23	BGR	Mesa
40	NYC97MA005	N914DL	Pax	MD-88	10/19/96 16:38	LGA	Delta
41	NYC99FA110	N232AE	Pax	Saab 340B	5/8/99 7:01	JFK	American Eagle
42	NYC99LA052	N215CJ	Pax	Beech 1900D	1/23/99 17:19	HYA	Colgan
43	SEA95FA170	N335PH	Pax	D-328	8/3/95 15:35	RDD	Horizon Air

Figure 2.4 – Accident Summary – 43 Accidents Identified by the FAA as Involving Flight Crews Where the Necessary Data Was Available *(page 2 of 5, columns 1&2 repeat)*

		General					
#	NTSB ID #	Crew Size	Augmentation	Citation in RIA (page number)	FAA Fatigue Type	Local Time	Crew Base Time
1	ANC98MA008	1	No	N/A	N/A	N/A	N/A
2	ATL96FA101	2	No	N/A	N/A	N/A	N/A
3	DCA00MA030	2	No	N/A	N/A	N/A	N/A
4	DCA02MA054	3	No	4, 16	1) Inadequate Sleep btw Duty Periods	N/A	N/A
5	DCA04MA011	2	No	N/A	N/A	N/A	N/A
6	DCA04MA045	2	No	N/A	N/A	N/A	N/A
7	DCA04MA068	2	No	39	5) Late Night	0:49	23:49
8	DCA05MA004	2	No	4, 25	2) Duty Time Limits	N/A	N/A
9	DCA05WA019	2	No	26	2) Duty Time Limits	N/A	N/A
10	DCA06MA009	2	No	N/A	N/A	N/A	N/A
11	DCA07FA037	2	No	5, 26	2) Duty Time Limits	N/A	N/A
12	DCA07MA072	2	No	5,16	1) Inadequate Sleep btw Duty Periods	N/A	N/A
13	DCA08RA063	3	No	N/A	N/A	N/A	N/A
14	DCA09MA027	2	No	30	3) Time Awake	N/A	N/A
15	DCA90MA030	2	No	N/A	N/A	N/A	N/A
16	DCA91MA010	2 and 3	No	N/A	N/A	N/A	N/A
17	DCA91MA021	2	No	38	5) Late Night	0:19	0:19
18	DCA92MA022	3	No	3, 38	5) Late Night	3:26	3:26
19	DCA92MA025	2	No	N/A	N/A	N/A	N/A
20	DCA93MA040	3	No	33	4) Chronic Fatigue	N/A	N/A
21	DCA93RA060	3	No	3, 24	2) Duty Time Limits	N/A	N/A
22	DCA94MA022	2	No	N/A	N/A	N/A	N/A
23	DCA94MA038	2	No	N/A	N/A	N/A	N/A
24	DCA94MA065	2	No	28	3) Time Awake	N/A	N/A
25	DCA95MA006	2	No	N/A	N/A	N/A	N/A
26	DCA96MA008	2	No	39	5) Late Night	23:55	23:55
27	DCA96MA029	3	No	N/A	N/A	N/A	N/A
28	DCA96MA079	3	No	N/A	N/A	N/A	N/A
29	DCA96RA020	2	No	29	3) Time Awake	N/A	N/A
30	DCA97MA017	2	No	N/A	N/A	N/A	N/A
31	DCA97MA055	2	No	39	5) Late Night	1:30	21:30
32	DCA98MA023	2	No	N/A	N/A	N/A	N/A
33	DCA99MA060	2	No	25	2) Duty Time Limits	N/A	N/A
34	DEN07LA101	2	No	27	2) Duty Time Limits	N/A	N/A
35	FTW03MA160	2	No	N/A	N/A	N/A	N/A
36	FTW96FA118	2	No	N/A	N/A	N/A	N/A
37	MIA97FA082	1	No	N/A	N/A	N/A	N/A
38	NYC96FA174	3	No	34	4) Chronic Fatigue	N/A	N/A
39	NYC97FA045	2	No	N/A	N/A	N/A	N/A
40	NYC97MA005	2	No	N/A	N/A	N/A	N/A
41	NYC99FA110	2	No	15	1) Inadequate Sleep btw Duty Periods	N/A	N/A
42	NYC99LA052	2	No	24	2) Duty Time Limits	N/A	N/A
43	SEA95FA170	2	No	N/A	N/A	N/A	N/A

Figure 2.4 – Accident Summary – 43 Accidents Identified by the FAA as Involving Flight Crews Where the Necessary Data Was Available *(page 3 of 5, columns 1&2 repeat)*

		Severity				
#	NTSB ID #	Fatalities	Severe Injuries	Minor Injuries	Substantial Damage	Minor Damage
1	ANC98MA008	8	0	0	1	0
2	ATL96FA101	0	1	4	1	0
3	DCA00MA030	0	3	42	1	0
4	DCA02MA054	0	3	0	1	0
5	DCA04MA011	0	0	2	1	0
6	DCA04MA045	0	1	19	1	0
7	DCA04MA068	1	0	1	1	0
8	DCA05MA004	11	2	0	1	0
9	DCA05WA019	0	2	0	1	0
10	DCA06MA009	1	1	21	1	0
11	DCA07FA037	0	0	0	1	0
12	DCA07MA072	0	0	3	1	0
13	DCA08RA063	0	0	5	1	0
14	DCA09MA027	49	0	0	1	0
15	DCA90MA030	0	1	3	1	0
16	DCA91MA010	8	10	26	1	0
17	DCA91MA021	0	2	0	1	0
18	DCA92MA022	4	0	0	1	0
19	DCA92MA025	27	0	0	1	0
20	DCA93MA040	0	2	38	1	0
21	DCA93RA060	0	3	0	1	0
22	DCA94MA022	18	0	0	1	0
23	DCA94MA038	0	0	30	1	0
24	DCA94MA065	37	16	3	0	0
25	DCA95MA006	15	5	0	1	0
26	DCA96MA008	0	0	78	1	0
27	DCA96MA029	0	1	470	1	0
28	DCA96MA079	0	0	2	1	0
29	DCA96RA020	160	4	0	1	0
30	DCA97MA017	29	0	0	1	0
31	DCA97MA055	0	0	5	1	0
32	DCA98MA023	0	0	120	1	0
33	DCA99MA060	11	45	65	1	0
34	DEN07LA101	0	0	0	1	0
35	FTW03MA160	0	0	68	1	0
36	FTW96FA118	0	0	0	1	0
37	MIA97FA082	2	0	3	1	0
38	NYC96FA174	0	0	0	1	0
39	NYC97FA045	0	0	2	1	0
40	NYC97MA005	0	3	0	1	0
41	NYC99FA110	1	0	0	1	0
42	NYC99LA052	0	0	0	1	0
43	SEA95FA170	0	0	0	0	0

Figure 2.4 – Accident Summary – 43 Accidents Identified by the FAA as Involving Flight Crews Where the Necessary Data Was Available *(page 4 of 5, columns 1&2 repeat)*

		NTSB Error Classification				
#	**NTSB ID #**	**Primary 1**	**Primary 2**	**Contributing 1**	**Contributing 2**	**Contributing 3**
1	ANC98MA008	Pilot Error	Frost	Asymmetric Fuel Loading	Lack of Management Monitoring	Self Induced Time Pressure
2	ATL96FA101	Pilot Error	N/A	Bird Strike	N/A	N/A
3	DCA00MA030	Pilot Error	N/A	ATC Positioning	N/A	N/A
4	DCA02MA054	Pilot Error	N/A	Fatigue	F/O Vision Deficiency	N/A
5	DCA04MA011	Pilot Error	N/A	Instructor Failure	N/A	N/A
6	DCA04MA045	Pilot Error	N/A	N/A	N/A	N/A
7	DCA04MA068	Pilot Error	N/A	Cross feed Procedures	Failure to Identify Problem	N/A
8	DCA05MA004	Pilot Error	N/A	Fatigue	CP Unprofessional behavior	N/A
9	DCA05WA019	Pilot Error	N/A	N/A	N/A	N/A
10	DCA06MA009	Pilot Error	N/A	Failure to divert	Incorrect Training	No Arrest Mechanism at RW
11	DCA07FA037	Pilot Error	N/A	Fatigue	Duty Hour Regulations	Inadequate Braking Information
12	DCA07MA072	Pilot Error	N/A	Fatigue	Attendance Policies	Long Landing, Short Runway
13	DCA08RA063	Pilot Error	N/A	Lack of Situational Awareness	Bird Strike	Incorrect Brake use
14	DCA09MA027	Pilot Error	N/A	Company Procedures	Lack of Sterile Cockpit	FC management failure
15	DCA90MA030	Pilot Error	N/A	N/A	N/A	N/A
16	DCA91MA010	Pilot Error	N/A	Weather	ATC	N/A
17	DCA91MA021	Pilot Error	N/A	Fatigue	Effects of Snow cover on stall	Ice cover on wings
18	DCA92MA022	Pilot Error	N/A	Failed Instrument	Physiological Factors	N/A
19	DCA92MA025	Pilot Error	Icing Formation	Inappropriate Procedures	FAA Determination of Delays	N/A
20	DCA93MA040	Pilot Error	N/A	Fatigue	Weather	N/A
21	DCA93RA060	Fatigue	Pilot Error	Inadequate Flight Duty Regulations	Ops at special airport	N/A
22	DCA94MA022	Pilot Error	N/A	Company Procedures	FAA Inadequate Surveillance	N/A
23	DCA94MA038	Pilot Error	N/A	N/A	N/A	N/A
24	DCA94MA065	Pilot Error	N/A	Incorrect ATC	Weather	N/A
25	DCA95MA006	Pilot Error	N/A	Company Monitoring	training	N/A
26	DCA96MA008	Pilot Error	N/A	ATC not giving Alt setting	N/A	N/A
27	DCA96MA029	Pilot Error	N/A	Company Procedures	Slippery Runway	N/A
28	DCA96MA079	Inflight Fire	N/A	Pilot Error	N/A	N/A
29	DCA96RA020	Pilot Error	N/A	Nav Information Problem	N/A	N/A
30	DCA97MA017	FAA Icing Certification	N/A	Operating in known icing conditions	N/A	N/A
31	DCA97MA055	Pilot Error	N/A	N/A	N/A	N/A
32	DCA98MA023	Pilot Error	N/A	Autopilot Malfunction	N/A	N/A
33	DCA99MA060	Pilot Error	N/A	Fatigue	Weather	N/A
34	DEN07LA101	Pilot Error	N/A	FO Failure to Intervene	Failure to go-around	N/A
35	FTW03MA160	Pilot Error	N/A	Weather	N/A	N/A
36	FTW96FA118	Pilot Error	N/A	No Landing Check list	N/A	N/A
37	MIA97FA082	Pilot Error	N/A	Inadequate FAA supervision	Failure to use nav aids	N/A
38	NYC96FA174	Pilot Error	N/A	Inadequate Checklist	Inadequate Manufacturing Inspection	Fatigue
39	NYC97FA045	Pilot Error	Inadequate Training	Abort T/O higher than V1	Airport not plowing	N/A
40	NYC97MA005	Pilot Error	Captain Vision Problems	Prescription of irregular lenses	Instrument failure	N/A
41	NYC99FA110	Pilot Error	N/A	Fatigue	Improper in flight decisions	N/A
42	NYC99LA052	Pilot Error	N/A	Fatigue	Improper Lever position	N/A
43	SEA95FA170	Pilot Error	N/A	N/A	N/A	N/A

Figure 2.4 – Accident Summary – 43 Accidents Identified by the FAA as Involving Flight Crews Where the Necessary Data Was Available *(page 5 of 5, columns 1&2 repeat)*

		Other Details						
#	NTSB ID #	Included in 22	Included in 250	Fatigue mentioned? NTSB	FAR Part	Effectiveness	Take-off, Landing, Inflight, Ground	Comments
1	ANC98MA008	No	Yes	No Mention	135	N/A	L	Single Pilot
2	ATL96FA101	No	Yes	No Mention	121	N/A	T	
3	DCA00MA030	No	No	No Mention	121	N/A	L	
4	DCA02MA054	Yes	No	Yes	121	0.75	L	
5	DCA04MA011	No	Yes	No Factor	121	N/A	L	"Based on the available evidence, fatigue was not a factor in this accident"
6	DCA04MA045	No	Yes	No Mention	121	N/A	L	
7	DCA04MA068	Yes	Yes	No Factor	121	0	L	"No evidence indicated that flight crew fatigue was a factor in this accident"
8	DCA05MA004	Yes	Yes	Yes	121	0.75	L	
9	DCA05WA019	Yes	No	No Mention	121	0	L	
10	DCA06MA009	No	Yes	No Factor	121	N/A	L	
11	DCA07FA037	Yes	Yes	Yes	121	0.9	L	
12	DCA07MA072	Yes	Yes	Yes	121	0.5	L	
13	DCA08RA063	No	No	No Mention	121	N/A	T	
14	DCA09MA027	Yes	No	Yes	121	0.5	L	
15	DCA90MA030	No	No	No Mention	121	N/A	L	
16	DCA91MA010	No	No	No Mention	121	N/A	G	
17	DCA91MA021	Yes	No	Yes	121	0.35	T	
18	DCA92MA022	Yes	No	No Mention	121	0.15	L	
19	DCA92MA025	No	No	No Mention	121	N/A	T	
20	DCA93MA040	Yes	No	Yes	121	0.15	L	
21	DCA93RA060	Yes	No	Yes	121	0.9	L	
22	DCA94MA022	No	No	No Mention	135	N/A	L	
23	DCA94MA038	No	No	No Mention	121	N/A	T	
24	DCA94MA065	Yes	No	No Mention	121	0.15	T	Fatigue cannot be determined based on duty time
25	DCA95MA006	No	No	No Mention	135	N/A	L	
26	DCA96MA008	Yes	No	No Factor	121	0	L	"They received the proper amount of crew rest before the accident flight"
27	DCA96MA029	No	No	No Mention	121	N/A	T	
28	DCA96MA079	No	No	No Factor	121	N/A	L	
29	DCA96RA020	Yes	No	No Mention	121	0.35	L	
30	DCA97MA017	No	No	No Factor	135	N/A	I	
31	DCA97MA055	Yes	No	No Factor	121	0	L	According to crew base time, not late night
32	DCA98MA023	No	No	No Mention	121	N/A	L	
33	DCA99MA060	Yes	No	Yes	121	0.15	L	
34	DEN07LA101	Yes	No	No Mention	121	0.15	L	11h on duty does not mean fatigue. Later, FAA reports associates risk on pg. 27
35	FTW03MA160	No	No	No Mention	121	N/A	L	
36	FTW96FA118	No	No	Yes	121	N/A	L	
37	MIA97FA082	No	No	No Mention	135	N/A	L	Single Pilot
38	NYC96FA174	Yes	No	Yes	121	0.35	L	
39	NYC97FA045	No	No	No Mention	135	N/A	L	
40	NYC97MA005	No	No	No Factor	121	N/A	L	
41	NYC99FA110	Yes	No	Yes	121	0.9	I	
42	NYC99LA052	Yes	No	Yes	91	0.15	L	Part 91
43	SEA95FA170	No	No	No Mention	121	N/A	L	

CHAPTER 3

COST ANALYSES PERFORMED AND COMPARISON WITH RIA ANALYSIS

3.1 HOW THE RIA AND OLIVER WYMAN REPORT ANALYSIS FIT TOGETHER

As explained below, the Report analyzes key provisions of the NPRM, but not all provisions. For those specific provisions included, it provides a more complete analysis than does the RIA. Although the Report does not capture all of the costs of the NPRM, the estimated cost of the specific NPRM provisions analyzed exceeds the FAA's estimated total cost of the NPRM.

The RIA identifies four primary cost categories of the NPRM.

1. Flight Operations
2. Schedule Reliability
3. Fatigue Training
4. Crew Rest Facilities

In three of these categories – Scheduling Reliability, Fatigue Training, and Crew Rest Facilities – the Report analyzes costs on a same-category-to-same category basis in comparison with the RIA.

The differing approaches taken by the RIA and this Report with regard to the remaining category – Flight Operations – are important and warrant detailed explanation. In the RIA, the Flight Operations analysis is itself divided into three subject areas:

1. Flight Duty Period
2. Rest Requirement
3. Flight Time Limitations

This Report analyzes one of these three subject areas – Flight Time Limits – on a same category-to-same category basis in comparison with the RIA. The Report does not include any analysis of Rest Requirement (minimum rest between duties) costs, although the RIA does. The Report's analysis of the remaining area – Flight Duty Period – differs from the RIA as explained in the table and text that follows.

Figure 3.1 – Comparison of RIA and Oliver Wyman Impact Analyses

Cost Component	**FAA RIA**	**Oliver Wyman Impact Analysis**
Flight Operations		
Flight Time Limits	✓	✓
Rest Requirement	✓	*Not Reviewed*
Flight Duty Period	Minimum rest between duties Reduced augmentation FMRS development costs Flight engineer supplemental operations	*Not Reviewed*
	Not Reviewed	Day of operations reserve Cumulative duty time from short call reserve Flight duty period extension Three consecutive nights Collective bargaining agreements (partially included in RIA analysis)
Schedule Reliability	✓	✓
Fatigue Training	✓	✓
Crew Rest Facilities	✓	✓
Proposed less costly/more effective alternatives	*Not Reviewed*	Flight duty period extension alternatives Split duty FDP Table A(1) vs. A(2)

The differences between the RIA approach to Flight Operations and the Report's approach are as follows:

1. The RIA provides an aggregate estimate of the cost of the Flight Operations provisions (see e.g., RIA at 103, which estimates the total cost for "Crew Scheduling.") The Report, however, takes a different approach; it does not attempt an overall aggregate estimate, but instead reviews selected provisions of the NPRM on an individual basis and provides cost estimates for each. Therefore, the Report cost estimate cannot be compared on a complete category-to-category basis with the RIA estimate as the Report does not capture the cost of all NPRM provisions.

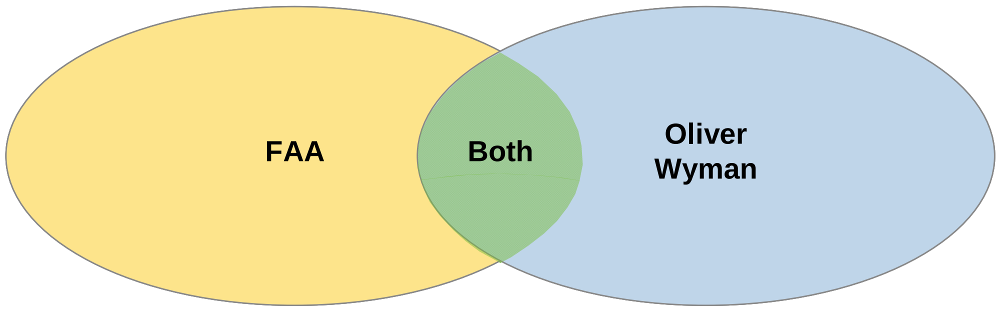
2. The costs of some provisions analyzed in the Report are not believed to have been included in the RIA's aggregate cost estimate. For example, the costs associated with Day of Operation Reserves, Cumulative Duty from Short-Call Reserves, and the Three-Consecutive-Night provision, are not included in the RIA aggregate cost estimate. Therefore, the Report includes those missing costs in its estimate.

3. Note as well that the RIA specifically excludes any analysis of the cumulative impact of the flight duty period provisions whatsoever. (See RIA at 76: "Only limits relating to individual flight duty periods were applied. Cumulative limits were not applied due to data limitations.") Thus, the RIA only analyzes the impact of the NPRM for individual duty or rest periods, not for subsequent duties which have 168-hour and monthly limits. The Report includes that analysis of cumulative impact where appropriate.

In summary, the Report provides a more exhaustive analysis of specific provisions of the NPRM, but it does not analyze all of the provisions. The Report analysis shows, however, that even the cost of the less-than-total set of rule provisions is substantially greater than the FAA estimated cost of the full NPRM.

Illustrated below is how the RIA and Report analyses fit together.

Figure 3.2 – How the RIA and Oliver Wyman Report Analyses Fit Together

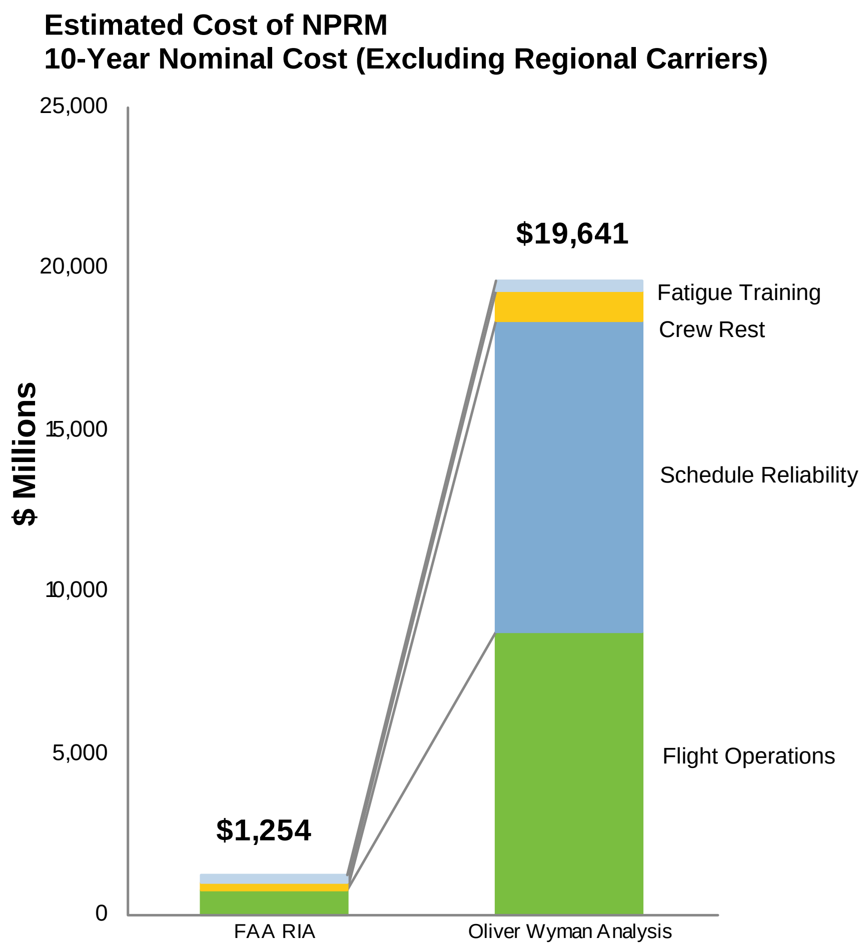


FAA *Topic area not included in Oliver Wyman report*	**Both** *Topic area appears in both reports*	**Oliver Wyman** *Topic area not included in FAA report*
▪ Rest Requirements ▪ Flight Duty Period – Minimum Rest Between Duties – Reduced Augmentation – FMRS Development Costs – Flight Engineer Supplemental Operations	▪ Flight Time Limits ▪ Schedule Reliability ▪ Fatigue Training ▪ Crew Rest Facilities	▪ Flight Duty Period – Day of Operations Reserve – Cumulative Duty Time from Short Call Reserve – FDP Extension – Three Consecutive Nights – Collective Bargaining Agreements (partially included in RIA analysis)

* Note, although this Report does not analyze Reduced Augmentation, the FAA estimates that this provision will result in a cost savings to the industry, and therefore this Report uses the FAA number to ensure comparability

A summary of the total costs analyzed in this Report compared with total costs included in the RIA is provided below. Costs represent a ten-year projected nominal cost, including the FAA's 25% optimization assumption applied to both the FAA and Oliver Wyman analyses. As noted, the Oliver Wyman figure below does not include an estimate for costs incurred by the regional carriers. The methodology for extrapolating to include regional costs is provided in the next section.

Figure 3.3 – Comparison of FAA Regulatory Impact Analysis (Entire Industry) and Oliver Wyman Economic Impact Analysis (Mainline, LCC, and Large Cargo only), Including FAA 25% Optimization Assumption



	FAA RIA	Oliver Wyman Analysis
Fatigue Training	262	331
Crew Rest	227	928
Schedule Reliability	5	9,624
Flight Operations	760	8,758
Total	$1,254	$19,641

3.2 EXTRAPOLATING TO INCLUDE REGIONAL CARRIERS

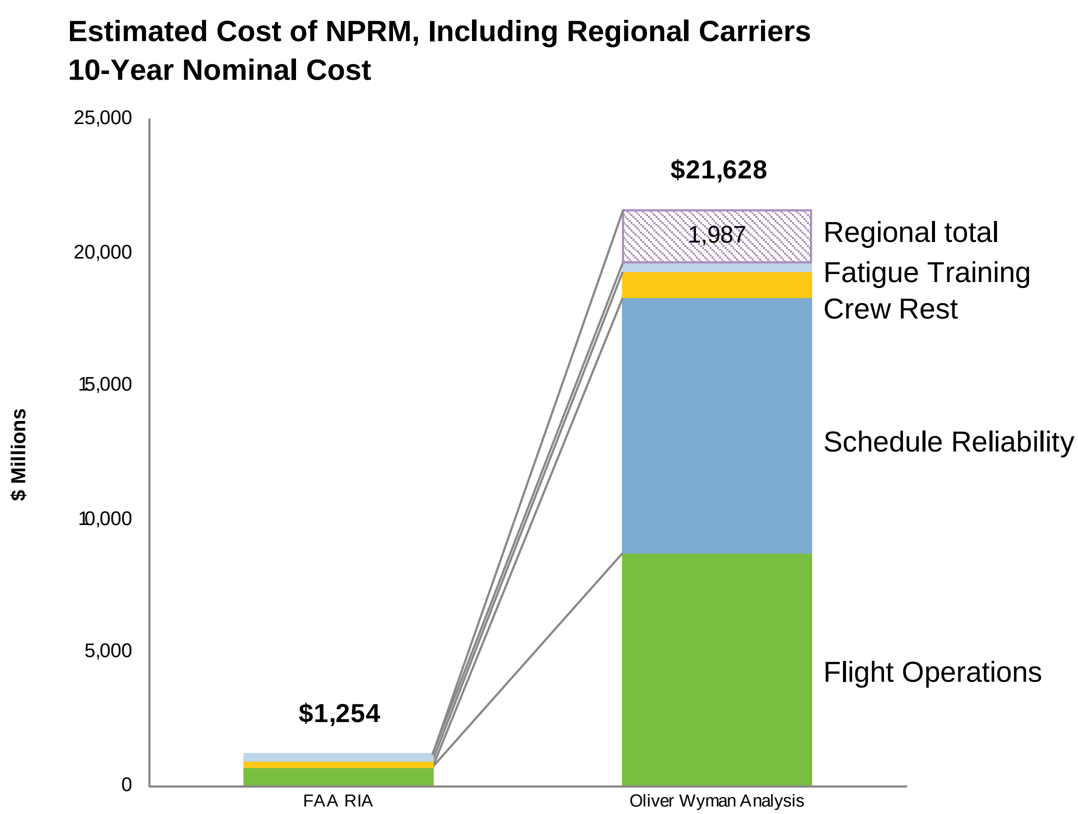
This section discusses the methodology used to extrapolate Oliver Wyman results to include the regional carriers. The FAA's total estimated cost of the NPRM includes costs incurred by all seven-carrier groups identified in the RIA: large cargo, commercial passenger, LCC, regional, small cargo, small passenger, and charter passenger. See RIA at pp 81 and following. Oliver Wyman's costs include only those for three of the seven air carrier groups – mainline, LCC, and large cargo. (As noted, Oliver Wyman's costs are understated as well because they include the estimated cost of key provisions of the NPRM, but not all provisions.)

The methodology used to extrapolate costs to include regional costs is as follows:

1. NPRM provisions applicable to regional carriers were identified.
2. Regional costs were then estimated based upon the impact of these provisions on the low cost segment, as both segments are focused on domestic, short haul operations.
3. Cancellation and pilot costs were scaled down to account for lower average pay rates in the regional sector and fewer passengers impacted by cancellations.

The result of applying this methodology is shown in Figure 3.4 below, which shows the FAA cost estimate, the Oliver Wyman cost estimate for mainline, LCC, and cargo, and the extrapolated estimate including regional carriers as well.

Figure 3.4 – FAA and Oliver Wyman Cost Estimates, Including Regional Carriers (10-year Nominal Cost and Including FAA 25% Optimization Assumption)



	FAA RIA	Oliver Wyman Analysis
Regional		1,987
Fatigue Training	262	331
Crew Rest	227	928
Schedule Reliability	5	9,624
Flight Operations	760	8,758
Total	1,254	21,628

CHAPTER 4

OBSERVATIONS ON FAA ASSUMPTIONS AND METHODOLOGY

The Regulatory Impact Analysis makes several important assumptions that are unrealistic or unsupported, including those regarding: (1) reduction of absenteeism as a result of fatigue management; (2) collective bargaining agreement impacts on estimated NPRM costs; (3) ability of the carriers to optimize the results to reduce costs; and (4) cumulative impacts. These assumptions are discussed here, along with two important inputs to this analysis: (1) flight crew labor costs, where the FAA uses unrealistically low numbers; and (2) flight cancellation costs, which the FAA does not include at all. This Chapter also discusses our treatment of cost savings from augmented operations.

4.1 ABSENTEEISM REDUCTIONS ASSUMED TO RESULT FROM FATIGUE MANAGEMENT

The Regulatory Impact Analysis concludes on page 94 that the "proposed rule will result in better-rested flightcrew members." And that it will therefore reduce the use of reserve flight crew 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." The RIA goes on to assume that sick time accounts for five percent of flight crew member pay, and that the proposed rule will reduce the use of sick time by five percent. The result is a projected nominal cost savings of $231.7 million ($142.1 million present value) over the ten-year period of analysis.

What these assumptions show is simply that 5% of 5% of the total flight crew payroll is a large number. The validity of the underlying assumptions, however, is not accepted by any of the multiple carriers interviewed. Some carriers suggest that an equally valid assumption would be that sick time will actually increase as a result of the NPRM. There are at least two reasons to conclude this: First, the average time away from base will increase as a result of the increased rest periods and overnights required by the NPRM, and therefore flight crews may find more occasions when they prefer to avoid or cancel a long trip. Second, the NPRM will require the hiring of more pilots, and therefore, in the absence of other factors, there will be more total sick leave hours and increased sick leave costs.

Note as well that some airlines incentivize flight crew members for not using all of their sick time. These crew members are not likely to change their already low use of sick time for which they are receiving financial incentives. In addition, for those flight crew members who already use their full sick time allowances, they are unlikely to change their approach and use less sick time.

In summary, there is no basis upon which to conclude that the NPRM will reduce sick time associated costs. The cost savings figure provided by the FAA is purely speculative.

4.2 COLLECTIVE BARGAINING AGREEMENT IMPACTS

There are both short-term and long-term collective bargaining agreement impacts on implementation of the proposed rules. In the short term, the benefits of the proposed rules – such as the longer flight hour limits for some flight duty periods – may not be realized because of CBA restrictions, while the costs of the proposed rules – such as longer rest periods, more restrictive split duty provisions, and greater reserve requirements – may be greater than in the absence of CBA restrictions. Examples of specific conflicts between the proposed rules and current CBAs are provided in Chapter 15.

Over the long term, the question is whether the CBAs will be conformed to the proposed rules in the normal course or whether there will be additional costs to the industry in the form of higher wages, lower productivity, etc. as part of the price to do so. The FAA concludes that the carriers will adjust their CBAs over time to take full advantage of any efficiencies permitted by the NPRM, and that this adjustment will occur without any additional cost to the carriers. Hence, the FAA does not provide a cost value for the adjustment to CBAs between flight crew and the company.

The FAA also specifically excludes from its analysis $100 million in CBA impacts. On page 90 of the RIA, the FAA divides rule costs into transfer costs and resource costs, and counts only resource costs as costs of the proposed rules "as they represent the true cost of the rule to society." Transfer costs, which the FAA defines as temporary cost increases resulting from short-term transfers between the carriers and flight crew members, however are also real costs to the carriers who likely must pass these costs on to the flying public. Moreover, the FAA's assumption that transfer costs will be limited to $64.4 million during the first year of implementation, $33.6 million during the second year of implementation, and nothing further after that, is regarded by the carriers as extremely optimistic. As noted, the FAA does not count even this $100 million in transfer costs as part of its cost assessment on the ground that this amounts only to a transfer between management and labor, and not an overall increase in resources required.

4.3 OPTIMIZATION ASSUMPTIONS

After estimating cost increases resulting from the additional crew resources required to implement the new rules, the FAA on page 85 of the RIA applies a short-term optimization factor of 25 percent. In other words, the FAA estimates the raw costs of implementing the rules and then assumes that these costs will be reduced by 25% as a result of carrier actions to optimize flight schedules and find other ways to optimize crew scheduling. On page 85 of the RIA, the FAA reports that "typically, industry will experience from 10 percent to 40 percent savings from reoptimizing in this fashion." Throughout this data analysis, Oliver Wyman conducted several airline interviews to gauge typical expectations around optimization factors anticipated in implementing the NPRM. The range of carrier optimization factors varies between airlines, but the overall reported range was 5% to 30%. This is below the 10% to 40% stated by the FAA, and could drive meaningful differences in real world costs.

Actual optimization results for the NPRM are unknown. The computer modeling tools required to optimize crew scheduling results for individual carriers under the new rules generally do not exist at the individual carriers, and it is not practical to develop these tools and complete the modeling within the time allotted to respond to the NPRM. For that reason, this Report uses the same 25% optimization factor used by the FAA. This is done with the sole purpose of providing a comparable result and should not be interpreted as Oliver Wyman's agreement with the FAA's assumption.

4.4 CUMULATIVE IMPACTS

As mentioned in Section 3.1, the RIA specifically excludes any analysis of the cumulative impact of the flight duty period provisions whatsoever. (See RIA at 76: "Only limits relating to individual flight duty periods were applied. Cumulative limits were not applied due to data limitations.") Thus, the RIA only analyzes the impact of the NPRM for individual duty or rest periods, not for subsequent duties which have 168-hour and monthly limits. The cost impact of the cumulative limits is substantial, and this Report includes an analysis of cumulative impact where appropriate.

4.5 FLIGHT CREW COSTS

The RIA estimates crew costs by taking 2006 salary data from an aviation industry publication, dividing by estimated credit hours, and escalating to a projected 2009 level using the ATA Passenger Airline Cost Index. This method of estimating crew costs does not produce an accurate result.

The raw average salary data used in the RIA does not approximate current, real world flight crew unit costs for several reasons: (1) It does not include payroll taxes, and pension and benefits; (2) Dividing by credit hours does not produce a cost per block hour; and (3) Escalating 2006 data is a poor substitute for using current data. A more realistic analysis would instead use DOT Form 41 data – which is readily available by block hour, by employee group, and by carrier for 2009 – in combination with average crew per flight data. Form 41 contains separate data for payroll, payroll taxes, and pension and benefits, all of which should be included when estimating the cost of hiring additional flight crews.

As acknowledged in the RIA, the NPRM will require the hiring of a substantial number of new flight crew members, each of whom has costs that go beyond basic salary and include at least payroll taxes, and pension and benefit costs. The table below shows the magnitude of the difference between the FAA's estimated flight crew cost per hour and the estimate cost based on Form 41 data:

Figure 4.1 – Average Block Hour Cost per Flight Crew Member

Group	DOT Form-41 Cost per Flight Crew BH	FAA Average Flight Crew Hourly Salary	Difference $	Form 41 Cost/ FAA Average Hourly Salary
Large Cargo	$745	$121	$624	6.2
Commercial Passenger	$297	$129	$168	2.3
LCC	$241	$107	$134	2.3
Regional	$113	$60	$53	1.9
Small Cargo	N/A*	$55	N/A*	N/A*
Small Passenger	$95	$45	$50	2.1
Charter Passenger	$240	$92	$148	2.6

* No DOT Form 41 data available for carriers in this group.

4.6 FLIGHT CANCELLATION COSTS

The RIA does not include any reference to flight cancellation costs. As discussed in the analysis, however, several provisions of the NPRM will sharply reduce airline scheduling flexibility and result in increased cancellations. To estimate the cost of cancellations, the Report relies on the cancellation cost estimates provided by DOT in its Final Regulatory Impact Analysis of Rulemaking on Enhanced Airline Passenger Protections, dated December 17, 2009 (the "REAPP").[5]

When a flight is cancelled, both the airlines and the passengers incur costs. That DOT Analysis contains separate estimates of the cost of cancellation for airlines, which amounts to $14,818 per flight cancelled (see REAPP, Table 15, p. 42), and for passengers, which amounts to approximately $174 per passenger (see REAPP, Table 16, p. 42). The per passenger cancellation cost has been extrapolated to produce a total passenger cost per cancelled flight of $20,735 by analyzing Form 41 data for the average number of passengers carried ($174 per passenger x 119 passengers/flight) on the flight segments analyzed.

[5] See Docket number DOT–OST–2007–0022.

4.7 COST SAVINGS FROM AUGMENTED OPERATIONS

The FAA estimates that the industry will achieve cost savings resulting from the elimination of maximum flight limit for augmented operations of $451.4 million over a ten-year period, or $276.9 million on a present value basis. The FAA's methodology assumes that the carrier CBAs will permit the reduction of augmented flight crews from four flight crew members to three. In addition, the RIA does not analyze the interaction between the new maximum flight time rules with the other more limiting provisions of the NPRM.

The actual cost savings from the NPRM provisions on augmented operations are unknown. The carriers interviewed believe the FAA's estimate is too high because of the impact of other restrictive NPRM provisions on the augmented operations provisions. It is not practical to complete the modeling of this provision within the time allotted to respond to the NPRM. For that reason, in comparing the FAA's overall costs and benefits of the NPRM with those calculated by Oliver Wyman, this Report uses the FAA's cost savings number. This is done solely to provide a basis for comparison and should not be interpreted as Oliver Wyman's agreement with the FAA's conclusion.

CHAPTER 5

FLIGHT TIME LIMITS (BLOCK HOUR RESTRICTIONS) WITHIN OVERALL FLIGHT DUTY PERIOD [SECTION 117.13]

5.1 KEY ISSUE

Section 117.13 of the NPRM, *Flight Time Limitation,* includes daily flight time limits (block hour restrictions) within a single duty period. These proposed flight time limits are in addition to the proposed FDP limitations. Moreover, these limits, as described by the FAA, are firm and may not be extended in the event of day-of-operation delays.

Current FAA regulations allow for duty periods to be scheduled up to a maximum of 8 block hours, but also permit the extension of actual flight time in the event of day-of-operation delays due to circumstances beyond the control of the air carrier. [6] The NPRM removes the ability to extend flight times. The practical impact of the proposed rule will be to reduce operational flexibility on the day-of-operations by eliminating a carrier's ability to extend flight times as a means of recovering from disruptions.

To mitigate the risk of flight cancellations, carriers will be required to adjust existing flight duty periods as part of their planning process. These adjustments will include the reduction of planned flight times within a single duty, as well as the restructuring of existing duties. The reduction in flight times within a single duty will result in an increase in total duties and will require additional pilots to operate those duties.

In addition to changes in planned duties, unforeseen operational delays that occur in or out of the carriers' control will still result in some duties becoming illegal after they have commenced. When this occurs, a change of flight crew will be required to operate the remainder of the duty. In the event that operational delays occur in non-domicile stations where no reserve crews are positioned, there is a high likelihood of additional delays or cancellations.

[6] See 14 CFR 121.471(g), which states: "A flight crewmember is not considered to be scheduled for flight time in excess of flight time limitations if the flights to which he is assigned are scheduled and normally terminate within the limitations, but due to circumstances beyond the control of the certificate holder (such as adverse weather conditions), are not at the time of departure expected to reach their destination within the scheduled time."

The proposed flight time limitations are expected to impact all carriers in the three industry segments under review. The FAA has correctly observed that operations that include multiple segments within a single duty period may be constrained first by FDP limits rather than flight time limits. As a result, this provision is likely to have less impact on carriers operating shorter segments as part of their normal operations, such as some low cost carriers, than on carriers operating longer segments.

Some of the assumptions used in the RIA differ substantially from those used in this analysis. These include, but are not limited to, the following two assumptions which are likely to drive substantial differences in cost estimates:

A. Average Hourly Salary

- The FAA includes a table of average hourly salaries for carriers of different market segments (*RIA, at 82, Table 11: Average Hourly Salary*). The table is based on a 2006 salary survey and does not mention the inclusion of any other costs, such as payroll taxes, and pension and benefits.
- Oliver Wyman's analysis derived average block and duty hour costs per flight crew member from publicly available Form 41 data and operational data provided by individual carriers. These costs include payroll, payroll taxes, and pension benefits, all of which should be included when estimating the cost of hiring additional flight crews.
- As discussed in section 4.4, the figures provided by the FAA are unrealistic and significantly lower than the figures used by Oliver Wyman because the FAA did not use fully burdened numbers. For most air carriers, the true flight crew costs per hour are more than double the FAA's numbers. This difference would have a meaningful impact on the final cost analysis.

B. Inclusion of Cancellation Costs

- The FAA has not included any potential flight cancellations as part of the RIA.
- Analysis of actual carrier delay information in conjunction with the proposed new firm flight time limits shows that increased cancellations are very likely as a result of the loss of ability to extend flight times as a result of day-of-operation delays.
- The cost of additional cancellations is included in this analysis. As explained in section 4.5, the DOT cancellation cost estimate used in the Enhanced Airline Passenger Protections rulemaking RIA is also used here.

As explained in Chapter 3, the RIA includes an overall aggregate cost estimate for Flight Operations provisions, which incorporates the impact of the Flight Time Limits. However, the RIA does not provide a separate breakout of the cost of the proposed Flight Times Limits. Therefore, it is not possible to compare the results of this analysis with that of the RIA.

5.2 METHODOLOGY

Multiple carriers provided Oliver Wyman with historical pairing and rostering information from at least two different months representing seasonal changes in schedules and operational performance. The carrier data analyzed included at least one dataset from each of the three industry segments.

The analysis consisted of two different components, with the estimated cost of each component added to make up the full economic impact of the proposed rule:

A. Changes to scheduled flight times required to reduce the likelihood of violating the flight time limit by adding a buffer
B. Comparison of actual flight times to scheduled flight times to identify flights that still would exceed the flight time limit

A. Changes to scheduled flight times required to reduce the likelihood of violating the flight time limit by adding a buffer

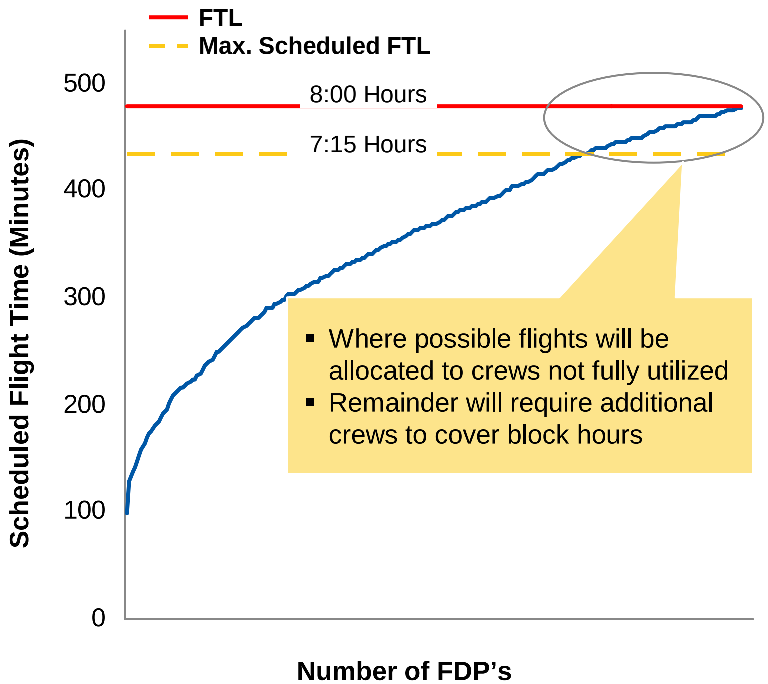
Scheduled duties in the historical dataset provided to Oliver Wyman were reviewed to identify duties that were close to the proposed flight time limitations. In interviews with the carriers, they proposed flight time buffers of between 30 minutes and 2 hours depending on historic delay patterns of destinations included in pairings. This buffer was to ensure that modest delays would not cause additional operational disruption. The range was simplified for the purposes of this analysis, and an average scheduled flight time of at least 45 minutes below the flight time limitation was selected.

For duties beginning between 2000 – 0459, the NPRM proposes flight time limits of 8 block hours ("8 block hour departure window"). As a result, duties in this window with scheduled flight times exceeding 7hrs 15mins were truncated as part of the analysis.

For duties beginning between 0500 – 1959, the NPRM proposes flight time limits of 9 or 10 block hours. Because current scheduling limits restrict flight times to 8 block hours, all duties departing in this window already have at least a 1-hour buffer between scheduled flight time and the proposed flight time limitations. For these duties, no truncation in block hours is required.

The truncated hours were then aggregated across all duties and multiplied by the average cost per block hour. This was done on a per carrier basis, using the appropriate carrier cost per block hour.

Figure 5.1 – Example Showing Required Buffering of Scheduled Flight Times: Mainline Carrier, Unaugmented, March 2009



B. Comparison of actual flight times to scheduled flight times to identify flights that still would exceed the flight time limit

Actual duty periods in the historical dataset were reviewed to identify duties that exceeded the proposed flight time limitations. Flight times were separated based on time of duty commencement to derive the correct flight time limitation.

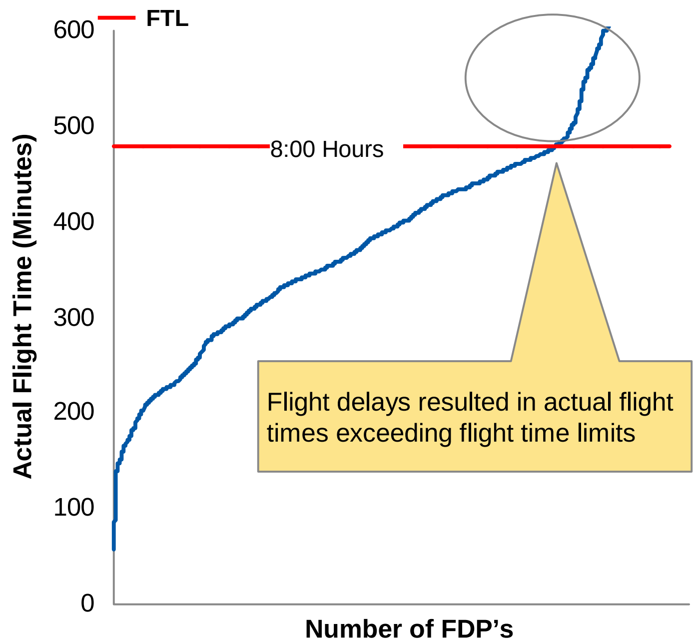
In the case of flight time that exceeded 7hrs 15mins and were in the 8 block hour departure window, the assumption was made that flight times would not have exceeded 7hrs 15mins. Therefore, only delays of at least 45 minutes would have resulted in operational disruption for these duties.

For duties that exceeded the flight time limitation, the flight segment resulting in the flight time violation was reviewed to determine if it originated at a domicile. If it did, the assumption was made that reserve pilots would be available and no additional costs would be incurred (even though the impact may be such that additional reserve pilots would be needed to cover the projected flight time increase). For segments departing from a non-domicile station, the assumption was made that no reserves would be available within a reasonable time and a flight cancellation would occur.

The DOT cancellation cost estimate used in the Enhanced Airline Passenger Protections rulemaking RIA (December 2009) was used to estimate the cost of cancellations. That analysis provides separate breakdowns of the estimated economic costs associated with cancellations for both carriers and passengers. Separately, individual carriers provided information that confirmed the validity of DOT's cancellation cost estimates.

The cost per cancellation was then multiplied by the estimated number of cancellations to derive a total cost of cancellations associated with actual flight times exceeding flight time limitations.

Figure 5.2 – Example Showing Actual Flight Times that Exceed Maximum Flight Time Limits (Even after Buffering): Mainline Carrier, Unaugmented, March 2009



Of all duties reviewed in the three-segment set, 0.55% of flight times exceeded the proposed flight time limitations in non-domicile stations. This includes duties that were buffered to ensure a minimum 45-minute buffer between scheduled flight time and maximum. The 0.55% of duties exceeding flight time limits would each likely result in a flight cancellation. While a seemingly small number, the year-to-date average cancellation rate for domestic US operations was 1.75% according to the DOT's Air Travel Consumer Report. This 32% increase in cancellations will result in noticeably less reliable service to the public.

5.3 RESULTS/CONCLUSIONS

Based on the above analysis, the total estimated annual cost of complying with the Flight Time Limit provisions is $571 million. This is comprised of the annual cost to the air carriers of $366 million, plus the annual cost to passengers of $205 million.

The FAA has assumed the aggregate cost of complying with the Flight Operations provisions of the NPRM would be reduced through the use of scheduling optimization systems, and that the reduction would be 25%. The results of applying that reduction to both the air carrier and passenger cost estimates are shown below. See section 4.3 for further discussion of optimization assumption.

Figure 5.3 – Chapter 5 Cost Estimates

	Driver per Year	Weighted Average Cost per Unit*	Base Case (0% optimization) ($ millions)	Optimized Case (FAA 25% assumption) ($ millions)**
Annual block hour related carrier cost (nominal)	350K Block Hours	$390	$137	$103
Annual cancellation related carrier cost (nominal)	11K Cancellations	$21K	$229	$172
Annual cancellation related passenger cost (nominal)	11K Cancellations	$18K	$205	$153
Total cost (nominal)			$571	$428

* Average block hour costs vary depending on the provision being analyzed based on the mix of carriers impacted by that provision.
** RIA assumption of average industry benefit from optimization.

This cost is included in the FAA's Flights Operations number, but is not broken out separately.

CHAPTER 6

SCHEDULE RELIABILITY [SECTION 117.9]

6.1 KEY ISSUE

Section 117.9 of the NPRM, *Schedule Reliability,* proposes that carriers report and adjust flight duty periods (FDPs) when the actual duty time exceeds the scheduled flight duty time. The FAA's intent, as stated in the NPRM is to "assure realistic scheduling." In its Response to Clarifying Questions, at 7, the FAA emphasized that the "The point of a schedule reliability requirement is to assure the integrity of schedules, not simply to assure that the time frames listed in the [Maximum Flight Time and Flight Duty Period] tables are not exceeded."

Section 117.9(a)(1) requires that carriers adjust their scheduled FDPs to ensure that 95% of systemwide actual FDP times are within the scheduled FDP time. For individual FDPs, the requirement is that actual FDPs must be less than scheduled FDPs 80% of the time. In the event that these parameters are exceeded, carriers must adjust their FDPs within 60 days so that future FDPs meet the limits.

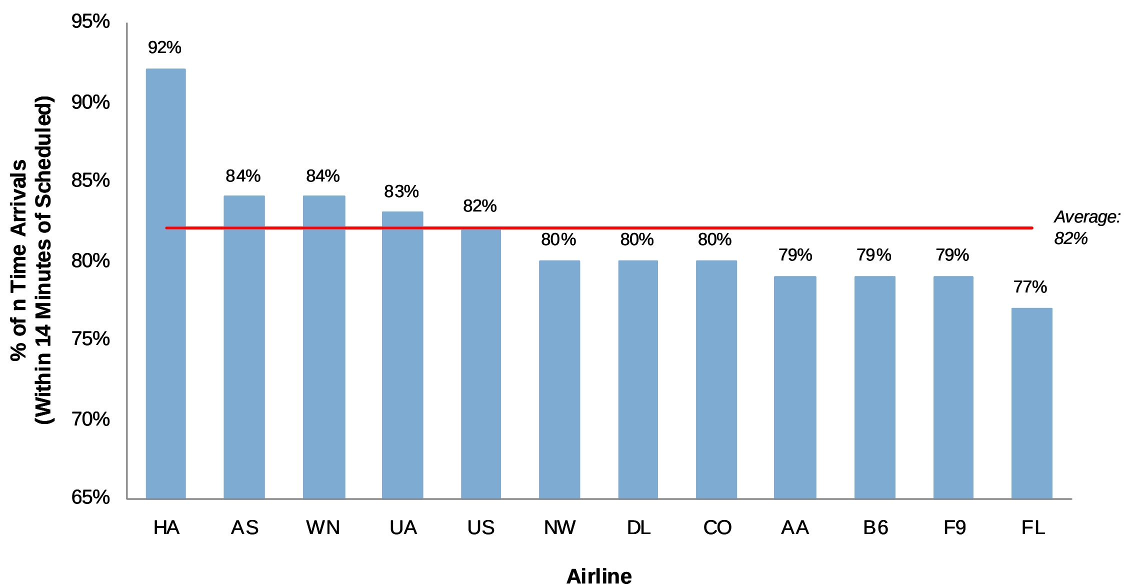
In searching for flight and duty requirements elsewhere in the world to better understand the potential application of this provision, there appear to be no comparable provisions anywhere. Unlike other jurisdictions, the FAA compares FDP schedule extensions against the original scheduled FDP, not the FDP maximum limits. The rules in other jurisdictions seek to measure use of extensions by requiring that carriers track actual versus maximum FDPs, not actual versus scheduled.

A review of CAP371 (UK), EU OPS Subpart Q (EU), and CAD 371 (Hong Kong) shows that all of these rules evaluate FDP extensions in relation to FDP maximum limits, not the scheduled FDP. For example, EU OPS Subpart Q requires that carriers not exceed FDP maximum limits more than 33% of the time, but has no reference to the actual FDP exceeding the scheduled FDP. See Figure 16.1 and discussion in Chapter 16, *Comparison of NPRM with Existing International Regulations,* for additional examples.

The implication of the NPRM is that FDPs that exceed scheduled times but remain within FDP maximum limits are somehow more fatiguing than FDPs that are both within scheduled times and FDP maximum limits. This implication has no scientific or operational support, yet it forms the basis for this extremely onerous and costly proposed rule.

In the RIA, the FAA concludes that the cost to the industry of the schedule reliability provisions will be minimal because the only carriers impacted would be those who do not schedule reliably and that "most carriers are already publishing realistic schedules overall". This conclusion reflects a fundamental misunderstanding of airline scheduling practices and the degree of control carriers have over their scheduled versus actual flight times. By way of comparison, in 2009, the carriers operated on a systemwide basis with an on-time arrival rate of approximately 82%, as measured using the DOT criteria that flights arriving 0-14 minutes late are considered "on time." The proposed rules, in contrast, would require that carriers operate on-time 95% of the time, as measured using the criteria that any flight arriving even one minute last is counted as late. See Figure 6.1 below for carrier on-time arrival rates, based on DOT criteria.

Figure 6.1 – US Carrier On-Time Performance; Arrivals within 14 Minutes of Schedule 2009

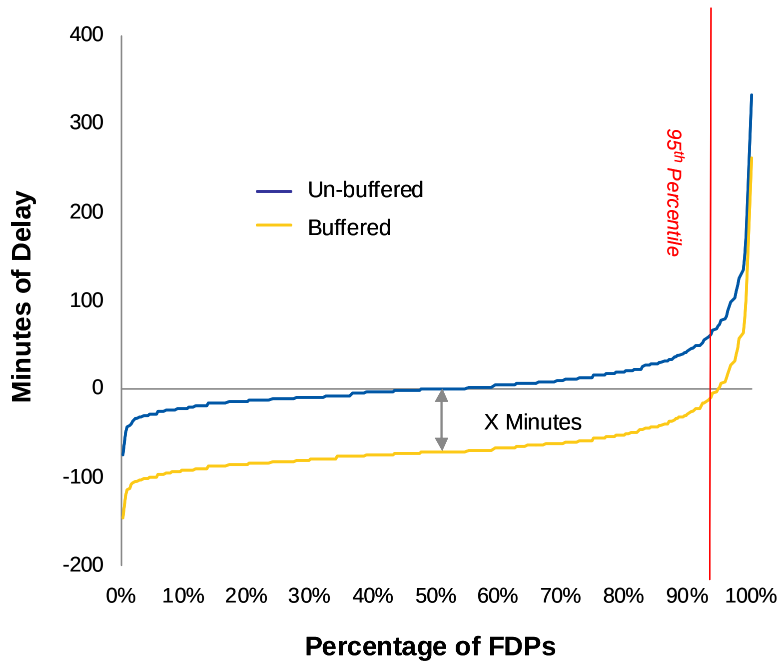


Source: US DOT Air Travel Consumer Reports 2009

As measured by the standard that any delay beyond scheduled time – even one minute – counts as a late flight (or in this case, a late FDP), the carriers are actually operating between 50% and 70% "on-time," driven by operational issues including airspace congestion and weather. As noted, this 50%-70% on-time rate translates into an industry on-time arrival rate of approximately 82%, when measured using the DOT criteria that flights arriving 0-14 minutes late are considered "on time." At this level of operational integrity, nearly 50% of flights in fact arrive early, while another large percentage of flights arrive only a few minutes beyond the scheduled arrival time. Nevertheless, this level of performance does not come close to meeting the NPRM's requirement that 95% of systemwide flights be absolutely on time.

The FAA's suggestion that airline schedules should be designed to accommodate weather and other foreseeable issues will not result in 95% schedule reliability unless the carriers build in enormous flight schedule buffers. Because of the uncertainty of predicting the timing and location of specific weather events, and because these events vary from day to day, a carrier cannot add a flight schedule buffer only to those flights it "knows" will be late. It must add sufficient buffer to enough flights so that 95% will arrive not a single minute late. Based on the analysis of current flight delays versus actual schedules, an average flight buffer of 52 minutes will be required to achieve this. Only by adding that buffer will 95% of flights arrive on-time or early. See Figure 6.2 below for graph showing required buffer.

Figure 6.2 – Buffering Required to Meet 95% FDP Schedule On-Time Requirement Based on Actual Carrier Delay Data



The RIA, by excluding the cost of schedule buffering, has omitted the major source of cost to the industry.

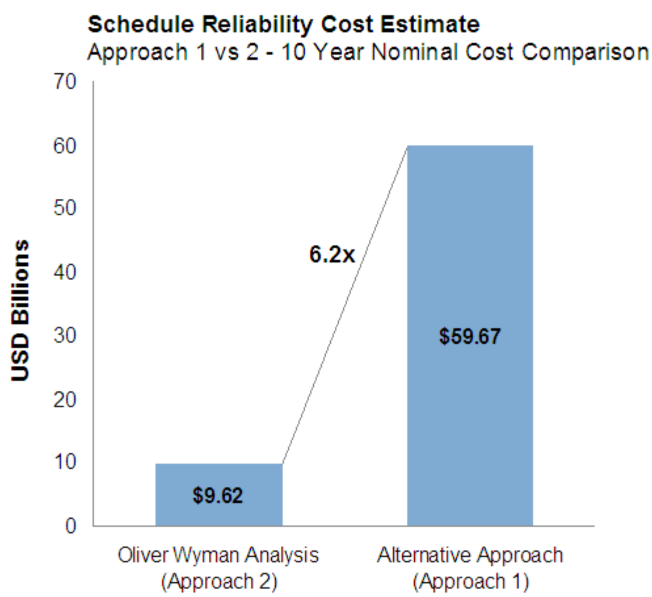
6.2 METHODOLOGY

The carriers have struggled to develop a definitive methodology to evaluate the NPRM's unique Schedule Reliability provisions. In attempting to analyze these provisions, three approaches were considered:

- **Approach 1 – Individual Flight Block Buffers**
  Increase the length of individual flight schedules by adding a sufficient buffer for all flights to ensure that 95 percent arrive on-time – meaning 0 minutes later than scheduled. Under this approach, the industry would be required to add block time for each individual flight. This is the approach that meets the requirements of the Schedule Reliability provisions in the most

straight forward manner. However, the cost of using this approach would be enormous because of: (1) the need to pay flight crew and cabin crew for the additional block time; and (2) the cost of lost aircraft utilization, which would result in the need to cut flights and markets, or to acquire additional aircraft. Based on the cost information provided by one mainline carrier, the cost of meeting the Schedule Reliability provisions using this approach would be approximately six times as high as the approach described in 2 below. Moreover, this does not include the costs to the airlines or passengers associated with flights arriving very early and sitting on the tarmac while waiting for a free gate. *Some carriers believe that this approach is required to comply with the Schedule Reliability provisions.* If so, the impact of this approach is to increase the total 10-year Schedule Reliability cost impact from $9.6 billion to $59.7 billion. See Figure 6.3 below.

Figure 6.3 – Cost Impact of Using Approach 1 – Individual Flight Block Buffers.



The adoption of this approach would increase the total 10-year cost of the NPRM to approximately $69.7 billion.[7]

- **Approach 2 – Last Flight (Flight Crew Only) Block Buffer**
  Increase each scheduled flight duty period by adding a sufficient block time buffer for the pilots only to the last flight to ensure that they arrive within the scheduled flight duty period 95% of the time. The average required buffer under this approach is 52 minutes, with the buffers required for the sample of carriers analyzed ranging from 18 minutes in one month to 70 minutes. Under this approach, it is assumed that flight crew would be paid for the

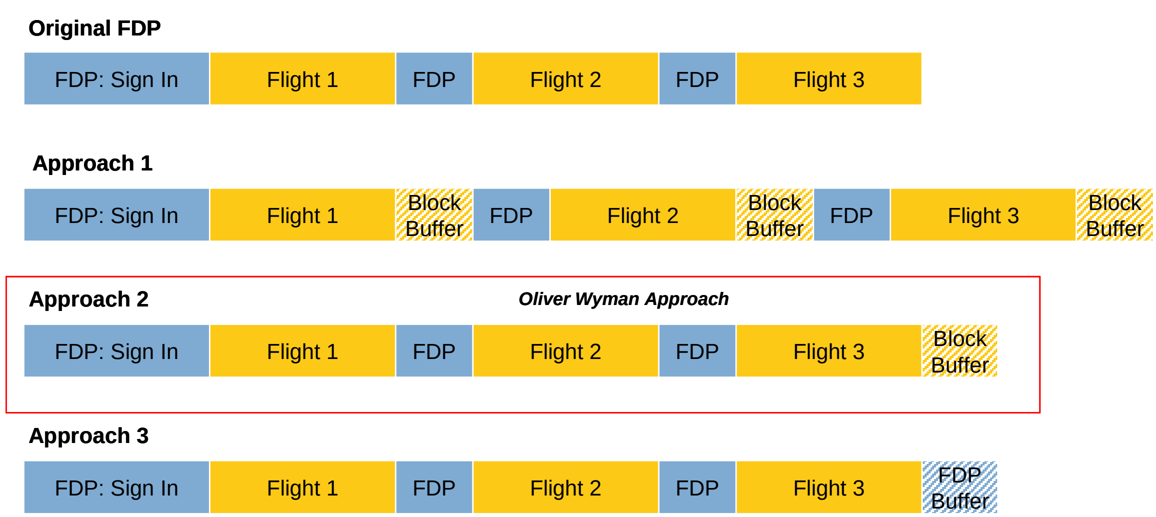
[7] The increase in Schedule Reliability costs under this approach would be offset slightly by reductions in the cost of some of the other NPRM provisions which interact with Schedule Reliability, but we have not modeled that impact.

additional block time buffer associated with the last flight. This approach also assumes that the scheduled flight time published to the flying public would remain unchanged and would not include the extended flight duty period. Under this approach, no loss of aircraft utilization or payments to non-flight crew members is assumed.

- **Approach 3 – Extended Sign-Out Period**
  Increase each scheduled flight duty period by adding an artificial buffer at the end of the last flight which would be used to extend the FDP by including an extended check-out. Under this approach, no block hour costs would be incurred. The primary cost of compliance would be the conflict between the extended FDPs and the daily, 7-day, and 28-day duty limits. As these limits are reached, duties would be truncated by removing the final segment of FDPs until the FDP was below the respective limit. This approach is the least costly of the three alternatives. However, on closer reading of the definition of FDP, this approach does not appear to be valid because the definition states that an 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." Thus, the NPRM does not permit the use of an artificial buffer at the end of the last flight. Even this approach to analyzing the Schedule Reliability provisions results in an estimated cost to the industry of $565 million annually due to the flight crew required to provide the necessary buffer.

The differences between the three approaches are illustrated in Figure 6.4 below. The approach taken in this analysis is the second of the three approaches outlined above, which attempts to comply with the Schedule Reliability provisions as written at the lowest possible cost.

Figure 6.4 – Schedule Reliability Approaches Considered to Comply with NPRM



Historical scheduled and actual FDP data was supplied from multiple carriers representing mainline, low cost and cargo carriers. The data covered two months of the year, each representing different weather and demand scenarios. Each data set was comprised of crew-specific FDP information, including scheduled start time, scheduled end time, actual start time and actual end time. Scheduled data was generated as of the day of operation. Only line data was used for this analysis as scheduling data for reserve crews was not available as they are not "scheduled" until the moment of call out.

From this data, the delay associated with each FDP was calculated and used to determine the level of block time buffer that would be required to ensure that 95% of flights operated without any delay to their scheduled duty. For the sample of carriers analyzed, the buffers required ranged from 18 minutes in one month to 70 minutes. The buffer was added to each FDP as additional block time on the last segment to derive a new scheduled FDP.

Costs associated with the block buffer were calculated based on the cost of the additional block hours. In some cases, the additional block time resulted in daily or cumulative FDP limits being exceeded, requiring additional crew members. The extra block time for all other FDP's was assumed to be operated by existing crew.

First, the need for additional crew was determined by evaluating the new scheduled FPDs against daily, 7-day and 28-day limits. For daily limits, given the use of historical data, we assumed that the FDP limit was as specified in the carrier's collective bargaining agreement (CBA). Duties where the new scheduled time exceeded the CBA limit were truncated by removing the final flight segment until the FDP was below the CBA limit. We assumed that truncated flights were operated by additional flight crew, with the cost calculated based on the block hour cost associated with the truncated flights. A similar process was followed for the 168-hour rolling limit and 672-hour rolling limit, with the exception that full FDPs, rather than flights were truncated. Again, it was assumed that block hours for the truncated FDPs were operated by incremental flight crew with the cost calculated based on dollars per block hour for the truncated FDPs.

Next, the cost of paying existing crew for the remaining buffered block time was calculated. These costs were determined by multiplying the marginal hourly rate for each pilot by the amount of the block time buffer. Only those FDPs which did not require new flight crew members were valued using this method.

In cases where incremental flight crew were required, fully burdened costs were used, based on Department of Transportation Form 41 Schedule P52 data. Costs included pilot wages and salaries, other pilots, training, and pension and benefits. (See Section 4.4.) For FDPs operated by existing flight crew, the cost of the extra block hour time was estimated based on the marginal, unburdened pay rate. This data was obtained directly from the carriers.

As for the analysis of block hour limits, we assumed that some portion of these costs will be recovered through the use of computer-based optimization. For consistency, we have applied the same optimization assumptions used by the FAA in its Regulatory Impact Assessment to reduce the amounts calculated using the above methodology. Our use of these same assumptions does not mean that we agree with them, but provides a basis for comparison given the lack of true optimization results available. See section 4.2, *Optimization Assumptions,* for further discussion of optimization.

6.3 RESULTS/CONCLUSION

This provision has the greatest impact on the cargo and mainline carrier segments, with the low cost segment being relatively unaffected. The difference is driven by the low cost carriers' domestic orientation and resulting tendency to have duty periods that are well below CBA maximums and therefore already have buffers built into them. In contrast, mainline and cargo carriers run longer duty periods associated with longer haul operations and less margin with respect to their CBA limits.

Based on the above analysis, the estimated cost to the industry of requiring airlines to achieve schedule reliability of 95% is $1.28 billion per year due to the additional flight crew required to provide the necessary buffer. The FAA has applied an optimization assumption of 25%, which we have included in the table below.

Figure 6.5 – Chapter 6 Cost Estimates

	Driver per Year	Weighted Average Cost per Unit*	Base Case (0% optimization) ($ millions)	Optimized Case** (FAA 25% assumption) ($ millions)
Annual carrier cost (nominal) using Approach 2. See note below for cost impact if required to use Approach 1.	Fully loaded block hours: 1.3M Incremental block hours: 4.9M	$345 $170	$1,283	$962
FAA annual reporting cost***			$4.9	$4.9
Total			$1,288	$967

* Average block hour costs vary depending on the provision being analyzed based on the mix of carriers impacted by that provision.
** RIA assumption of average industry benefit from optimization.
*** Incorporates FAA number without conducting independent analysis.

Note: As discussed, impact of adopting Approach 1 would increase annual base case total to $7.955 billion and annual optimized case total to $5.969 billion.

The FAA's Regulatory Impact Analysis substantially understates the economic impact to the industry of Section 117.9(a)(1) by omitting the cost of buffering, and including only the relatively small annual reporting cost of $4.9 million (which we have not separately analyzed). The assumption that carriers already schedule at a reliability level of 95% is factually incorrect based on publicly available DOT data.

To achieve a 95% level of reliability would be extremely difficult and expensive, and would have a variety of unintended consequences, including those stemming from the very early arrivals of a large majority of flights. Approximately 95% of flights would need to arrive early in order to meet the requirement. Passengers would arrive early most of the time, would wait longer at the airport for connections, and would sometimes see earlier connections they could have made had they known the real flight time. For congested and slot controlled airports, these problems would be compounded. And there would be a real and substantial cost to passengers as a result of the effects of unnecessarily low aircraft utilization. Furthermore, the costs associated with meeting this requirement will place US carriers at a competitive disadvantage to foreign carriers operating under systems where they are measured against flight duty limits rather than scheduled time.

A rule that measures actual performance against maximum flight time and flight duty period limits instead of planned limits would substantially reduce the costs estimated in this section. The preamble of the NPRM suggests that such a scheme was considered by the ARC. Regardless of what was considered, it is clear that the carriers and traveling public would be far better served if the rule were modified so that schedule reliability is measured against FDP maximum limits, not scheduled FDP, as is the case for CAP371, CAD 371, and EU OPS Subpart Q.

CHAPTER 7

FLIGHT DUTY PERIOD EXTENSIONS [SECTIONS 117.15(C) AND 117.19(F)]

7.1 KEY ISSUE

Sections 117.15(c) and 117.19(f) of the NPRM, *Flight Duty Period: Un-Augmented Operations and Flight Duty Period: Augmented Flightcrew,* propose to allow Flight Duty Periods to be extended for both un-augmented and augmented operations. The rules allow unlimited FDP extensions of less than 30 minutes and one FDP extension greater than 30 minutes within each 168 hours. In the case of un-augmented operations, the maximum extension permitted is two hours, while for augmented operations, an extension of up to three hours is permitted.

One key issue for carriers is that the NPRM permits these limited extensions only in cases where the actual time exceeds the scheduled time, instead of where the actual time exceeds the FDP limits defined in Table B (NPRM, Preamble, Section D, 75 Fed. Reg. 55859). This is the same "actual versus schedule" issue that is the subject of the previous Chapter on Schedule Reliability. As discussed there, a goal of the FAA may be to limit the number of FDP extensions that exceed FDP maximums. However, to severely limit the number of FDP extensions granted beyond the original scheduled times even though those extensions comply with FDP maximums, is extremely onerous and has no relationship to fatigue or safety.

As discussed in the previous chapter, a, review of CAP371 (UK), EU OPS Subpart Q (EU), and CAD 371 (Hong Kong) shows that all of these rules evaluate FDP extensions in relation to FDP maximum limits, not the scheduled FDP. Even on that basis, other regulatory regimes provide more flexibility for occasional extensions. For example, CAPS 371 provides no limit on the number of FDP extensions.

For carriers and the travelling public, the ability to extend scheduled FDPs is essential to maintaining a reliable operation. As measured by the standard that any delay beyond scheduled time (even one minute) counts as an extension – or, in this case, an extended pairing – the carriers are actually operating between 50% and 70% "on-time", driven by operational issues including airspace congestion and weather. As noted, this 50%-70% on-time rate translates into an industry on-time arrival rate of approximately 82%, when measured using the DOT criteria that flights arriving 0-14 minutes late are considered "on time." At this level of operational integrity, nearly 50% of flights in fact arrive early, while another large percentage of flights arrive only a few minutes beyond the scheduled arrival time. Nevertheless, this level of performance does not come close to meeting the NPRM's requirement that 95% of systemwide flights be absolutely on time.

If required FDP schedule extensions will not be permitted by FAA even though within the FDP maximums, then the carriers can only respond by adding buffers into their schedules in combination with accepting a greater rate of cancellation. Both approaches result in costs to the carrier and the public with increased headcounts and/or the costs of cancellation. In addition, the absence of similar requirements within the EU and UK regulations will place US-based carriers at a competitive disadvantage to carriers from these countries due to either the higher costs due to buffering or poor customer service due to cancellations.

In terms of the cost of the rule, it should be noted that there is a direct tradeoff between adding substantial schedule time buffers and the number (and cost) of cancellations required. If substantial schedule time buffers are added, then cancellation costs would be substantially reduced. However, as demonstrated in the Schedule Reliability analysis, the cost of adding substantial buffers is still high and results in poor service to the public. Neither outcome is desirable.

Although the rule as written refers to extension requests measured from the scheduled FDP, a more logical interpretation of the rule consistent with the practice in other countries would instead have the rule apply to extensions from the FDP maximums. Even in that case, the single extension permitted beyond 30 minutes in a 168-hour period is extremely restrictive, more so than in other countries. EU OPS permits two extensions within each 168-hour period. And, as noted, CAPS 371 provides no limit on the number of FDP extensions.

The relaxation of this "one-extension" limit to permit multiple extensions of no more than two hours, so long as they are not consecutive, or even just two extensions of no more than two hours or three hours, as applicable, within a 168-hour period so long as they are not consecutive, would provide the industry with much needed flexibility without affecting safety. The estimated costs of these two alternatives are provided in section 7.3.

7.2 METHODOLOGY

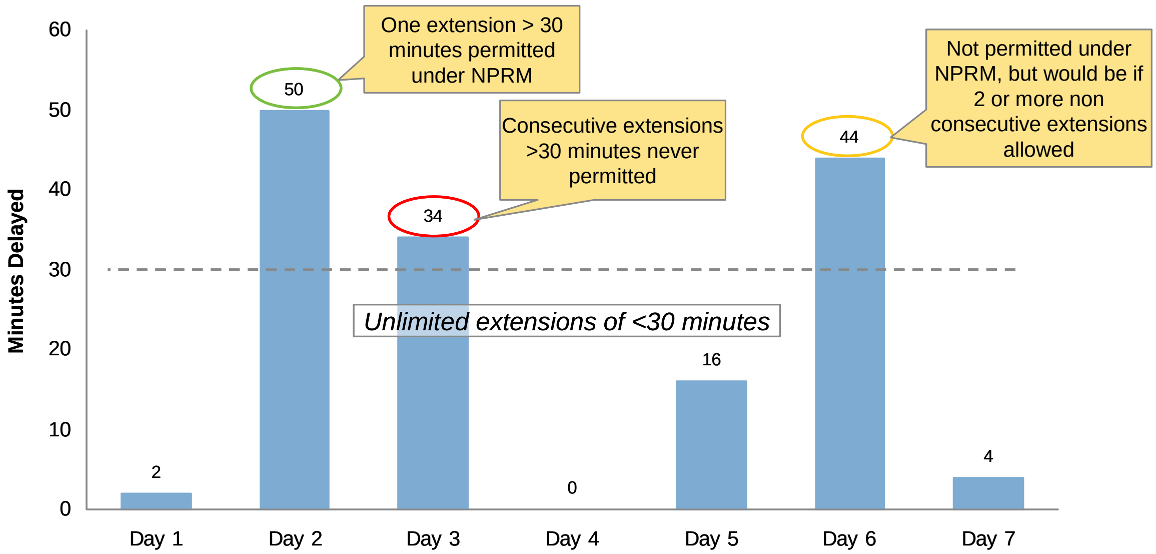
For this FDP extension analysis, scheduled FDPs and actual FDPs were provided by a group of carriers for two months of the year representing different weather and demand scenarios. The group of carriers represented at least one carrier from the mainline, low cost and cargo segments. The data provided included the scheduled FDP start, scheduled FDP end, actual FDP start, actual FDP end for each flight crew member.

Based on the line set of data, FDP delays were calculated for each crew member for each day by comparing actual FDP times against scheduled FDP times. Delays of less than 30 minutes were excluded from the analysis as the NPRM allows unlimited extension of less than 30 minutes. Extensions in excess of 30 minutes were also identified. If an extension was required, the preceding 168-hour period was also checked for extensions beyond 30 minutes and a total number of extensions for the preceding 168 hours calculated. To estimate the cost associated with the NPRM limit on extensions, it was assumed that the last flight of any FDPs delayed more than 30 minutes would be cancelled if one or more extensions beyond 30 minutes had already occurred in the preceding 168-hour period.

Cancellations were used as the measure because it is difficult for carriers to forecast the likelihood of individual crew members extending earlier within the 168-hour period. Cancellations were assumed to occur only if the last segment was not at one of the airline’s domiciles with the assumption being that reserve crews are available at the domiciles. The DOT cancellation cost estimate used in the Enhanced Airline Passenger Protections rulemaking RIA (December 2009) was used to estimate the cost of cancellations. That analysis provides separate breakdowns of the estimated economic costs associated with cancellations for both carriers and passengers.

Two alternative scenarios were considered. In one, an unlimited number of extensions beyond 30 minutes were granted, but not on consecutive days. In the other, two extensions beyond 30 minutes were granted, again, not on consecutive days. In each case, the length of any permitted extension was limited to 2 hours for unaugmented flights and 3 hours for augmented flights, as required in the NPRM. The difference between the NPRM and the alternative scenarios is illustrated below.

Figure 7.1 – Application of FTD Extension Provision as Written versus Alternatives



The difference between the NPRM scenario and the industry's proposed scenarios was then calculated and extrapolated based on block hours to determine the cost differential for both the industry and the public. In addition to calculating a discrete FDP extension value, a value was also calculated assuming that the buffers required to achieve 95% Schedule Reliability were included. Unlike the approach used by the FAA, this approach takes into account the interaction between different provisions of the NPRM and, in this case, ensures that the costs of this provision are not double-counted.

7.3 RESULTS/CONCLUSION

Limiting the number of extensions as proposed by the NPRM results in an estimated cost to the industry of $1.565 billion per year and to the public of $1.534 billion per year over and above a scenario where unlimited, but nonconsecutive extensions are allowed. No cost to the public for cargo cancellations was included. The FAA has applied an optimization assumption of 25%, which we have included in the table below. The impact is spread across all three segments of the industry. This cost is separate and distinct from schedule reliability costs because it does not include any buffering, which is captured in our Schedule Reliability analysis. An alternative (lower) set of numbers is provided in the event the Schedule Reliability buffers are incorporated.

Figure 7.2 – Chapter 7 Cost Estimates for NPRM as Written

	Driver per Year	Weighted Average Cost per Unit*	Base Case (0% optimization) ($ millions)	Optimized Case (FAA 25% assumption) ($ millions)**
Annual carrier cost (nominal)	Cancellations: 81K	$19K	$1,565 ($215 with schedule reliability buffers)	$1,174 ($161 with schedule reliability buffers)***
Annual passenger cost (nominal)	Cancellations: 74K	$21K	$1,534 ($214 with schedule reliability buffers)	$1,151 ($161 with schedule reliability buffers)
Total Cost (nominal)			$3,099 ($429 with schedule reliability buffers)	$2,325 ($322 with schedule reliability buffers)

* Average block hour costs vary depending on the provision being analyzed based on the mix of carriers impacted by that provision.
** RIA assumption of average industry benefit from optimization.
*** See additional discussion in text. Lower number results only if substantial block time buffers are added to comply with Schedule Reliability provisions.

This cost is not broken out separately by the FAA, and it is unlikely that the cost is included in the FAA's analysis. The RIA specifically excludes any analysis of the cumulative impact of the flight duty period provisions whatsoever. (See RIA at 76: "Only limits relating to individual flight duty periods were applied. Cumulative limits were not applied due to data limitations.") Thus, the RIA only analyzes the impact of the NPRM for individual duty or rest periods, not for subsequent duties which have 168-hour and monthly limits.

The two alternative scenarios considered – (1) two nonconsecutive extensions beyond 30 minutes are permitted; and (2) unlimited extensions are permitted – result in far fewer flight cancellations compared to the NPRM proposal. In the case of unlimited consecutive extensions, there are 85% fewer flight cancellations compared to the NPRM proposal. Based on the above analysis, the estimated annual cost savings that would result from adopting these two alternatives are provided below.

Figure 7.3 – Chapter 7 Estimated Cost Savings from NPRM for Two Alternative Provisions

Alternative Provisions Cost Savings	Base Case (0% optimization) ($ millions/year)	Optimized Case (FAA 25% assumption) ($ millions/year)
Annual savings from unlimited nonconsecutive extensions	\$625 (Carriers) \$702 (Public)	\$469 (Carriers) \$526 (Public)
Annual savings from two nonconsecutive extensions	\$532 (Carriers) \$604 (Public)	\$399 (Carriers) \$453 (Public)

CHAPTER 8

DAY OF OPERATION RESERVE [SECTION 117.21(C)]

8.1 KEY ISSUES

Current FAA regulations exclude time associated with short call reserve (the "reserve availability period") from duty. Section 117.21(c) of the NPRM, *Reserve Status,* proposes a new rule that would count that time as part of a flight crew's duty period and, in addition, would limit the total duration of a flight crew's reserve duty period.

The proposed rule is likely to have the following impacts:

1. Carriers currently structure short call reserve periods to provide sufficient flexibility to react to unforeseen disruptions. This can sometimes result in short call reserve periods that exceed the FAA's proposed limits. As a result of the proposed rule, some short call reserve periods will need to be shortened to fit within the proposed reserve duty period limits, likely resulting in either an increase in the number of short call reserve periods or a loss of operational flexibility. An increase in reserve duties will likely require the hiring of additional flight crew to cover the new duties. Without additional flight crew, carriers would need to reduce total scheduled short call reserve which would also reduce the availability of flight crew on reserve, reducing operational flexibility.

2. The proposed rule will result in flight crew being increasingly limited in the duties they can be called out for as they progress through their reserve availability period. This is because the reserve duty period is made up of the sum of the reserve availability period and assigned flying duty period. Therefore as time progresses in crew members' reserve availability period, their remaining permitted flying period will also be reduced. This will likely result in short call reserve duties being further shortened to maintain operational usefulness.

3. Some carriers with networks that require significant international flying, such as some cargo carriers, schedule duty periods that may span multiple days without returning to base. These duties include scheduled rest that meet legal requirements but generally do not include significant buffers beyond requirements. The proposed restrictions on maximum FDP for pilots called from short call reserve will require duties being divided to maintain the legality of pilots being called from reserve. Because the pairings most likely to be impacted are scheduled involving multiple non-domicile destinations, the

division of a scheduled duty into two or more new duties will generally require the dead-heading of crew. This will result in increased pairing costs.

Section 117.21(c) of the NPRM provides for extensions of the maximum reserve duty period in cases where the flight crew is called out during their reserve availability period. However, based on data provided by carriers, the extended reserve duty period will unlikely be sufficient to cover the reduced flexibility from the proposed rule.

In summary, the rule is expected to reduce operational flexibility, require the addition of new pilots, and increase the cost of operated pairings.

8.2 NOTE ON INTERPRETATION OF THE NPRM

Analysis of the impact of the proposed rule requires an important assumption with regard to the FAA's intended meaning of Section 117.21(c) of the NPRM. As the NPRM is written, almost all flight duties called from short call reserve (unless called during the first minute of reserve availability) would result in an illegal duty. This Report assumes the FAA did not intend to make illegal all flight duty periods called from short call reserve, and therefore the analysis excludes this interpretation.

The NPRM language below must be re-interpreted in order to avoid having all reserve periods being out of compliance:

Section 117.21 Reserve status

(4) ***The maximum reserve duty period for un-augmented operations is the lesser of*****—**

(i) 16 hours, as measured from the beginning of the reserve availability period;

(ii) The assigned flight duty period, as measured from the start of the flight duty period; or [emphasis added]

(iii) The flight duty period in Table B of this part plus 4 hours, as measured from the beginning of the reserve availability period.

(iv) 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 in paragraph (c)(4)(iii) of this section 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.

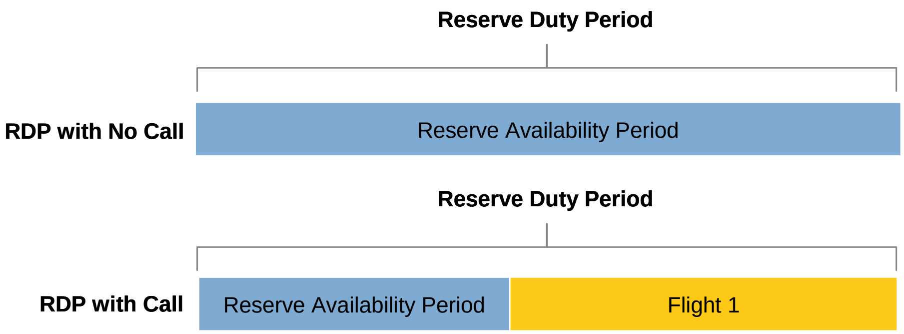
When read in conjunction with:

Section 117.3 Definitions.

Reserve duty period means the time from the beginning of the reserve availability period to the end of an assigned flight duty period, and is applicable only to short call reserve

The bolded section in the text above is, under all circumstances, the most restrictive definition of maximum reserve duty period of the four categories listed. Since the reserve duty period is the sum of the reserve availability period and the assigned flight duty period, the reserve duty period must always be equal to or greater than the flight duty period. Therefore, as the NPRM is currently written, all reserve duty periods would exceed the limit. See Figure 8.1 below.

Figure 8.1 - Definition of Reserve Duty Period



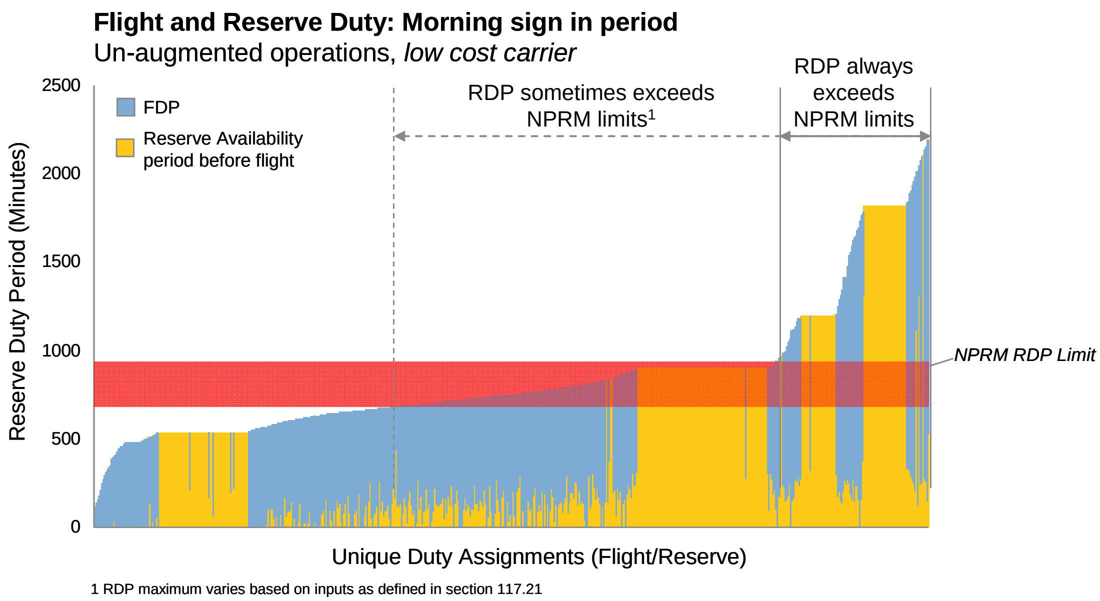
8.3 METHODOLOGY

Multiple carriers provided historical data on both reserve duties and line duties from at least two different months representing seasonal changes in schedules and operational performance. This data included both lineholder and reserve flight crew members. The carrier data included an empirical dataset representing all of the three segments of the industry under review.

The data included numerous instances of short call reserve duties that exceeded the proposed maximum flight duty period. For this analysis, it was assumed those duties would be truncated to fit within the proposed limits. For each carrier that provided data, the truncated hours for all flight crew members were aggregated and multiplied by the per duty hour cost. The total additional costs were then aggregated and extrapolated across the industry. In addition, one carrier conducted its own detailed analysis of this provision based on its particular circumstances. Therefore, in calculating the total industry cost impact of this rule, Oliver Wyman blended: (1) the extrapolated industry cost for all carriers, with (2) the separate cost analysis of this rule conducted by the one carrier.

The graph in Figure 8.2 below uses carrier data to illustrate the day of reserve impact on flights permitted.

Figure 8.2 – Example of Day of Operation Reserve Impact on Flights



Reserve (orange) and flying (blue) duty periods that are below the NPRM RDP limit (red band) are unaffected by the proposal. All duties that are above the NPRM RDP limit must be truncated to meet the proposed limits. The duties that fall within the NPRM RDP limit would require more information to determine the specific RDP limit for that duty. The actual RDP limits depicted by the band vary based on details of the duty, including: duty start time, whether a flying duty was assigned and whether any part of the reserve period was between 0000-0600.

8.4 RESULTS/CONCLUSIONS

The estimated total annual industry cost of this provision is $110 million. The FAA has applied an optimization assumption of 25%, which we have included in the table below.

Figure 8.3 – Chapter 8 Cost Estimates

	Base Case (0% optimization) ($ millions)	Optimized Case (FAA 25% assumption($ millions)**
Annual carrier cost (nominal)*	$110	$83

* No unit or unit cost numbers were provided because of the blended approach of this analysis
** RIA assumption of average industry benefit from optimization.

Note, multiple provisions of the NPRM impact airline crew reserve requirements, and it is possible to allocate NPRM reserve cost impacts among separate provisions in multiple ways. This Chapter estimates the cost of the Day-of Operation Reserve provision only. The FAA did not include this rule in their economic analysis. The data analysis shows the cost of this rule is significant, and therefore should have been included in the RIA.

Without the benefit of schedule optimization systems and the ability to simulate network impact of system delays, it is not possible to determine what an appropriate optimization factor should be.

CHAPTER 9

CUMULATIVE DUTY TIME FROM SHORT-CALL RESERVE [SECTION 117.23]

9.1 KEY ISSUES

As discussed in the previous chapter, current FAA regulations exclude time associated with short call reserve (the "reserve availability period") from duty. However, Section 117.23 of the NPRM, *Cumulative Duty Limits,* proposes a new rule that would count that time as part of a flight crew's duty period and, in addition, would limit the total duration of a flight crew's reserve duty period. The previous chapter analyzed the ongoing single period impacts of the new rule, i.e., the impacts of effectively reducing the usable amount of time available from reserves during individual flight duty periods.

This Chapter analyzes the cumulative impact of the rule as a result of its inclusion of the reserve availability period as part of flight crew members' cumulative weekly and monthly duty limits. By including the reserve availability period in these limits, the total cumulative duty time per flight crew member will increase. And that increase may result in total duty exceeding weekly or monthly maximums.

9.2 NOTE ON INTERPRETATION OF THE NPRM

Just as with Chapter 8, this analysis of the impact of the proposed rule requires an important assumption with regard to the FAA's intended meaning of Section 117.21 of the NPRM. The way the NPRM is written, all flight duties called from short call reserve (unless called during the first minute of reserve availability) would result in an illegal duty. This Report assumes the FAA did not intend to make illegal all flight duty periods called from short call reserve, and therefore the analysis excludes this interpretation.

9.3 METHODOLOGY

Multiple carriers provided historical and pairing and rostering information from at least two different months representing seasonal changes in schedules and operational performance. This data included both lineholder and reserve flight crew members. The carrier data included at least one dataset from each of the three segments of the industry under review.

For each dataset, total flight duty and reserve duty times were aggregated by flight crew. Figures were compared against maximum weekly and monthly duty period limits using limits defined in section *117.23 Cumulative duty limitations* of the NPRM. All duty hours that exceeded the cumulative duty limits were truncated.

For each carrier that provided data, the truncated hours for all flight crew members were aggregated and multiplied by the per duty hour cost. The total additional costs were then aggregated and extrapolated across the industry.

9.4 RESULTS/CONCLUSIONS

Based on the above analysis, the estimated total annual industry cost of this provision is $19 million. The FAA has applied an optimization assumption of 25%, which we have included in the table below.

Figure 9.1 – Chapter 9 Cost Estimates

	Driver per Year	Weighted Average Cost per Unit*	Base Case (0% optimization) ($ millions)	Optimized Case** (FAA 25% assumption) ($ millions)
Annual carrier cost (nominal)	Duty Hours: 95K	$200	$19	$14

* Average block hour costs vary depending on the provision being analyzed based on the mix of carriers impacted by that provision.
** RIA assumption of average industry benefit from optimization.

The FAA excludes the cumulative impact of short call reserve duty from its analysis, so there is no direct comparison between figures presented in the RIA and this Report. The analysis for this Report shows the cost of this rule is significant, and therefore it should have been included in the RIA.

Without the benefit of schedule optimization systems and the ability to simulate the impact of reduced short call reserve periods, it is not possible to determine what an appropriate optimization factor should be.

CHAPTER 10

SPLIT DUTY [SECTION 117.17]

10.1 KEY ISSUES

Section 117.17 of the NPRM, *Flight Duty Period: Split Duty,* proposes new regulations with regard to split duty that limit the total flight duty permitted and mandate a 4-hour minimum rest period. The proposed regulations allow for a flight duty period to be extended by up to 50% of the rest received by a flight crew member. However, the maximum flight duty period for a split duty cannot exceed 12 hours.

Current regulations permit maximum flight duty periods of 16 hours, making it unnecessary to provide carriers with a means to extend flight duty periods. The proposed limits on flight duty periods in the NPRM (Table B to Part 117) prescribe maximum flight duty periods based on time of duty start and number of segments operated that under certain circumstances are less than 12 hours. Under those circumstances, which occur during the early morning or late at night, the operation of a split duty with an appropriate rest period would enable the carrier to increase the maximum flight duty period to 12 hours.

The proposed split duty rules will primarily impact carriers that have night time operations but do not generally use layovers. This includes almost all cargo carriers as well as some mainline carriers. Low cost carriers are not materially impacted by this regulation.

As written, the proposed rules will increase carrier costs primarily as a result of two factors: (a) the rule requires a minimum four-hour rest time in order for carriers to have any ability to extend the FDP. This is despite the conclusions of fatigue scientists that rest of as little as 20 minutes is considered beneficial; (b) the proposed rule limits extensions of the FDP to a maximum of 12 only hours, despite the fact that in-hotel rest is generally considered superior to in-plane rest yet augmented crews may extend their FDPs for up to 16 hours under Table C of Part 117.

10.2 METHODOLOGY

The analysis does not review the costs of implementing the proposed split duty rules, but instead evaluates the cost difference between the proposed rules and an alternate set of rules. The alternate set of rules contains two specific changes:

A. Decrease to 90 minutes of rest time required to extend flight duty period, with extension credit provided for half of the rest time
B. Increase in maximum flight duty period to 16 hours

The analysis conducted in this Chapter incorporates the results of carrier optimization programs run by carriers representing the mainline and cargo segments of the market. Based on carrier interviews, this rule does not have a significant impact on the operations of low cost carriers and no data was analyzed that covers that segment of the market.

Optimizations using a single historical roster period were run once for each set of regulations being evaluated. For each optimization run, the primary results used for comparison were the number of unique duties and the total pairing costs. Total pairing costs included hotel, meal allowance and travel costs associated with the operation of the pairing.

For the duties comparison, an average flight crew member was assumed to be able to conduct a fixed number of duties per month. This number was based on averages derived from the carriers. Any change in the number of duties would result in a corresponding change in the number of flight crew members required to operate the roster.

For the pairing cost analysis, the difference in costs required to operate each optimization solution were used.

Total costs associated with split duties were extrapolated from the sample datasets to the entire industry, excluding the low cost carrier segment.

10.3 RESULTS/CONCLUSIONS

Based on the above analysis, the estimated annual cost saving to the industry that would result from adopting this alternative to the Split Duty provisions in the NPRM is $9.9 million. The FAA has applied an optimization assumption of 25%, which we have included in the table below.

Figure 10.1 – Chapter 10 Cost Estimates

	Base Case (0% optimization) ($ millions)	Optimized Case* (FAA 25% assumption) ($ millions)
Annual carrier cost saving (nominal)	$9.9	$7.4

* RIA assumption of average industry benefit from optimization.

We do not know if the FAA included this rule in its economic analysis; the cost of the rule is not broken out separately in the RIA. The data analysis shows the cost of this rule is significant, and therefore it should have been included in the RIA.

While the cost to the overall industry is low, the costs are disproportionately borne by cargo carriers. This is due to the fact that many of their current duties are split but provide less than the minimum rest proposed in the NPRM. In addition, the duty patterns at most cargo carriers make them less able to reduce the cost impact through optimization.

CHAPTER 11

A1 VS. A2 FLIGHT DUTY TABLES

11.1 KEY ISSUES

The NPRM proposes different flight duty limits depending on the time when duty commences and the number of segments operated by the flight crew. FDP limits are the shortest for FDPs that begin during the 0000-0359 period. In addition, FDP limits are shortened depending on the number of segments operated. These provisions of the NPRM represent a fundamental departure from the current regulatory system in which flight duty limits do not change regardless of the flight crew's commencement time or number of segments operated.

The preamble to the NPRM presents two tables – A(1) and A(2) – containing different sets of Flight Duty Period limits. Table A(1), representing the position of labor participants in the ARC, provides for lower FDP limits. Table A(2), representing the position of some carrier participants in the ARC, provides for higher FDP limits. In the NPRM, the FAA proposes to apply the lower FDP limits.

A summary of the differences between the two tables is provided below:

Figure 11.1 –Table A(1) vs. A(2): Flight Duty Period: Un-Augmented Operations

Time of start (Home base or acclimated)	Difference in flight duty period (hours) between Table A(1) vs. Table A(2) *(Positive numbers are where Table A(2) is greater than A(1))*						
	1	2	3	4	5	6	7+
0000-0159	0	0	0	0	0	0	0
0200-0359	+1	+1	+1	+1	0	0	0
0400-0459	0	0	+1	+1	0	0	0
0500-0559	+1	+1	+1	+1	+1.5	+1.5	+1.5
0600-0659	0	0	0	0	0	0	0
0700-1259	0	0	0	0	0	0	+0.5
1300-1659	0	0	0	0	0	0	0
1700-2159	0	0	+1	+1	-0.5	0	0
2200-2259	0	0	+1	+1	0	0	0
2300-2359	0	0	+0.5	+0.5	0	0	0

Adoption of Table A(1), with its lower FDP limits, disproportionately impacts cargo carriers because they have a high percentage of duties commencing late night or in the early morning. Some passenger carrier operations would be impacted as well. The likely result of this set of lower FDP limits is that the carriers will need to split the duties that exceed the proposed flight duty periods into two separate duties. As a result, the carriers will incur costs associated with additional flight crew required to operate the additional duties, as well as additional pairing costs related from hotel, meal allowance and transportation costs.

Because there appears to be no scientific basis for the FAA's selection of the Table A(1) values, the key issue is the estimated additional cost impact of these more restrictive provisions. Note that as part of the ARC, the Cargo Association of America submitted an alternative flight duty period table, Table A(4), tailored to the operations of the cargo carriers. That option was not discussed in the NPRM and it has not been included in this analysis.

11.2 METHODOLOGY

The purpose of the analysis conducted here is to estimate the additional costs resulting from the application of Table A(1) instead of Table A(2). (This analysis does not compute the total cost impact of either table, only the incremental costs resulting from the application of Table A(1).)

This analysis incorporates the results of carrier optimization programs, as well as a review of historical data. Carriers representing the mainline and cargo segments of the market provided data. Based on carrier interviews, this rule is not expected to have a significant impact on the operations of low cost carriers and therefore no data was analyzed that covers that segment of the market.

For a given historical schedule, two optimization scenarios were run. One scenario was based on Table A(1), another based on Table A(2). Each of these scenarios provided a required number of duties to cover the flights (Duties A(1), Duties A(2)). A comparison of number of duties was done to identify the difference in total duties (Δ = # Duties A(1) – # Duties A(2)). This difference was subsequently analyzed based on flight crew headcount required, and valued using flight crew unit costs.

In addition, the optimization runs also produced total pairing costs for each of the scenarios. The difference in total pairing costs between the scenarios was valued. Differences in pairing costs were driven by a change in layover duties and the associated hotel, meal allowance, and transportation costs.

The total cost difference between scenarios Table A(1) and Table A(2) was determined for each of the carriers that provided data. Those totals were then extrapolated to the entire industry, excluding the low cost carrier segment.

11.3 RESULTS/CONCLUSION

Based on the above analysis, the estimated annual cost saving to the industry that would result from adopting the less restrictive provisions of Table A(2) for the industry is $27 million annually. The FAA has applied an optimization assumption of 25%, which we have included in the table below.

Figure 11.2 – Chapter 11 Cost Estimates

	Base Case (0% optimization) ($ millions)	Optimized Case (FAA 25% assumption) ($ millions)*
Annual carrier cost saving (nominal)	$27	$20

* RIA assumption of average industry benefit from optimization.

While the increased cost of the more restrictive provisions of Table A(1) to the overall industry is relatively low, the costs are disproportionately borne by cargo carriers. This is due to the fact that many of their current duties commence late night or in the early morning when the flight duty period limits are most restrictive. As noted, the analysis conducted here does not consider the option tailored to cargo carrier operations that was presented by the Cargo Airline Association in conjunction with the ARC.

CHAPTER 12

CREW REST INFRASTRUCTURE [SECTION 117.19]

12.1 KEY ISSUES

The NPRM proposes maximum flight duty periods for augmented operations that may be extended depending on the type of crew rest facility installed on the aircraft. As a result, most carriers are expected to install new rest facilities or upgrade their existing rest facilities.

The RIA includes estimates for:

- the average cost of installation of new crew rest facilities
- the number of aircraft expected to receive new or upgraded rest facilities

The key issue here is whether the FAA's estimates are realistic.

12.2 METHODOLOGY

This analysis estimates the costs associated with the installation or upgrade of crew rest facilities based primarily on information provided by carriers representing mainline and cargo market segments. Low cost carriers are not expected to incur any costs related to the installation or upgrade of crew rest facilities.

The carriers provided estimates for:

- rest facility installation costs,
- lost revenue due to displacement of passenger seats or cargo space, and
- the additional cost of pairings required to operate routes with un-augmented flight crew.

Important differences between the methodology used in this analysis and that of the RIA are highlighted below:

A. Cost per Class 1 Rest Facility installation

FAA assumption

- Cost per class 1 rest facility ranges from $259K - $1.5M per aircraft. (The FAA indicates their estimates came from "two supplemental type certificate (STC) holders.")

Our findings

- We received estimated costs from the carriers of between $625K - $3.5M per class 1 rest facility installation.
- Based on this feedback, the cost estimates provided by the FAA are believed to be less than half of the actual costs required to install class 1 rest facilities. The carriers are in the best position to know the actual cost of the required modifications since they have made these modifications to many aircraft.

B. Number of aircraft requiring rest facility installation or upgrades

FAA assumption

- 104 aircraft would require installation or upgrade of rest facilities, of which 19 would require new installations and 85 would require upgrades.

Our findings

- Based on carrier information, the FAA's estimated total number of aircraft requiring modification grossly underestimates the total modifications planned by carriers.
- Because of aircraft rotations and scheduling of maintenance activities, all aircraft capable of operating internationally with augmented operations are likely to be upgraded. This would be true even if a small number of aircraft are actually operating internationally at any one time. The total estimated number of aircraft requiring modification is over 500 aircraft in the mainline and cargo carrier segments.

C. Loss of Passenger Revenue

FAA assumption

- Class 1 rest facilities would be installed in areas of the aircraft that will not impact passenger revenue.

Our findings

- Based on carrier information, the installation of Class 1 rest facilities will almost always impact available passenger seats.
- The loss of passenger seats would result in a reduction in revenue on full flights where the lost seats would have otherwise been sold. Based on very high load factors in the premium cabin, the installation of rest facilities will often reduce carrier revenue.

D. Ad**ditional Pairing Costs**

FAA assumption

- The FAA assumed that over the long run it was always cost advantageous to install crew rest facilities rather than hire additional flight crew.

Our findings

- Under some circumstances, pairing changes would be more cost effective over the long run than upgrading or installing rest facilities.
- This analysis includes estimated costs for pairing changes required to maintain un-augmented operations.

E. Upgrades to Class 2 & 3 rest facilities

FAA assumption

- No class 2 or 3 rest facilities would need to be added or upgraded, resulting in zero cost.

Our findings

- While some aircraft are equipped to provide class 2 or 3 rest facilities without modification, this is not true for many aircraft.
- Most aircraft will require only minor modifications to provide class 2 rest facilities. However, some aircraft will require installation of class 2 or 3 rest facilities at substantial cost.

F. Loss of aircraft utilization

FAA assumption

- The FAA does not mention the possibility that installation of crew rest facilities will require additional aircraft out-of-service time.

Our findings

- In a majority of cases, installation of crew rest facilities cannot be completed during normal maintenance periods, and additional installation time will be needed.
- The time required to install new crew rest facilities will reduce aircraft availability and result in a one-time loss of revenue. Carriers have estimated approximately 2 weeks is required to install class 1 crew rest facilities.

12.3 RESULTS/CONCLUSIONS

Based on the above analysis, the estimated total one-time cost to the carriers for providing new or upgraded rest facilities is $461 million. No optimization was applied as the costs are not driven by flight crew scheduling.

Figure 12.1 – Chapter 12 Cost Estimates

	One-time Costs ($ millions)	Annual On-going Costs ($ millions) Nominal
FAA Estimate	$67.5	$17.7
Report Estimate	$461	$47

The large difference between the FAA cost estimate and the estimate provided here is largely the result of the numerous simplifying assumptions in the RIA that fail to take into account operational realities.

CHAPTER 13

NPRM IMPLEMENTATION

13.1 KEY ISSUES

The RIA includes cost estimates for the implementation of the NPRM, which are divided into two general categories:

- Computer Programming
- Flight crew fatigue training

The first key issue here is whether those cost estimates are realistic. The additional key issue here is that the FAA has not included in its estimate additional pilot hiring and training costs resulting from the implementation of the rule.

Computer Programming Costs

The FAA assumes that the carriers will need to make programming changes to their existing crew scheduling systems to comply with the new regulations. The FAA estimates that these changes will cost from $50,000 to $250,000 per carrier, depending on the number of flight crew members employed at each carrier. See table below and also RIA, Table 20, at 94.

Figure 13.1 – FAA Computer Programming Cost Estimates

Flight Crew Members	Cost per Carrier
>1,000	$250,000
250-1000	$100,000
<250	$50,000

These cost estimates are based on the FAA's assumption that a programming professional working at a rate of $2,500/day will require 20 to 100 working days to make the required programming changes. The RIA estimates that the total number of days required will fall within the three categories in the table above based on the number of flight crew.

As explained in the Methodology section below, the FAA's approach does not reflect real world programming requirements or costs for this type of programming.

Flight crew fatigue training

For development of costs associated with flight crew fatigue training, the NPRM assumes an average hourly salary for flight crew while in training. The Report analysis uses a different methodology to derive average hourly payments for flight crew while in training based on actual carrier data. Despite the difference in methodology, the hourly rates are similar to those used by the FAA in their analysis.

Additional flight crew hiring required in advance of the effective date of the proposed rules
Some carriers expect they will need to hire a large number of additional flight crew to comply with the NPRM. The introduction of these pilots cannot be accommodated by the carriers on short notice primarily because of training capacity limitations. Therefore, the carriers estimate that they will need to begin hiring pilots 18-24 months prior to the effective date of the proposed rules. The pre-effective date cost of these pilots needs to be included in analyzing the cost of the NPRM.

Additional training events triggered by additional flight crew hiring
As incremental pilots are hired, carriers experience a cascading effect in their training requirements. One incremental captain position on a widebody aircraft may trigger seven training events for pilot ranks below that. On average, adding a pilot position may require 3-1/2 training events. The one-time cost of these multiple training events resulting from the hiring of additional pilots needs to be included in analyzing the cost of the NPRM.

13.2 METHODOLOGY

This analysis estimates the costs required to implement the NPRM, based primarily on information provided by the carriers. The carrier information is based on their experience in implementing other programming changes and training programs.

Computer Programming Costs
For programming-related costs, carriers representing all three market segments provided costs based on internal estimates. In some cases, those cost estimates were based on outside vendor estimates. Cost categories included: programming and testing costs and hardware upgrades where necessary. Observations made by the seven carriers interviewed included:

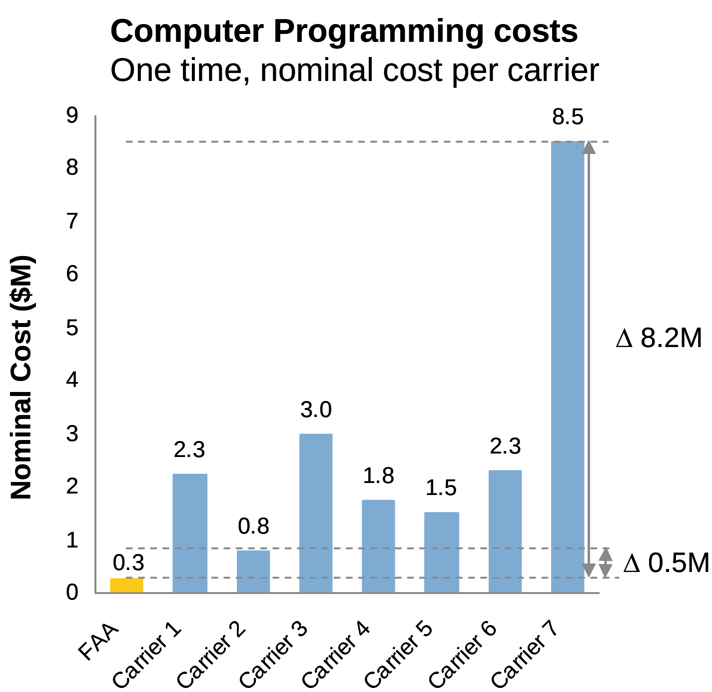
- Programming costs associated with implementation of the NPRM are not correlated with the number of flight crew. Instead, the number of systems used to manage crew scheduling and tracking, and their degree of integration and automation, are much more important determinants of the cost of programming changes.

- For example, a small carrier with multiple systems that are not integrated or automated would likely see high re-programming and testing costs. The costs are therefore not driven by number of flight crew.

- A range of 20 to 100 days of programming grossly underestimates the actual time required to program and test the systems used in the crew scheduling functions. Actual time estimates were dependent on the number and complexity of systems.

Carrier cost estimates ranged from just under $800K to $8.5M for programming and testing related costs, with an average cost of $2.9M per interviewed carrier. Using the cost estimates provided by seven carriers, the total industry cost was extrapolated to include carriers that did not provide cost estimates. Figure 13.2 illustrates reported carrier computer programming costs.

Figure 13.2 – Comparison of FAA and Oliver Wyman/Airline Cost Estimates for Computer Programming

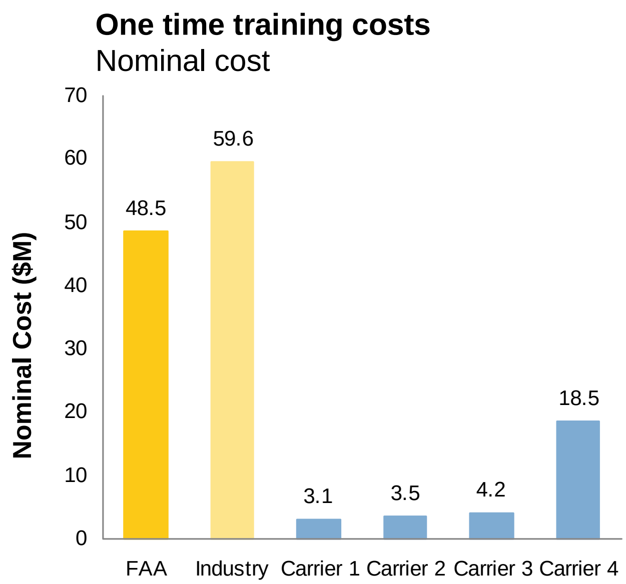


Fatigue Training Costs

The cost associated with fatigue training for flight crew was based on information provided by four carriers and extrapolated to the rest of the industry. Carriers representing all market segments under review provided fatigue training costs for flight crew based on internal estimates. Costs included hourly flight crew pay, instructor pay, and additional flight crew required to operate uncovered duties.

This analysis derived a per flight crew cost by dividing the first year cost estimates for each carrier by the number of flight crew reported in their Form P10 data. This cost represented the average cost of providing one flight crew member 5 hours of training. Based on the number of flight crew in the four-segment-set, this unit cost was aggregated to a total industry training cost. Figure 13.3 illustrates reported carrier one-time training costs.

Figure 13.3 – Comparison of FAA and Oliver Wyman/Airline Estimates of One-Time Training Costs



Additional flight crew hiring required in advance of the effective date of the proposed rules

The introduction of additional pilots required as a result of the NPRM cannot be accommodated by all carriers on short notice primarily because of recruiting and training capacity limitations. Not all carriers have these limitations, but of those that do, an estimated 18-24 months is needed prior to the effective date of the proposed rules to hire the flight crew needed to meet the requirements of the NPRM. Seven carriers provided estimates of their hiring requirements, advance time required to complete recruiting and training, and average compensation. This information was used to calculate results for the individual carriers submitting data and then aggregated to produce an industry result. Based on information provided by the carriers, it is estimated that:

- the average carrier will need to hire 9.6% more pilots in advance of the effective date of the rules
- the average pilot hired will be employed 14.75 months prior to the effective date of the new rules
- the average annual compensation costs for these pilots will be $192,000

Additional training events triggered by additional flight crew hiring

As incremental pilots are hired, carriers experience a cascading effect in their training requirements. One incremental captain position on a widebody aircraft may trigger seven training events for pilot ranks below that. On average, adding a pilot position will require a total of 3.75 training events. Seven carriers provided estimates of their training costs and the number of training events triggered for each incremental captain position. This information was used to calculate results for the individual carriers submitting data and then aggregated to produce an industry result. Based on information provided by the carriers, an average training event is estimated to cost approximately $24,400. Therefore, each new hire generates approximately $91,700 in training costs.

13.3 RESULTS/CONCLUSIONS

Based on the above analysis, the estimated total programming costs and first year training costs for the industry for the industry total $502 million. This is made up of $60 million in flight crew fatigue training costs, $27 million in programming costs required to implement the NPRM, $1,048 million in pre-effective date pilot costs, and $562 million in one-time training effects from incremental pilot hiring (cascading). This compares to a total cost of $59 million estimated by the RIA, made up of $49 million in flight crew fatigue training costs and $10 million in programming costs.

Figure 13.3 – Chapter 13 Cost Estimates

	FAA Estimate ($ millions)	Report Estimate ($ millions)
One-time Programming Costs	$10	$27
First year Fatigue Training Costs	$49	$60
Pre-effective date pilot costs	$0	$1,048
One-time training effects from incremental pilot hiring	$0	$562
Total	$59	$1,696

Note, after first year fatigue training, the estimated annual training costs are $27 million. Total 10-year fatigue training costs are $331 million.

Based on this analysis, the FAA's cost estimates for flight crew fatigue training are in line with the estimates provided by individual carriers. However, the FAA's estimated total programming cost is less than half of the estimate based on information provided by the carriers**.**

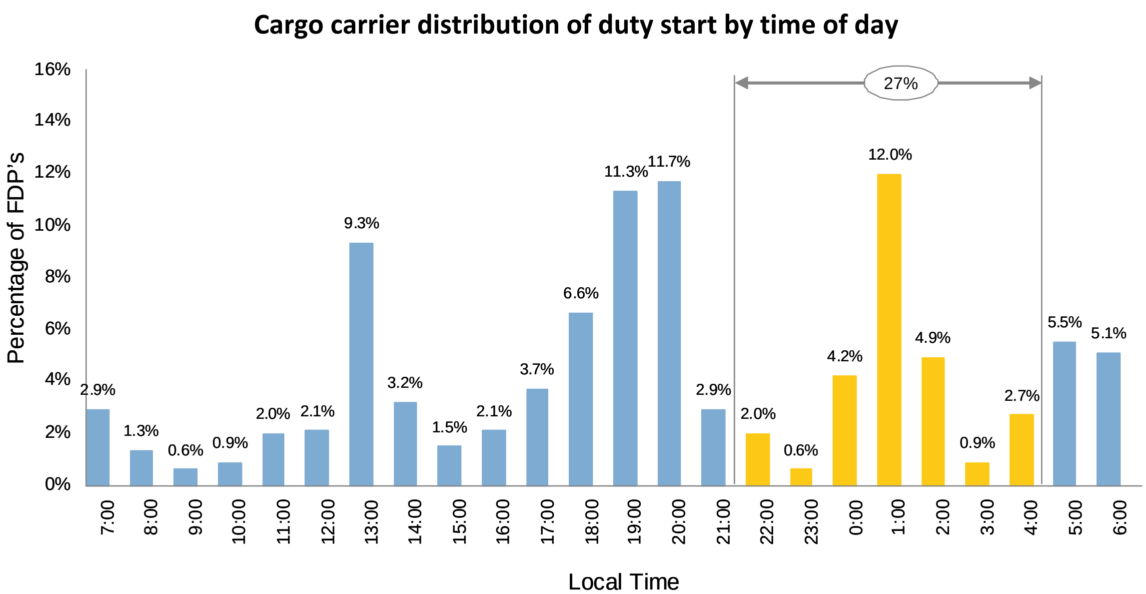
CHAPTER 14

THREE CONSECUTIVE NIGHTS [SECTION 117.27]

14.1 KEY ISSUE

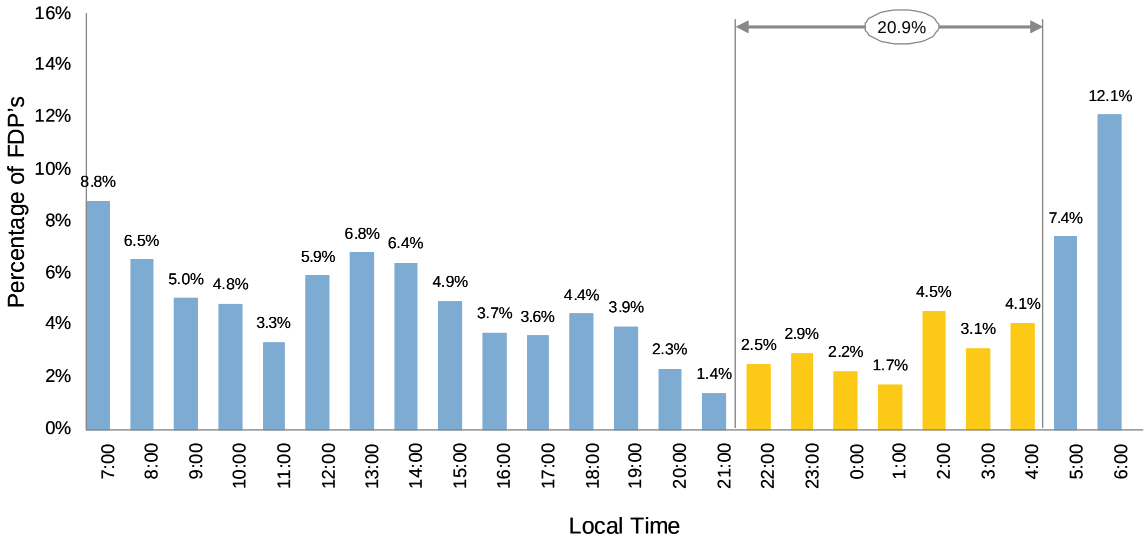
Section 117.27 of NPRM, *Consecutive Nighttime Operations,* limits consecutive night time flight duties to no more than three consecutive nights unless a rest opportunity is provided. This new restriction is more likely to impact cargo carriers partly because they have a substantial concentration of operations during the night time period and flight crews that are accustomed to night time operations. For cargo carriers, 27% of FDPs start between 2200 and 0459.

Figure 14.1 – Cargo Carrier Distribution of Duty Start by Time of Day



For mainline carriers, the impact is lower, as 20.9% of their FDPs start between 2200 and 0459 and also because they are less likely to have a single crew that flies three consecutive nights. For LCCs, the rule does not have a substantial impact.

Figure 14.2 – Mainline Carrier Distribution of Duty Start by Time of Day



14.2 METHODOLOGY

Multiple carriers provided historical FDP data for two months of a year representing different weather and demand scenarios. The data was provided for individual flight crew members and included the scheduled FDP start, scheduled FDP end, actual FDP start, and actual FDP end. Data was provided by one or more carriers representing each of the mainline, low cost and cargo segments.

The first step of the analysis was to determine the appropriate local FDP start and end times, both scheduled and actual. FDPs where the origin was within four time zones of the flight crew member's domicile were evaluated using the domicile time. Those FDPs more than four time zones from the flight crew member's domicile were evaluated against the acclimatization rules. If the crew member had 36 or more hours of rest prior to starting the duty, they were considered acclimatized and the local time at the FDP origin was used. Similarly, if the crew member had been operating in the same theatre (within four time zones of the departure point) for the preceding 72 hours, they were also considered acclimatized. Again local time at point of departure was used to determine the application of the "night" definition. In the case that neither of these circumstances was true, local time at the flight crew member's domicile was used.

Once the correct local time zone had been determined, consecutive nights were counted using the monthly data. For an operation to be considered consecutive, the preceding operation had to commence between 22:00 and 05:00 local time. Additionally, the preceding operation needed to encroach on the uninterrupted rest period defined by the FAA in its Response to Clarifying Questions (02:00-07:00) to be considered consecutive. As the data used provided FDP start and end, rather than rest, a one-hour buffer on either side of 02:00-07:00 was used to allow for travel and hotel check-in. Therefore, any night time duty commencing where the preceding the rest period encompassed 01:00 to 08:00 was assumed to be non-consecutive.

To estimate the economic impact of the rule, the 4th consecutive night time FDP was identified and assumed to be operated by a new crew member. The cost of the incremental crew members was determined by multiplying the 4th consecutive night FDP block hours by the block hour cost for the carrier as described in section 4.4.

Based on the FAA's definition of night, we believe that carriers are likely to be able to more evenly distribute duties between night and day, making the application of a 25% optimization factor appropriate.

14.3 RESULTS/CONCLUSION

The limitation of nighttime duties to three consecutive nights, using the definition of "nighttime duties" provided by the FAA in its Response to Clarifying Questions, results in an estimated cost to industry of $4.6 million per year. The FAA has applied an optimization assumption of 25%, which we have included in the table below. As expected, the greatest impact is on cargo carriers, with those carriers incurring over 90% of the total cost of this provision. Note that any change to the definition of "nighttime" as used in interpreting this provision is likely to have a major cost impact, especially on cargo carriers. Figure 14.3 below summarizes the overall impact of this provision.

Figure 14.3 – Chapter 14 Cost Estimates

3 Consecutive Night Industry Cost Impact

	Driver per Year	Weighted Average Cost per Unit*	Base Case (0% optimization) ($ millions)	Optimized Case (FAA 25% assumption) ($ millions)**
Annual carrier cost (nominal)	7.6K	$662	$5.1	$3.8

* Average block hour costs vary depending on the provision being analyzed based on the mix of carriers impacted by that provision.
** RIA assumption of average industry benefit from optimization

The FAA did not include this rule in their economic analysis. The data analysis shows the cost of this rule is significant, and therefore should have been included in the RIA.

CHAPTER 15

COLLECTIVE BARGAINING AGREEMENTS

15.1 OVERVIEW

The FAA makes two important assumptions regarding the interaction between Collective Bargaining Agreements (CBAs) and the proposed rules:

First, the FAA concludes that the carriers will adjust their CBAs over time to take full advantage of any efficiencies permitted by the NPRM, and that this adjustment will occur without any additional cost to the carriers. Hence, the FAA does not provide a cost value for the adjustment to CBAs between flight crew and the company.

Second, the FAA divides rule costs into "transfer costs" and "resource costs," and only counts resource costs as the costs of the proposed rules "*as they represent the true cost of the rule to society.*" Any changes to pilot contracts are labeled as transfer costs, which the FAA defines as temporary cost increases resulting from short-term transfers between the carriers and flight crew members. Although the FAA estimates that the industry will incur $100 million in transfer costs over the first two years the new rules are in effect, it excludes this cost because it is "only" a transfer cost.

In summary, the FAA makes the assumption that the interaction between the CBAs and the proposed rules will not impose any additional costs on the carriers that the carriers would not have incurred in the absence of CBAs.

15.2 REVIEW OF CBAs

The FAA's conclusion that the interaction of CBAs with the provisions of the new rules will not result in additional costs to the carriers is incorrect. There are three fundamental situations in which the interaction of the new rules with existing CBAs results in additional costs:

- Where the CBA is more constraining than NPRM, the carrier cannot take advantage of any efficiencies otherwise granted by the new rules.
- Where the NPRM is more constraining than CBA, the carrier loses bargained-for productivity.
- Where the CBA and the new rules interact so that the combination of the two produces a far more restrictive result than the application of either set of restrictions independently, which is referred to as the "Conglomerate effect of rules".

To understand each of these situations, it is necessary to carefully compare individual CBAs with the provisions of the new rules. To do so, a comprehensive subset of flight crew CBAs was analyzed, including those from mainline, low cost and cargo carriers. Based on carrier data collected, the following key topics were identified and compared across the current regulations under Part 121, the NPRM, and the respective carrier CBAs.

- Flight time limits
- Split duty
- Flight duty periods
- Crew rest infrastructure

The amendable date of each particular CBA is critical given the expected time before the new rules are implemented. As the CBAs are themselves very technical, the examples provided below may require specific knowledge of airline CBAs to be readily understandable. Nevertheless, several examples are provided of the additional restrictions, and therefore additional costs, that result from the interaction of CBA provisions and the provisions of the new rules.

15.2.1 CBA is more constraining than NPRM

The example below illustrates how some CBAs will prevent the carriers from taking advantage of potential benefits of the NPRM, i.e., the NPRM changes can only be implemented after the current CBAs become amendable or are renegotiated. Renegotiation will trigger negotiation costs for the carrier and foregone benefits.

Example

Topic: Split duty
Current Part 121: No incentive in Part 121 to provide flight crew rest within a duty
NPRM: Credit for split rest toward extension of FDP
CBA Low Cost Carrier: Does not allow for credit from split rest

The NPRM allows for the extension of maximum flight duty period by applying credit for split rest. At least one CBA, however, restricts the use of split duties. Therefore, the CBA precludes the use of split duty to extend maximum flight duty periods.

15.2.2 NPRM more restrictive than CBA

The example below illustrates how the NPRM is more constraining than the CBAs currently in place and, as a result, the carriers will incur additional costs to implement the new rules in that they bargained for and paid for higher productivity which they will not be able to realize.

Example 1

Topic: Flight duty period limitations

Current Part 121: Maximum FDP for unaugmented operations of 16 hours

NPRM: Maximum FDP for unaugmented operations from 9 to 13 hours, based on time of duty start and number of segments

CBA Mainline Carrier: Maximum FDP for unaugmented operations from 12 to 14 hours, based on time of duty start

CBA Cargo Carrier: Maximum FDP for unaugmented, domestic operations from 11 to 15 hours, based on time of duty start

CBA Low-Cost Carrier: Maximum FDP for unaugmented operations from 11 to 15 hours, based on time of duty start

The flight duty period limitations proposed by the NPRM are more restrictive than most of the CBAs that were reviewed. Therefore, carriers will be required to truncate current duties that exceed the limits proposed in the NPRM.

Example 2

Topic: Crew rest infrastructure

Current Part 121: No rest facility requirement for 3 pilot augmented operation. FAA-approved rest facility for 4 pilot augmented operation

NPRM: Specific definition of rest facilities permitted for augmented operations (Class 1, 2 or 3). Class 4 (economy seat) facilities do not qualify as suitable rest facility. Maximum FDP limits for augment operations based on class of rest facility, number of pilots and time of duty start.

CBA Mainline Carrier #1: If rest infrastructure not available, best seat has to be assigned

CBA Mainline Carrier #2: 3 economy class seats used as rest facility

The proposal defines the requirements for rest facilities to permit augmented operations with in-flight rest. These requirements exceed those defined in the CBAs reviewed. Carriers will be required to upgrade or install rest facilities in aircraft used for augmented operations. Cost of installation or upgrades to rest facilities will require great expense to carriers from installation/upgrade costs, loss of passenger or cargo space and loss in revenue from aircraft downtime.

15.2.2 Conglomerate effect of rules

When different bodies of rules (e.g., CBAs and NPRM) are in place, the combined effect on operational productivity can be significantly more constraining than the basic aggregation of the individual, stand-alone rules. The over-proportional productivity restriction due to multiple rules is often referred to as the multiplier effect of conglomerate effect. Carrier analysis of the possible conflicting interactions is under way, but it is too early for the carriers to have fully analyzed the possible multiple interactions between the rules and their CBAs.

Example 1

Topic: Start of rest period (NPRM) and debrief time as per CBA

NPRM: FDP ends with the last movement of the aircraft. Rest begins after a flight crew member arrives at the rest facility (hotel or home)

Typical carrier CBA: 15-minute debrief period after last movement of the aircraft

NPRM-CBA impact: Transportation to rest facility begins after the debrief period, therefore delaying the time till start of rest, and potentially delaying the next duty start time

A debrief time of at least 15 minutes after the last aircraft movement is common in many CBAs and flight operation manuals. However, the NPRM assumes that a flight duty ends with aircraft parking / engine shut down. The NPRM does not consider debrief time when considering travel time required before the beginning of rest. The debrief time of 15 or more minutes will result in a later start of the rest period and hence a potential delay in starting the subsequent duty.

Example 2

Topic: Multiple rules affecting duty start times

The following example of how multiple rules would interact may better illustrate the type of situation that carriers will encounter as they study the interaction of the new rules with existing CBAs:

Rule 1: Two night duties have to be followed by a day off

Rule 2: The earliest start time after a night duty is 8am

Rule 3: If there is a night duty extension, 12 hours of rest are required

Impact: The multiplier effect of different rules over-proportionately inhibits an airline to flexibly assign staff

The combination of the above illustrative rules would add multiple constraints. For example, a night duty could be followed by a day off, an 8am start, or if it was extended a 12-hour rest period. The complexities to planning and assigning the day following a night duty would be added by different rules leading to an over-proportionately constrained situation. This conglomerate effect also applies to CBAs in conjunction with the NPRM and could significantly decrease the productivity of the crew and incur large-scale implementation costs for the carrier.

15.3 CONCLUSION

The examples above show how specific provisions in existing CBAs can interact and interfere with the proposed NPRM in more constraining ways. The costs of adjusting an existing CBA to align with the NPRM are difficult to quantify due to the differences in CBAs by airline. However, given the examples shown above, the FAA assumption that airlines will not incur CBA-related costs is not valid. The interaction of existing CBAs with the NPRM is expected to have a major cost impact in implementing the NPRM.

CHAPTER 16

REGULATORY COMPARISON

16.1 OVERVIEW

The purpose of this analysis is to compare the provisions of the NPRM with those of two well-established and well-regarded sets of regulations governing flight duty, each of which is also designed to mitigate flight crew fatigue:

- CAP-371, originally issued by the United Kingdom in 1975, and released in its fourth version in 2004
- EU Subpart Q, included in EU Ops in 2006, and effective in 2008

Both CAP-371 and EU Subpart Q are cited multiple times by the FAA in the NPRM.

Approximately 54% of passengers to and from the US are carried by foreign carriers governed by different regulations. Therefore, FAA rules that are unnecessarily more restrictive than those that apply to foreign carriers would place US carriers at a competitive disadvantage in the global marketplace.

16.2 REGULATORY COMPARISON OF NPRM, CAP-371, AND EU SUBPART Q

The most important differences between the three sets of regulations are as follows:

- Flight Time Limits
  Unlike CAP-371 and EU Subpart Q, the NPRM:
    - Imposes daily flight time limits and further restricts those flight limits by prohibiting extensions even under circumstances beyond the control of the air carrier

- Flight Duty Period Extensions
  Unlike CAP-371 and EU Subpart Q, the NPRM:
    - Limits the extensions based on the scheduled FDPs, versus the FDP maximum
    - Permits only one extension in a 168-hour period

- Schedule Reliability
  Unlike CAP-371 and EU Subpart Q, the NPRM:
    - Imposes required reliability standards on actual versus scheduled FDPs, as opposed to actual FDPs versus the FDP maximum
    - Imposes a much higher reliability requirement of 95%

- Consecutive Nights

  The NPRM is more restrictive than CAP-371 and EU Subpart Q

The major provisions are discussed in more detail below.

Flight Time Limits

<u>NPRM</u>

Daily Limit: 8-10hrs daily limit (dependent on duty start time)
Monthly Limit: 100 block hours
Annual Limit: 1000 block hours (measured using 365 consecutive days)

<u>EU Subpart Q</u>

Daily Limit: N/A
Monthly Limit: 100 block hours
Annual Limit: 900 block hours (per calendar year)

<u>CAP-371</u>

Daily Limit: N/A
Monthly Limit: 100 block hours
Annual Limit: 900 block hours (measured using previous 12 months)

Neither EU Subpart Q nor CAP-371 impose daily flight limits, instead relying on the flight duty time limits which are the foundation of this type of fatigue-based rulemaking. The daily flight limit proposed by the FAA – which applies to actual, not scheduled flight time – means that US carriers will be operating under more restrictive and complicated rules than their European counterparts.

Flight Duty Period

<u>NPRM</u>

Unaugmented: 9 to 13 duty hours (dependent on duty start time and number of sectors)
Augmented: 12 to 18 duty hours (dependent on duty start time, number of sectors and class of rest facility)
Other: Deadhead preceding operations counted as flight duty period

<u>EU Subpart Q</u>

Unaugmented: 11 to 13 duty hours based on sector
Augmented: N/A (credit for rest facility not included in Q)
Other: Basic FDP starts at 13h, reduced for each sector after third, by 30min up to 2h
Other: If starting in WOCL, reduced by 100% of encroachment. If ending, reduced by 50% of the encroachment.

CAP-371

Unaugmented: 9 to 14 duty hours based on segments, time, and acclimatization

Augmented: 9 to 18 duty hours based on segments, time, acclimatization and FDP credit given to type of rest facility

Other: Deadhead preceding operations counted as FDP

The three sets of regulations have relatively similar overall limits. CAP-371 is the only one that uses preceding rest as a variable for determining FDP for non-acclimatized flight crew. When a duty has only one segment, the NPRM is considerably more restrictive than CAP-371. Outside the WOCL, especially with more segments, the NPRM is also considerably more restrictive than Subpart Q, with a 2-hr duty difference.

Cumulative Duty Limits

NPRM

Total duty period: Cumulative Duty Hours: 65h per week (168 consecutive hours), 200h per month (28 consecutive days)

Additional: Can be extended to 75h per week (168 consecutive hours), 215h per month (28 consecutive days) if duty includes deadhead or short call reserve.

EU Subpart Q

Cumulative Duty Hours: 60h in any 7 consecutive days, 190h 28 consecutive days

CAP-371

Cumulative Duty Hours: 55h per 7 consecutive days, 190h 28 consecutive days

Additional: Can be extended to 60 hours if unforeseeable delays

In general, the cumulative duty periods are similar across all regulations. The NPRM, however, has a special allowance of 10 hours per week and 15 hours per month that can be used for deadheading back to base. It is a unique aspect to the NPRM that adds a higher degree of crew utilization and gives more operational flexibility to the carriers

FDP Extension

NPRM

Measured: Against scheduled FDP

Maximum extension: 2 duty hours

Maximum frequency: 1 in 168-hr period

Other: Unlimited extensions up to 30 minutes

EU Subpart Q

Measured: Against maximum FDP

Maximum extension: 1 duty hour

Maximum frequency: 2 in 168-hr period

Other: No extensions for flights with more than 6 sectors. If it encroaches on WOCL by up to 2h, extensions limited to 4 sectors. If in WOCL by more than 4h, 2 sectors.

CAP-371

Measured: Against maximum FDP

Maximum extension: 3 duty hours by captain discretion

Maximum frequency: N/A

Other: Discretion of up to 2 hours can be used in first and second sector, in flight with more than 2 sectors. Full discretion may be used in single sector, or last leg of multi-sector flight

The NPRM is much more restrictive than its counterparts as it grants one extension above scheduled FDP, not above maximum. Also, the NPRM limits extensions to one in a 168-hr period. EU Subpart Q is more restrictive than CAP-371, limits 1-hr extensions to actual FDP to twice in the same period.

Schedule Reliability

NPRM

Systemwide: Actual FDP should not exceed scheduled, 95% of the time

Individual Crew Parings: Should not exceed Max FDP 80% of the time

EU Subpart Q

Systemwide: Actual FDP should not exceed maximum, 67% of time

Individual Crew Pairings: N/A

CAP-371

Systemwide: N/A

Individual Crew Pairings: N/A

NPRM provisions are unique. EU Subpart Q limits the systemwide flights that can exceed the maximum FDP. The NPRM goes two steps further, by first increasing the reliability requirement to 95%, and then changing it to be scheduled vs. actual, instead of actual vs. maximum.

Split Duty

NPRM
Minimum rest time: 4 hours
FDP Credit: Given to 50% of rest up to a maximum FDP of 12 hours

EU Subpart Q
Minimum rest time: N/A
FDP credit: N/A
Additional: Split Duty has to be approved by authority

CAP-371
Minimum rest time: 3 hours
FDP credit: 50% credit given to rest of up to 10 hours

NPRM is more restrictive than CAP-371. By imposing a minimum actual rest requirement of 4 hours, it reduces the opportunities to use the rule. There are also key differences in the upper limits. In some situations, with the same amount of rest, CAP-371 carriers can extend a duty up to 18 hours, assuming a 10-hour rest, while the NPRM benefits are capped at 12 hours.

Rest

NPRM
Rest time at base: 9-hr rest between duties, beginning after transfer to rest facility
Rest time off base: 9-hr rest between duties, beginning after transfer to rest facility

EU Subpart Q
Rest time at base: 12 hrs or preceding FDP; also whichever is higher
Rest time off base: 10 hrs rest or preceding FDP, whichever is higher

CAP-371
Rest time at base: 12 hrs or preceding FDP. Also whichever is higher
Rest time off base: 12 hrs, and can be reduced up to 11 if there is nearby hotel

Unlike the NPRM, both the EASA and CAP-371 make a distinction between rest on and off base. The NPRM is less restrictive than its counterparts.

Crew Rest Infrastructure

NPRM

Class Division: 3 classes

FDP impact: For a four-man crew in a bunked (Class 1) facility, duty can go up to 19:40. A Class 3, four-man crew, duty goes down to 12:15 in some cases.

EU Subpart Q

Class Division: N/A

FDP Impact: N/A

Other: Requests have to be submitted to the authority based on scientific knowledge, reasonable provisions, and operational expertise. No set specifications.

CAP-371

Class Division: 2 classes, bunk or rest seat

FDP Impact: FDP extended by half of total rest up to 18 hours, if in a bunk. If taken in a seat, 1/3 of period added to FDP to a maximum of 15 hours.

Despite having a different way of classifying the types of seats, CAP-371 and the NPRM are similar. The NPRM is slightly more lenient, allowing a higher maximum FDP extension in case of a bunked bed. Subpart Q is different from both regulations, as it takes operational expertise into account. Due to the new NPRM definitions on Crew Rest infrastructure, carriers will incur substantial costs to upgrade their infrastructure in order to continue flying longer pairings with the same aircraft. This is different for carriers under Subpart Q, as they can use their operational expertise to argue against the upgrade.

Consecutive Nights

NPRM

Night duty: commences between 22:00 and 5:00

Reset requirements: Legal rest encompassing 02:00 and 07:00

Preceding duty requirements: N/A

EU Subpart Q

Night duty: N/A

Reset requirements: N/A

Preceding duty requirements: N/A

CAP-371

Night duty: Any flight that encompass anything between 02:00 and 04:59

Reset requirements: Legal rest period

Preceding duty: Should finish before 21:00

Other: Operator given the choice to allow crew to decide on a 23:59 extension

The NPRM is more restrictive than CAP-371 although both have a three-consecutive nights rule. While night in CAP-371 is restricted to the three first hours of the WOCL, night in the NPRM includes seven hours. Also the NPRM adds a specific time of the day when the rest should be completed.

Reserves

NPRM

Maximum reserve duty period: 4 hrs above FDP table up to 16 hrs

Other: Long-call reserve, requires 9-hr notification

EU Subpart Q

Maximum Reserve Duty Period: N/A

Other: Airport standby followed by a flight period count towards FDP. All airport standby counts toward cumulative duty hours.

CAP-371

Maximum reserve duty period: <6 hours of standby, standby plus max FDP.

Other: >6 hours of standby, maximum RDP is same as calculated above, with number of reserve hours that exceed 6 subtracted from the final calculation.

The reserve requirements of the NPRM are slightly more restrictive than those of CAP-371. The major difference is that the NPRM caps the maximum reserve duty period at 16 hours, while in CAP-371 it can exceed the maximum FDP table limit by up to 6 hours. This places US carriers at a disadvantage when competing head-to-head with CAP-371 carriers in international flights. CAP-371 pilots will be able to stay in reserve for a longer time before they are unable to complete a long-haul flight. US pilots will have a lower level of utilization and productivity in this case, as their available reserve period will be shorter.

Figure 16.1 provides a side-by-side comparison of the primary provisions of the three sets of regulations

Figure 16.1 – Side-by-Side Comparison of NPRM, CAP-371, and EU Subpart Q

Topic Area	Sub-Area	NPRM	CAP-371	EU Subpart Q
Flight Time Limits (BH)	Daily Limit Monthly Limit Annual Limit	– 8-10, based on duty start – 100 – 1,000	– N/A – 100 – 900	– N/A – 100 – 900
Flight Duty Period (DH)	Unaugmented Augmented Other	– 9-13, based on duty start and no. of segments – 12-18 based on duty start, no. of segments and rest facility – Preceding deadhead included	– 9-14, based on duty start, no. of segments and acclimatization – 9-18, based on duty start, no. of segments and rest facility – Preceding deadhead included.	– 11-13, based on no. of segments – N/A – Reduced if starting or ending in WOCL.
Cumulative Duty Limits (DH)	Weekly Limit Bi-weekly limit Monthly Limit Annual Limit	– 65-75 – N/A – 200-215 – N/A	– 55-60 – 95 – 190 – N/A	– 60 – N/A – 190 – N/A
FDP Extension	Measurement Max Extension Other	– Against scheduled FDP – 2 DH – <30 min: unlimited extensions – >30min: 1 in 168hr window	– Against maximum FDP – 3 DH – 2 DH if FDP has 2 or more sectors	– Against maximum FDP – 1 DH planned, 2 DH unplanned – 2 in 168h period
Schedule Reliability	Measurement All Duties Individual Pairings	– Against scheduled FDP – 95% on-time – 80% (measured against max FDP)	– N/A – N/A – N/A	– Against maximum FDP – 67% on-time – N/A
Split Duty	Minimum Rest Min Rest FDP Credit Other	– 4h – 50% of rest credited to Max FDP. – 12h Max FDP	– 3h – 50% of rest credited to FDP for rest of up to 10h – Up to 5h extension	– Only permitted with specific regulatory approval
Rest	Min rest at base Min rest out of base	– 9h – 9h	– Greater of 12h or Previous Duty Period – 11h	– Greater of 12h or previous Duty Period – Greater of 10h or previous Duty Period
Crew Rest Facility	Rest facility Classification FDP Increase	– 3 (Class 1, 2 & 3) – 1-7h FDP extension based on Class of rest facility and number of pilots	– 2 (Bunk or reclining seat) – Bunk: 50% of rest credited to FDP up to 18h – Seat: 33% of rest credited to FDP up to 15h	– N/A – N/A
Night Duty	Night Definition Consecutive Nights	– 22:00-05:00 – 3 consecutive nights allowed	– 02:00-04:59 – 5 consecutive nights	– N/A – N/A
Reserves	Max Reserve Availability Max RDP Other	– 14h – Lesser of 16h, or 4h + Max FDP – Short call reserve included in Duty Period	– 12h – Time on Reserve + Max FDP - Reserve over 6h	– N/A – N/A – Airport reserve included in Duty Period

Key Definitions Used in Figure 16.1

Weekly Limits:
NPRM – 168 consecutive hours
CAP371 & EU Ops – 7 consecutive days
All Monthly Limits: 28 consecutive days
Bi-Weekly Limits:
CAP371 – 14 consecutive days
Annual Limits:
NPRM – 365 consecutive days
CAP371 – 12 calendar months
EU Ops – calendar year

16.3 CONCLUSION

The three sets of regulations are similar in a number of respects. However, there are several major provisions of the NPRM that are unique among the regulations analyzed and have major negative cost and operational impacts. As discussed previously, the most important of these unique NPRM provisions are those covering:

- Schedule Reliability
- Flight Duty Period Extensions
- Flight Time Limits

For the reasons discussed previously, these provisions in their current form will impose substantial unnecessary costs on US carriers and therefore limit their ability to compete effectively against foreign carriers. Also in cases where US carriers participate in joint ventures with foreign carriers, these provisions create incentives for the foreign carrier to operate a greater proportion of the flights.

CHAPTER 17

CONCLUSIONS

This Chapter summarizes the findings of this Report, and points out the major factors leading to the extremely high cost of the NPRM.

17.1 SUMMARY OF REPORT FINDINGS

Chapter 2 of this Report analyzes the benefits of the NPRM as measured by the avoidance of accidents caused by pilot fatigue. Our review of the individual accidents identified by the FAA as caused by fatigue revealed that the FAA misclassified multiple accidents. Among the most serious of these misclassifications are those where the NTSB specifically found that fatigue was not a factor in the accident, but the FAA nevertheless chose to categorize the accident as caused by pilot fatigue. Other types of misclassifications are discussed in Chapter 2. As explained there, it is likely that the FAA's benefit number of $659.5 million should be reduced by at least 40% to $395.6 million.

The analysis of NPRM costs is more complex, as the FAA used multiple unrealistic simplifying assumptions, specifically excluding any consideration of the inter-relation of different rule provisions, and made no estimate whatsoever for the costs associated with the substantial flight buffering and flight cancellations that will be required. These issues are discussed in more detail in Chapter 4 of the Report and the subsequent chapters that analyze particular NPRM sections.

Figure 17.1 below lists our cost estimates for each of the provisions analyzed, including the annual or one-time costs, the 10-year costs, and the NPV (based on the FAA's assumed 7% discount rate).

Figure 17.1 –Cost Estimates for Provisions Analyzed, Including Annual, 10-Year, and NPV**

<table>
<tr><th>NPRM Provisions</th><th>Standalone Impact (Millions, Assuming 25% Optimization)</th><th>Additive Impact (Millions, Assuming 25% Optimization)</th></tr>
<tr><td>Flight Time Limits*</td><td>1 Year Cost: $428
10 Year Cost: $4,276
10 Year NPV: $3,003</td><td rowspan="3">1 Year Cost: $1,578
10 Year Cost: $15,740
10 Year NPV: $11,056</td></tr>
<tr><td>Schedule Reliability*</td><td>1 Year Cost: $962
10 Year Cost: $9,624
10 Year NPV: $6,756</td></tr>
<tr><td>FDP Extension*</td><td>1 Year Cost: $2,325
10 Year Cost: $23,246
10 Year NPV: $16,237</td></tr>
<tr><td>Day of Operation Reserve</td><td colspan="2">1 Year Cost: $83
10 Year Cost: $826
10 Year NPV: $580</td></tr>
<tr><td>Cumulative Duty Time from Short Call Reserve</td><td colspan="2">1 Year Cost: $14
10 Year Cost: $143
10 Year NPV: $100</td></tr>
<tr><td>Crew Rest Infrastructure</td><td colspan="2">1 Year Cost: $507
10 Year Cost: $928
10 Year NPV: $789</td></tr>
<tr><td>NPRM Implementation</td><td colspan="2">1 Year Cost: $1,723
10 Year Cost: $1,967
10 Year NPV: $1,886</td></tr>
<tr><td>Three Consecutive Nights</td><td colspan="2">1 Year Cost: $4
10 Year Cost: $38
10 Year NPV: $27</td></tr>
<tr><td>Totals (10 Year Additive)</td><td colspan="2">$19,641 Nominal
$14,439 NPV</td></tr>
</table>

*Additive cost impact of Flight Time Limitations, Schedule Reliability, and FDP Extension is less than the standalone cost impact of FDP Extension. This is true because 1) an increase in Schedule Reliability buffer results in a reduction in the need for FDP Extensions; and 2) the cost of adding a Schedule Reliability buffer is lower than the cost of flight cancellations caused by the FDP Extension limits.

** The FAA's NPV discount rate of 7% is used.

17.2 MAJOR FACTORS LEADING TO THE EXTREMELY HIGH COST OF THE NPRM

As discussed in the Report and illustrated in Figure 17.1 above, three of the provisions analyzed are responsible for 93.6% of the enormous cost of the NPRM:

- Schedule Reliability
- Flight Duty Period Extensions
- Flight Time Limits

Those three provisions have been discussed at length in this Report, but deserve final emphasis here for the following reasons:

- The provisions are unique to this NPRM. They are not found in any of the other major international flight duty regulatory systems.

- The provisions are not related to safety, e.g., the NPRM requirement that 95% of flight duty periods be completed within the scheduled flight duty time regardless of whether individual flight duty periods are under the maximum limit.

- The provisions are inflexible. For example, the block hour limit embedded within the flight duty period limit is not only *not found* in other international flight duty regulatory systems, but also inflexible as it eliminates the current ability of carriers to extend the block hour limit in the event of day-of-operation delays due to circumstances beyond the control of the carrier.

The estimated cost of the three provisions cited above makes the cost of the remaining provisions appear small in comparison. However, as explained in the Report, many other provisions of the NPRM would also impose significant costs individually and even greater costs collectively as a result of their cumulative impact.

Oliver Wyman
12007 Sunrise Valley Drive
Reston, Virginia 20191
www.oliverwyman.com

Oliver Wyman project team: Bob Hazel, Max Kownatzki, Andrew Watterson, Shane Lord, Nicholas Maisano, and Luiz Pinto

Oliver Wyman is an international management consulting firm with more than 2,900 professionals in 40 offices around the globe.

Attachment 3

Comments Solicited By FAA
In The 2010 Fatigue NPRM

Numbered Questions In The NPRM

1. *Please comment on adopting maximum FDPs. Should the maximum FDP vary based on time of day? Should it vary based on the number of scheduled flight segments? Should the proposed limits be modified up or down, and to what degree? Please provide supporting data.*

   ATA members generally support the concept of maximum FDPs to the extent they are based on the best available science, consistent with international standards, and address fatigue without imposing undue costs and burdens on the industry and general public. ATA members do, however, object to certain maximum FDP values contained in Tables B & C to the NPRM. In addition, ATA sees no need for, and strongly objects to, flight duty time limitations in addition to maximum FDPs and the proposed limitations on extensions to the flight duty period.

   See Sections II. A, B, G of ATA's Comments for further discussion.

2. *Please comment on permitting flightcrew members and carriers to operate beyond a scheduled FDP. Is the proposed 2-hour extension appropriate? Is the restriction on a single occurrence beyond 30 minutes in a 168-hour period appropriate? Should a flightcrew member be restricted to a single occurrence regardless of the length of the extension? Please provide supporting data.*

   ATA members object to the NPRM's proposed limitations on extensions to the flight duty period. No logical basis exists to limit extensions beyond scheduled FDP where the actual FDP is within the maximum FDP limits. Neither of the leading FDP-based fatigue mitigation schemes, CAP-371 and EU Subpart Q, is concerned with exceedances beyond scheduled FDP, only maximum FDP.

   In addition, the proposed limitation of FDP extensions exceeding thirty minutes to once in any consecutive 168 hour period is unnecessary, overly restrictive, and will result in undue burdens and costs. As discussed in the report submitted by ATA's fatigue experts, no scientific evidence supports restricting extensions of greater than thirty minutes to once in 168 hours. The proposal also disregards operational reality. To achieve a minimum degree of operational robustness, carriers must be permitted to extend the FDP more than once every seven days. Such extensions would be necessary for recovery of normal schedules from weather and other disruptive events, to the detriment of the traveling and shipping public.

   For similar reasons, ATA's members also oppose the limit on extensions of greater than thirty minutes to the scheduled FDP for unaugmented operations on consecutive days in certain circumstances. For instance, FAA should not define "consecutive days" to include time periods when a crewmember has 30 consecutive hours of rest between FDPs. For example, a crewmember has a FDP on Monday that is extended beyond 30 minutes, if that crewmember is on rest and does not begin a FDP until Thursday, the FAA should allow an extension on Thursday if necessary and not consider these consecutive days.

See Sections II. B, G of ATA's Comments for further discussion.

3. *Please comment on the proposed schedule reliability reporting requirements. Should carriers be required to report on crew pairings that exceed the scheduled FDP, but not the maximum FDP listed in the FDP table?*

ATA members oppose the proposed schedule reliability reporting requirements because they are unrelated to fatigue mitigation and will impose substantial unjustified costs on carriers. Neither the proposed requirement that system wide actual FDPs meet scheduled FDPs 95% of the time nor the 80% reliability requirement for each specific FDP would mitigate fatigue because the extent of any deviation between actual and scheduled FDP is irrelevant to pilot fatigue. In other words, even if a flight arrives later than its scheduled time, so long as the pilot does not exceed the FDP limit for the day (and receives required rest before starting the next FDP), how closely the actual FDP corresponds to the scheduled FDP has no connection with fatigue. Were the NPRM to be imposed, carriers would adjust pairings as a matter of course to ensure that they do not violate the daily FDP maximums and limits on FDP extensions. Carriers would also ensure that each pilot receives the required rest opportunity as proposed. Therefore, none of the requirements in proposed Section 117.9 are justified or necessary.

See Section II. D of ATA's Comments for further discussion. Also see generally ATA's Economic Impact Analysis submitted herewith.

4. *Should carriers be required to report on more parameters, such as cumulative duty hours or daily flight time? If so, why?*

No. The FDP limits and rest requirements in the proposed rule are sufficient to mitigate fatigue without additional reporting parameters such as cumulative duty hours or daily flight time. Imposing these additional requirements would impose unnecessary administrative burdens and costs on the carriers.

See Section II. D of ATA's Comments for further discussion.

5. *What should be the interval between reporting requirements?*

See Response #3 above.

6. *How long after discovering a problematic crew pairing should the carrier be afforded to correct the scheduling problem?*

See Response #3 above.

7. *Is a 3-day adjustment to a new theater of operations sufficient for an individual to acclimate to the new theater?*

Yes.

8. *Is a 36-hour break from duty sufficient for an individual to acclimate to a new theater?*

Yes.

9. *Should flightcrew members be given a longer rest period when returning to home base than would otherwise be provided based on moving to a new theater?*

No. There is no need for additional mitigations in this instance in light of the other mitigations in the NPRM.

10. *Should the FAA have different requirements for flightcrew members who have been away from their home base for more than 168 hours? If so, why?*

No. If adopted as proposed, the new regulations would require 9 consecutive hours between FDPs and 30 consecutive hours free from all duty in any 168 consecutive hour period. There is no need for additional mitigations in this instance in light of the these other mitigations in the NPRM.

11. *Should the FAA require additional rest opportunities for multiple pairings between two time zones that have approximately 24-hour layovers at each destination? What if the scheduled FDPs are well within the maxima in the applicable FDP table or augmentation table?*

No. There is no need for additional mitigations in this instance in light of the other mitigations in the NPRM.

12. *If the FAA adopts variable FDP limits, is there a continued need for daily flight time limits?*

No. Hard daily flight time limits in addition to FDP would be redundant, inconsistent with the NPRM's FDP-based scheme and devoid of any safety benefit. The proposal is contrary to FDP-based international standards, operationally unwieldy and would impose additional costs and burdens without increasing safety.

See Section II. A of ATA's Comments for further discussion.

13. *If the FAA retains daily flight time limits, should they be higher or lower than proposed? Please provide data supporting the answer.*

See Response #12.

14. *Should modifications be made to the proposed flight time limits to recognize the relationship between realistic flight time limits and the number of flight segments in an FDP?*

See Response #12.

15. *Should augmentation be allowed for FDPs that consist of more than three flight segments? Does it matter if each segment provides an opportunity for some rest?*

Yes. To the extent a meaningful rest opportunity is provided, augmentation should be allowed. The key consideration is rest: if a crewmember can get rest, that rest should be credited. Categorically prohibiting augmentation for FDPs that consist of more than three flight segments would be unreasonable and contrary to the best available science on the subject.

See Appendix 2, Sec. 6 (Gregory Belenky, M.D. and R. Curtis Graeber, Ph.D., *Scientific Issues Regarding NPRM*)

16. *Should flight time be limited to 16 hours maximum within an FDP, regardless of the number of flightcrew members aboard the aircraft, unless a carrier has an approved FRMS?*

No. There is no basis in science or the logic underpinning an FDP-based scheme that imposes additional flight time limits of any kind.

See Section II. H of ATA's Comments for further discussion.

17. *Should some level of credit be given for in-flight rest in a coach seat? If so, what level of credit should be allowed? Please provide supporting data.*

Some credit should be given for rest in a coach seat. The NASA cockpit napping study clearly indicated that even a cockpit pilot seat offered measurable rest benefits.

18. *Is there any reason to prohibit augmentation on domestic flights assuming the flight meets the required in-flight rest periods proposed today?*

No, and the FAA provided no analysis to suggest why such a limitation should be adopted.

19. *Are the proposed required rest periods appropriate?*

No. While ATA members support the concept of providing crewmembers with an eight hour rest opportunity, they oppose proposed Section 117.25(d), which places the responsibility on carriers under unreasonable circumstances to ensure that crewmembers have nine hours at a rest facility. This proposal is impractical and unreasonable.

See Section II. F of ATA's Comments for further discussion.

20. *Should credit be allowed if a flightcrew member is not type-rated and qualified as a PIC or SIC?*

Yes.

21. *Please comment on whether a single occupancy rest facility provides a better opportunity for sleep or a better quality of rest than a multiple occupancy facility such as a multi-bed crew sleeping facility or multi-bed living quarters. Please provide supporting data.*

We have no evidence that a single occupancy ground rest facility will provide better opportunity for sleep or rest than a multiple occupancy facility. Carriers worldwide have substantial positive operational experience using multiple occupancy in-flight crew rest facilities in Boeing 747 and 777 aircraft. There is no reason to believe a different result would occur in a ground rest facility.

22. *Should there be any restriction on consecutive nighttime operations? If not, why?*

No. The Proposal's three night limit on consecutive FDPs is unreasonable and disregards science and operational reality. The industry's substantial experience with nighttime operations shows that pilots who frequently operate nighttime flights are well suited to consecutive night duties because they have training and experience specific to such operations. The proposal fails to take full account of mitigations such as split duty rest that carriers provide during nighttime operations. These mitigations have been shown to sustain performance for more than three nights in a row. In addition, we have the same concerns the FAA articulated in the preamble, that "simply limiting nighttime operations to three consecutive nights could result in a significant increase in the number of first night operations" and that "taking an approach that may appear safer in modeling could lead to adverse safety impacts in the real world." 75 FR 55867.

The proposal is also unreasonable because it applies the limit to augmented operations. Because crewmembers receive rest during augmented operations no limit on consecutive nights can be justified.

See Section II. J of ATA's Comments and Appendix 2, Sec. 4 (Gregory Belenky, M.D. and R. Curtis Graeber, Ph.D., *Scientific Issues Regarding NPRM*) for further discussion.

23. *If the nighttime sleep opportunity is less than that contemplated under the split duty provisions of this notice, should a carrier be allowed to assign crew pairing sets in excess of three consecutive nights? Why or why not?*

Yes. A carrier should be allowed to assign crew pairing sets in excess of three consecutive nights, period. The three-consecutive-night limit is not supported by science. As discussed in the accompanying report by ATA's fatigue experts, sleep obtained by workers assigned to night duty can sustain performance across greater than three consecutive nights. Scientific evidence shows that sleep obtained by night workers, even if broken into shorter periods, sustains performance over multiple nights. The proposal disregards the best available science about the consecutive night duty and, indeed, could lead to increased crewmember fatigue. Industry experience shows that the first night flight in sequence tends to be more fatiguing than the night flights that follow it because, during the first flight, pilots are unaccustomed to being awake all night. The proposal will likely result in substantially more first night flights than compared to today, where crewmembers commonly work more than three consecutive nights in a row.

ATA members also oppose the unnecessarily restrictive proposed 4-hour minimum rest requirement to obtain credit for split duty. This proposal is arbitrary, counter-intuitive, operationally unsound and not science-based. According to the fatigue experts, sleep of as little as twenty minutes provides recuperative value on a full minute-by-minute basis. Nevertheless, the FAA proposes that recuperative rest begins at four hours with a 50% credit, allowing a crewmember to extend the FDP by two hours. The proposal also defies logic since, according to the NPRM, in some cases rest on the ground is worth less than rest in the air.

See Section II. J of ATA's Comments, and Appendix 2, Sec. 3 (Gregory Belenky, M.D. and R. Curtis Graeber, Ph.D., *Scientific Issues Regarding NPRM*) for further discussion.

24. *If the nighttime sleep opportunity meets the split duty provisions of this notice, should the carrier be allowed to extend the flight duty period as well as the number of consecutive nighttime flight duty periods? Why or why not?*

Provided that a crewmember receives sufficient sleep opportunities, then the carrier should be allowed to extend the flight duty period as well as the number of consecutive nighttime flight duty periods.

As discussed in ATA's Comments, ATA members oppose the proposed four-hour minimum for a rest opportunity to be credited during split duty, as well as the proposed consecutive nighttime flight duty period restrictions.

See Response #23; Section II. E of ATA's Comments; and Appendix 2, Secs. 3 and 4 (Gregory Belenky, M.D. and R. Curtis Graeber, Ph.D., *Scientific Issues Regarding NPRM*) for further discussion.

25. *Should a fourth night of consecutive nighttime duty be permitted if the flightcrew member is provided a 14-hour rest period between flights nights three and four?*

No, the FAA should not limit consecutive nighttime operations to four nights; it should permit five consecutive nights as long as the crewmember receives the required minimum rest and does not exceed the maximum FDP limits. See Response #24

26. *Please comment on whether a 16 maximum hour FDP for long call reserve is appropriate when the maximum FDP for a lineholding flightcrew member is 13 hours.*

It is not appropriate for the FAA to include a further FDP limit in addition to Table B, especially with no explanation why a further limit is necessary after a crewmember has received a required rest period. By the proposed definition of long call reserve, a crewmember must receive rest before reporting for duty, so Table B FDP limits should apply once the crewmember reports.

27. *Please comment on whether the proposed maximum extended FDP of 22 hours for an augmented flightcrew member is appropriate. If not, please provide an alternative maximum FDP.*

This question appears to contain a typographical error by referring to "FDP" instead of "RDP." Assuming that the question is intended to refer to reserve duty period, then ATA members believe that the proposed maximum extended RDP of 22 hours for an augmented flightcrew member is appropriate.

28. *Please comment on whether a certificate holder should receive credit for not calling a flightcrew member during the WOCL while on reserve.*

Yes. A certificate holder should receive credit for not calling a flightcrew member during the WOCL while on reserve, consistent with science that recognizes the restorative benefits of rest during the WOCL.

29. *Should minimum required rest while on reserve status be greater than the amount of rest required for a lineholding flightcrew member? If so, please provide supporting data, if not, please provide rationale.*

No. The minimum required rest while on reserve status should never be greater than the amount of rest required for a lineholding flightcrew member. The ARC recommended reserve system was designed to provide a level of predictability similar to a lineholder. Although a reserve crewmember may not receive the full minimum required rest, he or she is having a normal day, similar to a lineholder. As ATA's sleep scientist experts concluded, being on short-call reserve is not the equivalent of being on duty because it does not entail any significant work load. The crewmember is provided a meaningful break and sufficient notice to allow him or her to properly prepare for eligible duty. The only task a pilot has on short call reserve, for example, is to answer the phone. Otherwise, the pilot is free to do what he or she wants, and to plan the day to take advantage of any available rest opportunities.

See Section II. C of ATA's Comments and Appendix 2, Sec. 2 (Gregory Belenky, M.D. and R. Curtis Graeber, Ph.D., *Scientific Issues Regarding NPRM*) for further discussion.

30. *Please comment on the level of complexity on the proposed reserve system.*

ATA's members believe the proposed reserve system is complex and contains an error. Proposed section 117.21(c)(4) is confusing because proposed 117.21(c)(4)(ii) will always be the shortest RAP option, eliminating the need for the other three options. That being said, a topic as complicated as reserve will always have a level of complexity. ATA believes a reserve system without proposed 117.21(c)(4)(ii) and that does not include short call reserve as duty would be a much less complex system.

31. *The FAA seeks input on the appropriate cumulative limits to place on duty, flight duty periods and flight time. Is there a need for all the proposed limits? Should there be more limits (e.g., biweekly, or quarterly limits)?*

The biggest concern ATA members have with cumulative limits is the expansive definition of duty the FAA has proposed, which would unnecessarily accumulate duty hours. If the current definition of duty is retained we see no need for the cumulative limitations on duty proposed in Section 117.23(d) of the NPRM. The FAA concedes that it decided to take a "conservative approach" to cumulative limitations "[d]espite the lack of validated data." Rulemaking without a scientific basis is arbitrary rulemaking. Cumulative limits are also redundant because the other FDP limits and minimum rest requirements in the NPRM are sufficient to address fatigue without additional cumulative duty limitations being imposed. We see no need for additional limits nor has the agency presented any evidence that additional limits are needed.

See Section III. L of ATA's Comments for further discussion.

32. *The FAA also asks for comments on measuring limits on an hourly rather than daily or monthly basis. Does this approach make sense for some time periods but not for others?*

See Response #12.

33. *If transportation is not considered part of the mandatory rest period, is there a need for a longer rest period for international flights?*

No. The international versus domestic distinction overlook the possibility that international flights can be significantly shorter, and cross fewer time zones, than long haul domestic flights.

34. *Whether some elements of an FRMS, such as an incident reporting system, would be better addressed through a voluntary disclosure program than through a regulatory mandate?*

Yes. ATA members have supported the use of voluntary disclosure programs and non-punitive safety reporting programs to raise and address safety and compliance issues. The FAA should follow other voluntary disclosure principles used in SMS or ASAP.

35. *Are there other types of operations that should be excepted from the general requirements of the proposal? If so, what are they, and why do they need to be accommodated absent an FRMS?*

Yes. The proposal is flawed because it applies a one-size-fits-all approach that does not take into account the broad variety of diverse operations conducted by U.S. air carriers. The proposal thoroughly fails to address the operational circumstances of carriers that provide non-scheduled or on-demand services. In many significant respects it also overlooks the nature of all-cargo operations, and, if imposed, would result in substantial burdens on all-cargo carriers, for the reasons discussed in their individual submissions and the separate submission of the CAA.

TAB 10

BEFORE THE
FEDERAL AVIATION ADMINISTRATION
WASHINGTON, D.C.

Flightcrew Member Duty and Rest Requirements

Docket No. FAA-2009-1093

COMMENTS OF THE CARGO AIRLINE ASSOCIATION

Inquiries concerning these Comments should be addressed to:

Stephen A. Alterman, President
Yvette Rose, Senior Vice President
Cargo Airline Association
1620 L Street, NW
Suite 610
Washington, DC 20036
202-293-1030

November 15, 2010

Table of Contents

Table of Authorities

CASES

STATUTES

OTHER AUTHORITIES

RULES

BEFORE THE
FEDERAL AVIATION ADMINISTRATION
WASHINGTON, D.C.

Flightcrew Member Duty and Rest Requirements

Docket No. FAA-2009-1093

COMMENTS OF THE CARGO AIRLINE ASSOCIATION

I. INTRODUCTION

By publication in the September 14, 2010, edition of the *Federal Register*, the Federal Aviation Administration ("FAA" or "the Agency") has proposed significantly amending its regulations with respect to the flight, duty and rest requirements applicable to both certificate holders and flightcrew members.[1] The Agency's Notice of Proposed Rulemaking, entitled Flightcrew Member Duty and Rest Requirements ("NPRM", "proposed rule" "proposal"), follow, by just over one year, the recommendations of an FAA-established Aviation Rulemaking Committee ("ARC") that compiled a comprehensive record on the state of fatigue science and transmitted a series of recommendations to the Agency that reflected the views of each segment of the aviation community represented on the ARC.

Even though air transportation has an enviable safety record and is by far the safest mode of transport, all-cargo carriers remain committed to improving the safe operation of our aircraft and the safety of our employees and flightcrew members. Given the changing operational landscape and advancements in scientific research, fatigue in aviation deserves the industry's and

[1] Flightcrew Member Duty and Rest Requirements; Proposed Rule, 75 Fed. Reg. 55852 (Sept. 14, 2010).

FAA's attention and should be addressed appropriately based on scientific data – but as it relates specifically to each aviation sector and its unique operational characteristics. CAA is committed to the goal of enhancing safety, but must oppose the FAA's proposal as it fails to meet that goal. The proposal is unjustifiably burdensome, highly unlikely to achieve the desired safety benefits and procedurally and legally flawed in many respects.

The Association has reviewed both the NPRM and the accompanying Regulatory Impact Analysis, as well as the entire Regulatory Docket, and has concluded that the NPRM has:

- Failed to take into account the substantial operating differences between industry segments that require different methods of mitigating fatigue;
- Proposed prescriptive new regulations in areas that should be left to the collective bargaining process;
- Failed to base its proposed rules on applicable scientific principles and indeed advanced certain proposals directly contrary to the scientific principles it allegedly embraces;
- Failed to meet legal and procedural standards of review for agency rulemaking;
- Substantially understated costs to the industry and society in general; and
- Wildly overstated the benefits of implementing the rule.

CAA representatives almost literally devoted their lives to the ARC process during the Summer of 2009, evaluating all of the evidence presented and formulating a thoughtful proposal designed to meet the operational needs of the all-cargo carriers. The proposal appropriately took into account that the air carriers responsible for transporting much of the nation's goods fly predominantly at night, often internationally, and sometimes to diverse locations throughout the world. Two of our members are the world's largest integrators. Many of our members provide vital services for the U.S. military, transporting equipment and supplies that constitute the lifeblood of our national defense. In these circumstances, CAA thought that the FAA would have given the proposal serious consideration – especially since CAA advanced it as one whose application could be limited to all-cargo carriers. Significantly, in recognition of the fact that all-cargo carriers typically provide more rest opportunities to flight crewmembers than domestic passenger carriers do, the CAA flight and duty time matrix would allow relatively long flight duty periods and, at the same time, require relatively long rest periods. In the NPRM, however, the FAA ignored its own conclusions that "[t]he most effective fatigue mitigation is sleep" and that "[f]or most people 8 hours of sleep in each 24 hours sustains performance indefinitely."[2] ; determined that "one size must fit all"; and based its proposal primarily on one submitted by labor stakeholders for specific application to the domestic passenger carrier industry.

Not surprisingly, the proposed rule will seriously impede the operating flexibility of the all-cargo carriers and, even where operations remain feasible, will dramatically increase costs. Our economic consultants, Campbell-Hill Aviation Group, have collected and analyzed data showing that if the proposed rule is implemented, it will increase all-cargo operating costs by $2.666 billion (Net Present Value). But the negative consequences will extend far beyond this direct financial impact. We estimate that if the $2.666 billion cost increase is passed along to the shipping public through rate increases, it will drain **at least** $8.4 billion over ten years in economic activity within the United States, over and above the direct costs to the industry, and result in a permanent loss of over 7,000 jobs.[3] Some flights, moreover, will no longer be operable as scheduled; often they are long-haul flights operated for the U.S. Air Mobility Command to locations in the Middle East and Afghanistan. The specifics are described in the individual comments of CAA members.

[2] 75 Fed. Reg. at 55872.
[3] Economic Assessment of FAA's Regulatory Impact Analysis, November 15, 2010 (Campbell-Hill), pp.83-85; Appendix B, pp. 5-6 and discussion *infra.* at pp. 42-43.

In addition, the Association submits that it is extremely important to understand that the FAA is proposing to impose these new, "operations changing" rules on an industry that is already extremely safe and has few fatigue-related problems. Over the past twenty years, improvements in safety programs have significantly reduced **accident rates generally**, with a 26% drop in accidents involving cargo aircraft between the decade of 1990-1999 and the decade of 2000-2009. The drop in fatalities in the same time periods is even more dramatic, with an 82% improvement. With respect specifically to **fatigue-related accidents**, the FAA's own data indicate a substantial reduction in accidents in the past ten years, with cargo accident fatalities dropping 89% in the past ten years (over the previous ten years). In fact, since 2003, the all-cargo industry has conducted approximately 7.6 million mainline flight operations **without even one fatigue related accident.**[4] And there has never been an accident involving a U.S. all-cargo air carrier attributed to fatigue on flights operated with augmented crews. Faced with this enviable safety record, there is clearly no need for the draconian measures proposed herein.

Finally, the legal deficiencies in the rulemaking process ought to be underscored. The FAA has unfairly and illegitimately truncated the comment process, advanced a complex almost unworkable set of prescriptive regulations unsupported by science, and arbitrarily changed the existing regulatory framework without adequately evaluating the consequences. The Regulatory Impact Analysis claims the proposed rule will produce estimated benefits of $463.8 million at present value while imposing $804 million in costs. As explained below, the analysis is plainly inadequate. Insofar as the all-cargo industry is concerned, the proposed rule would impose costs of $3,800 for each $1 of benefits.

With all of these factors in mind, the Association submits the following Comments.[5]

---

[4] Campbell-Hill, pp. 45-46.
[5] Members of the all-cargo community will also be filing individual Comments herein directly to the Docket.

II. SUMMARY OF THE CAA PROPOSAL SUBMITTED TO FAA THROUGH THE AVIATION RULEMAKING COMMITTEE

The Cargo Airline Association ("CAA" or "the Association") is the nationwide trade organization representing the interests of United States all-cargo air carriers.[6] The Association has participated in all aspects of this rulemaking effort, including membership on the ARC and, at the request of the FAA, the submission of a proposal to the ARC and the FAA detailing the positions of the all-cargo community. The proposal submitted by the Association recognized the importance of updating current regulations relating to flightcrew member fatigue and set forth a regulatory scheme that takes proper account of the unique operations conducted by all-cargo carriers (and others similarly situated). This proposal would:

- Recognize the distinct aspects of domestic vs. international operations;
- Establish limits where none now exist;
- Account for the effects of "time of day" (the Window of Circadian Low or "WOCL");
- Address the challenge of crossing multiple time zones ("acclimatization");
- Reduce the flight duty periods from those currently in effect; and
- Increase the required rest periods for both domestic and international operations from those in current regulations.[7]

The following chart illustrates a comparison between the current FAA Federal Aviation Regulations and the CAA proposal including the percentage changes in stringency:

---

[6] U.S. direct air carrier members of the Association are ABX Air, Atlas Air, Capital Cargo, FedEx Express, Kalitta Air and UPS Airlines.

[7] A copy of the Association's proposal (in Power Point form) is attached hereto as Attachment A.

Comparisons Between Current FAR and CAA Proposal

Flight Duty Period (Hours)			
	Current	CAA Proposal	Change
Domestic	16	9-13	19%-44%
3 Crew Domestic	16	9-13	19%-44%
International	16	11:30-14	12.5%-28%
3 Crew International	Unlimited	14:30-16:30	-

Rest (Hours)			
	Current	CAA Proposal	Change
Domestic	8	10	25%
3 Crew Domestic	8	10	25%
International	8	12	50%
3 Crew International	8	12	50%

This proposal was comprehensive and based on extensive operational experience, recognizing the importance of increased rest to allow for an increased FDP.[8] It was a clear alternative to the proposal set forth in the Notice of Proposed Rulemaking – yet, as is apparent from the NPRM, it was summarily dismissed without any appropriate regulatory analysis by the FAA.

III. THE U.S. ALL-CARGO AIR CARRIER INDUSTRY'S OPERATIONAL MODEL SHOULD BE CONSIDERED SEPARATELY

Although the FAA alleges that "(t)he proposal recognizes the growing similarities between the types of operations . . ."[9], the simple fact is that all segments of the aviation community are **not** the same (or even growing more similar). The all-cargo operational environment, for example, is significantly different from the passenger carrier model and there are even variances within each industry segment. It is important to understand these differences and their impact on the crewmember fatigue issue.

[8] As detailed on pages 24-25**, the Association opposes any limitations on "flight hours"**. However, in the event that the FAA chooses to impose such restrictions, the CAA proposal (Attachment A) contains suggested limits. These limits, which range from 7 to 12 hours, take into account the number of segments and time of day, as well as the CAA's proposal's expanded opportunities for rest and reduced Flight Duty Periods.

[9] 75 Fed. Reg. at 55852.

The all-cargo industry is composed of both scheduled and on-demand operators providing a worldwide network of air transportation and delivery services. Express delivery services are a critical component of the nation's economy, with customers ranging from individuals and small businesses in small communities to multi-billion dollar corporations shipping packages or heavy freight throughout the world. Included among this broad range of services are the delivery of critical medical supplies, human organs, various immunization materials and other time-critical perishables. In addition, CAA members and others in the all-cargo marketplace provide international services for government agencies, the military and non-governmental organizations such as the United Nations and the World Health Organization which depend on mission-critical airlift services to virtually all points in the world.

In order to provide these critical global services to individuals, businesses, governments and non-governmental organizations, some all-cargo carriers, unlike their domestic passenger counterparts, generally do not maintain U.S. domicile bases and regularly operate long-haul flights and point-to-point operations outside the United States, traveling across multiple time zones at all hours of the day and night. All-cargo carriers also regularly operate around-the-world in all directions with extended overseas routings, not quick overnight turns at foreign destinations. These backside-of-the-clock and around the world operations are the norm for international all-cargo carriers and their experienced flight crews come prepared to fly such operations.

Moreover, unlike destinations served by domestic passenger carriers, global all-cargo operations operate service to remote, undeveloped, and sometimes hostile locations requiring timely turnaround capabilities because the pre-positioning of reserve crews at such locations is not possible and local infrastructure is minimal. For on-demand operations, such service is also unpredictable, driven by the customer's needs, not a pre-published schedule from which the customer chooses. Therefore, attempting to apply the domestic passenger model to the operations of the all-cargo carriers in determining the appropriate crew duty and rest requirements is simply not appropriate, nor, in fact, safe.

Importantly, regardless of whether in the air or on the ground, all-cargo crews have more and longer rest opportunities than their domestic passenger counterparts. For example, all-cargo carriers that fly into a hub for package sorting purposes provide their crews the opportunity for significant rest in a horizontal sleep facility during the night prior to the next launch while the sort is underway. In this regard, both FedEx and UPS have invested millions of dollars to provide their flight crews with lie-flat single occupancy hotel room like facilities with climate controls at their principal U.S. hubs during the package sorting process to facilitate sleep and mitigate fatigue. Similarly, all-cargo carriers provide enhanced opportunities for rest while airborne. CAA members have invested millions of dollars in high-quality lie-flat bunks or substantially reclined rest facilities on-board their long-haul aircraft. The ability to receive effective rest on all-cargo aircraft is further enhanced since there are no distractions and noise from passengers and flight attendants.

Finally, it is important to understand that all-cargo crewmembers *already* fly far fewer hours than their passenger counterparts. A survey of Cargo Airline Association members indicates that the overnight express segment of the industry averages approximately 28.0 block hours per pilot per month, while other cargo industry segments average approximately 45.5 hours. Informal industry discussions indicate that both figures are substantially below the industry averages for passenger carriers.

Taken together, these facts clearly demonstrate the unique operational characteristics of the all-cargo industry – characteristics that belie the FAA's conclusion that there are growing similarities between types of operations. These differences must be recognized by the FAA in any Final Rule. Indeed, as noted by FAA Administrator J. Randolph Babbitt in talking to an ALPA Safety Forum in 2009, "In rulemaking, not only does one size **not** fit all, but it's unsafe to think that it can."[10]

Most importantly, 49 U.S.C. Section 44701(d)(2) requires the FAA to "classify a regulation or standard appropriate to the differences between air transportation and other air commerce."[11] The FAA's consideration of this statutory duty has been deficient. In spite of the recognized difference in operational characteristics – and the need to tailor regulations to these characteristics – the FAA has not done so here. [12] Instead, it appears that the Agency has used a domestic passenger airline model to develop its proposals and has ignored the differing characteristics of all other industry segments. As noted in the NPRM, ". . . this rulemaking proposes to establish **one set** of flight time limitations, duty period limits, and rest requirements for pilots in Part 121 operations."[13] Moreover, as discussed in more detail below, the Agency failed to consider and fully analyze other alternatives than the "one size fits all" approach.[14]

---

[10] *We Can't Regulate Professionalism*, Speech of FAA Administrator J. Randolph Babbitt to the ALPA Air Safety Forum, August 5, 2009 (emphasis added).
[11] 49 U.S.C. §44701 (d)(2) (2010).
[12] Compare *United Glass and Ceramic Workers v. Marshall*, 584 F.2d 398, 404-05 (D.C. Cir. 1978) (noting that the Labor Department must "investigate a wide range of industries" and that the agency's investigative techniques must necessarily "vary with the structure of the industry, the available sources of information, and the number of other causative factors at work").
[13] 75 Fed. Reg at 55852.
[14] *See, e.g., Pillai v. CAB*, 485 F.2d 1018, 1027-30 (D.C. Cir. 1973) (vacating order regarding air carrier rates because the agency considered only alternative to be open rates, ignoring other regulatory approaches).

IV. REGULATORY PRACTICE AND PROCEDURE

A. THE AVIATION RULEMAKING COMMITTEE (ARC) PROCESS WAS FUNDAMENTALLY FLAWED

The FAA established the Flight and Duty Time Limitations and Rest Requirements Aviation Rulemaking Committee on July 15, 2009. It was chartered for only six weeks with recommendations due to be submitted to the FAA no later than September 1, 2009.[15] The Cargo Airline Association understands the need to revisit the issue of crewmember fatigue and to modify existing regulations to mitigate the causes or risk of fatigue where necessary to increase aviation safety. However, the compressed time-frame of the ARC precluded effective consideration of all aspects of the pilot fatigue issue. Moreover, the CAA has, from the beginning, been concerned about both the ARC process and, eventually, the focus of the NPRM.

The first job of any body studying the effects of pilot fatigue on aviation safety should be to study and isolate the causes of fatigue in aviation flightcrew members. After establishing such causes, the body should examine various actions than can be used to mitigate the causes of fatigue in each industry segment. After such studies are completed – supported by scientific validation appropriately correlated to the relevant aviation industry segment – several alternative regulatory recommendations can be developed to address the identified issues. Unfortunately, this was not the path followed by the FAA or the ARC. Rather, from the outset, 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.[16] Only lip service

[15] *See* FAA Charter, Flight and Duty Time Limitations and Rest Requirements Aviation Rulemaking Committee, June 24, 2009, page 3.
[16] "[A]n artificial narrowing of the scope of the regulatory problem is itself arbitrary and capricious and is ground for reversal." *Home Box Office, Inc. v. FCC,* 567 F.2d 9, 36 (D.C. Cir., *cert. denied,* 434 U.S. 829 (1977)

was ever paid to elements such as unprofessional pilot commuting, inappropriate use of allotted rest periods or the identification of medical sleep disorders which are more likely causes of pilot fatigue in an aviation context.[17] Indeed, taken to its extreme, a scheme could be developed whereby flightcrew members fly only eight hours a month, but if the flightcrew commutes overnight to start the eight hours of flight, the issue of fatigue is still present. As a result, the proposals contained in the NPRM are, on the whole, simply designed to reduce the flightcrew hours of service.

If there were any doubt about the FAA's lack of understanding and consideration of the role of commuting in developing the proposals in the NPRM, that doubt was erased when the Agency, responding to a specific Congressional mandate, requested the National Research Council (NRC) to form a Committee on the Effects of Commuting on Pilot Fatigue to study and report on the issue. The first notice of this project was presented to industry on October 19, 2010, and the first meeting of this committee will not take place until **after** the comments are due to be filed herein.[18] In order to fully address the flightcrew member fatigue issue, this committee's report should have been completed **before** the NPRM was issued, thereby giving the Agency a more complete picture of the issue and affording interested parties an opportunity to comment on the NRC report in the context of the overall rule.

Moreover, the characterization of the "ARC Recommendations" in the NPRM is both misleading and prejudicial. The "Draft NPRM" submitted to the Agency clearly states that it is

---

(overturning cable TV regulations because record did not support the conclusion of the existence of the problem at which the regulations were aimed).

[17] Agencies cannot ignore significant alternatives. *See, e.g., City of Brookings Mun. Tel. Co. v. FCC*, 822 F.2d 1153, 1169 (D.C. Cir. 1987) ("In our view, the FCC has breached this duty in failing to consider the approach calling for a full-scale cost study of scientifically selected average schedule companies. The proposed alternative was certainly 'significant'").

[18] Attached hereto as Attachment B is a copy of the e-mail announcing the formation of the NRC Committee.

not a consensus document.[19] As such, it is really not an ARC recommendation at all. The Association also takes issue with the way in which the ARC "product" was submitted to the FAA. Apparently, the positions forming the basis of the "Draft NPRM" were only those of a *portion* of the ARC membership, prepared by a "Writing Committee" with no cargo industry representation and no subsequent ability to provide needed edits. The positions and detailed recommendations, including regulatory language specifically requested by the FAA[20], submitted on behalf of the all-cargo industry were relegated to an attachment to the ARC document. The clear implication was that the all-cargo positions were secondary to those of other interests. Such an implication is blatantly prejudicial since, as a matter of fact, there were four separate proposals submitted to the ARC, none of which should have taken precedence over the other. All should have been submitted to the FAA on the same plane as equal alternative proposals and, in any event, the Agency is now legally required to consider each of them carefully.

The work of the ARC forms the basis for the FAA's proposal, but the rushed ARC process imposed on it by the FAA, coupled with the focus on hours of service and the ignoring of some very real causes of fatigue, such as commuting, has now led to provisions proposed by the FAA which cannot be supported. The Association does support the need to address fatigue in aviation, but maintains that the FAA take a step back and thoroughly consider all alternatives before moving forward and finalizing the NPRM.

[19] *See* Regulatory Docket, Regulations.gov, FAA-2009-1093-0005, posted Sept. 14, 2010, Header, page 2.
[20] A copy of the CAA Draft Regulatory language submitted to the FAA is appended hereto as Attachment C.

B. THE FAA HAS VIOLATED THE PROVISIONS OF THE ADMINISTRATIVE PROCEDURE ACT BY FAILING TO GIVE INTERESTED PARTIES SUFFICIENT TIME TO PROVIDE MEANINGFUL COMMENT AND REFUSING TO SUPPLY CRITICAL INFORMATION

In spite of the fact that it took the FAA over a year from the time ARC recommendations were transmitted to the Agency to issue an NPRM containing 289 pages of exceedingly complex new regulations and economic analysis, the FAA refused to grant any extension of time whatsoever over the short 60-day period in the NPRM for the industry to submit Comments.[21] The problem of adequately responding to the FAA proposals has been further exacerbated by the fact that the NPRM raised a number of significant questions that had to be answered before a complete analysis, including complex computer modeling of the effects of the proposed rules, could be undertaken.[22] For example, attached hereto as Attachment E is the list of questions submitted by the Association in response to the FAA's request for such questions dated October 12, 2010. The FAA did not respond to these questions until October 22, 2010, (and then omitted much of the information requested) giving the Association only **23 days** to digest the FAA responses. This tight time-frame provided insufficient time for analysis and deprived interested parties the opportunity to include additional information in these Comments. In addition, the Regulatory Impact Analysis ("RIA") specifically cited a Technical Report "submitted to the docket for the scoring results of the above accidents used in this analysis."[23] However, this

[21] The Association requested a short 30 day extension of time to file comments on September 22, 2010. A copy of this Extension Request is attached hereto as Attachment D. Subsequently, after denial of this request, the Association requested reconsideration in the context of submitting clarifying questions in response to the FAA's October 12, 2010, Notice requesting such questions. At this point, the Association requested that comments not be due until 60 days after the agency provided the requested answers.
[22] *See, e.g.*, *Gerber v. Norton*, 294 F.3d 173, 179 (D.C. Cir. 2002) (APA opportunity for comment must be a meaningful one).
[23] FAA Regulatory Impact Analysis, 67 (Sept. 3, 2010).

critical document[24] was not made part of the regulatory docket until October 18, 2010, making it impossible for interested parties to review the FAA's rationale and data crucial to the FAA's final determinations until 34 days had passed since the NPRM was issued.[25]

This unwillingness to extend the comment period beyond 60 days from the original publication date is contrary to both the spirit and requirements of Executive Order 12866 ("Executive Order" or "E.O. 12866") which clearly states "… each agency should afford the public a **meaningful** opportunity to comment on any proposed regulation, which in most cases should include a comment period of not less than 60 days",[26], as well as to administrative case law.[27] Failure to provide meaningful comment opportunity harms not only regulated parties, but frustrates effective judicial review.[28] If the most rudimentary proposed regulation should contain a comment period of not less than 60 days, it is wholly unreasonable to give only 60 days in a case of the current magnitude.

This failure to give adequate opportunity for comment also violates the specific provisions of the Administrative Procedure Act ("APA"), specifically 5 U.S.C. Section 553, which requires giving interested parties ". . . an opportunity to participate in the rule making through submission of written data, views, or arguments."[29] While a comment period was provided in this case, it was not sufficient to satisfy APA requirements. First, the comment period was unreasonably short given the complex nature of the proceeding and the need for

---

[24] In actuality, this "Technical Report"turned out to be merely a spreadsheet containing data developed from NTSB Reports and accident-specific "effectiveness ratings", with no information on the criteria or method used to arrive at the stated values.
[25] *See, Gas Appliance Mfrs. Ass'n, Inc. v. Secretary of Energy*, 722 F. Supp. 792, 796 (D.D.C. (1989) (DOE's "failure to put these studies in the public record denied GAMA any opportunity to comment on DOE's reliance on them").
[26] Executive Order 12866, 58 Fed. Reg. 51735, 40 (Oct. 4, 1993) (emphasis added).
[27] *See, Honeywell Int'l, Inc. v. EPA*, 372 F.3d 441, 449 (D.C. Cir. 2004) ("agency notice must provide sufficient factual detail and rationale for the rule to permit interested parties to comment meaningfully") (internal quotation marks omitted).
[28] *See, Northeast Md. Waste Disposal Auth. v. EPA*, 358 F.3d 936, 949 (D.C. Cir. 2004).
[29] 5 U.S.C. §553 (2010).

substantial clarification by the Agency before comments could be developed. If a 60 day comment period were to be established, it should not have begun until the FAA provided the clarifying data on October 22, 2010 – not from the date of the original publication of the proposals in the *Federal Register*.

It is further significant to note that, in 1996, when the FAA issued a far less complex NPRM on the crewmember fatigue issue (FAA Docket 28081), the Agency granted interested parties **an additional 90 days** to file comments, noting that, "The extension of the comment period is warranted because of the scope and complexity of the proposal and the need to allow time for commenters to consider the agency's response to the above questions."[30] The situation with respect to the current NPRM is closely similar to the situation in 1996 that warranted a 90 day extension. Again, there is an immensely complex proposal put forth to deal with the issue of crewmember fatigue and a set of clarifying questions to which the FAA responded over a month after the original publication of the proposed rules. Yet, in the present case, absolutely no extension was granted. There is simply no rational way to argue that there is a difference between the two proposals that could possibly justify the rigid position on the requested extensions that the FAA has taken herein.

In addition, the Agency still has not provided all the information necessary to prepare effective comments.[31] More specifically, in spite of a specific request to do so, the FAA has failed to produce the data necessary to assess the validity of various assumptions made in the Agency's Regulatory Impact Analysis (see details below in the discussion of the Regulatory Impact Analysis). This failure violates both the APA and the Information Quality

[30] Flight Crewmember Duty Period Limitations. Flight Time Limitations and Rest Requirements; Notice of Proposed Rulemaking; Extension of Comment Period, 61 Fed. Reg. 11492 (March 20, 1996).
[31] *See also, National Classification Committee v. United States*, 779 F.2d 687, 695 (D.C. Cir. 1985) (agency is barred from relying on data known only to itself).

Act of 2000 ("IQA")[32]. The omission of significant portions of the information relied upon by the Agency is, not merely a procedural flaw, it has deprived the Association of the opportunity fully to develop its arguments herein.

In reviewing the actions of federal agencies, the Courts look to the specific provisions of the APA. As noted by the United States Court of Appeals for the District of Columbia Circuit, "Under the APA, we must set the rule aside if it is 'arbitrary, capricious, an abuse of discretion, or otherwise not in accordance with law,' 5 U.S.C. section 706(2)(A), or if it was promulgated 'without observance of procedure required by law'. . . ."[33] The instant NPRM fails to meet these standards.

An extensive body of D.C. Circuit cases explains how the APA's procedural mandates map onto agency obligations to provide meaningful comment opportunities. Relying on Section 553(b)(3) of the APA (Agencies must ". . . give interested persons an opportunity to participate in the rulemaking through submission of written data, views, or arguments"), the Court has clearly ruled that, integral to the APA requirements ". . . is the agency's duty 'to identify and make available technical studies and data that it has employed in reaching the decisions to propose particular rules. . . . An agency commits serious error when it fails to reveal portions of the technical basis for a proposed rule in time to allow for meaningful commentary.'"[34] Perhaps the most graphic explanation of the APA requirements is found within the case of *Connecticut Light and Power Co. v. Nuclear Regulatory Commission* wherein the Court found that "[t]o allow an agency to play hunt the peanut with technical information, hiding or disguising the

---

[32] 44 U.S.C. §3516 note (b)(2)(B) (2010).
[33] *Owner-Operator Independent Drivers Association v. Federal Motor Carrier Safety Administration*, 494 F.3d 188 (D.C. Cir. 2007).
[34] *Solite Corp. v. EPA*, 952 F. 2d 473, 484 (D.C. Cir. 1991), quoting *Connecticut Light and Power Co. v. NRC*, 673 F. 2d 525, 530-31 (D.C. Cir. 1982).

information that it employs, is to condone a practice in which the agency treats what should be a genuine interchange as mere bureaucratic sport."[35]

In the instant case, the FAA, in the NPRM, failed to include the data necessary for interested parties to effectively analyze the proposed rule, and then compounded this deficiency by failing to disclose this information even after specific requests for the data (see detailed discussion of the specific requests at pages 38-39 *infra*.) were made in response to an FAA Notice soliciting any such requests for further information.[36]

Nor is the FAA's failure to provide the information necessary to assess the validity of its conclusions consistent with the IQA. Under the IQA, an agency must "establish administrative mechanisms allowing affected persons to seek and obtain correction of information maintained and disseminated by the agency."[37] The FAA's failure to provide data after specific requests for it cannot be squared with this express statutory command.

C. <u>FAA FAILED TO ADDRESS THE IMPACT OF INTERNATIONAL TRADE AND INVESTMENT</u>

As the FAA is keenly aware, the aviation industry operates in a global marketplace. Rules promulgated by the United States government have a very real international impact on both United States and foreign air carriers. The U.S. government recognizes the relationship between the application of U.S. law and European Union ("EU") legislation in many areas, not just transportation. In fact, in May 2008, the Office of Management and Budget ("OMB") co-authored a report with the Secretariat General of the European Commission entitled, "*Review of the Application of EU and US Regulatory Impact Assessment Guidelines on the Analysis of Impacts on International Trade and*

[35] 673 F.2d at 530.
[36] Flightcrew Member Duty and Rest Requirements; Notice of Procedures for Submission of Clarifying Questions, 75 Fed. Reg. 62486 (Oct. 12, 2010).
[37] 44 U.S.C. §3516 note (b)(2)(B) (2010).

Investment".[38] The report notes that, Executive Order 12866 states in its introduction, that "private sector and private markets are the best engine for economic growth."[39] In Section 6 (a)(3)(C)(ii), the Executive Order also states that agencies, for economically significant regulatory actions under Section 3(f)(1), have an obligation to provide an assessment of "any adverse effects on the efficient functioning of the economy, private markets (including productivity, employment, and competitiveness), health, safety, and the natural environment), together with, to the extent feasible, a quantification of those costs."[40] As international trade is a key component of the efficient functioning of private markets, agencies have an obligation to consider such trade impacts in their Executive Order 12866 analyses for economically significant rulemakings.

OMB Circular A-4, Regulatory Analysis, elaborates on this requirement established by the Executive Order for economically significant rules. Specifically, it states that:

> The role of Federal regulation in facilitating U. S. participation in global markets should also be considered. Harmonization of U.S. and international rules may require a strong Federal regulatory role. Concerns that new U.S. rules could act as non-tariff barriers to imported goods should be evaluated carefully.[41]

While Circular A-4 does not offer clear guidance on how to consider the international trade and investment effects of U.S. regulation, Executive Order 12866 does ask for a description of distributional effects (i.e. how benefits, costs, and transfers are distributed among sub-populations of particular concern) so that decision makers can properly consider them along with the effects on economic efficiency.

In this case, the FAA failed to properly analyze the impact of its proposal on international trade and certainly how such a rule would put U.S. air carriers at an economic disadvantage vis-a-vis their foreign air carrier competitors.

---

[38] *Review of the Application of EU and US Regulatory Impact Assessment Guidelines on the Analysis of Impacts on International Trade and Investment*, Final Report and Conclusions, Brussels/Washington DC, May 2008.
[39] *Id.* at 11.
[40] *Id*.
[41] *Id.* at 12.

V. THE FAA PROPOSAL

A. OVERVIEW

The flightcrew member duty and rest regulations proposed by the FAA would replace existing rules designed to promote safety **for passengers** by ensuring that flightcrew members are adequately rested when operating aircraft. Accordingly, the FAA has clearly stated that "[t]he objective of the proposed rule is to **increase the margin of safety for passengers** traveling on U.S. part 121 air carrier flights."[42] Perhaps this is why the Agency applied a passenger airline model in developing the NPRM, but it cannot explain why members of the all-cargo industry should be included under the same model, with no consideration given to the all-cargo industry's different operational characteristics.

While parts of the NPRM might enhance safety, others are either unneeded from a safety standpoint, operationally unwieldy and/or completely unsupportable scientifically. And overlaying the entire structure of the proposed regulations is this question -- **can any demonstrated benefits be justified when compared with the multi-billion dollar cost of implementation?** Each of these elements of the proposed rule will be discussed below.

In order to assist the Association in its analysis, in partnership with the Air Transport Association, two of the most respected experts in the area of sleep science and fatigue were engaged to provide their analysis of the science allegedly embedded in the proposed rule. The report of these scientists, Dr. Gregory Belenky, Director of the Sleep and Performance Research Center at Washington State University and Dr. R. Curtis Graeber, leader of ICAO's Fatigue Risk Management Task Force, is appended hereto as Attachment F. ("Belenky-Graeber"). In addition, the Association retained the services of the Campbell-Hill Aviation Group ("Campbell-

[42] 75 Fed. Reg. at 55881 (emphasis added).

Hill Report" or "Campbell-Hill") to assist in the analysis of the Agency's Regulatory Impact Analysis. The Campbell-Hill report is attached as Attachment G.

B. <u>THE NEED FOR INCREASED REST</u>

Although, as discussed below, there are virtually no demonstrable safety benefits that would result from imposing the proposed rules on members of the all-cargo industry, the Cargo Airline Association believes that changes in the current system can be made which might reduce fatigue among flightcrew members, if any such changes are carefully designed. For example, proposed **Section 117.25(d)** requires a nine consecutive hour rest period, measured from the time the crewmember reaches the rest facility or home, before beginning a reserve or flight duty period ("FDP"). The CAA strongly agrees that **the opportunity for adequate rest is the cornerstone of an effective fatigue mitigation strategy** and our proposal would therefore increase rest requirements from the current 8 hours to 10 hours (domestic operations) or 12 hours (international operations) [43].

These rest periods would be measured from the time that the crewmember is released from duty. We urge the FAA to adopt the CAA approach. If any rest period is measured from the time the crewmember reaches the rest facility (as proposed by the FAA), air carriers will

---

[43] The difference between the proposals for domestic and international operations takes into account the time required to clear customs and other time consuming requirements at international destinations. For purposes of the CAA Proposal, "Domestic Operations" are defined as:

i. Operations between any points within the contiguous States of the United States or the District of Columbia; or
ii. Operations solely within the 48 contiguous States of the United States or the District of Columbia; or
iii. Operations entirely within any State, territory, or possession of the United States; or
iv. When specifically authorized by the Administrator, operations between any point within the 48 contiguous States of the United States or the District of Columbia and any specifically authorized point outside of the 48 contiguous States of the United States or the District of Columbia, or operations between any two specifically authorized points located outside of the 48 contiguous States of the United States.

have no certainty as to when that crewmember may be scheduled for future operations since the carrier has no control over the time between release from duty and "check in" at a suitable rest facility. What if the crewmember eats a lengthy meal, visits friends or relatives, or engages in any number of possible recreational activities before going to the facility? The values proposed by CAA (which are greater than those proposed by the Agency), on the other hand, will provide enough time for the crewmember to reach the rest facility **and** will allow carriers to schedule their crews with more certainty. The impact on the all-cargo industry of the FAA's proposed rule, starting the rest-period clock from the time crewmembers reach rest facilities, is an important aspect of the problem that the FAA cannot ignore.[44]

C. VALIDATED SLEEP SCIENCE MUST SUPPORT REGULATORY CHANGES TO ADDRESS FLIGHTCREW MEMBER FATIGUE

Before dealing with additional individual sections of the NPRM, it is useful to understand the status of sleep science as it pertains to the aviation environment. All parties to the current debate agree that any regulations must be based on the best available information and should be driven, to the extent possible, by solid scientific principles.[45] The FAA ARC, for example, received presentations from a variety of scientists, including Dr. Belenky, dealing with various areas of sleep science. However, "[w]hile the principles of sleep science are generally well

[44] *See, Motor Vehicle Mfrs. Ass'n of the U.S., Inc. v. State Farm Mut. Auto Ins. Co.*, 463 U.S. 29, 43 (1983) ("Normally, an agency rule would be arbitrary and capricious if the agency has relied on factors which Congress has not intended it to consider, entirely failed to consider an important aspect of the problem, offered an explanation for its decision that runs counter to the evidence before the agency, or is so implausible that it could not be ascribed to a difference in view or the product of agency expertise").
[45] Any other approach would violate the Supreme Court's definition of the standards for sifting true science from substandard science, on which it would be arbitrary and capricious for an agency to rely. *See, Daubert v. Merrell Dow pharmaceuticals Inc.*, 509 U.S. 579 (1993). *See also, Niam v. Ashcroft*, 354 F.3d 652, 660 (7th Cir. 2004) (Posner, J.) ("[T]he spirit of *Daubert* does apply to administrative proceedings," since "[j]unk science has no more place in administrative proceedings than in judicial ones."); 44 U.S.C. Section 3516 note (b)(2)(A) (requiring agencies to "issue guidelines ensuring and maximizing the quality, objectivity, utility, and integrity of information (including statistical information) disseminated by the agency").

understood and accepted, their practical application to any operational environment, including aviation, is very much a work in process."[46] Drs. Belenky and Graeber go on to conclude that:

> The goal of the NPRM is to put together a system of regulations or, alternatively, a framework to enable the implementation of an FRMS, to manage the complex interaction between sleep loss, circadian rhythm phase, and workload in order to reduce fatigue risk by preventing error, incident, or accident. The complex interaction of three factors causing fatigue is not easily captured in a set of prescriptive rules and is in our opinion much more amenable to management by an FRMS.[47]

Significantly, an alternative way of managing aviation-related fatigue solely through the use of an FRMS was never actively considered by the FAA, in spite of specific requirements to do so.[48]

The Association strongly supports the FRMS concept and urges the FAA to convene, as quickly as possible, a joint government-industry task force, including representatives from the all-cargo industry, to develop the parameters of an effective FRMS system. It is extremely important that any established FRMS contain a complete description of the data to be supplied and the precise requirements for Agency approval.

VI. SPECIFIC AREAS OF THE NPRM THAT CANNOT BE SUPPORTED

Although agreeing that increased rest is an important element of any fatigue mitigation strategy, as noted above, there is no rational or scientific basis for many of the other FAA proposals. Described below are several specific sections of the NPRM that pose very significant problems for members of the all-cargo industry. In addition, appended hereto as Attachment H are the Association's answers to 35 questions posed by the FAA in the NPRM. Taken together, the narrative (along with accompanying attachments) and the answers to the FAA questions constitute the CAA response to the substantive portions of the NPRM.

---

[46] *Scientific Issues with NPRM*, Gregory Belenky, M.D. and R. Curtis Graeber, Ph.D. (Belenky-Graeber), p. 1 (Nov. 5, 2010).
[47] Belenky-Graeber, pp. 1-2.
[48] *See*, for example, Executive Order 12866, 58 Fed. Reg. 51735 (October 4, 1993).

A. SECTION 117.9 -- SCHEDULE RELIABILITY

The regulatory requirements of this section apply to circumstances wherein **scheduled** flight times are exceeded, irrespective of whether or not **maximum** flight duty periods have been breached. The Association submits that this section constitutes little more than an unnecessary and unwarranted government intrusion into the area of labor-management relations and that the section should be deleted as currently written. This part of the proposed rule clearly violates the *Chevron* bounds of the FAA's authority under its organic statute.[49] The FAA principally relies on 49 U.S.C. Section 44701(a)(5) to support its proposed rule (and only secondarily invokes Subsection (a)(4), *See* 75 Fed. Reg. at 55881).[50] But **both** of those provisions limit the FAA's regulatory powers to **safety** regulation, and do not permit the agency to regulate for other purposes.[51] Regulations to serve other objectives, whether those of labor policy or any other non-safety objectives, are, quite simply, *ultra vires.*

Within the parameters of the maximum FDPs, carriers must have the operational flexibility to manage their crewmember schedules as they see fit (or consistent with negotiated collective bargaining agreements) without interference by a government agency acting pursuant to a safety mandate. At the same time, we agree that it is relevant to know the extent of any operations that exceed the maximum allowable flight duty periods and would not object to a reasonable reporting scheme that requires carriers to detail occurrences that go beyond maximum limits and to adjust schedules if such limits are consistently being exceeded.

---

[49] *See, Chevron U.S.A. v. NRDC*, 467 U.S. 837, 842-43 (1984). *See also, Doe v. Department of Transportation, FAA*, 412 F.2d 674 (8th Cir. 1969) (purpose of the Federal Aviation Act is safety).

[50] The FAA's principal reliance on the catch-all in Section 44701(a)(5) does not augment its powers beyond safety regulation. Subsection (a)(5) is a catch-all permitting additional forms of regulation beyond setting maximum hours, but does not remove the requirement that the agency be acting to promote safety.

[51] *See* 49 U.S.C. Section 44701(a)(4) ("regulations ***in the interest of safety*** for the maximum hours or periods of service of airmen and other employees of air carriers"); 49 U.S.C. Section 44701 (a)(5) ("regulations and minimum standards for other practices, methods, and procedure the Administrator ***finds necessary for safety*** in air commerce and national security").

Similarly, the Association opposes the provision in the proposed **Section 117.15(c)(2)** that would prohibit extensions of the flight duty period more than once in any 168 consecutive hour period. This provision unreasonably restricts carriers' ability to effectively manage its crew scheduling, is contrary to the position of the ARC which would prohibit extensions on consecutive nights but not limit the extensions to one in each 168 hour period, and is not supported by scientific principles. As noted by Drs. Belenky and Graeber:

> There is clear scientific evidence that extended work hours over consecutive work days reduces the opportunity for sleep and can lead to cumulative sleep loss and fatigue. **However there is no clear scientific evidence to support restricting an extension of greater than 30 minutes and less than or equal to 2 hours to once in 7 days.**[52]

B. SECTION 117.13 -- FLIGHT TIME RESTRICTIONS

Section 117.13 of the proposed regulations would impose limits on flight time within a flight duty period. The Association submits that there is no need for this prescriptive regulation and urges that it be deleted from the Final Rule. Eliminating this requirement would be consistent with both international practice (see, for example, UK CAA CAP 371 and EU Ops Subpart Q) and scientific principles. As noted by Drs. Belenky and Graeber:

> There are no scientific papers supporting the idea that flight time should be treated differently from duty time except perhaps in so far as they involve differences in workload. Workload in the commercial aviation context is thought of primarily in terms of number of segments, specifically number of takeoffs and landings. Since both number of segments and circadian timing are taken care of in the duty time limits there is no rationale for putting further limits on flight time.[53]

As if to underline this position, the FAA, in October 2002, considered a "no daily flight time limit" option in its Draft Regulatory Impact Analysis noting:

> Under Option Three, the FAA proposes no daily flight time limit, for any size crew. Under this option the duty period limit and rest period requirements would provide the protection against fatigue. This option provides more scheduling flexibility than option

[52] Belenky-Graeber, p. 2 (emphasis added).
[53] Belenky-Graeber, p. 6.

one or option two for certificate holders and flight crews. **The FAA does not believe this would result in overly tiring flight schedules. . . .** [54]

The Cargo Airline Association proposal recognizes these issues by providing for a flight duty period that is shorter than current regulatory requirements, a rest period longer than that currently in effect, and different duty limits based on time of day and number of segments.[55] These initiatives are more than sufficient to mitigate fatigue and obviate the need for the regulation of flight time.

C. SECTION 117.19(C)(1)(2) AND (3)

This Section requires, *inter alia*, that the last segment of an augmented flight must provide the flightcrew opportunity for two hours of consecutive rest. As a practical matter, this requirement is simply impossible to meet, especially when the final segment is a duration which is shorter than four hours. And such short final segments are not isolated occurrences, but rather the norm in all-cargo operations. Implementation of these provisions will therefore have a dramatic adverse impact on members of the industry by forcing air carriers to drastically alter operations that are tailored to the needs of customers worldwide.

In addition to the fact that finalization of Sections 117.19(c)(1-3) will severely restrict operational flexibility, it should be noted that the "final leg-two hour rest provision" is totally unnecessary from a scientific perspective. As explained by Drs. Belenky and Graeber:

> . . . a last segment may be too short to encompass a 2-hour sleep period in which case the rest period may need to occur in the previous segment. The science would also support an additional rest shorter than 2 hours before the top of descent since the data suggest that any sleep longer than 20 minutes provides full minute-by-minute recuperative value

[54] *Draft Regulatory Impact Analysis, Initial Regulatory Flexibility Analysis, International Trade Impact Assessment, and Unfunded Mandates Assessment: Flight Crewmember Duty, Flight and Rest Requirements (Part 121),* at 6-7. (emphasis added).

[55] Recognizing that flight time limits are being considered by the FAA, the CAA proposal also includes suggested flight time limits should the Agency determine to move forward with this flawed regulatory approach.

> (Bonnet and Arand, 2003). This value was dramatically demonstrated in NASA's study of the effectiveness of controlled rest on the flight deck where the pilot's rest was not obtained in a bunk but rather in his assigned duty seat (Rosekind, et al., NASA Technical Memorandum108839, 1994). . . Since naps longer than 30 minutes have the same minute-by-minute recuperative value as longer naps and main sleep periods and the recuperative effect of sleep is cumulative across sleep periods, it is also possible that the 2 hour sleep opportunity could be broken up and distributed over more than one segment.
>
> Furthermore, if the short segment was the final segment, and the required rest were allowed to occur during the last 6 hours of duty, then it may be appropriate to reduce the manipulating pilot's workload by limiting the pilot to only one landing after his or her rest.[56]

In short, while the Association recognizes the need for a well-rested pilot to be at the controls during the final leg of an augmented flight, there is no reason to impose the overly restrictive requirements of Section 117.19(c). Rather, any new regulation must adopt, not ignore, applicable science and provide that any required rest can be spread over different flight segments.

D. THE NPRM'S "LOWER END" FLIGHT DUTY PERIOD VALUES MUST BE ADJUSTED UPWARD

The Association also takes issue with the NPRM's "lower end" values for the Flight Duty Period, especially for segments 1 through 4.[57] These values would require FDPs as low as 9 hours during hours when a majority of all-cargo operations are conducted. CAA submits that these FAA values are unsupported (and unsupportable) by any scientific data and are significantly lower than current international standards.[58]

[56] Belenky-Graeber, p. 5 (emphasis added).
[57] *See* 75 Fed. Reg. at 55859.
[58] Both CAP 371, The Avoidance of Fatigue in Aircrews, Civil Aviation Authority (Jan. 2004) and EU Ops Subpart Q, European Commission Regulation (EC) No. 859/2008 (EU Ops Subpart Q) (Aug. 20, 2008) contain a lower limit of 11 hours for FDPs.

Indeed, it is significant to note that the Campbell-Hill Report, using statistical data analyzed by Professor John Imbrie of the University of Virginia, has concluded, using FAA methodology, that **no** regulation of duty time short of the 15th hour is even necessary or appropriate. As the Campbell-Hill Report notes:

> The report (FAA Regulatory Impact Analysis) uses Chi-square analysis to test for statistical significance of differences between accident rates at different times within the pilot's duty period. . . .***Because the data indicate an increase in accidents only in the 15th hour and beyond, it is important to realize that restrictions on duty hours below this point are not justified by the evidence presented by the FAA. From the point of view of benefit-cost analysis, there is no benefit to limiting duty time below the 15th hour of duty*.**[59]

Campbell-Hill goes on to conclude that the nonparametric Kolmogorov-Smirnov test to measure the statistical significance of the variations in accident rates with duty time confirms the Chi-square results.

The alternative proposal submitted by the Association understands, and takes into account, the Campbell-Hill conclusions and adjusts the FDPs downward to match the FDPs to the operational requirements of industry members. Therefore, we urge that the minimum FDP value for segments 1 through 4 be at the CAA-recommended 11 hours.

E. SECTION 117.21 -- RESERVE STATUS

Although the ARC members actually reached consensus on the **issue of how to manage reserve status,** for all practical purposes**,** the FAA, in the NPRM, has chosen to reject these recommendations. Of primary concern is the decision of the Agency to classify short call reserve as "duty".[60] This determination would, if finalized, seriously limit the ability of air

[59] Campbell-Hill, p. 52.
[60] 75 Fed. Reg. at 55887.

carriers to effectively use their reserve pilots and is totally unnecessary from a scientific perspective. As explained by Drs. Belenky and Graeber:

> Being on short-call reserve is **not** being on duty. Short-call reserve does not entail any significant work load. . . . By declaring being on short-call reserve as being on duty, the FAA is effectively claiming that being on short-call reserve, i.e., being available at home or in a hotel to answer the phone, is as fatiguing as flying an airplane. **There is no scientific much less operational support for the claim that flight duty and short-call reserve are equivalent in terms of fatigue.**[61]

It is also important to point out that, by declaring short-call reserve to be duty, the FAA is proposing to create a situation whereby deadheading pilots with adequate on-board sleeping accommodations can have their duty periods extended by up to 10 hours, while no such extensions are provided for short-call reserve pilots, although such pilots also have adequate, or better, rest opportunities at home or in a hotel.

In view of these facts, the Association submits that there is no basis for declaring short-call reserve "duty" and this provision should be deleted from any Final Rule.

F. <u>SECTION 117.17 -- SPLIT DUTY</u>

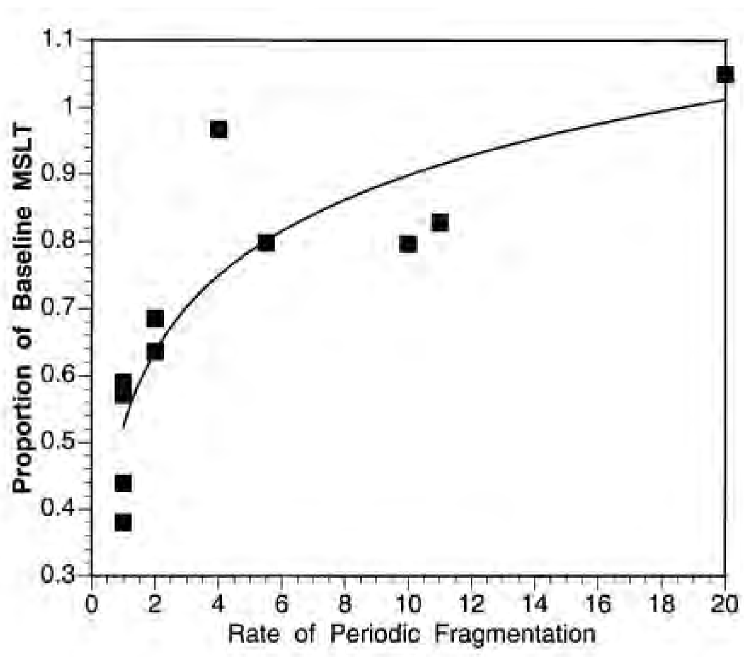
Split Duty is essentially "duty" where there is a "gap" between the actual flight segments flown by flightcrew members. The split duty concept is commonplace among the operations of the all-cargo air carriers, especially those engaged in the express cargo business. Split duty provides flightcrew members with the opportunity to rest and the FAA appropriately recognized this concept. However, the Association would recommend a different method to determine exactly how much credit in the form of an extension to the FDP period should be allotted for any given rest opportunity between flight segments.

[61] Belenky-Graeber, pp. 2-3 (emphasis added).

The Association again reiterates its strong support for the concept of allowing credit for rest obtained during a flightcrew member's "down time", but submits that accepted scientific information reveals that it is not necessary for a flightcrew member to have a minimum of four hours rest for such a flight duty period extension to be applicable.

As noted by Drs. Belenky and Graeber:

> In actuality, the science suggests that any sleep longer than 20 minutes provides full minute-by-minute recuperative value (Bonnet and Arand, 2003; see Figure 2). For napping during nighttime operations, assuming the normal adult sleep latency for that time of day of between 5 and 10 minutes, any time behind the door of more than 30 minutes would have recuperative value. **The requirement that the sleep opportunity must be at least 4 hours in duration before granting an extension of duty of 50% of the time spent behind the door is not supported by science**. Any time behind the door beyond 30 minutes should be given the time behind the door extension credit. The 50% of the time behind the door extension credit is especially conservative for sleep obtained in a suitable rest facility on the ground during usual bedtime hours but may be warranted for split duties that require daytime sleep.[62] [63]



---

[62] Belenky-Graeber, pp. 3-4.

[63] It should be noted that the FAA proposes to give more credit (75%) for airborne rest than for sleep facility time. This anomaly is counterintuitive and suggests that airborne rest is somehow better than rest in near hotel room conditions. If a 75% credit is appropriate for airborne rest, the same percentage should be given for rest facility time.

Figure 2 – Proportion of baseline multiple sleep latency test (MSLT) representing the minute-by-minute recuperative value of sleep (the higher the proportion the more recuperative value per minute of sleep) plotted as a function of rate of sleep fragmentation (the interval of time between awakenings or partial awakenings during the night). The shorter the interval between sleep fragmenting events, the less the recuperative value. When sleep is fragmented at one minute intervals the proportion and hence recuperative value is near zero. When sleep is fragmented every 20 minutes the proportion is near 1 to 1 indicating full minute-by-minute recuperative value with sleep broken every 20 minutes when compared to normal, continuous, unbroken sleep. Adapted from Bonnet and Arand (2003).[64]

In view of these scientific findings, the Association urges that the FAA revise its split duty formula to provide that:

Any period of at least one hour of rest "behind the door" can be considered for credit toward extending FDPs. Rest behind the door is defined as the total time in the sleep facility minus 30 minutes. The 30 minutes allows time to fall asleep as well as recover from sleep prior to reporting. For example,

Duty Start	Credit to FDP limit
1700-0359	1 to 1
0400-0659	2 to 1
0700-1659	3 to 1

In no case through the use of split duty extensions should a FDP exceed 15 hours operational. Nor should split duty apply to augmented operations.

G. SECTION 117.27 -- CONSECUTIVE NIGHTTIME OPERATIONS

This one-sentence provision states that flightcrew members may not be scheduled for more than three consecutive nighttime flight duty periods unless such flightcrew member is provided the rest set forth in Section 117.17, i.e., four hours behind the door during split duty.

[64] Belenky-Graeber, pp. 3-4.

Since all-cargo operations are typically during nighttime hours, this provision has the potential for seriously disrupting the normal business operation of Association members. Drs. Belenky and Graeber have also addressed this issue in their Report. As they note:

> Assuming the goal of the NPRM is to assure 7-8 hours of sleep per 24 hours, the issue of consecutive night duties is critically tied to the ability of the split duty rest periods to provide sufficient sleep. In a recent study comparing the sleep of physicians working night shifts and day shifts (McDonald et al., 2010, it was found that they got equivalent amounts of sleep (i.e., approximately 7 hours)) when working either type of shift. When working days their sleep was consolidated into a single 7 hour sleep period at night. When working nights, they split their sleep averaging 4 hours of sleep off duty during the day and three hours of sleep on duty at night. Performance tested when going on and off shift was equivalent for day and night shifts. It is therefore important to realize that the NASA study of night cargo operations showed that crews obtained 5 hours sleep during each day after duty. This is similar to other studies on shift workers (Akerstedt, 2003) that found that they also slept 5 hours during daylight hours. **Obtaining another 2 hours of sleep during split night duty should sustain performance across more than 3 consecutive nights.** This is supported by Mollicone et al's laboratory studies (2007, 2008) that showed that following restricted sleep for the same total sleep time performance was the same whether the sleep was consolidated into a single sleep period or split into two sleep periods.[65]

Given this clear scientific evidence, and anecdotal evidence that suggests that the **first** of a series of flights is more tiring than a fourth or fifth night, the Association urges that Section 117.27 be modified to provide that the three consecutive night restriction does not apply if there is the opportunity for 7 hours of sleep when combining split duty rest with the opportunity for rest during daylight hours.

H. SECTION 117.5 -- COMMUTING

The FAA's approach in the area of commuting is highly flawed. All anecdotal evidence indicates that excessive commuting may be the most prevalent cause of crewmember fatigue. And it is clear that commuting more than two hours to work has become a staple of commercial pilot activity. As stated by Captain Chesley "Sully" Sullenberger:

[65] Belenky-Graeber, p. 4 (emphasis added).

> Lorrie and I wanted to remain in California, so like others based far from home, I've made a decision to commute across the country to start my work. We have chosen this life, and I'm grateful the airline allows it. **Still, the logistics of it are wearying**.[66]

Indeed, the catalyst for this entire rulemaking effort was the Colgan Air crash on February 12, 2009, in Buffalo, New York, where, to the extent that fatigue was an issue, it was caused by overnight commuting by the first officer from the West Coast to the East Coast.[67]

The FAA proposal to deal with commuting is Section 117.5 entitled "Fitness for Duty". This section of the NPRM is completely inadequate. It simply provides that flightcrew members must report fit for duty and that the certificate holder must assure that no fatigued crewmember is assigned to a flight.[68] In essence, a large part of the burden for ensuring that fatigued crewmembers do not operate aircraft is suddenly shifted to the air carrier, with no objective standards for measuring fatigue set forth. For example, Section 117.5(b) provides that a certificate holder may not assign a flightcrew member to a flight duty period if the certificate holder ". . . believes that the flightcrew member is too fatigued to safely perform his or her assigned duties."[69] Is this purely subjective or are there scientific standards to be applied? Similarly, sections 117.5(d) and (e) require that "any person" who suspects a flightcrew member is fatigued to report that information to the certificate holder and, once notified, that the certificate holder "must evaluate" the crewmember's fitness for duty.[70] What standards are to be applied for such notifications and evaluations? Are there scientific tests to be administered? What is FAA's intent in the scope of the term "any person"? Is this limited to an air carrier's direct employees or could this mean anyone who comes into contact with that flightcrew member? The Agency's response to such questions is simply a reference to AC 120-100, *Basics*

---

[66] Sullenberger, Captain Chesley, *Highest Duty*, Harper Publishing (Paperback), 2010, p. 20 (emphasis added).
[67] In actuality, fatigue was never found to be a cause of this tragedy.
[68] *See* 75 Fed. Reg. at 55885.
[69] *Id.*
[70] *Id.* at 55885-6.

of Aviation Fatigue (June 7, 2010) and a statement that it ". . . has already drafted a training AC [Advisory Circular] that provides information on how to recognize the signs of fatigue."[71]**.** However, "[n]o other specialized training, or use of specific medical equipment or personnel is contemplated. A certificate holder could develop its own checklist to ensure that all evaluations are conducted using the same criteria."[72] Simply stated, the FAA has dealt with perhaps the most important element of pilot fatigue by creating an amorphous regulation with no objective criteria and requiring carriers to make on-the-spot, highly subjective, determinations of whether a crewmember is fatigued. The industry and the public deserve more. Perhaps the new National Research Council committee established to study commuting in the context of airline operations will shed some light on this subject, but that committee will not even hold its first meeting (much less make any recommendations) until one week after Comments are due herein. Therefore, the industry has been deprived of the opportunity to present effective comments on a major issue in the context of a proposed rule because much of the information needed to prepare such comments has not yet been developed.

VII. POTENTIAL UNINTENDED CONSEQUENCES

In addition to the direct impact of the proposed rules, the FAA should be aware of, and take into consideration, potential unintended consequences of implementing the rules as currently written. For example, as detailed in the Campbell-Hill Report compliance with the proposed rules will require the hiring of an additional 1,731 pilots in the all-cargo industry alone. Where will these pilots come from? Most likely they will be drawn from the ranks of

[71] FAA *Response to Clarifying Questions, 14 CFR parts 117 and 121*, p. 5 (Oct. 22, 2010).
[72] *Id*. at 6.

crewmembers currently working for regional air carriers. If that is the case, from what pool will the regional carriers replace the pilots defecting to the major passenger or all-cargo carriers – especially in view of the new requirement that commercial pilots have 1,500 hours experience, a requirement included in P.L. 111-216 signed by the President on August 1, 2010. With few real options, what will be the real world impact on regional air service – both for passenger and all-cargo operators?

Simply stated, implementation of the current FAA proposals seriously threatens the current system of regional air transportation, with a resultant potential loss of critical air service to the smaller communities of the United States. The FAA must consider this likely result as a serious problem with its proposed approach.[73] The U.S. all-cargo industry prides itself on being able to deliver packages overnight to and from every point in the country, thereby allowing these smaller communities complete access to the United States and worldwide marketplace. Compromising the ability of regional feeder service to continue its current level of service will therefore have a severe impact on the entire economy.[74] All such "societal costs" are captured by the Campbell-Hill Report, Appendix B, either directly or as part of the "multiplier effect" to the direct costs.

Another unintended consequence of implementing the proposed rules will be that, by restricting the hours for the most experienced pilots and replacing them with hours for the least experienced pilots, there is a danger that safety will be degraded. More experience and training

---

[73] *See, Office of Communication of the United Church of Christ v. FCC*, 779 F.2d 702, 707 (D.C. Cir. 1985) (reasoned decisionmaking requires agency not employ means that undercut its ends).

[74] Executive Order 12866, issued by President Clinton on October 4, 1993, (58 Fed. Reg. at 51735, et seq.), requires agencies to provide an assessment of "…any adverse effects on the efficient functioning of the economy…." E.O. 12866, 58 Fed. Reg. at 51741. By ignoring the impact on regional air service and small community air service, the FAA has failed to address this requirement.

in the unique operations flown by individual carriers translates into safer skies; introducing over 1,700 new pilots in a relatively short time frame will necessarily reduce this experience level.

VIII. THE REGULATORY IMPACT ANALYSIS

Executive Order 12866 provides the framework for analyzing federal regulatory proposals.[75] It sets forth the requirement, among others, that agencies must ". . . assess both the costs and benefits of the intended regulation and . . . propose or adopt a regulation only upon a reasoned determination that the benefits of the intended regulation justify its costs."[76] The agency must also "… identify and assess available alternatives to direct regulation…."[77] E.O. 12866 considerations are relevant to the FAA's substantive regulatory requirements because of the public interest mandate that the FAA has been given when promulgating regulations under Section 44701(a). *See*, 49 U.S.C. Section 44701(f).[78] In addition, the FAA may impose safety regulation only to the extent that such mandates do not become counterproductive.[79] Regulations that flunk the most basic of cost-benefit tests go beyond the degree of safety regulation that is possible in the public interest.

The detailed requirements of the Executive Order have been articulated by the Office of Management and Budget ("OMB") in OMB Circular A-4 which orders the heads of all governments to provide "an examination of alternative approaches."[80] It also requires that the agencies' analyses be transparent, i.e, "[i]t should be possible for a qualified third party reading

---

[75] 58 Fed. Reg. 51735, et seq.
[76] 58 Fed. Reg. at 51736.
[77] *Id.*
[78] The public interest regulatory mandate that constrains the FAA here is also itself constrained by a mandate to move conduct in and out of regulation based only on a consistent approach, *See, Airmark Corp. v. FAA*, 758 F2d. 685 (D.C. 1985).
[79] *See*, 49 U.S.C. Section 44701(d)(1)(A) ("highest **possible** degree of safety in the public interest.")(emphasis added).
[80] Office of Management and Budget Circular A-4 (Sept.17, 2003) p. 2.

the report to see clearly how you arrived at your estimates and conclusions."[81] And the OMB Circular goes on to conclude that "[a] good analysis provides specific references to all sources of data, appendices with documentation of models (where necessary), and the results of formal sensitivity and other uncertainty analysis."[82] **The FAA Regulatory Impact Analysis fails on each and every count.**

In fact, the Regulatory Impact Analysis in this case does not even comply with the Agency's own requirements for those requesting federal airport funding. On December 15, 1999, the FAA published its *FAA Airport Benefit-Cost Analysis Guidance* ("Guidance Document") which mirrors the requirements of Executive Order 12866 and OMB Circular A-4. As detailed in the attached Campbell-Hill Report, the Agency failed to follow its own guidelines by:

- Failing to properly define the project objective;
- Failing to state and justify the assumptions made in constructing the proposed rules;
- Failing adequately to identify and define a base case;
- Failing to identify and screen reasonable alternatives;
- Failing to determine an appropriate evaluation period;
- Failing to identify, quantify and evaluate benefits and costs;
- Failing to compare the benefits and costs of viable alternatives; and
- Failing to perform the necessary sensitivity analysis.

The FAA has also failed to comply with its own benefit-cost analysis guidelines for regulatory initiatives as outlined in its *Economic Analysis of Investment and Regulatory Decisions – Revised Guide*, January 1998 ("Economic Analysis Guide"). More specifically, there is not a

[81] *Id.*
[82] *Id*. at 3.

valid determination of which accidents could have been prevented by the proposed regulation; the assessment of the extent of death, injury and damage mitigation is flawed; and many of the proposal's judgments are based on emotional or political appeal and not valued in dollar terms.[83] Put somewhat differently, the FAA's conclusions are not rooted in facts or based on empirical analysis. Rather, they are based on subjective judgments apparently designed to validate a preconceived course of action. The Economic Analysis Guide specifically discusses the use of such a "judgmental method." Accordingly:

> (The judgmental method) has the disadvantage of almost always overstating the benefits of any proposed activity. . . .[A] proposed activity which fails to muster benefits in excess of costs when the judgmental method is used is probably not worth undertaking.[84]

In this case, **the FAA's own analysis** estimates that projected costs will exceed claimed benefits by 73.2% on an industry-wide basis and, as detailed below, the true disparity is much larger.

Before delving into the details of the FAA Regulatory Impact Analysis ("RIA"), it is important to note that the RIA, as originally placed in the Docket, contained many ambiguities and omitted extensive backup materials necessary to evaluate the FAA's assumptions and methodologies. This fact raises the same administrative law defect involving subterranean data, models, and methodologies discussed above. Accordingly, when invited by the FAA on October 12, 2010, the Association took the opportunity to submit 68 questions and requests for information (Attachment E) relating to the RIA. The answers received on October 22, 2010, consisted of a two and a half page general narrative, along with several charts relating information on the accidents relied upon by the FAA to construct its benefits analysis, along with an October 30, 2000, GRA Study. However, virtually all of the other requested documentation needed to analyze the Agency's conclusions was withheld.

---

[83] *Economic Analysis of Investment and Regulatory Decisions – Revised Guide*, January 1998, page 1.
[84] *Id.* at 3.

Among the most important information, documents and analyses that were requested but not provided were:

- While the FAA has provided a list of the accidents included in its RIA analysis, it has **not** provided any data indicating how it determined that any of the accidents were in fact caused by pilot fatigue when the NTSB reports did not list fatigue as a cause or contributing factor.

- While the RIA provides some cargo-specific data, the FAA has refused to provide a "cargo only" version of Table 1 and has not provided the data that would have enabled the industry to construct such a cargo-only version of the FAA analysis.

- In order to replicate FAA simulations, it is necessary to have the FAA input data, assumptions about qualitative relationships and specifications, output statistics and a complete description of simulation models used. None of this information has been provided.

- The RIA projects 5.8 all-cargo accidents over the next 20 years (see pp. 40 and 45 of RIA). Without the clarification requested, it is not possible to determine exactly how this number was derived.

- In order to assess the reasonableness of the FAA benefits analysis, the Association requested all backup data and a detailed description of the 5,000 simulations run with the combined 10-accident and 49-accident cargo aircraft samples (see p. 59 of RIA). The FAA refused to provide these data.

- A key to understanding the FAA analysis lies in an analysis of the FAA "effectiveness categories" (see p. 66 of RIA) and scoring techniques for each referenced accident. None of the information requested to test the FAA methodology was provided.

- The Association requested assumptions, input data and calculations used to support the annual $90 million cost figure found on page 70 of the RIA. The FAA declined to do so, even though these data are necessary to determine how (or whether) the FAA has determined that pilot fatigue was actually a factor in ground accidents referenced.

- In spite of a specific request, the FAA has failed to break out its projected costs by industry segment. This failure prevents the Association from analyzing the data separately for passenger and cargo operations. In addition, the Agency has failed to provide the detailed work papers, spreadsheets, costing models and source materials that support the FAA cost analysis.

- The FAA has failed to provide the supporting calculations, assumptions, justification and source documents that the Agency used as a basis for its massive downward adjustment of costs presented at page 85 of the RIA.

- The FAA has failed to disclose its scheduling optimization model used as a basis for adjusting industry costs.

- The Association requested the FAA to provide the assumptions and evidentiary bases that led the FAA to conclude that there would be a $276.9 million saving from augmented operations (Table 25 to RIA). The FAA failed to do so.

- The FAA failed to provide a breakdown between passenger and cargo airline fatigue training costs (pp. 106-113 of RIA), a breakdown necessary to enable the Association to weigh claimed benefits against claimed costs.

- With respect to the 18 accidents listed on page 40 of the RIA, the Association requested an identification of which of these accidents involved an all-cargo aircraft. This information is necessary to determine how the Agency determines benefit values for the cargo industry segment. The FAA refused to provide these data.

- With respect to FAA simulation models, the Association requested a description of the probability or other functions that were used for accident probability, fatality probability and estimated costs per accident. This information is essential in understanding the inputs and structure of the simulation models used. It was not provided by the Agency.

- The FAA, in its “Upper Estimate Results” (pp. 50-54 of the RIA) uses a set of 235 accidents in addition to the 43 accidents in which fatigue was claimed to be a factor. The Association requested the analysis used to conclude that the cause of these “extra” 235 incidents could in any way be linked to pilot fatigue. It was not provided.

- The FAA was requested to provide the basis for its conclusion that 58% of the alleged 39 additional cargo accidents had pilot fatigue as a cause. (See p. 53 of RIA). The Agency was specifically asked if any of the accident reports mentioned pilot fatigue as a contributing factor. The FAA failed to provide this information.

These omissions (and others not enumerated here) were central to the Association’s ability to determine the validity of the FAA estimates. If these documents had been provided, the Association would have been able to effectively break out all-cargo data from passenger costs and benefits. This breakout is critical in order to perform the necessary analyses on the FAA data to determine the validity of the methodologies used by the FAA to determine the impact on the all-cargo industry. Even without the missing information, however, it is clear on its face that the RIA cannot be used to support the proposition that the miniscule benefits of the proposed rule justify its massive costs.

Focusing specifically on the cost side of the equation, the steadfast refusal of the FAA to entertain any extension of the time for filing comments has also seriously hampered the ability of the industry to develop comprehensive cost data. Trying to ascertain the precise effect on carrier costs has required an extensive review of the impact of the proposals on air carrier operations. This review has included retaining experts in crew scheduling optimization in order to test the FAA conclusions in this area.[85] These reports were not concluded until the first week in November making reliable cost calculations by the November 15 due date difficult to produce.

Moving to the substance of the RIA, it is important to reiterate that the United States aviation industry is not a unified whole, but rather is composed of segments with very different operating characteristics. This fact is of crucial importance in any benefit/cost analysis of the proposed flightcrew member duty and rest requirements. While the FAA has presented its version of costs and benefits on an industry-wide basis, this methodology clearly discriminates against all-cargo air carriers. By failing to break out the all-cargo costs and benefits separately, all-cargo carriers are saddled with findings that are only applicable to the passenger segment of the industry. One of the most egregious results of this continued "one-size-fits-all" methodology is that, in calculating benefits, the "lives saved" on an industry-wide basis fails to recognize that all-cargo carriers carry only a handful of individuals, almost always crewmembers, while passenger carriers may carry hundreds of people on each flight.

Industry Costs – Incredibly, the FAA has concluded that the total aggregate industry costs to comply with the proposed regulations **over a ten year period** are $1,254.1 million (nominal costs) or $803.5 million (Present Value costs). These numbers are wildly understated.

---

[85] Such "optimization studies" are critical since both the FAA and labor interests have claimed that companies significantly reduce the costs of the proposed regulations through schedule optimization.

In order to provide a realistic picture of the costs involved in complying with the proposals in the NPRM, the Association requested detailed cost analyses from all-cargo industry members. Participating in this study were ABX Air, Atlas Air, Capital Cargo, FedEx Express, Kalitta Air, National Air Cargo, Polar Air Cargo and UPS Airlines.[86] These all-cargo carriers prepared internal studies of the cost impacts imposed by the FAA's proposed rule. Key cost categories included (1) crew scheduling (resources) net of any savings, (2) pilot training, (3) fatigue training, (4) augmentation, (5) travel and per diem, (6) rest facilities, (7) lost revenue and (8) incidental expenses. The results of this survey were staggering. The cost to the eight all-cargo survey members over a ten year period (undiscounted) totals $ 4.253 billion ($2.666 billion discounted), **more than three times the amount the FAA found for the entire universe of Part 121 air carriers (92 carriers).**

Moreover, as noted above, the NPRM does not even try to address the costs on society generally, including potential loss of air service to smaller communities and the resultant loss of jobs at a time the economy is struggling to recover from one of the worst recessions in history. Additionally, the Agency does not effectively address the disproportionate costs to U.S. air carriers compared to foreign air carrier competitors. In an attempt to complete the record, Campbell-Hill conducted an analysis of the probable effects of the proposed rules on the economy of the United States. This effort was adversely affected by the compressed time frame to file comments, but, using the best readily available information, Campbell-Hill was able to conclude that the economic effects of the rule extend well beyond the airline industry. As a result of implementing the FAA's proposed rules:

[86] These eight all-cargo air carriers accounted for 88% of the Revenue Ton Miles for U.S. all-cargo carriers for Calendar Year 2009; Department of Transportation, Bureau of Transportation Statistics, Air Carrier Summary Data (Form 41), U.S. Air Carrier Traffic and Capacity Statistics, 2009.

- Increased operating costs will proportionately increase domestic and international all-cargo freight and express rates;
- Flight delays will increase point-to-point delivery times and network disruptions will severely hamper the reliability and value-added demanded by the shipping community;
- The combination of increased rates and potentially reduced service capability will increase the delivered price of air-dependent products leading to –
    - Reduced demand for the services provided by U.S. all-cargo carriers;
    - Reduced sales of air-dependent products;
    - Induced impacts (multiplier effect) throughout the U.S economy due to the direct impacts on the air transportation and manufacturing sectors.

In addition, the relative cost and service disadvantages experienced by U.S. air carriers will necessarily impact U.S. import and export markets, non-scheduled charter activity and overseas foreign-to-foreign markets. Finally, the rule will have a disproportionate impact on small businesses and small communities that depend on the services of the all-cargo sector to participate in the worldwide economic marketplace.

As detailed in Appendix B to the Campbell-Hill Report, these negative effects of NPRM implementation translate directly into a substantial cost to the entire economy in terms of both dollars and jobs lost. To arrive at the estimated societal cost of the proposed rules, Campbell-Hill started with the projected costs developed in the survey of all-cargo carriers and compared this number with operating expenses reported by the carriers on Form 41. The result of this comparison revealed that projected costs would increase by 1.7% due to implementation of the FAA proposals. It was then assumed that this 1.7% increase in costs would be passed on to shippers in the form of higher rates. The result of such an increase was then studied, with the ultimate conclusion being that the cost to the nation of implementation would be $8.4 billion (Net Present Value) over the next ten years using the FAA assumption that costs will not be seen until 2013 or $9.6 billion (Net Present Value) if it is assumed that cost elements will be seen starting in 2011. In addition, the Report concluded that implementation of the FAA proposals would cost the nation over 7,000 jobs.[87] The failure to consider such costs is directly contrary to the specific provision in Executive Order 12866 that requires agencies to take into account "any adverse effects on the efficient functioning of the economy. . . ."[88]

The Lack of Benefits – Even more appalling than the understated costs of complying with the proposed rules is the utter lack of a credible study of the benefits that allegedly would flow from the NPRM. The Agency alleges that the nominal benefits over 10 years would be $659.40 million (using a $6.0 million value of human life) or $837 million (using a human life value of $8.4 million). The Present Value of these perceived benefits are given at $463.80 million and $589 million respectively. None of these numbers can withstand scrutiny. **Indeed, when the all-cargo segment is studied, the benefits that can logically be attributed to implementation of the proposed rules are $1.1 million (nominal) and $0.7 million (Net Present Value).**

The basic problem with the FAA analysis is that it bases its conclusion on a study of accidents over the past 20 years, but the accidents selected (and the unreasonable interpolations therefrom) cannot logically be used to support the Agency's conclusions. As detailed in the Campbell-Hill Report, in order for an accident to be used as a basis for any benefits calculations, it must satisfy three criteria:

---

[87] Campbell-Hill, Appendix B, pp. 5-6.
[88] 58 Fed. Reg. at 51741.

- The flight in question must be permitted under current rules, but not permitted under the proposed rules. Only in such cases would the proposed rules make a difference in preventing a recurrence of the same accident.
- The proposed rule must have a significant mitigating effect on the future probability (and damages) for a forecasted accident.
- Pilot error must be at least a contributory factor in the accident. (Not all pilot errors are due to fatigue, but, if pilot error is not involved, then fatigue is clearly not an issue).[89]

The first criterion noted above is of primary importance because accident investigations going back 20 years have uncovered safety issues that have already been addressed either with new, updated technology or with new regulations designed to mitigate the safety problem identified. With respect to such incidents, it is simply wrong to continue using them in an attempt to justify further regulatory requirements. In other words, in starting to assess the benefits of any proposed rule, a valid baseline incident rate must be established. And this baseline must take into account **current** safety-related technology and the **today's** rules and regulations. Otherwise, the benefits calculated will appear to be much greater than they actually are.

In this case, the FAA has used "effectiveness analysis" to assess the likelihood that the proposed rule would have prevented a future accident. However, this methodology does not eliminate accidents that would not have been allowed under current rules. And, although some accidents do receive low "effectiveness scores", the FAA applies the effectiveness analysis on an average basis, with irrelevant accidents remaining in the analysis, thereby creating false accident mitigation scores.

---

[89] *See*, Campbell-Hill, p. 40.

In attempting to justify its proposed rules, the FAA has relied on three sets of accidents occurring from 1990 through 2009. These sets were as follows:

- 22 fatigue-related accidents associated with five separate fatigue categories;
- 43 accidents (presumably including the 22 mentioned above) for which adequate information was available to determine whether fatigue was a factor; and
- 278 accidents (presumably including the 43 above[90]) for which pilot error was a cause.

The use of these data by the FAA reveals a host of errors and inconsistencies which are detailed in the Campbell-Hill Report (Section 4-2, pp. 20 *et seq.*).

Focusing on the accidents attributable to the all-cargo industry, Campbell-Hill has noted that there are **only eight (8) all-cargo accidents** that form the entire base of the Agency's entire analysis of this industry segment. However, section 4.0 of the Campbell-Hill Report conclusively demonstrates that seven (7) of these accidents are completely irrelevant to the issues herein and the one remaining accident had relatively minor damage and no loss of life. Accordingly, the only conclusion that can be drawn is that the benefits from imposing the comprehensive set of new regulations are, at best, **only $0.7 million**.

The Benefit-Cost Ratio – As noted above, for any proposed rule to pass regulatory muster, its costs must be justified by demonstrable benefits. In this case, for all-cargo operations, the proposed rules utterly fail to meet this standard. In fact, when comparing the costs and benefits that can reasonably be attributed to the requirements of the NPRM ($2.666 million in costs against $0.7 million in benefits), **there are less than three one-hundredths of one cent of benefits for every dollar of costs (or put somewhat differently, for every dollar of benefits there are $3,800 in costs).**

[90] Because of the FAA's unwillingness or inability to provide backup data on all the referenced accidents, the Association can only assume the universe of accidents in each enumerated category.

Even if one were to use the FAA's own flawed numbers, the NPRM cannot pass the cost-benefit test for all-cargo operations. Although the FAA failed to segregate cargo costs from those in the passenger industry segment, assuming a 75:25 ratio would yield all-cargo costs of $200.9 million. Comparing these costs against the FAA-computed benefits of $20.9 million for cargo operations, the ratio of benefits to costs is still 1:10, a ratio that cannot possibly justify the proposed rules as they relate to all-cargo operations.[91]

IX. CONCLUSIONS

As detailed above, the new regulations proposed by the FAA are both procedurally and substantively defective. The Agency has not afforded interested parties sufficient time to adequately address all the issues presented and has compounded this failure by failing to provide a full disclosure of the bases for many of its decisions. Substantively, the rules fail to recognize the unique operating characteristics of the all-cargo segment of the aviation industry and are unsupportable from both a safety and scientific perspective. Finally, with respect especially to "hours of service" issues, the proposals constitute an unwarranted government intrusion into the field of labor-management relations.

Moreover, the FAA's Regulatory Impact Analysis, a necessary component of any significant rulemaking proceeding, cannot in any way be used to justify the proposed rules as written. Even using the Agency's faulty data and methodologies, costs overwhelm benefits and, when the FAA's calculations are adjusted to present a real world picture of the all-cargo industry, every dollar of benefit carries with it $3,800 of costs.

In spite of these deficiencies, the Cargo Airline Association continues to believe that improvements in the area of crewmember fatigue are possible. The Association proposal

[91] Campbell-Hill, p. 86.

submitted to the ARC and the FAA – a proposal that addresses all of the issues raised by the FAA – should have been, and must be, considered an alternative for the entire rule or for the all-cargo sector. The Association submits that this proposal recognizes both operational and scientific issues and represents the best solution for moving forward. Therefore, we respectfully urge the FAA to modify its recommendations and base its new rules on the proposal submitted by the Cargo Airline Association.

Respectfully submitted,

Stephen A. Alterman, President

Yvette A. Rose, Senior Vice President
Cargo Airline Association
1620 L Street, NW, Suite 610
Washington, DC 20036

November 15, 2010

Comments of the Cargo Airline Association FAA-2009-1093

Flightcrew Member Duty and Rest Requirements; Proposed Rule, FAA-2009-1093

November 15, 2010

Attachments A – H

Comments of the Cargo Airline Association

Flightcrew Member Duty and Rest Requirements; Proposed Rule, FAA-2009-1093

November 15, 2010

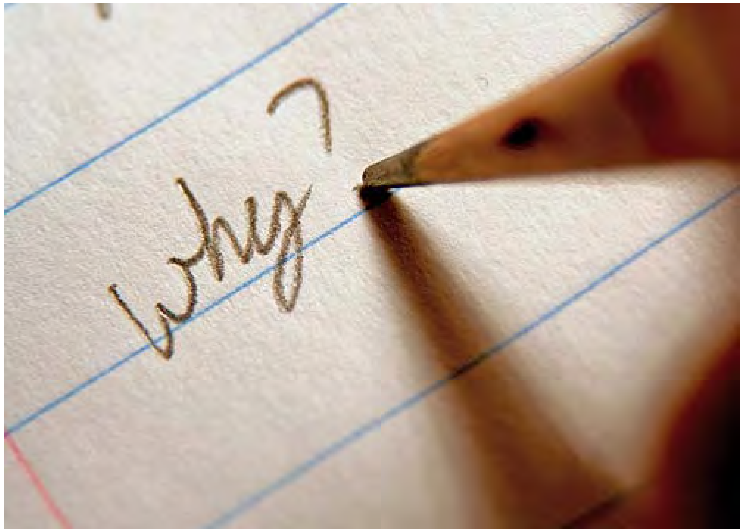
Attachment A

Cargo Airline Association (CAA)
Presentation to the Aviation Rulemaking Committee
Flight and Duty Time Limitations and Rest Requirements

August 25, 2009

CAA 1220 19th Street, NW, Suite 400, Washington, DC 20036
tel: 202.293.1030 • fax: 202.293.4377

Why are we here?



"We must find the right balance of safety, science, cost and operational efficiency regarding amendments to our current rules."

Gregory Kirkland, FAA,
Presentation on Crewmember Flight, Duty and Rest Requirements, at the FAA Fatigue Management Symposium, June 17-19, 2008.

What is most important?

"Eight hours of sleep opportunity is much more important than time on task, duty time, etc. for assuring safe levels of alertness."

R. Curtis Graeber, Ph.D.
August 2009

Why CAA's all-cargo proposal needs to be adopted?

"In rulemaking, not only does one size not fit all, but it's unsafe to think it can."

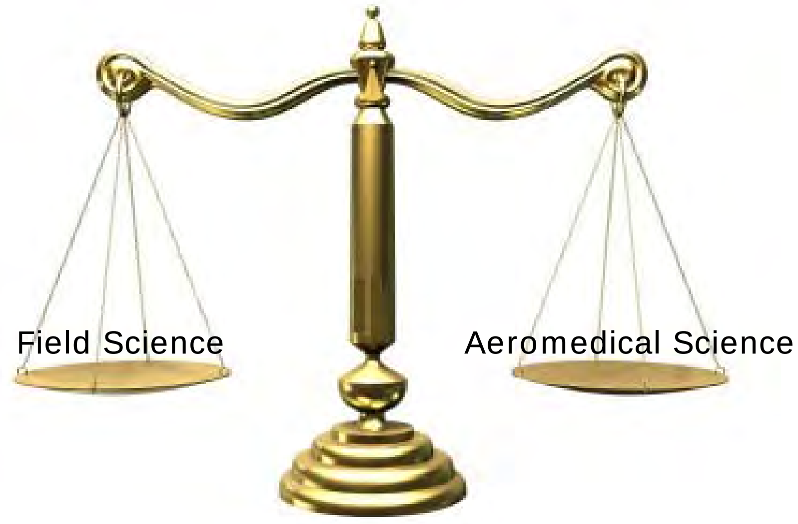
Administrator Randy Babbitt
Speech to the ALPA Air Safety Forum
August 5, 2009.

Safety Risks Of Not Getting It Right

- Unintended consequences can jeopardize safety.
  - No one knows the fatigue tradeoff between:
    - Longer duty periods with fewer nights worked
    - Shorter duty periods with more nights worked
- We need to better understand the cumulative fatigue effect of increased night work/day-life transitions.
- While current scientific models can support Fatigue Risk Management (FRM) with validation, they are too immature to support prescriptive rules.

Guiding Principles

- Responsibility to "get it right".
- Acceptance that fatigue is a legitimate flight safety concern.
- Need to apply science, recognizing the limits of current aeromedical knowledge and lack of scientific validation in the aviation environment.
- Need to apply field science (operational experience), particularly that of international long-haul and domestic cargo carriers.
- Need to maintain and enhance safety while allowing U.S. carriers to remain competitive, recognizing the different business models and distinct operating environments of the aviation industry segments.



1115

Global All-Cargo Operating Environment

- ♣ Backside of the clock is the norm, and our crews come prepared...We know how to do it right!
- ♣ Around the world in all directions is the norm.
- ♣ Traditional crew base model does not always apply.
- ♣ Length and number of rest opportunities are greater in cargo operations.
- ♣ Less hassle factor and no distractions from passengers and flight attendants.
- ♣ Point-to-point operations outside of the United States.
- ♣ Remote locations require turnaround capability.
- ♣ Fewer annual landings and lower annual flight time per pilot.
- ♣ Customer driven schedule, which is often unpredictable.

Competitive & Economic Risks Of Not Getting It Right

- ♣ Loss of U.S. carrier competitiveness.
  - ♣ Highly competitive global market where foreign competitors are not subject to similar restrictions.

- ♣ Adverse effects on national defense.
- ♣ Adverse effects on international humanitarian interests.
- ♣ Increased operational costs will result in service reductions for individuals, businesses, and communities.

Objectives Of CAA's Recommendations

- ♣ Enhance safety based on current scientific knowledge and our members' and our crews' extensive operational experience.

- ♣ Recognize the operating environment and business models of all-cargo carriers.

- ♣ CAA's proposal harmonizes the flight, duty, and rest rules with our global cargo operations, without discounting current science as the older rules have done.

Principles Underlying CAA's Recommendations

- ♣ Protecting sleep is essential – CAA's proposal increases minimum daily and cumulative rest opportunities.

- ♣ CAA has established limits in areas where currently there are no limits.

- ♣ CAA's proposal takes into account time of day.

- ♣ CAA's proposal takes into account crossing multiple time zones.

- ♣ Through increased training, CAA members have improved crew understanding and ability to deal with sleep-performance issues.

- ♣ It is essential to distinguish between domestic and international Flight Duty Periods (FDP).

CAA's Domestic All-Cargo Proposal

	Flight Duty Period			Domestic Rest	
Time of Start (Designated Base)	1 to 4 Sectors	5 + Sectors	Extensions for Operational Irregularities	Minimum	In 168 look back
0000-0459	11	9	+ 2 *		
0500-1459	13	11	+ 2 *		
1500-1659	12	10	+ 2 *		
1700-2359	11	9	+ 2 *	10**	24***

(In Hours)

* Extensions for Operational Irregularities include conditions and requirements unforeseen or beyond the control of the certificate holder, including but not limited to weather conditions, aircraft equipment, air traffic control, acts of God, hostilities, etc.

** Reducible to 9 at certificate holder's discretion (can only occur once in any 168 hour look back)

*** Applies when report to a FDP

1120

CAA's Domestic All-Cargo Proposal

(In Hours) Time of Start (Designated Base)	Flight Duty Period			Flight Time		Domestic Rest	
	1 to 4 Sectors	5 + Sectors	Extensions for Operational Irregularities	1 to 4 Sectors	5+ Sectors	Minimum	In 168 look back
0000-0459	11	9	+ 2 *	8	7		
0500-1459	13	11	+ 2 *	11	9		
1500-1659	12	10	+ 2 *	10	8		
1700-2359	11	9	+ 2 *	8	7	10**	24***

* Extensions for Operational Irregularities include conditions and requirements unforeseen or beyond the control of the certificate holder, including but not limited to weather conditions, aircraft equipment, air traffic control, acts of God, hostilities, etc.

** Reducible to 9 at certificate holder's discretion (can only occur once in any 168 hour look back)

*** Applies when report to a FDP

CAA's International Fatigue Mitigation Countermeasures

Domestic → International

CAA's FDP Recommendations

Fatigue Mitigation:

- Increased Rest (Currently 8 Hours)
  10 → 12
- Increased Cumulative Rest
  24 → 30
- Reduced Flight Time
  11 → 8 (Within the WOCL)
- New lower FDP limits
- Cumulative Duty Limit protections
- Time of Day/WOCL protection
- Acclimatization Penalty

1122

CAA's International All-Cargo Proposal

(In Hours)	2 Pilot (or 2 Pilot and Flight Engineer) Flight Duty Period: International 2 Pilot/2 Pilot and Flight Engineer 1 to 4 sectors	Flight Duty Period: International 2 Pilot/2 Pilot and Flight Engineer 5+ sectors	Flight Duty Period: Extensions for Operational Irregularities	Flight Time: 2 Pilot	Flight Time: 2 Pilot and Flight Engineer	International Rest: Minimum	International Rest: In 168 look back
Unacclimatized/WOCL***** **	12:30	11:30	+ 2 *	8	12	12***	30****
Unacclimatized/Non-WOCL**	13:00	12:00	+ 2 *	10	12	12***	30****
Acclimatized/WOCL*** **	13:30	12:30	+ 2 *	8	12	12***	30****
Acclimatized/Non-WOCL	14:00	13:00	+ 2 *	10	12	12***	30****

* Extensions for Operational Irregularities include conditions and requirements unforeseen or beyond the control of the certificate holder, including but not limited to weather conditions, aircraft equipment, air traffic control, acts of God, hostilities, etc.

** Crews become unacclimatized after duties that exceed 4 time zones -- 30 hours free from duty to become acclimatized. Continental U.S. is considered one time zone for acclimatization purposes.

*** Reducible to 11 at certificate holder's discretion (can only occur once in any 168 hour look back)

**** Applies when report for a FDP

***** If any portion of the FDP occurs between 0200-0559, time computed at crewmember's acclimatized location.

CAA's International All-Cargo Augmentation Proposal

3 Pilot Augmentation (or 3 Pilot 2 Flight Engineer)
(In Hours)

Flight Duty Period					Flight Time	International Rest	
International 3 Pilot with horizontal sleep opportunity 1 to 2 sectors	International 3 Pilot with horizontal sleep opportunity 3 to 4 sectors	International 3 Pilot seat 1 to 2 sectors	International 3 Pilot seat 3 to 4 sectors	Extensions for Operational Irregularities		Minimum	In 168 look back
16:30	15:45	14:45	14:30	+ 2 *	12	12**	30***

4 Pilot Augmentation (or 4 Pilot 2 Flight Engineer)				
Flight Duty Period			International Rest	
International 4 Pilot with horizontal sleep opportunity 1 to 2 sectors	International 4 Pilot with horizontal sleep opportunity 3 to 4 sectors	Extensions for Operational Irregularities	Minimum	In 168 look back
19:30	18:45	+ 2 *	12**	30***

* Extensions for Operational Irregularities include conditions and requirements unforeseen or beyond the control of the certificate holder, including but not limited to weather conditions, aircraft equipment, air traffic control, acts of God, hostilities, etc.

** Reducible to 11 at certificate holder's discretion (can only occur once in any 168 hour look back)

*** Applies when report to a FDP

1124

Math Behind the Numbers

3 Pilot Augmentation

	1-2 Sectors	3-4 Sectors
Horizontal 3 Pilot	16:30 Hours	15:45 Hours
Seat 3 Pilot	14:45 Hours	14:30 Hours

14:00 Hours (Max 2 Pilot FDP)
- 4 Hours (2½ show & 1½ 2nd sector)

10:00 Flight Hours
÷ 3 (Crew Complement)

3.33
x .75 Horizontal Sleep Factor

2.5 Sleep Credit
+ 14:00 Hours (Max 2 Pilot FDP)

16.5 (16:30) Hours (Max FDP)

1125

Math Behind the Numbers

3 Pilot Augmentation

	1-2 Sectors	3-4 Sectors
Horizontal 3 Pilot	16:30 Hours	15:45 Hours
Seat 3 Pilot	14:45 Hours	14:30 Hours

14:00 Hours (Max 2 Pilot FDP)
- 4 Hours (2½ show & 1½ 2nd sector)

10:00 Flight Hours
÷ 3 (Crew Complement)

3.33
x .25 Seat Factor

.833 Sleep Credit
+ 14:00 Hours (Max 2 Pilot FDP)

14.83 (14:45) Hours (Max FDP)

1126

Math Behind the Numbers

4 Pilot Augmentation

	1-2 Sectors
Horizontal 4 Pilot	19:30 Hours
Seat 4 Pilot	N/A

19:30 Hours (Max 4 Pilot FDP)
- 4 hours (2½ show & 1½ 2nd sector)

15:30 Flight hours (Rest Opportunity)
÷ 2 (2 crews)

7.75
x .75 Horizontal Sleep Factor

5.81 Sleep credit
+ 14:00 (Max 2 Pilot FDP)

19.81 (19:30) Hours (Max FDP)

1127

Math Behind the Numbers

4 Pilot Augmentation

	3-4 Sectors
Horizontal 4 Pilot	18:45 Hours
Seat 4 Pilot	N/A

19:30 Hours (Max 4 Pilot FDP)
- 7 hours (Preflight and Sector Penalty)

12:30 Flight hours (Rest Opportunity)
÷ 2 (2 crews)

6.25
x .75 Horizontal Sleep Factor

4.68 Sleep credit
+ 14:00 (Max 2 Pilot FDP)

18.68 (18:45) Hours (Max FDP)

1128

Cumulative Time Limits

- Cumulative duty limits (to be determined at the point the crewmember reports for a flight duty period):
  - 24 hour (domestic) - 30 hour (international) free of duty in a 168 hour look back
  - 75 hour duty limit in 168 hour look back
  - 215 hour duty limit in 672 hour look back
  - 100 block hours (in 28 day look back)
  - 1,200 block hours annual (in 365 day look back)
- Deadheading:
  - Front-end: To an operating leg counts in calculation of FDP

Comparisons Between Current FAR and CAA Proposal

Flight Duty Period (Hours)		
	Current	CAA Proposal
Domestic	16	9-13
3 Crew Domestic	16	9-13
International	16	11:30-14
3 Crew International	Unlimited	14:30-16:30

Flight Time (Hours)		
	Current	CAA Proposal
Domestic	8	7-11
3 Crew Domestic	8	7-11
International	8	8-10
3 Crew International	12	12

Rest (Hours)		
	Current	CAA Proposal
Domestic	8	10
3 Crew Domestic	8	10
International	8	12
3 Crew International	8	12

1130

Summary of CAA's Recommendations

- Flight Duty Period (2 Pilots):
  - Domestic: 9-13 hours depending upon time of day and number of sectors.
  - International: 11:30 to 14 hours depending on:
    - Number of sectors
    - Whether or not acclimatized
    - WOCL
- Extension for Operational Irregularities: 2 hours
- Flight Time (2 Pilots):
  - Domestic: 7-11 hours depending upon time of day and number of sectors.
  - International: 8-10 hours

Summary of CAA's Recommendations

- Rest:
  - Domestic: 10 Hours, reducible to 9 (only one reduction in any 168 hour period).
  - International: 12 Hours, reducible to 11 (only one reduction in any 168 hour period).
  - Cumulative: 24 Hours in 168 hour period (Domestic)
    30 Hours in 168 hour period (International)

- Augmentation:
  - 3 Pilot Augmentation
    - Flight Duty Period - 14:30-16:30 hours depending upon level of rest accommodation and number of sectors.
    - Flight Time - 12 hours
  - 4 Pilot Augmentation –
    - Flight Duty Period - 18:45-19:30 hours depending upon number of sectors.

The FAA Must Address Pre-Duty Required Rest

- ♣ Flight/duty/rest requirements alone do not address fatigue without also addressing pre-duty required rest.
- ♣ Pre-duty activity including recreation, working in another capacity, and commuting to duty must be considered.
- ♣ Pilots must report fully rested and fit for duty.
- ♣ The obligation to report fit and rested for duty is solely the responsibility of the individual crew member.
- ♣ The FAA must promulgate regulatory limitations.

CAA Strongly Supports The Development Of Fatigue Risk Management System (FRMS)

- Collection of data – FAA Scientific Steering Committee.

- Validation of fatigue science to aviation operations which considers:
  - Effects of multiple time-zones and acclimatization
  - Effects of the backside of the clock
  - Augmentation and on-board sleep

- CAA members will adjust fatigue mitigation programs as scientific evidence matures.

Conclusion

- ♣ CAA recognizes that improved safety requires rule changes.
- ♣ CAA accepts that rule changes will impose significant operational changes and costs on all-cargo operators.
- ♣ The attributes of the all-cargo industry must be reflected in flight-duty rules adopted by the FAA.

Comments of the Cargo Airline Association

Flightcrew Member Duty and Rest Requirements; Proposed Rule, FAA-2009-1093

November 15, 2010

Attachment B

From: O"Connell, MaryEllen
To: Chen, Eric C
Cc: Wanchisen, Barbara
Subject: NRC Committee to Review the Effects of Commuting on Pilot Fatigue: Public Comment Opportunity
Date: Tuesday, October 19, 2010 8:21:01 AM
Attachments: FAA Project _ Reply Form.FINAL.doc

COMMITTEE TO REVIEW THE EFFECTS OF COMMUTING ON PILOT FATIGUE ANNOUNCES AN OPPORTUNITY FOR PUBLIC COMMENT

At the request of the Federal Aviation Administration (FAA), as directed by Congress, the National Research Council is in the process of forming an expert committee to review the effects of commuting on pilot fatigue. The work of the committee is intended to guide the development of regulations by FAA.

Although committee membership is not yet finalized, the committee's first meeting has been scheduled for November 22-23, 2010 at the National Academies' Keck Center located at 500 5th Street, NW in Washington, DC. Portions of the meeting on November 22nd will be open to the public (although space is limited) and the committee has set aside a limited amount of time for public comments. Interested parties are invited to formally share thoughts and ideas on the questions listed below in writing and to present their comments to the committee in person. The committee's second meeting will take place on December 20-22, 2010, also in Washington, DC. That meeting may offer a second opportunity for public input. Scheduling will depend on the time available at each meeting and the number of individuals who express an interest in speaking.

Please indicate your interest in submitting written comments and/or making a brief presentation (and, if you would like to make a presentation, indicate your availability for the November or December dates listed), on the attached response form and return by October 26, 2010 to Eric Chen at ecchen@nas.edu or via fax at (202) 334-2210. We will send an agenda prior to each meeting.

Written comments should be submitted by November 8th, also to Eric Chen.

Please focus your comments on your perspective in the following areas, as relevant:

(A) the prevalence of pilots commuting in the commercial air carrier industry, including the number and percentage of pilots who commute greater than two hours each way to work;

(B) the characteristics of commuting by pilots, including distances traveled, time zones crossed, time spent, and methods used;

(C) the impact of commuting on pilot fatigue;

(D) whether, and if so how, the commuting policies and/or practices of commercial air carriers (including passenger and all-cargo air carriers), including pilot check-in requirements and sick leave and fatigue policies, ensure that pilots are fit to fly and maximize public safety;

(E) whether, and if so how, pilot commuting practices ensure that they are fit to fly and maximize public safety;

(F) how "commuting" should be defined in the context of the commercial air carrier industry;

(G) how FAA regulations *related to commuting* could or should be amended to ensure that pilots arrive for duty fit to fly and to maximize public safety.

Please note that all written materials provided to the committee must be submitted to the Academies "public access file" and made available to anyone who requests this information.

We look forward to hearing from you as we begin this ambitious study. Please feel free to contact Barbara Wanchisen, Director of the Committee on Human-Systems Integration at bwanchisen@nas.edu or me at or moconnell@nas.edu if you have any questions or if you would like additional information.

Regards,
Mary Ellen O'Connell, Interim Study Director
Committee to Review the Effects of Commuting on Pilot Fatigue

Mary Ellen O'Connell
Deputy Director
BBCSS/COHSI
National Research Council
202-334-2607

Comments of the Cargo Airline Association

Flightcrew Member Duty and Rest Requirements; Proposed Rule, FAA-2009-1093

November 15, 2010

Attachment C

THE CARGO AIRLINE ASSOCIATION
The Voice of the Air Cargo Industry

SUBMISSION OF THE CARGO AIRLINE ASSOCIATION FLIGHT/DUTY TIME AND REST REQUIREMENTS REGULATORY LANGUAGE

As noted in footnote 5, page 3, of the Cargo Airline Association (CAA) recommendations to the Aviation Rulemaking Committee for Flight/Duty Time Limitations and Rest Requirements (ARC), CAA respectfully submits the following language for inclusion in the Preamble and regulatory text of a new flight and duty time rule:

PREAMBLE LANGUAGE

Subpart ___ sets forth the rules applicable to Large All-Cargo Air Carriers. It is essential to create a separate subpart for the all-cargo industry to take into account the unique operating characteristics of this industry segment. Air carriers providing all-cargo operations include not only the overnight express carriers that provide overnight delivery services to all parts of the United States and expedited services to all parts of the world, but also the carriers that provide heavy freight services throughout the world, including military, diplomatic and humanitarian efforts.

To provide their services, members of the global all-cargo air carrier industry operate in a substantially different environment than passenger airlines. Carriers with all-cargo operations generally do not maintain U.S. domicile bases and regularly operate long-haul flights and point-to-point operations outside the United States at night and during the backside-of-the clock. Flights may travel across multiple time zones. Service is also provided to remote, undeveloped and often dangerous locations, demanding timely turnaround capabilities because pre-positioning of crews is not possible and local infrastructure is minimal, at best.

At the same time, these operations also provide for more, longer, and better rest opportunities during duty periods than that provided in the passenger environment. For example, all-cargo carriers that fly into a hub for package sorting purposes provide crews with up to four hours' rest in a horizontal sleep facility prior to their next launch. In addition, there is more opportunity for in-flight rest, since there are no distractions or noise from passengers and flight attendants that tend to diminish or interrupt the integrity of the rest opportunity. These opportunities are further enhanced by the lie-flat bunks or reclined rest facilities on board long-haul aircraft. Finally, because of the nature of all-cargo operations, the average annual flight hours for a pilot at a major all-cargo air carrier are significantly below the hours flown by passenger counterparts.

The regulations in Subsection ___ take into account the all-cargo operating environment while at the same time enhancing safety by:

- Establishing flight duty time limits where currently none exist;
- Accounting for the effects of "time of day" flying;
- Recognizing the distinct and different characteristics of domestic and international all-cargo operations;
- Addressing the impacts of crossing multiple time zones;
- Reducing flight duty periods for domestic and international operations from those currently in place; and
- Increasing required rest periods for domestic and international operations from those currently in place.

Comparisons Between Proposed and Current FARs

Flight Duty Period (Hours)		
	Current	**Proposed**
Domestic	16	9-13
3 Crew Domestic	16	9-13
International	16	11:30-14
3 Crew International	Unlimited	14:30-16:30

Flight Time (Hours)		
	Current	**Proposed**
Domestic	8	7-11
3 Crew Domestic	8	7-11
International	8	8-10
3 Crew International	12	12

Rest (Hours)		
	Current	**Proposed**
Domestic	8	10
3 Crew Domestic	8	10
International	8	12
3 Crew International	8	12

The proposed regulations differ in design from the current requirements since they do not differentiate between those carriers operating under "domestic", "flag" and "supplemental" rules, but rather, for the purposes of Subpart ____, group requirements solely as either "domestic" or "international".

REGULATORY STRUCTURE

The Cargo Airline Association urges the FAA to adopt a new section of the Federal Aviation Regulations (FARs) dealing solely with mitigating flight crew member fatigue issues. One subsection of this new regulation should establish a regulatory scheme dealing with large all-cargo air carrier operations. A separate subsection should establish the regulatory requirements for passenger carrier operations and an additional subsection should provide a regulatory framework to deal with use of pre-duty required rest time for commuting, second jobs and excessive recreation. Such pre-duty regulations should establish an enforceable obligation requiring flight crew members to report for work fit for duty.[1] Finally, a subsection should be included requiring the establishment of a Fatigue Risk Management System (FRMS) by a date-certain.

With respect to the proposed all-cargo operations subsection, following is a structure that can be used in the final writing of the Notice of Proposed Rulemaking (NPRM) to be issued by the FAA[2]:

Subpart _____: All-Cargo Operational Requirements

Section ____.200 Applicability

This subsection prescribes flight time limitations and rest requirements for all-cargo operations conducted by air carriers, except that certificate holders conducting such operations with aircraft having a maximum payload capacity of 7,500 pounds or less may comply with the applicable requirements of sections 135.261 through 135.273 of the Federal Aviation Regulations.

Section ____.201 Definitions

For purposes of this Subsection, the term –

Acclimated/Acclimatized means a person performing duty in a location more than four time zones away from their home base, before which they have received a break in duty of at least 30 hours in that location. The continental United States is considered one time zone for purposes of this definition. Once acclimated in a time zone, a crewmember is

[1] Regulatory language for pre-duty requirements is not being submitted at this time.
[2] The language set forth below does not add any new substantive proposals. Rather, it translates the proposals made orally to the ARC on August 25, 2009, and in writing on September 1, 2009, into a regulatory structure.

considered acclimated until reporting for a flight duty period more than four time zones from the zone in which he/she was last acclimated.

All-cargo operation means an operation with an all-cargo aircraft conducted by an air carrier certified by the Department of Transportation and the Federal Aviation Administration or, if passengers are carried, they are only those specified in section 121.583(a).
Deadheading means the transferring of a non-operating crew member from one place to another required by the aircraft operator.

Domestic all-cargo operations means:

(i) Operations between any points within the 48 contiguous states of the United States or the District of Columbia; or
(ii) Operations solely within the 48 contiguous States of the United States or the District of Columbia; or
(iii) Operations entirely within any State, territory, or possession of the United States; or
(iv) When specifically authorized by the Administrator, operations between any point within the 48 contiguous States of the United States or the District of Columbia and any specifically authorized point located outside of the 48 contiguous States of the United States or the District of Columbia, or operations between any two specifically authorized points located outside of the 48 contiguous States of the United States.

Flight duty period (FDP) means the period beginning at required report time for duty and ending when the aircraft finally comes to rest at the end of a flight on which the crew member is assigned to a crew position.

Flight time means the total time, in hours or portion thereof, from the time of removal of the wheel chocks upon departure of a flight until the time of insertion of the wheel chocks upon arrival of the flight, as recorded in the captain's flight log or other electronic system used by the air carrier.

Look back means the period of time prior to the beginning of a flight duty period during which duty and rest requirements must be met in order to begin a flight duty period.

Operational Irregularities means conditions and requirements unforeseen or beyond the control of the certificate holder, including, but not limited to, weather conditions, aircraft equipment issues, air traffic control acts of God and hostilities.

Scheduled means the duty for which the crew member is assigned prior to the time that he reports. A schedule that meets the duty and rest requirements under this subpart may continue as legally scheduled up to the limits provided for that schedule.

Sector means a flight to which an individual is assigned as a flight crew member in which the aircraft is airborne.

Section ____.202 Flight Time Limitations: Domestic All-Cargo Operations

(a) A certificate holder conducting domestic all-cargo operations may schedule a flight crew member for duty and flight time for such operations according to the following chart[3]:

DOMESTIC ALL-CARGO OPERATIONS

Time of Start (Designated Base)	Flight Duty Period			Flight Time		Domestic Rest	
	1 to 4 Sectors	5 + Sectors	Extensions for Operational Irregularities	1 to 4 Sectors	5+ Sectors	Minimum	In 168
0000-0459	11	9	+ 2	8	7		
0500-1459	13	11	+ 2	11	9		
1500-1659	12	10	+ 2	10	8		
1700-2359	11	9	+ 2	8	7	10*	24

* Reducible to 9 at certificate holder's discretion (can only occur once in any 168 hour look back)

(b) Cumulative duty limits, measured from the point a flight crewmember reports for a flight duty period, are –

(i) 75 hour duty limit in any 168 hour look back
(ii) 215 hour duty limit in any 672 hour look back
(iii) 100 flight time limit in any 28 day look back
(iv) 1,200 flight time limit in any 365 day look back

(c) Deadheading to an operating leg in continuous duty counts in the calculation of flight duty period.
(d) Every flight duty period will be preceded by a minimum break of 10 hours except that a reduction to 9 hours is allowed one time in any consecutive 168 hours.
(e) In the 168 hours prior to the beginning of any flight duty period, a pilot will have at least one period of 24 hours free from all duty.

[3] CAA submits that flight time limitations are unnecessary and should not be included in the FAA NPRM. However, the regulations set forth herein contain proposed flight time limitations in the event that the FAA determines that flight time limits are appropriate.

Section ____.203 Flight Time Limitations: Non-Augmented International All-Cargo Operations

(a) A certificate holder conducting non-augmented international all-cargo operations may schedule a pilot for duty and flight time for those operations according to the following chart:

INTERNATIONAL ALL-CARGO OPERATIONS (Non-Augmented Crew)

	Flight Duty Period			Flight Time		International Rest	
	International 2 Pilot/ 2 Pilot and Flight Engineer 1 to 4 sectors	International 2 Pilot/ 2 Pilot and Flight Engineer 5+ sectors	Extensions for Operational Irregularities	2 Pilot	2 Pilot and Flight Engineer	Minimum	In 168
Unacclimatized/ Inside 0200-0559	12:30	11:30	+ 2	8	12	12*	30
Unacclimatized/ Outside 0200-0559	13:00	12:00	+ 2	10	12	12*	30
Acclimatized/ Inside 0200-0559	13:30	12:30	+ 2	8	12	12*	30
Acclimatized/ Outside 0200-0559	14:00	13:00	+ 2	10	12	12*	30

* Reducible to 11 at certificate holder's discretion (can only occur once in any 168 hour look back)

(b) Cumulative duty limits, measured from the point a pilot reports for a flight duty period, are –

(i) 75 hour duty limit in any 168 hour look back
(ii) 215 hour duty limit in any 672 hour look back
(iii) 100 flight time limit in any 28 day look back
(iv) 1,200 flight time limit in any 365 day look back

(c) Deadheading to an operating leg in continuous duty counts in the calculation of flight duty period.

(d) Every flight duty period will be preceded by a minimum break of 12 hours except that a reduction to 11 hours is allowed one time in any consecutive 168 hours.

(e) In the 168 hours prior to the beginning of any flight duty period a pilot will have at least one period of 30 hours free from all duty.

Section ____.204 Flight Time Limitations: Augmented International All-Cargo Operations

(a) A certificate holder conducting augmented international all-cargo operations may schedule a pilot for duty and flight time for such operations according to the following chart:

INTERNATIONAL ALL-CARGO OPERATIONS (Augmented Crew)

3 Pilot Augmentation (or 3 Pilot 2 Flight Engineer)

Flight Duty Period					Flight Time	International Rest	
International 3 Pilot with horizontal sleep opportunity 1 to 2 sectors	International 3 Pilot with horizontal sleep opportunity 3 to 4 sectors	International 3 Pilot seat 1 to 2 sectors	International 3 Pilot seat 3 to 4 sectors	Extensions for Operational Irregularities		Minimum	In 168
16:30	15:45	14:45	14:30	+ 2	12	12*	30

4 Pilot Augmentation (or 4 Pilot 2 Flight Engineer)				
Flight Duty Period			International Rest	
International 4 Pilot with horizontal sleep opportunity 1 to 2 sectors	International 4 Pilot with horizontal sleep opportunity 3 to 4 sectors	Extensions for Operational Irregularities	Minimum	In 168
19:30	18:45	+ 2	12*	30

* Reducible to 11 at certificate holder's discretion (can only occur once in any 168 hour look back)

(b) Cumulative duty limits, measured from the point a pilot reports for a flight duty period, are –

(i) 75 hour duty limit in any 168 hour look back
(ii) 215 hour duty limit in any 672 hour look back
(iii) 100 flight time limit in any 28 day look back
(iv) 1,200 flight time limit in any 365 day look back

(c) Deadheading to an operating leg in continuous duty counts in the calculation of flight duty period.
(d) Every flight duty period will be preceded by a minimum break of 12 hours except that a reduction to 11hours is allowed one time in any consecutive 168 hours.
(e) In the 168 hours prior to the beginning of any flight duty period a pilot will have at least one period of 30 hours free from all duty.

Section ____.205 Fatigue Risk Management System (FRMS)

(a) A Fatigue Risk Management System (FRMS) shall be developed by an air carrier and submitted to FAA for approval. All approved FRMS shall be managed by FAA headquarters personnel.
(b) A FRMS must be approved by the Administrator prior to implementation.
(c) FRMS is not intended to generally permit deviations from Subpart ___ and Subsections ___, *provided, however*, deviations from the rules set forth in Subpart _____may be allowable if sufficient evidence, taking into account the nature of operations, is provided showing fatigue is further mitigated by the FRMS and if approved by the Administrator.

Comments of the Cargo Airline Association

Flightcrew Member Duty and Rest Requirements; Proposed Rule, FAA-2009-1093

November 15, 2010

Attachment D

CARGO AIRLINE ASSOCIATION

1620 L Street, NW
Suite 610
Washington, DC 20036
Tel 202.293.1030
Fax 202.293.4377
www.cargoair.org

September 22, 2010

Ms. Rebecca MacPherson
Office of the Chief Counsel
Regulations Division (AGC-200)
Federal Aviation Administration
800 Independence Avenue, SW
Washington, DC 20591

Re: Flightcrew Member Duty and Rest Requirements Notice of Proposed Rulemaking; Docket No. FAA-2009-1093

Dear Ms. MacPherson:

The Cargo Airline Association (the Association)[1] respectfully requests an extension of 30 days, until December 15, 2010, to file its comments with respect to the Notice of Proposed Rulemaking (NPRM) on Flightcrew Member Duty and Rest Requirements, Docket No. FAA-2009-1093. In support of this request, the Association states as follows:

The NPRM on Flightcrew Member Duty and Rest Requirements was published in the *Federal Register* on September 14, 2010, **over one year** after receiving the report of the Aviation Rulemaking Committee designed to provide recommendations to the Agency. The NPRM is a complex 145 page document accompanied by a 144 page Regulatory Analysis. In spite of the fact that the Federal Aviation Administration (FAA or Agency) took over one year to develop the proposals in the NPRM and presented industry with a complicated rule and cost/benefit analysis, the comment period is an extremely short 60 days (Comments due on November 15, 2010).

As a practical matter, analyzing the impacts of the proposed rule and the justifications behind it will be an extremely time-intensive task. The work of the ARC is cited throughout the NPRM and several documents that were made part of the ARC record were also added to the NPRM's regulatory docket. A thorough review of the ARC record and any scientific sleep studies and work of international bodies, such as the International Civil Aviation Organization (ICAO) and the European Union (EU) are both necessary and appropriate, but will take time. Moreover, several Advisory Circulars were issued by the FAA dealing with commuting, flightcrew member rest facilities and fatigue training and additional time is needed to review the interrelationship of those proposals to the NPRM.

---

[1] Cargo Airline Association all-cargo airline members include ABX Air, Atlas Air, Capital Cargo, FedEx Express, Kalitta Air and UPS Airlines.

Accomplishing these analyses and drafting effective comments in a 60 day time period will be extremely difficult, if not impossible.

The all-cargo segment of the industry is one of the most dramatically impacted by the proposed rules and relatively more time is needed to assess the consequences and to prepare comments. Further complicating these tasks is the fact that the industry is currently in the midst of developing a required Fatigue Risk Management Plan (FMRP) which must be filed with the Agency by October 31, 2010, two weeks before comments to the NPRM are currently due to be filed. The same industry experts necessary for analyzing the effects of the proposed rules are currently absorbed in the development of the FRMP. This fact compromises the ability of the Association to effectively file comments by November 15, 2010.

In view of the complexity of the proposed rules, the breadth of the regulatory docket and related agency actions and the fact that the industry is also involved in the creation of FRMPs at the same time that comments are being prepared, the association requests an additional 30 days to file its comments in the above-cited docket.

Sincerely yours,

Stephen A. Alterman

Stephen A. Alterman
President

cc: Regulatory Docket No. FAA-2009-1093

Comments of the Cargo Airline Association

Flightcrew Member Duty and Rest Requirements; Proposed Rule, FAA-2009-1093

November 15, 2010

Attachment E

CARGO AIRLINE ASSOCIATION

1620 L Street, NW
Suite 610
Washington, DC 20036
Tel 202.293.1030
Fax 202.293.4377
www.cargoair.org

October 15, 2010

Ms. Rebecca MacPherson
Office of the Chief Counsel
Regulations Division (AGC-200)
Federal Aviation Administration
800 Independence Avenue, SW
Washington, DC 20591

Re: Flightcrew Member Duty and Rest Requirements, Docket No. FAA-2009-1093; Notice of Procedures for Submission of Clarifying Questions and Supplemental Request for Additional Time to Submit Comments

Dear Ms. MacPherson:

As requested in the Notice of Procedures for Submission of Clarifying Questions (Notice), the Cargo Airline Association hereby submits its clarification questions with respect both to the above-referenced Notice of Proposed Rulemaking (NPRM) and the Regulatory Impact Analysis that accompanied the NPRM. *See* Notice, 75 Fed. Reg. 62486 (Oct. 12, 2010).

Attachment 1 contains the questions that directly relate to issues raised by the proposed new Part 117, while Attachment 2 deals with issues raised by the Regulatory Impact Analysis. As directed in the October 12 Notice, copies of these questions are also being sent directly to the persons named therein.

In view of the volume of clarification and needed documentation issues, and the resultant inability of the industry to develop positions until answers to these questions are provided, the Association respectfully requests that the FAA reconsider and reverse its October 14, 2010, denial of all requests for extension and provide that Comments may be filed within sixty (60) days of the date of the FAA responses.

If you have any questions with respect to these requests, please do not hesitate to contact me. Thank you very much.

Sincerely yours,

Stephen A. Alterman

Stephen A. Alterman
President

cc: Regulatory Docket No. FAA-2009-1093.

Attachment 1

THE CARGO AIRLINE ASSOCIATION
The Voice of the Air Cargo Industry

Flightcrew Member Duty and Rest Requirements; Proposed Rule
FAA-2009-1093
Questions Submitted to FAA for Clarification
October 15, 2010

§ 117.1 Applicability

1. The Applicability section provides that flights conducted under Part 91 are now covered by the provisions in Part 117. Please confirm that FAA intends for Part 117 to cover only those Part 91 flights conducted by flightcrew members *for the certificate holder or under the direction and control of the certificate holder* (emphasis added).

2. If FAA intends for Part 117 to apply to all Part 91 flights, including even Part 91 flights conducted by flightcrew members during their time free from duty and/or for personal reasons, then will the certificate holder be required to track all Part 91 flying by one of its crew members in the calculation of these limits?

3. How does FAA expect certificate holders to be able to track Part 91 flights outside their direction and control? Will the certificate holders be required to report these flights to FAA?

4. Will all of Part 117, including its augmentation requirements and class of rest facility provisions, apply when a certificate holder is ferrying an aircraft into a foreign theatre under Part 91? (Example: narrow-body aircraft used in intra-Asia operations.)

5. Even with the addition of a new Part 117, some sections of Part 121 remain intact. Given the expansion of the applicability of a new Part 117 to include Part 91 flights, which requirements under Part 121 will be applicable to certificate holders for Part 91 operations? If not entirely, which sections of Parts 91 and 121 will apply?

§ 117.3 Definitions

The Association believes that a major component of a successful regulatory scheme is a set of definitions that are clear and easily understood. Such definitions avoid future "misunder-standings" regarding the intent of the regulations, resulting in fewer interpretations after the rules are promulgated. The following questions are designed to ensure that the definitions used in the Final Rule are easily understood.

Acclimated

6. Is the 36-hour acclimated threshold based on scheduled or actual operations?

7. Please confirm that the 72/36 hour clock is based on the exact time of block in at the end of the Flight Duty Period.

Airport/standby reserve

8. Please define "*close proximity*" as this term is used in Part 117.

9. Is a certificate holder required to calculate Flight Duty Period (FDP) and duty as an airport/standby reserve if that flight crewmember is in a *short call reserve* status at a hotel that is attached to the terminal or across the street from it? At what distance is the definition of "*close proximity*" no longer considered in the status of the reserve?

Duty

10. Please define "*administrative work*" as it is used in the proposed definition of *duty*? For clarification, please provide examples of those activities characterized as "administrative work".

Flight duty period (FDP)

11. Under the proposed definition of *flight duty period*, the last sentence states that, "[a] flight duty period includes 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." Is training conducted in a flight simulator or flight training device considered part of a FDP even in those cases which training does not precede an actual flight?

12. Is the use of computer based training considered a training device for the purposes of this definition?

Unforeseen Operational Circumstance

13. Please define "operational circumstance" as that term is used in Part 117. Please provide examples. Under what circumstances would FAA prohibit the use of extensions under the provisions of § 117.15 (FDP: Unaugmented) and § 117.19 (FDP: Augmented)? For instance, could a certificate holder be authorized to use an extension for circumstances that are completely beyond its control, but are based strictly on an economic business consideration (such as holding an aircraft to wait for payload from a customer who is late)?

Attachment 1

Additional Questions Regarding Definitions

14. Please provide a definition for *night and/or nighttime*? These terms are used several times within other definitions and in section 117.27 and could lead to confusion without a precise definition.

§ 117.5 Fitness for Duty

15. §117.5 (e) requires a certificate holder to evaluate the flightcrew member for fitness for duty. What medical equipment will be required and what diagnostic standards will apply in performing this task?

    a. Is FAA proposing to publish uniform standards for this evaluation?

§ 117.7 Fatigue Risk Management System

16. Will FAA have a Fatigue Risk Management System (FRMS) approval process in place before the implementation date of the regulation so that carriers who have already developed fatigue mitigation strategies as part of their collective bargaining process can transition directly into FRMS without having to implement all parts of these prescriptive rules in the interim while waiting for FAA's approval process?

17. When will FAA begin implementing FRMS approvals?

18. The elements of the FRMS appear to mirror the required FRMP. What additional steps will certificate holders be required to take in order to obtain relief from the prescriptive language of Part 117?

§ 117.9 Schedule reliability

19. FAA states in the Preamble to the NPRM that a certificate holder must make system adjustments if the actual system-wide FDPs exceed the maximum levels in the FDP table [Table B] more than five percent of the time or any actual FDP exceeds the pairing-specific schedule by more than twenty percent. 75 Fed. Reg. at 55883. The regulatory language in proposed § 117.9 (a) states that, "[E]ach certificate holder must adjust within 60 days…its system wide flight duty periods if the total actual flight duty periods exceed the scheduled flight duty periods more than 5 percent of the time and…any scheduled flight duty period that is shown to actually exceed the schedule 20 percent of the time." 75 Fed. Reg. at 55886. This proposed section refers to a five percent or 20 percent difference between the actual and scheduled flight duty period, when the Preamble indicates the reliability refers to actual FDPs exceeding Table B limits. Do certificate holders have to measure and report actual vs. scheduled, or actual vs. maximum limits?

20. Please clarify how the FAA expects a carrier to handle minimal volume pairings that only fly twice per year and fail once.

21. Are certificate holders being asked to compare actual flight crewmember duty or what they were "originally scheduled to do"? How does a certificate holder account for schedule changes that occur within a FDP?

22. In § 117.9 (a) the carrier is required to measure reliability by FDP but the reporting in § 117.9 (b) is required by pairing. Please confirm that reporting should be done on a duty period basis or clarify the intent of the reporting.

23. How will the FAA measure compliance: actual versus scheduled times? Actual versus exceedence?

24. How does the proposed rule treat unscheduled operations in terms of schedule reliability?

25. Are certificate holders required to compare what the flight crewmember actually flew in the duty period or what the flight crewmember was "originally planned to fly"? How should a certificate holder account for schedule changes that occur within a FDP?

§ 117.11 Fatigue education and training program

26. What was the basis for establishing 5 hours for initial training and the 2 hours for recurrent training? Given FAA's strong support for value of AQP, will AQP carriers be allowed to use AQP methodologies to set the training objectives, media type and recurrent training intervals to their unique operation?

27. Will covered employees who are currently employed by the certificate holder be subject to the 5-hour initial training requirement of this regulation?

28. Does FAA contemplate standard industry-wide training? If so does FAA plan on providing certificate holders industry-wide training material to ensure standardization?

29. What is the definition of "operational control" as used in proposed Part 117? What job functions are considered to determine if an individual is responsible for "operational control"? Would this requirement include all station managers and specific personnel at those stations (domestic and abroad)?

30. If a certificate holder relies on vendors to provide "operational control" of an aircraft while on the ground (e.g.: weight and balance, ground security, and observing regulations with regard to hazardous materials handling), are those employees and their management teams also subject to this training requirement?

31. With regard to the interval of recurrent training:

a. Will the annual training requirement follow the base month concept of flight crew training or will it have to be done on the calendar month?

b. Does FAA foresee adjustments in the training requirements to fit within a certificate holders training cycle?

Note: Responses to these clarifying questions are critically necessary to assess the actual costs of compliance with any new regulations.

§ 117.13 Flight time limitations

32. Will FAA only consider home base time in Table A?

33. Is it a correct understanding of the regulation as written that no extensions are permitted to Table A values, even due to "unforeseen circumstances"?

34. Does the limitation in § 117.13 that a crewmember may not continue an assigned flight duty period if the limits in Table A will be exceeded apply to single-leg flight duty periods with flights that are already airborne? How about to flights that encounter a ground delay after block out but prior to takeoff?

35. Please confirm whether augmented operations have a maximum flight time limit of 16 hours. The preamble "executive summary" table and the regulatory impact analysis both state that there is no flight time limit for augmented operations, contrary to the language in § 117.13(b).

§ 117.15 Flight Duty Period: Un-augmented operations

36. Does the proposed rule reduce FDP periods after the fourth segment (as stated in the preamble) or reduce FDP periods after the second segment (as stated on Table B)? (Note: the ARC agreed on a reduction after the fourth segment).

37. Section 117.15 (c) uses the term "unforeseen circumstances" which is an undefined term. Did FAA intend to use the term "unforeseen operational circumstances" which **is** defined. If not, what is the intended definition of "unforeseen circumstances"? Shouldn't this definition be included in the Definitions section?

38. Are deadhead flights conducted at the end of a duty period counted as flight segments when using the FDP limit chart? Are deadhead flights conducted at the beginning or in the middle of duty counted as flight segments?

§ 117.19 Flight Duty Period: Augmented

39. Did FAA consider that non-scheduled operations with regard to unique customer demands may require a short last segment? How was such consideration factored into the proposed rule?

40. § 117.19 (e) states that "at least one flight crewmember with a PIC type-rating must be **alert** and on the flight deck." (emphasis added). Please define the word "alert".

41. § 117.19 (c) 1 seems to suggest that augmentation is prohibited if any flight leg in the duty period does not provide a 2 hour rest period. Please clarify.

§ 117.21 Reserve status

42. § 117.21 (e) places restrictions on shifting a Reserve Crewmember's availability periods. This seems to support reserve availability periods that occur generally in the same location. It is very common for cargo carriers to start a reserve availability period at the Crewmember's domicile, but once called for a flight duty to an international location, the individual will then be placed on reserve at an international location upon arrival, often many time zones away from the domicile. How will reserve availability periods be applied/restricted once in a new theater? Would the individual be restricted to the same local times in the new theater as he was previously assigned at his domicile? If so, would that be in local time or home base time? Would the reserve Crewmember eventually become acclimated and have a new set of rules?

§ 117.23 Cumulative duty limitations

43. Will a certificate holder be prohibited from scheduling a flightcrew member to the extended cumulative duty limits (75/168 and 215/672) if:

    a. The planned deadhead of a crew member is for a seat in an aircraft cabin that allows for a flat or near flat sleeping position, but none are available at the time of departure of that deadhead activity?

    b. Are deadhead activities in cargo aircraft that do not have a cabin seat restricted from utilizing the extended accumulative duty limits, even though they have a class one sleep facility, but it is not in the aircraft cabin?

44. Will a certificate holder be considered in violation of this regulation if a flight crewmember is at the end of their cumulative duty limits, but the air carrier cannot allow that individual to be free of duty due to circumstances beyond their control? (e.g., ramp congestion, fueling delays, , de-icing delays, ATC delays, etc.)

45. Does the proposed rule require certificate holders to maintain and track all time spent on administrative duty of their management pilots?

117.25 Rest Period

46. In order to clarify the circumstances when a certificate holder will be required to provide three physiological nights rest upon return to home base (Part 117.25 (b) (1)):

a. Please clarify the intent of the "flight duty periods that exceed 168 hours" provision. Does this mean total time away from base, or does it mean a pairing that has accumulated 168 hours of FDP in one crew pairing?

b. To avoid confusion, please provide an example of when this provision would apply.

47. Please clarify the "four time zones" requirement in Part 117.25 (b) (1). Please also clarify the following:

    a. Please indicate in each example if the following crew pairing would trigger the 117.25 (b) (1) provision and requirements:

        i. A flight that crosses four time zones but begins and terminates within four time zones (JFK-LAX-DFW).

        ii. A series of FDPs that all begin and end will transition less than four time zones for a given FDP, but at some point in the crew pairing, the crew lays over at a location that is more than four times zones from their home base.

        iii. In the following hypothetical example, the certificate holder has established a Dublin crew base. The flight crewmember accomplishes the following schedule

            Day One: DUB-FRA, (3 time zones)

            Day Two: FRA-IST, (3 time zones)

            Day Three: IST- DXB, (3 times zones)

            Day Four: A DXB-BOM-DXB turn (2 time zones each way in a single duty period,

            Day Five through Seven: operated in reverse back through IST with a total time away from base in less than 168 hours.

48. Does the 36-hour rest requirement apply if the flight crewmember does not end an FDP in a new theater, but simply touches it during the course of the FDP?

49. Does the operation of an aircraft in airspace that is in a new theater, but never lands there, trigger the provisions of this 36-hour rest requirement? (e.g. The ATC flight plan overflies a country that does not observe daylight savings time).

50. How does FAA expect a certificate holder to measure the start of the rest period for a crewmember that lives in the layover city? Does the certificate holder need to measure travel time to the crewmember's home of record in such instances?

51. Draft AC 120-FIT (page 12) requires the certificate holder to "take into consideration the potential effects of fatigue when building schedules, especially when they know the crewmembers are commuting to the domicile." Does FAA expect required rest at home base to calculate travel time to/from a crewmember home address in determining minimum rest requirements between crew pairings ending and commencing at the home base?

§ 117.27 Consecutive nighttime operations

52. Is the application of this provision predicated on a flight crewmember's acclimated theater or is it based entirely on "nighttime" at home base?

53. Does this section apply to augmented flights?

54. Do the provisions of "unforeseen operational circumstances" apply to this requirement?

55. Is a certificate holder permitted to exceed three consecutive nights if this is the result of other parts of this regulation that change the schedule in order to accommodate the dynamic nature of real-time schedule adjustments? (e.g. variable block and FDP periods, a possible unintended acclimated crew due to a late departure, a delay in getting to the hotel for required rest, etc.)

56. Can a certificate holder utilize the provision that allows more than three consecutive nighttime operations if the split duty rest was only available on one night? If so, does it matter which night? Or are split duty requirements needed on all nights FDPs?

§ 117.29 Deadhead Transportation

57. If a crewmember deviates from published deadhead transportation activity at his/her own discretion, is the certificate holder obligated to apply the provisions of § 117.29 as if that deadhead activity were scheduled by the certificate holder?

58. Is it the intent of the provisions of § 117.29(c) to provide a flightcrew member assigned solely to a deadhead transportation assignment with more rest in the destination city than is required for the crew operating the flight?

§ 117.31 Operations into unsafe areas

59. What is the definition of "safe" versus "unsafe"? Please include in the section on "Definitions".

60. Is this section intended to cover planned, unplanned, or both? Who makes the determination that an operation is in an area that is unsafe?

Attachment 1

61. The regulation states that, in covered situations, the certificate holder may exceed the maximum applicable flight duty periods “to the extent necessary” to reach a destination where the flightcrew can be relieved or receive the requisite amount of rest. Does FAA intend for the certificate holder to merely use its best judgment in making these determinations or are there any standards that must be followed? After operating to an unsafe airport, must the certificate holder stop at the nearest safe and suitable airport or can it extend the FDP to complete the next commercially scheduled leg?

62. Many countries around Afghanistan will not permit a landing from a carrier that is departing a US military installation inside Afghanistan. Is the carrier required to operate an aircraft away from its next point of revenue operation (ie in the wrong direction) in order to comply with augmentation requirements described in § 117.19 (c) if a suitable airport in the general direction of the next point of revenue operation can be found, but does not comply with § 117.19 (c)?

63. Where operations are for the U.S. military into safe areas, are there any circumstances in which the rule permits the certificate holder to exceed the maximum applicable flight duty periods, perhaps because it is impossible to place a crew (example: the military installation at Diego Garcia in the Indian Ocean)?

64. Does this provision apply not only to hostile war zones, but also to areas that have extraordinarily high crime rates where the carrier has otherwise forbidden crew changes in such locations out of concern for the flightcrew’s personal safety? Does it apply to areas where the State Department has issued a travel advisory recommending that Americans avoid travel to certain countries/areas?

Clarifying Questions within Preamble language

65. Question (19) asks, “Are the proposed required rest periods appropriate”? 75 Fed. Reg. 55866 (Sept. 14, 2010). Please clarify what “required rest periods” FAA is seeking comment on (e.g., the minimum 9-hour rest requirement or the varying in-flight rest period concepts and their effect on FDP’s).

Attachment 2

THE CARGO AIRLINE ASSOCIATION
The Voice of the Air Cargo Industry

Requests of the FAA for Information, Documents and Clarification of Regulatory Impact Analysis

A. Data and Documentation Request

A1. Direct Benefits

1. Please provide detailed data backup for Table 1 including sources, time frame and carrier type?

2. Please provide details for all 43 accidents in the database used for analysis and simulations. Please provide the specific data source used to identify these 43 accidents and the criteria used for selection. If based on an NTSB accident data source, was any other source (internal or external) used to characterize these accidents? If so, provide all data from those sources, why they were selected, and how the data were associated with the NTSB data. For example, provide the source data or other evidence relied upon for the FAA to conclude that pilot fatigue was a contributing factor in those cases where the NTSB did not cite pilot fatigue.

3. Provide the same information for the 235 additional accidents (196 passenger and 39 cargo) that were used in the "Upper Estimate Results".

4. Please provide the source, time period and data used for pilot hours in Table 1. Does the distribution of captains' hours in the sample data in column 1 of Table 1 replicate the same distribution of pilot hours of the carriers involved in the 43 accidents shown in Column 3? If yes, please provide analytical proof that this is correct. Are these two series of data drawn from the same 20-year time period?

5. Please provide the cargo airline hours in Column 1 of Table 1 and the cargo airplane accidents in Column 3. In other words, please prepare a "cargo only" version of Table 1.

6. Please provide the source(s), time period and detailed data for the number of operations shown in Table 3. Also provide a detailed breakdown of the operations by type of operation using the same "group" categories as shown in Table 7. Provide this detailed operations data separately for each time-of-day period (line) represented by the data in Table 3.

7. Please provide all of the (1) input data, (2) assumptions about the qualitative relationships and specifications, (3) bases for such assumptions and estimates, (4) output statistics, and (5) complete descriptions of the simulation model(s) employed in the FAA's study.

8. Please provide all detailed calculations and/or computer runs to support the FAA's projections that there would be 5.8 cargo airplane accidents over the next 20 years (referenced on pages 40 and 45 of the FAA's Regulatory Impact Analysis).

9. Please provide all backup and detailed description of the 5,000 simulations run with the combined 10-accident and 49-accident cargo aircraft samples (referenced on page 59).

10. Please provide all backup work papers, notes, spreadsheets and other documentation to support the definition of effectiveness categories (referenced on page 66), and provide the details underlying the scoring of each accident evaluated for effectiveness. What was the number of accidents considered initially, how many were discarded for one reason or another, how many were assigned a score of 0%, and how many were scored with positive effectiveness numbers (15% to 90%)?

11. Please provide the frequency distribution for all accidents in terms of FAA's effectiveness score (0%, 15%, 35%, 50%, 75% and 90%) referenced at pages 66-67.

12. FAA refers on page 67 to a technical document supplied in this docket. The CAA does not find such a document in the docket. Please provide this document directly to CAA.

13. Please provide the GRA report cited in footnote 8 (page 18).

A2. Additional Benefits

14. Please supply all assumptions, input data and data sources, and calculations to support the $90 million annual cost figure on page 70.

A3. Costs

15. For some cost elements, the Regulatory Impact Analysis reports the FAA's findings separately for passenger and cargo carriers. For other cost elements, it does not show the costs separately. Please provide the cargo airline costs separately for every cost element or category used in this study. This is essential to the cargo airlines' ability to analyze and evaluate the accuracy, completeness and reasonableness of the Regulatory Impact Analysis as it pertains to the cargo carriers.

16. Provide detailed work papers, spreadsheets, costing models and all source materials that support the cost estimates provided in the Regulatory Impact Analysis. For example, please provide the detailed calculations by carrier, or carrier group, for the estimate of noncompliant flight hours shown in Table 10.

17. Please provide the detailed information for the estimates of hotel and per diem costs relative to salary costs. Please provide analysis used to support assumption that a single carrier's estimates are representative of all types of carriers.

18. Please provide all supporting calculations, assumptions, justification, source documents, and any other materials used to "adjust" the FAA's cost estimate presented at p.85 ff. The unadjusted crew cost estimate is $2,075.6 million (Table 12) and after "adjustment" it was reduced to $854.2 million (Table 17). Please provide all backup assumptions, input data, and computations to explain the adjustment completely.

19. Please provide a complete copy of the FAA's crew scheduling "optimization" model(s), and a full description of the data, methodology, and assumptions. Was this model vetted with any airline(s)? If so, which carriers participated and what were their responses and suggestions (separate by carrier)?

20. Provide the detailed assumptions and calculations that explain the construction of Tables 14, 15 and 16.

21. Please provide details describing and supporting all "additional long-term optimization on factors…"[1] used by FAA to construct Table 17.

22. Comparing the NPV estimate in Table 13 of $1,556.7 million to the final estimate of $854.2 million in Table 17, the FAA has attributed $702.5 million to so-called "long term optimization factors." Please provide a detailed schedule that itemizes each individual adjustment "factor", and the NPV amounts for each, starting with the unadjusted cost of $2,075.6 million (Table 12) and ending with $854.2 million (Table 17). Provide each amount separately for passenger and cargo aircraft operations.

23. Please provide the evidence FAA relied upon for each assumption it made in arriving at its estimated cost savings from reduced reserves. This amounts to $142.1 million (NPV) as shown in Table 21. For example, what is the evidence FAA relied upon to support the assumed 5% reduced sick time assumption? Please provide the cargo carrier cost savings estimate separate from the passenger estimate in Table 21.

24. Please provide the assumptions and evidentiary basis for each element in the analysis that leads to an ultimate estimate of $276.9 million in savings from augmented operations (Table 25). Provide all details and cost estimates separate for cargo and passenger operations.

25. What is the time period used to derive the percentage distribution in Table 22?

26. Please provide the breakdown between passenger and cargo airlines fatigue training costs (pages 106–113).

27. What time is covered by the Part 121 crew member counts in Table 30?

[1] From the bottom of page 87.

28. Of the six carriers submitting crew schedule data for purposes of this cost analysis, please summarize their route structure by counting the flights between zero and one block hour, one and two block hours and so on. Are ultra-long haul carriers represented?

B. Clarification of Analysis and Methodologies

B1. Direct Benefits

29. What is the basis for estimating “projected number of accidents” and “possible accidents avoided” as presented in Table 2?

30. In regard to the 18 accidents cited on page 40, were these accidents part of the total 43 accidents cited at page 18 and elsewhere? If so, please identify which ones involved a cargo airplane. In which lines of Table 1 are these cargo accidents located? For each cargo accident within the 18 “fatigue” related accidents, please denote the type of aircraft, the operator, and whether it was operating at the time of the accident pursuant to Part 121, Part 91, or Part 135.

31. What was the justification for including accidents that were not Part 121 at the time?

32. What was the justification for using simulation to estimate benefits including justification for the particular model selected or designed? How this methodology been applied in the past and have the results been previously verified? What other methodologies were considered and why were they rejected?

33. Did the simulation runs separately identify the 18 accidents where pilot fatigue was a contributing factor according to FAA? Were any runs made with only these 18 accidents? Were any runs made for only the cargo accidents within the subset of 18? If yes to any of these questions, please provide complete details, as requested above.

34. What specific probability or other functions were used in the simulations for (1) accident probability, (2) fatality (or other damage) probability, and (3) estimated costs per accident? What statistical or other analysis was performed to determine that these were the appropriate functions to use, and was that analysis done separately for the passenger and cargo models?

35. How were accident costs estimated for the simulations (and what was included)? Was the same methodology and data used for the passenger and cargo models and, if not, why not?

36. Why do the simulation runs project possible outcomes for the next 10 years but all the data inputs are derived from a 20 year accident history?

37. What analysis or other justification was used to conclude that the 235 accidents used in the "Upper Estimate Results" (pages 50-54) were based on pilot error but that the "presence or absence of pilot fatigue" was not known? What analysis was conducted to conclude that the probability of pilot fatigue being the cause for these 235 accidents should be exactly the same as for the 43 accidents where the cause was identified?

38. What statistical tests were performed to assure the FAA that casualty simulations using the 278 accident data set (for "higher" estimates) could be based on the 18 that FAA claims were related to pilot fatigue? What analysis was done to conclude that the probability of occurrence and the expected severity in terms of damages, injuries, and fatalities for the 18 accidents could be applied to the accidents without pilot fatigue as a causal factor? Please provide all of the detailed results of such tests. For example, do the probability distributions (e.g. Figures 5 and 8) look closely similar in shape?

39. How do the key flight and duty time parametric values for the 18 fatigue accidents compare with the population of 235 additional pilot error accidents? How do the distributions of the variables shown in Table 1 compare between these two sets of accidents (18 vs. 235)?

40. Please provide the basis for assuming that 39.4% of the 196 "pilot error" accidents referenced on page 50 were due in part to pilot fatigue. Did FAA examine all 196 case reports and validate this assumption? If yes, then please provide all notes, analyses and assumptions supporting the validation. How many of the 196 accident reports explicitly mention pilot fatigue as a contributing factor? Please provide a list of such cases. How can pilot fatigue be cited as contributing to accidents when the NTSB accident review excluded it as a causal factor?

41. For the "Upper Estimate Results" analysis, please provide the basis (empirical, anecdotal or otherwise) for assuming that 58% of the alleged 39 additional cargo aircraft accidents had pilot fatigue as a contributing cause (see page 53). How many of the accident reports for the 39 cases made mention of pilot fatigue as a contributing factor? If any, please identify them and provide backup data.

42. The "best estimates" NPV of benefits is stated at page 63 to be $114.5 million for avoiding cargo aircraft accidents and it is reported as $105.7 million at page 68. There is no explanation of why there is a difference. Please clarify.

B2. Additional Benefits

43. On page 69 the FAA alleges that in the U.S. "total costs of ramp incidents and accidents exceed $3 billion per year." Please provide the source of this figure, and all backup analysis/workpapers if it was computed by or for the FAA. How much of this cost is a direct result of pilot fatigue and show how this estimate is derived.

44. What analyses were conducted to estimate the portion of the $3 billion that is attributable in whole or in part to air traffic controller errors/fatigue? What portion is attributable to ground worker errors/fatigue (outside the aircraft)?

45. The FAA refers on page 70 to US Flight 1549 that landed safely in the Hudson River. Except to the extent already available from the NTSB report on this accident, please provide details of the flight crew's activities (flight and ground time segments) covering all hours of their four day trip? Is it a fact that the notable flight from LGA to CLT was the last segment of their four day trip?

46. On page 120 the FAA used $12.6 million for the value of life and $600 million over 10 years for minor accident cost savings to show what amounts of increased benefits would be required to equate total benefits and total costs as estimated by the FAA. Did FAA conduct its own internal empirical analysis on these numbers and findings?

B3. Costs

47. On page 75, it is stated that six airlines provided actual crew schedule data to the FAA to assist in the study analyses. Please name the six carriers. Because the data were collected for one month in the spring of 2009 and one month in summer of 2009, how did the FAA make appropriate adjustments to reflect year-round weather conditions and other operating conditions? Please provide the basis for the assumption that these months were considered to be representative of the entire year and all of the forecast years?

48. How did the FAA's analysis account for, and analyze, the scheduling needs of the cargo airlines during peak season (November and December)?

49. Did the pilot "salary" cost used by the FAA (referenced on page 81-82) include all benefits, social security and Medicare taxes? If not, why not? What are the fully loaded wage costs per hour?

50. On page 85 of the report it states that FAA used a factor of 25% to discount the unadjusted crew scheduling costs determined in Table 12, and the results are shown in Table 13. Provide all assumptions and workpapers that justify the choice of 25% as a discount factor.

51. Please provide the bases and evidence to support the assumption on page 87 that the "share of pay to existing crews will increase while the share of new hire salary will decrease".

52. Section 117.5 (e) requires a certificate holder to evaluate the flightcrew member for fitness for duty. What medical equipment or diagnostic testing equipment or materials are necessary to perform this task and how were such costs considered?

53. Section 117.5 (g) requires the development and implementation of an internal evaluation and audit program for monitoring fitness for duty. Such a program will yield considerable costs in equipment and personnel. How were such costs considered?

54. In regard to the FAA's estimate of cost savings from augmented operations, the report at page 97 states . . . "the resulting potential cost estimate is highly uncertain." Did FAA perform any sensitivity tests, and if so what were the assumptions and quantitative factors underlying each test, and what were the NPV dollar cost results for each test?

55. How did FAA account for the all-cargo carrier costs associated with rest facilities compliance?

56. §117.13 Flight time limitation: This section imposes new restrictions upon the industry by prohibiting a crewmember from <u>continuing</u> his assigned flight duty period if he will exceed his total flight time in Table A, even if due to unforeseen circumstances such as weather, mechanical, or Air Traffic Control. This might suggest carriers will build flight-time buffers into their schedules in the future that do not exist today. What assumptions were made with regard to carrier scheduling behavior to ensure the flight crewmember can meet the *new* flight time

limitations, even in the event of unforeseen circumstances referenced above? Did the FAA consider that carriers will have to become more conservative in the scheduling assumptions with regard to flight time limits as a result of being unable to continue a Flight Duty Period that was otherwise scheduled legally?

57. § 117.19 Augmented Flight Crew: Paragraph 117.19 (c) places significant new stage length restrictions on flights and duty periods which can be augmented. It appears to prohibit augmentation in cases where the stage lengths do not meet the prescribed in-flight rest requirements. Cargo, non-scheduled and supplemental carriers often operate into remote areas of the world. In many cases it is not possible to pre-position Crewmembers into these remote locations for a variety of reasons including lack of safe commercial passenger carriers, infrequent operations into these stations, inability to obtain visas in advance, etc. Did the FAA consider the operational and financial impact associated with lost revenues, idle aircraft, rerouted aircraft possibly adding additional flight time with no corresponding revenues, etc that is created by restricting the ability of all carriers to augment duty periods that may include short flight segments?

58. § 117.19 Augmented Flight Crew: Commercial Air Travel is a very significant cost component for cargo airlines as most cargo carriers do not have a passenger network upon which crews can be pre-positioned. In addition, many cargo carriers operate very infrequently into many stations, perhaps only a few times per year. In many cases carriers cannot use augmented crews because of in-flight rest requirements described in 117.19 (c). Did the FAA consider the costs of additional commercial air travel as well as the loss of crew productivity that is unique to the Cargo industry, that results from additional crew changes both domestically and at points outside the United States?

59. § 117.21: The cost analysis provided by the FAA assumes that carriers will enjoy a reduced requirement for reserves due to fewer sick calls pertaining to fatigue. There was no mention of increased reserve requirements. Did the FAA also consider the following may drive the need for additional reserves:

    a. Restrictions on completing a duty period that exceeds flight time limits due to unforeseen circumstances?
    b. Restrictions on number of FDP extensions per 168 hour period?

c. Restrictions on ability to shift reserve availability periods (by not more than 12 hours later; not more than 5 hours earlier, except 3 hours if the shift is into the flight crewmember's circadian low; and not more than 12 hours in any 168 hour period?

d. Inclusion of time spent on short-call reserve in cumulative duty limits?

e. Limitations on reduction of post-duty rest to not more than once per 168 consecutive hour period?

f. Reference § 117.17 and § 117.27: The affect of unforeseen circumstances that eliminate the opportunity to receive 4 hours rest mid-duty period for night cargo operators, leading to a flight crewmember becoming illegal for what was otherwise legally scheduled to be his 4^{th} or 5^{th} consecutive night operation?

60. Did the FAA consider the economic impact upon aircraft manufacturers and related industries that may result from potential buyers being dissuaded from purchase of newer aircraft with longer range that may become of less value due to flight crew duty restrictions?

61. § 117.25: Did the FAA consider the effect upon all-cargo carriers, particularly those that operate in an unscheduled environment, associated with the following new rest provisions:

a. 30 consecutive hours in 168 hour period?

b. 36 hours for a Crewmember operating in a new theater?

c. Limitations upon reduced rest in any 168 hour period?

62. Has the FAA performed a sensitivity analysis to assess the impact of a cargo-carrier restructuring under Chapter 11 Bankruptcy protection as a result of customer losses stemming from the proposed regulation?

63. On long haul operations, the cost to position crews including their deadhead pay and other non-flying costs are often many multiples of the flying costs once the crew is positioned. It appears that the FAA analysis assumes one-to-one incremental cost of flying time that cannot be flown as a result of the NPRM. Please indicate the added cost of the NPRM if the cost is two-to-one for duty periods containing segments that are over eight hours.

64. On page 76, the effect of cumulative limits were not estimated due to data limitations. Data limitations in other parts of the analysis were solved with assumptions, and we would suggest the same approach is appropriate in instance. Cumulative limits will create substantial costs for the

affected carriers. Cumulative limits could add [xx%] to the costs of the NPRM and it is not reasonable to exclude them.

65. On page 84, “nearly 40% of flights were eliminated due to their duty period exceeding the maximum by less than 60 minutes.” The carriers object to the characterization of these new illegalities as zero-cost events. If extended to all carriers’ flying, staffing or scheduling for a total of x,xxx,xxx annual flight segments would have to be changed. These events will have to be solved, and a cost will be borne by the carriers to accomplish that. What is the foundation of “the FAAs belief” that including these 40% of flights will overestimate the cost of the Proposed Rule?

66. On pages 85, 87 and 88, the FAA embeds an assumption that further optimization will lead to a lower effective cost of the Proposed Rule. All of the large carriers have fully optimized schedules today and the use of optimization science is highly developed in these carriers. Some smaller carriers may benefit from further optimization, they have not applied optimization science to their crew scheduling efforts because of the costs and complexities of these systems. To assume carriers can schedule crews “ever more efficiently” is an unjustified assumption and should be removed.

67. On page 97, the assumption that labor agreements will allow the carriers to reduce the number of crewmembers from four to three must be validated. What CBAs has the FAA identified that will allow this change as validation of the assumption?

68. Has the FAA assessed the overall loss of business to foreign flag carriers that will be able to offer lower prices and better schedules relative to their US counterparts as a result of this Proposed Rule?

Comments of the
Cargo Airline Association

Flightcrew Member Duty and Rest Requirements; Proposed Rule, FAA-2009-1093

November 15, 2010

Attachment F

Scientific Issues Regarding NPRM

Gregory Belenky, M.D. and R. Curtis Graeber, Ph.D.
November 5, 2010

General Comments:

While the principles of sleep science are generally well understood and accepted, their practical application to any operational environment, including aviation, is very much a work in progress. The reason is that such environments typically involve extended work hours, work through the circadian trough, and/or 24x7 operations. Because fatigue is the result of the interaction of sleep/wake history, circadian rhythm, and workload as well as individual factors, the precision of any predictions for a specific scheduled or non-scheduled operation is challenging and limited in accuracy.

The interaction of these three variables is complex. For example, in the first 24 hours of an operation where no sleep is possible the circadian rhythm in alertness and performance is dominant. With time awake extending beyond 24 hours, the homeostatic drive for sleep (the effect of sleep/wake history) gradually becomes more dominant displacing the importance of the circadian rhythm. Both homeostatic sleep drive, increasing with time awake, and circadian rhythm, waxing and waning in a 24 hour cycle, modulate performance and amplify the effect of workload (time on task) which can vary in intensity and complexity based on a number of operational factors. Thus, fatigue is not simply the result of sleep loss but rather the interaction of sleep loss, time of day and workload. For these reasons, the specific application of sleep science in aviation is far from settled.

This is not to say that a limited number of very practical, scientifically robust, studies have been carried out in commercial flight operations by NASA and other laboratories. These studies have enabled some application of sleep science principles to specific industry uses. However, there are a significant number of practical fatigue related questions for which the science is currently limited to extrapolations and application of general sleep science principles based primarily on non-aviation research. A good example of this is the current attempt to develop mathematical models to predict performance from the three interacting factors that underlie fatigue. Integration of such models into today's "industrial strength" rostering and scheduling software will likely enable turn-key fatigue risk management as they are validated by actual flight crew data in the future.

The operational environment is one in which the performance of the human in the loop is critical. Adequate sleep, working at a favorable circadian phase and bearing a reasonable workload will sustain nominal performance. We know that fatigue degrades performance and (in the words of the USAF fighter pilot, John Boyd) the operator's ability to "observe, orient, decide, and act." The goal of the NPRM is to put together a system of regulations or, alternatively, a framework to enable the implementation of an FRMS, to manage the complex interaction between sleep loss, circadian rhythm phase, and workload in order to reduce fatigue risk by preventing error, incident, or accident. The complex interaction of three factors causing fatigue is not easily captured in a set of prescriptive rules and is in our opinion much more amenable to management by an FRMS.

In this regard it is important to note that the NPRM's definition of Fatigue is inconsistent with ICAO's proposed definition: "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." The ICAO definition captures the fatigue inducing effects of the interaction of sleep loss, circadian phase and workload and provides the scientific basis for FRM. Managing the interactive effects of sleep loss, circadian phase, and workload in commercial aviation is the purpose of the NPRM.

Comments on Specific Provisions of the NPRM:

1. FDP Extension 117.15(c)(2) restricts carriers to only one extension of 30 minutes or more in each 168 hour period.

Comment: There is clear scientific evidence that extended work hours over consecutive work days reduces the opportunity for sleep and can lead to cumulative sleep loss and fatigue. However, there is no clear scientific evidence to support restricting an extension of greater than 30 minutes and less than or equal to 2 hours to once in 7 days. A more sensible rule would be to ban extensions over consecutive duty days in order to allow recovery from a prior extension and to not allow more than two extensions within any one 168 consecutive hour period. It is our understanding that this is similar to the recommendation of the ARC.

2. Short Call 117.21(c) & 117.23(d)

Comment: Being on short-call reserve is not being on duty. Short-call reserve does not entail any significant work load. The only task the pilot has while on short-call reserve is to answer the phone and acknowledge information. Further, a short-call reserve pilot has the same, predictable rest and sleep opportunities as a regularly scheduled pilot. A short-call reserve pilot, even if he or she thought a call unlikely, would take advantage of these opportunities. Even if called while sleeping, we expect that all but the most inexperienced would fall right back to sleep as is the case in other professionals, e.g., physicians, who are on call and are called without the immediate need to do something beyond acknowledging receipt of information.

The effect of anticipating a phone call in creating anxiety and disturbing sleep we expect would be minimal. Actually receiving a call would reduce to zero any uncertainty ensuring a rapid return to good sleep subsequent to the call. By declaring being on short-call reserve as being on duty, the FAA is effectively claiming that being on short-call reserve, i.e., being available at home or in a hotel to answer the phone, is as fatiguing as flying an airplane. There is no scientific much less operational support for the claim that flight duty and short-call reserve are equivalent in terms of fatigue. In addition, there appears to be an inconsistency between the NPRM position on deadheading pilots and its position on short-call reserve pilots. For deadheading pilots with adequate on board sleeping accommodations, the NPRM allows extending the cumulative duty period limitations by up to 10 hours. In contrast, short-call reserve pilots who also have adequate sleep accommodations (home or hotel) are not allowed a similar extension.

3. Split Duty 117.17 –

Comment: In actuality the science suggests that any sleep longer than 20 min provides full minute-by-minute recuperative value (Bonnet and Arand, 2003); see Figure 2). For napping during night operations, assuming the normal adult sleep latency for that time of day of between 5 and 10 minutes, any time behind the door of more than 30 minutes would have recuperative value. The requirement that the sleep opportunity must be at least 4 hours in duration before granting an extension of duty of 50% of the time spent behind the door is not supported by the science. Any time behind the door beyond 30 min should be given the time behind the door extension credit. The 50% of the time behind the door extension credit is especially conservative for sleep obtained in a suitable rest facility on the ground during usual bedtime hours but may be warranted for split duties that require daytime sleep.

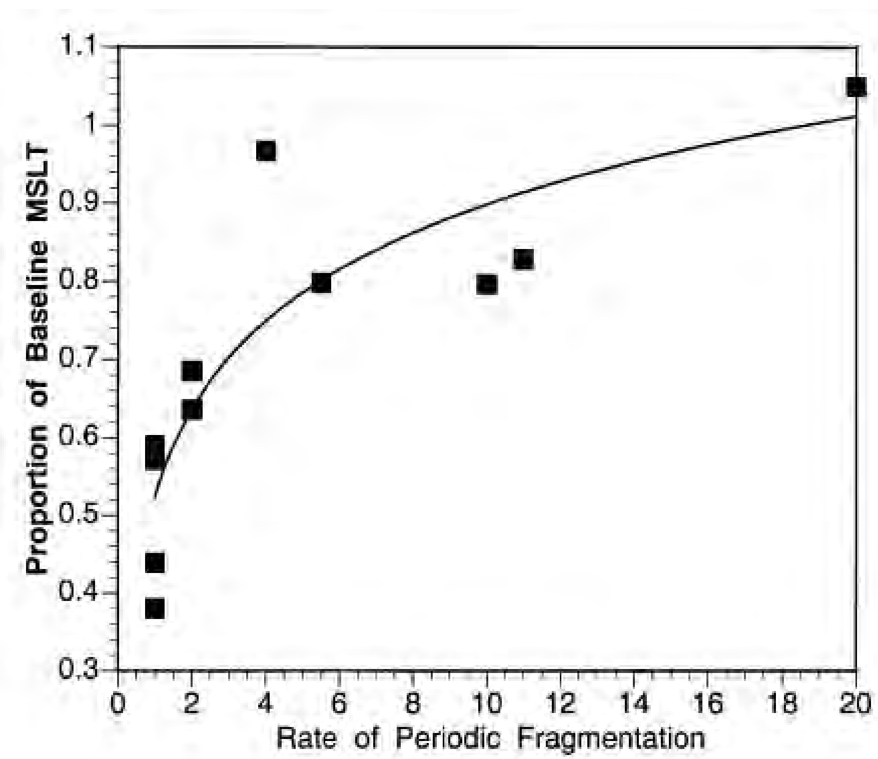


Figure 2 – Proportion of baseline multiple sleep latency test (MSLT) representing the minute-by-minute recuperative value of sleep (the higher the proportion the more recuperative value per minute of sleep) plotted as a function of rate of sleep fragmentation (the interval of time between awakenings or partial awakenings during the night). The shorter the interval between

sleep fragmenting events, the less the recuperative value. When sleep is fragmented at one minute intervals the proportion and hence recuperative value is near zero. When sleep is fragmented every 20 minutes the proportion is near 1 to 1 indicating full minute-by-minute recuperative value with sleep broken every 20 minutes when compared to normal, continuous, unbroken sleep. Adapted from Bonnet and Arand (2003).

4. Consecutive Nighttime Operations 117.27 - 17)

Comment: Assuming the goal of the NPRM is to assure 7-8 hours of sleep per 24 hours, the issue of consecutive night duties is critically tied to the ability of the split duty rest periods to provide sufficient sleep. In a recent study comparing the sleep of physicians working night shifts and day shifts (McDonald et al., 2010), it was found that they got equivalent amounts of sleep (i.e., approximately 7 hrs) when working either type of shift. When working days their sleep was consolidated into a single 7 hr sleep period at night. When working nights they split their sleep averaging 4 hrs of sleep off duty during the day and 3 hours of sleep on duty at night. Performance tested when going on and off shift was equivalent for day and night shifts.

It is therefore important to realize that the NASA study of night cargo operations showed that crews obtained 5 hrs sleep during each day after duty. This is similar to other studies on shift workers (Akerstedt, 2003) that found that they also slept five hours during the daylight hours. Obtaining another 2 hrs of sleep during split night duty should sustain performance across more than 3 consecutive nights. This is supported by Mollicone et al's laboratory studies (2007, 2008) that showed that following restricted sleep for the same total sleep time performance was the same whether the sleep was consolidated into a single sleep period or split into two sleep periods.

5. Fitness for duty 117.5(e) –

Comment: The state-of-the-art of fatigue science today cannot provide an objective standard to identify fitness for duty for compliance with this section. Even if a tool such as the PVT could be used as a basis for such assessments there would be several major obstacles to overcome: (1) each pilot would need to be tested to establish his or her own well rested norm, (2) even with a norm, the airline and the FAA would have to determine the % deviation from the baseline defining unfitness to perform, and (3) in making that decision circadian phase effects would have to be considered because despite being well rested a pilot could "fail" at one phase and "pass" at another.

More important are the general difficulties from a scientific viewpoint posed by paragraphs (d) and (e) of this section. It is not at all clear whether the NPRM literally means "any person" "must immediately report". Such persons could range from passengers, ground workers, and security to cabin crew and other pilots. While the latter two groups may be assumed to have some working experience with tired crews, there is little reason to believe that the general public or non-flying aviation personnel could make an informed judgment. Regarding para (e), despite the claims of draft AC 120-FIT para 8 (b), a person trained in accordance with 117.11

would be unable to make such an assessment in a reliable manner. There is no evidence that even a certified aeromedical specialist could make a reliable assessment in this situation unless the level of fatigue was obviously debilitating. At a minimum an accurate sleep-wake history is required to begin the task. This of course would raise significant privacy issues. All this begs the question of how the FAA is going determine how such assessments should be carried out.

6. Flight Duty Period: Augmented Crew 117.19 (c) (1)(2)(3) -

Comment: In order to assure that the landing pilot has adequate rest he or she should time the in-flight rest opportunity to coincide with time that he or she is most likely to sleep. In the case of a single long-haul flight, this requirement should be readily satisfied. The requirement becomes an issue when a short flight (<4 hrs) occurs within the augmented flight duty. The time when the pilot is most likely to sleep may not necessary be the last available rest period or occur during the last segment of a multi-segment flight. Similarly such a last segment may too short to encompass a 2-hr sleep period in which case the rest period may need to occur in the previous segment.

The science would also support an additional rest shorter than 2 hrs before top of descent since the data suggest that any sleep longer than 20 min provides full minute-by-minute recuperative value (Bonnet and Arand, 2003). This value was dramatically demonstrated in NASA's study of the effectiveness of controlled rest on the flight deck where the pilot's rest was not obtained in a bunk but rather in his assigned duty seat (Rosekind et al., 1994) NASA Technical Memorandum 108839, 1994). Short naps (including controlled napping on the flight deck) are an effective fatigue mitigation to sustain pilot performance during critical phases of flight (Graeber, et al., 1990). Since naps longer than 30 min have the same minute-by-minute recuperative value as longer naps and main sleep periods and the recuperative effect of sleep is cumulative across sleep periods, it is also possible that the 2 hr sleep opportunity could be broken up and distributed over more than one segment.

Furthermore, if the short segment was the final segment, and the required rest were allowed to occur during the last 6 hrs of duty, then it may be appropriate to reduce the manipulating pilot's workload by limiting the pilot to only one landing after his or her rest. Conversely, we also point out that a short flight segment could be at the start of a multi-segment duty period where the NPRM would limit the length of such flights to greater than 4 hours and prohibit an operator from capitalizing on a well rested crew at the beginning of the flight duty period.

7. Tables B & C -

Comment: It is interesting to note that the longest duty times are allowed for the 0700-1259 start times in both Tables B and C. This is presumably because crews are assumed to have gotten a full night's sleep and, in accordance with the scientific evidence, are therefore fully rested at the start. That said, there is no scientific basis for the different hours assigned as limits for different departure times.

In reality modern onboard crew rest facilities are designed to enable the crew to manage their alertness throughout the flight and especially that of the landing crew. Unpublished 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. In other words, a sufficient on-board rest prior to top of descent may mitigate landing crew fatigue sufficiently to obviate the need different duty limits for fully augmented crews based on departure time. Studies of sleep and performance in ultra-long range and long range flights are underway to test this.

8. Limiting flight time in addition to duty time –

Comment: There are no scientific papers supporting the idea that flight time should be treated differently from duty time except perhaps in so far as they involve differences in workload. Workload in the commercial aviation context is thought of primarily in terms of number of segments, specifically number of take offs and landings. Since both number of segments and circadian timing are taken care of in the duty time limits there is no rationale for putting further limits on flight time.

References:

Akerstedt, T. (2003) Shift work and disturbed sleep/wakefulness. Occup. Med., 55, pp. 89-94.

Bonnet, M.H. and Arand, D.L. (2002) Clinical effects of sleep fragmentation versus sleep deprivation. Sleep Medicine Reviews, 7, no. 4 pp. 297-310.

Gander, P.H., Gregory, K.B., Connell, L.J., Miller, D.L., Graeber, R.C., and Rosekind, M.R. (1996) Crew Factors in Flight Operations VII: Psychophysiological responses to overnight cargo operations. NASA Technical Memorandum 110380.

Graeber, R.C., Rosekind, M.R., Connell, L.J., and Dinges, D.F. (1990) Cockpit napping. The ICAO Journal, 45, pp. 6-10.

Rosekind, M.R., Graeber, R.C., Connell, L.J., Dinges, D.F., Rountree, M.S., Spinweber, C.L., and Gillen, K.A. (1994) Crew Factors in Flight Operations IX: Effects of preplanned cockpit rest on crew performances and alertness in long-haul operations. NASA Technical Memorandum 108839.

McDonald, J.L., Tompkins, L.A., Lillis, T.A., Bowen, A.K., Grant D.A., Van Dongen, H.P.A., and Belenky, G. (2009) Work hours, sleep, and performance in medical residents working night float vs. day shift. Sleep, 32, pp. A394.

Mollicone, D.J., Van Dongen, H.P.A., and Dinges, D.F. (2007) Optimizing sleep/wake schedules in space: Sleep during chronic nocturnal sleep restriction with and without diurnal naps. Acta Astronautica, 60, no. 4-7, pp. 354-361.

Mollicone, D.J., Van Dongen, H.P.A., Rogers, N.L., and Dinges, D.F. (2008) Response surface mapping of neurobehavioral performance: Testing the feasibility of split sleep schedules for space operations. Acta Astronautica, 63, no. 7-10, pp. 833-840.

Wesensten, N.J., Belenky, G., Thorne, D.R., Kautz, M.A., and Balkin, T.J. (2004) Modafinil versus caffeine: Effects on fatigue during sleep deprivation. Aviat. Space Environ. Med., 75, pp. 520-525.

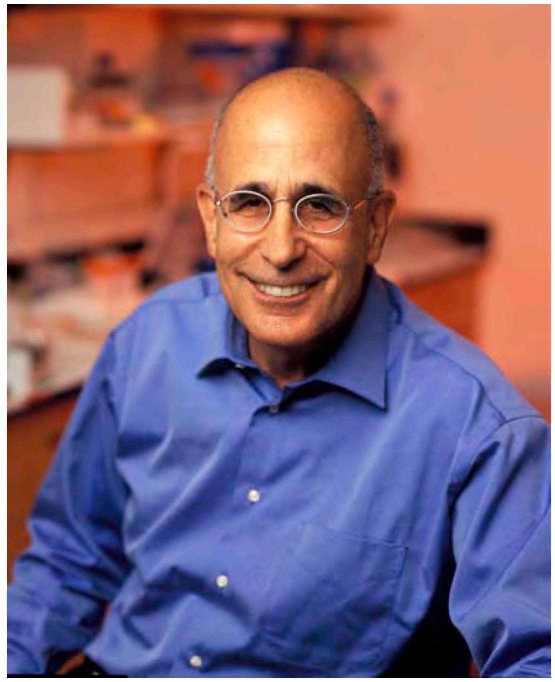
Curriculum Vitae

Gregory Lucas Belenky, M.D.

Research Professor & Director
Sleep and Performance Research Center
Washington State University Spokane
P.O. Box 1495
Spokane, WA 99210-1495

Tel: 509-358-7738
Fax: 509-358-7810
Cell: 509-953-6035
Email: belenky@wsu.edu
Web: http://www.wsu.edu/sprc

Colonel, Medical Corps, U.S. Army (Retired)



Education

B.A.	Psychology, Yale University, New Haven, CT	1966
M.D.	Stanford University School of Medicine, Palo Alto, CA	1971

Research and Professional Experience

1966-1968	Research Assistant, Sleep Research Laboratory (Dr. William Dement), Stanford University School of Medicine, Stanford, CA
1971-1972	Intern (Internal Medicine), School of Medicine, University of Utah, Salt Lake City, UT
1972-1975	Resident (Psychiatry), School of Medicine, Yale University, New Haven, CT
1975-1984	Research Psychiatrist, Department of Medical Neurosciences, Division of Neuropsychiatry, Walter Reed Army Institute of Research (WRAIR), Washington, D.C.
1976-1978	Instructor, Department of Psychiatry, School of Medicine, Uniformed Services University of the Health Sciences (USUHS), Bethesda, MD
1977-2004	Emergency Service Psychiatrist (part-time), Woodburn Center for Community Mental Health, Annandale, VA
1978-1980	Assistant Professor, Department of Psychiatry, School of Medicine, USUHS, Bethesda, MD
1980-1996	Associate Professor, Department of Psychiatry, School of Medicine, USUHS, Bethesda, MD

1984-1995	Chief, Department of Behavioral Biology, Division of Neuropsychiatry, WRAIR, Washington, D.C.
Jan-Apr 1991	Chief, Mental Health Team, Medical Troop, Regimental Support Squadron, Second Armored Cavalry Regiment, Operation Desert Storm, Saudi Arabia, Kuwait, and Iraq
1995-2003	Director, Division of Neuropsychiatry, WRAIR
1996-2004	Professor, Department of Psychiatry, School of Medicine, USUHS
Jun-Aug 2003	Division Psychiatrist, Second Infantry Division, Camp Casey, South Korea
2003-2004	Director, Division of Neuroscience, WRAIR
2004-pres.	Research Professor and Director, Sleep and Performance Research Center, Washington State University Spokane

Military Service

1975-2004 Active Duty, U.S. Army; retired as a Colonel

Professional Organizations

American Psychiatric Association	Member Fellow Distinguished Fellow	1975 - 1984 1984 - 2002 2003 - present
American Academy of Sleep Medicine	Member	2000 - present
Sleep Research Society	Member	2000 - present
European Sleep Research Society	Member	2000 - present

Other Organizational Affiliations

Sleep Disorders Research Advisory Board National Heart, Lung & Blood Institute	Ex-Officio Member	1998 - 2004
Board of Directors National Sleep Foundation	Member	2000 - 2008

Board Certification

American Board of Psychiatry & Neurology June 1978

Medical Licenses

Commonwealth of Virginia # 0101030411

State of Washington # MD00047310

Hospital Privileges – none at present

Ongoing Research Support

W81XWH05-1-0099 Belenky (PI) 04/15/04 – 04/14/10
U.S. Army Medical Research and Materiel Command
Laboratory and Field Studies of Sleep and Performance
This project will conduct a series of laboratory and field studies in the Sleep and Performance Research Center investigating the effects of restricted sleep on human performance.
Role: PI

Number N/A Belenky (PI) 01/01/07 – 12/31/10
W.M. Keck Foundation
New Theoretical, Technical and Experimental Approaches to Brain Organization of Sleep and Performance.
This project will conduct a series of laboratory studies in humans and animals to test the theory that sleep is a use-dependent, local phenomenon of cortical columns and other neuronal assemblies.
Role: PI

DTMC75-07-D-00006 Task Order #5 Belenky (PI) 04/04/08 – 08/10/2011
Federal Motor Carrier Safety Administration
Investigation of Split Sleep Schedules on Commercial Vehicles Driver Safety and Health
This project will investigate the effects of split vs. consolidated sleep on performance and health-related parameters, including glucose regulation and inflammation.
Role: PI

DTMC75-07-D-00006 Task Order #7 Belenky (PI) 05/02/08 – 08/10/11
Federal Motor Carrier Safety Administration
Motorcoach Driver Fatigue
This project will investigate the effects of split vs. consolidated sleep on performance and health-related parameters, including glucose regulation and inflammation.
Role: PI

T8200-066506/001/MTB Mallis (PI) 09/02/08 – 03/01/10
Transport Canada
Investigation of Effective Recovery and Napping Strategies for Commercial Motor Vehicle Drivers
This field study with within-subject design examines the effects of different nap and recovery sleep amounts on driving performance in commercial motor vehicle drivers
Role: Co-I

Number N/A Belenky (PI) 03/15/07 – 04/30/11
Continental Airlines
Field Studies of Ultra Long-Range Flights
This project will compare the objectively measures sleep (using actigraphy) and performance (using Palm OS Psychomotor Vigilance Test) of flight crew (pilots) flying ultra-long range (>16 hours) vs. long range (>7 hours < 16 hours) flights.
Role: PI

Number N/A Vila (PI) 02/01/09–07/31/10
Defense Advanced Research Projects Agency
Accelerating Realistic Deadly-Force Judgment and Decision Making Training
This subcontract involves the development of methodology for controlled simulator studies of deadly force decision making and training thereof.
Role: Co-I

Selected Completed Research Support

R01-HL70154 Van Dongen (PI) 04/01/02–03/31/07
NIH / NHLBI
Individual Differences in Response to Sleep Deprivation
This investigation was the first to establish individual differences in the neurobehavioral and recovery sleep responses to sleep deprivation as human phenotypes.
Role: Co-I

Number N/A Belenky (PI) 03/08/07 – 03/31/07
Airline Pilots Association (ALPA)
Fatigue Analysis of Comair Flight 3191
This project will apply the SAFTE/FAST sleep/performance prediction model to the reconstructed sleep/wake histories of the Captain, First Officer, and Air Traffic Controller involved in the crash of Comair Flight 3191
Role: PI

Number N/A Belenky (PI) 07/01/07-12/15/07
American Trucking Association
Modeling Divided vs. Consolidated Sleep
This project will use a mathematical sleep performance prediction model to predict the relative efficacy in sustaining performance of consolidated vs. split sleep.
Role: PI

Number N/A Belenky (PI) 04/15/06 – 04/14/07
DURIP
U.S. Air Force, Office of Scientific Research
Sleep and Performance Research Center Equipment
This DURIP is to equip the Sleep and Performance with high sampling rate polysomnographic (PSG) recording systems and near-infrared optical topography systems.
Role: PI

DURIP No. N000149810802 Vila (PI) 05/01/08-07/30/09
U.S. Navy, Office of Naval Research
Critical Job Task Simulation Laboratory, Expansion for the WSU Sleep and Performance Research Center
This DURIP is to equip the Sleep and Performance Research Center with an integrated system of high fidelity simulators and measurement devices that enable the replication of a sleep/wake/work environment in which to conduct long-term (days/weeks) residential laboratory studies of the impact of sleep deprivation on performance of critical job tasks. Target occupational groups for initial studies include police officers, soldiers in counter-insurgency and peacekeeping operations and drivers/engineers/pilots in trucking, rail, air, and sea operations.
Role: Co-I

Patents:

Patent No. US 6,241,686 – System and method for predicting human cognitive performance using data from an actigraph.
Patent No. US 6,419,629 – Method for predicting human cognitive performance.
Patent No. US 6,527,715 – System and method for predicting human cognitive performance using data from an actigraph.
Patent No. US 6,530,884 – Method and system for predicting human cognitive performance.
Patent Pending (US and International) – Computer implemented scheduling systems and associated methods

Editorial Board

Aviation, Space and Environmental Medicine – 2006–present

Editor

Section on Occupational Sleep Medicine, In Kryger, M., Roth, T., and Dement, W.C. Principles and Practice of Sleep Medicine, 5th Edition, in press. The section on Occupational Sleep Medicine consists of 11 chapters, 3 co-authored by me (see Book Chapters under Publications).

Course Chair

WWAMI Spokane, First Year Medical School Curriculum, Nervous System Course – 2008–present

Reviewer

Accident Analysis and Prevention
Aviation, Space, and Environmental Medicine
Behavior Research Methods
Behavioral Sleep Medicine
Journal of Sleep Research
Psychopharmacology
Sleep
Sleep Medicine Reviews

Grant Reviewer

NASA

NIH

DOJ

Consultant

Qantas Airlines/University of South Australia (Drew Dawson) - Fatigue Management Research Study (FMRS) – actigraph/palm pilot PVT sleep and performance study of pilots flying international routes – 2002-2006

The Boeing Corporation – Effect of oxygen supplementation during sleep at altitude on subsequent waking performance – 2004–2009

Continental Airlines – Flight and cabin crew sleep and performance during ultra-long-range flight operations – 2007–present

FedEx – Flight crew sleep and performance in short-haul, frequent take off and landing, backside of the clock operations – 2008–present

Air Transport Association – Fatigue due to sleep loss, circadian rhythm phase, and workload effect on pilot performance in commercial aviation – 2009–present

Military Training:

Air Assault School (rappelling from helicopters), Fort Campbell, KY, 1981

Airborne School (parachuting), Fort Lee, VA, 1982

Wartime Service:

Chief, Mental Health Team, Medical Troop, Regimental Support Squadron, Second Armored Cavalry Regiment, Operation Desert Storm, Saudi Arabia, Kuwait, and Iraq, January-April 1991

Awards:

Angier Prize for Best Undergraduate Research in Psychology
High Honors in Psychology
Yale University, New Haven, CT, June 1966

The Alvin Thompson Award, Northwest Association for Biological Research
Seattle, WA, May 2006

Publications

1) Cole, M., **Belenky, G.L.,** Boucher, R., Fernandez, R., Myers, D. (1965) Probability learning to escape from shock. *Psychonomic Science, 3,* 127-129.

2) **Belenky, G.L.,** Cole, M. (1968) The role of test trials in paired-associate verbal learning. *Psychonomic Science, 10,* 201-203.

3) Ferguson, J., Henriksen, S., McGarr, K., **Belenky, G.L.,** Gonda, W., Cohen, H., Dement, W.C. (1968) Phasic event deprivation in the cat. *Psychophysiology, 5,* 238-39.

4) **Belenky, G.L.,** Henriksen, S., McGarr, K., Ferguson, J., Cohen, H., Dement, W.C. (1968) Effect of anticholinesterase (DFP) on the sleep-wakefulness cycle of the cat. *Psychophysiology, 5,* 243.

5) **Belenky, G.L.** Unusual visual experiences reported by subjects in the British Army study of sustained operations, Exercise Early Call. (1979) *Military Medicine, 144,* 695-696.

6) **Belenky, G.L.**, Holaday, J.W. (1979) The opiate antagonist naloxone modifies the effects of electroconvulsive shock (ECS) on respiration, blood pressure, & heart rate. *Brain Research, 177,* 414-417.

7) Holaday, J.W., **Belenky, G.L.** (1980) Opiate-like effects of electroconvulsive shock in rats: a differential effect of naloxone on nociceptive measures. *Life Sciences, 27,* 1929-1938.

8) Belenky, G.L. & Holaday, J.W. (1981) Repeated electroconvulsive shock (ECS) & morphine tolerance: demonstration of cross sensitivity in the rats. *Life Sciences, 29,* 553-563.

9) Tortella, F.C., Cowan, A., **Belenky, G.L.,** & Holaday, J.W. (1981) Opiate-like electroencephalographic & behavioral effects of electroconvulsive shock in rats. *European Journal of Pharmacology, 76,* 121-128.

10) **Belenky, G.L.,** Newhouse, P., & Jones, F.D. (1982) Prevention & treatment of psychiatric casualties in the event of a war in Europe. *Revue Internationale des Services de Sante, 55,* 303-307.

11) Holaday, J.W., Hitzemann, R.J., Curell, J., Tortella, F.C., **Belenky, G.L.** (1982) Repeated electroconvulsive shock or chronic morphine treatment increases the number of 3H-D-Ala2, D-Leu5-enkephalin binding sites in rat brain membranes. *Life Sciences, 31,* 2359-2362.

12) **Belenky, G.L.,** Kaufman, L.W. (1983) Cohesion & rigorous training: observations of the air assault school. *Military Review, 63,* 24-34.

13) **Belenky, G.L.** Gelinas-Sorell, Kenner, J.R., Holaday, J.W. (1983) Evidence for delta-receptor involvement in the post-ictal antinociceptive responses to electroconvulsive shock in rats. *Life Sciences, 33,* Supplement I 583-585.

14) Kaufman, L.W., **Belenky, G.L.** (1984) Staying alive: Knowing what to do until the medic arrives. *Military Review, 64,* 28-33.

15) **Belenky, G.L.,** Noy, S., & Solomon, Z. (1985) Battle stress: The Israeli experience. *Military Review, 65,* 28-37.

16) Deeken, M.G., Newhouse, P.A., **Belenky, G.L.,** Eshelman, S.D., Parker, M.T., Jones F.D. (1985) Division psychiatrists in peacetime. *Military Medicine, 150,* 455-457.

17) **Belenky, G.L.,** Noy, S., Solomon, Z., & Jones, F.D. (1985) Contemporary Israeli studies in combat psychiatry. *Annales Medicinae Militaris Fenniae, 60,* 105-110.

18) Holaday, J.W., Tortella, F.C., Meyerhoff, J.L., **Belenky, G.L.**, Hitzemann, R.J. (1986) Electroconvulsive shock activates endogenous opioid systems: Behavioral & biochemical correlates. *Annals of the New York Academy of Sciences, 467,* 249-255.

19) Holaday, J.W., Tortella, F.C., Long, J.B., **Belenky, G.L.,** Hitzemann, R.J. (1986) Endogenous opioids & their receptors: Evidence for involvement in the post-ictal effects of electroconvulsive shock. *Annals of the New York Academy of Sciences, 462,* 124-139.

20) **Belenky, G.L.** (1987) Varieties of reaction & adaptation to combat experience. *Bulletin of the Menninger Clinic, 51,* 64-79.

21) Hitzemann, R.J., Hitzemann, B., Blatt, S., Tortella, F.C., Kenner, J.R., **Belenky, G.L.**, Holaday, J.W. (1987) Repeated electroconvulsive shock: Effect on sodium dependency & regional distribution of opioid-binding sites. *Molecular Pharmacology, 31,* 562-566.

22) **Belenky, G.L.** Psychiatric casualties: The Israeli experience. (1987) *Psychiatric Annals, 17,* 528-31.

23) O'Donnell, V.M., Balkin, T.J., Andrade, J.R., Simon, L.M., Kamimori, G.H., Redmond, D.P., **Belenky, G.** (1988) Effects of triazolam on performance & sleep in a model of transient insomnia. *Human Performance, 1,* 145-160.

24) Penetar, D., Redmond, D., & **Belenky, G.** (1989) Effects of triazolam on sleep & memory during long range deployments by air. *Aviation, Aerospace & Environmental Medicine 60,* 594-98.

25) Balkin, T.J., O'Donnell, V.M., Kamimori, G.H., Redmond, D.P., & **Belenky, G.** (1989) Sleep inertia following triazolam-induced recovery sleep. *Human Psychopharmacology 4,* 291-296.

26) Balkin, T.J., O'Donnell, V.M., Kamimori, G.H., Redmond, D.P., & **Belenky, G.** (1989) Administration of triazolam prior to recovery sleep: Effects on sleep architecture, subsequent alertness and performance. *Psychopharmacology 99,* 526-531.

27) Newhouse, P.A., **Belenky, G.,** Thomas, M., Thorne, D., Sing, H.C. & Fertig, J. (1989) The effects of d-amphetamine on arousal, cognition, and mood after prolonged total sleep deprivation. *Neuropsychopharmacology 2,* 153-164.

28) Ursano, R.J., Holloway, H.C., Jones, D.R., Rodriquez, A.R., and **Belenky, G.L.** (1989) Psychiatric care in the military community: family and military stressors. Hospital & *Community Psychiatry 40,* 1284-1289.

29) Pleban, R.J., Valentine, P.J., Penetar, D.M., Redmond, D.P., and **Belenky, G.** (1990) Characterization of sleep and body composition changes during ranger training. *Military Psychology 2,* 145-56.

30) McCann, U.D., Penetar, D.M., and **Belenky, G.** (1990) Acute dystonic reaction in normal humans caused by catecholamine depletion. *Clinical Neuropharmacology 13,* 565-568.

31) Kamimori, G.H., Smallridge, R.C., Redmond, D.P., **Belenky, G.L.,** and Fein, H.G. (1990) The effect of exercise on atropine pharmacokinetics. *European Journal of Clinical Pharmacology 39*, 395-397.

32) Penetar, D.M., Sing, H.C., Thorne, D.R., Thomas, M.L., Fertig, J.B., Schelling, A.S.D., Sealock, J.C., Newhouse, P.A., and **Belenky, G.** (1991) Amphetamine effects on recovery sleep following total sleep deprivation. *Human Psychopharmacology 6*, 319-323.

33) Balkin, T.J., O'Donnell, V.M., Wesensten, N., McCann, U., and **Belenky, G.** (1992) Comparison of the daytime sleep and performance effects of zolpidem versus triazolam. *Psychopharmacology 107,* 83-88.

34) McCann, U.D., Penetar, D.M., Shaham, Y., Thorne, D.R., Gillin, J.C., Sing, H., Thomas, M. & **Belenky, G.** (1992) Sleep deprivation and impaired cognition: The role of catecholamines. *Biological Psychiatry 31*, 1082-97.

35) Newhouse, P.A., Penetar, D.M., Fertig, J., Thorne, D.R., Sing, M., Thomas, M., Cochran, J. & **Belenky, G.** (1992) Stimulant drug effects on performance and behavior after prolonged sleep deprivation: A comparison of amphetamine, nicotine, and deprenyl. *Military Psychology 4*, 207-233.

36) Wesensten, N.J., Crowley, J., Balkin, T., Kamimori, G., Iwanyk, E., Pearson, N., Devine, J., **Belenky, G.** & Cymerman A. (1993) Effects of simulated high altitude exposure on long-latency event-related brain potentials and performance. *Aviation, Space and Environmental Medicine 64,* 30-36.

37) McCann, U.D., Penetar, D.M., Shaham, Y., Thorne, D.R., Sing, H.C., Thomas, M.L., Gillin, J.C., & **Belenky, G.** (1993) Effects of catecholamine depletion on alertness and mood in rested and sleep deprived normal volunteers. *Neuropsychopharmacolgy 8,* 345-356.

38) Penetar, D., McCann, U., Thorne, D., Kamimori, G., Galinski, C., Sing, H., Thomas, M. & **Belenky, G.** (1993) Caffeine reversal of sleep deprivation effects on alertness and mood. *Psychopharmacology 112*, 359-365.

39) Wesensten, N.J., Balkin, T.J., Kamimori, G.H., Crowley, J.S., Iwanyk, E., Kaufman, D., Pearson, N., Amoroso, P., **Belenky, G.,** & Cymerman, A. (1993) Effects of simulated high altituted exposure on long-latency ERPs and performance. *Aviation, Space and Environmental Medicine 64,* 30-36.

40) Wesensten, N.J., Balkin, T.J., & **Belenky, G.** (1995) Effects of daytime administration of zolpidem versus triazolam on memory. *European Journal of Pharmacology 48,* 115-122.

41) Wesensten, N.J., Balkin, T.J., Davis, H.Q., and **Belenky, G.** (1995) Reversal of triazolam and zolpidem-induced memory impairment by flumazenil. *Psychopharmacology 121,* 242-249.

42) McCann, U., Hall, T., Thorne, D., Thomas, M., Sing, H., Popp, K., & **Belenky, G.** (1995) The effects of l-dihydroxyphenylalanine on alertness and mood in alpha-methyl-para-tyrosine treated normal volunteers: Further evidence of the role of cathecholamines in arousal and anxiety. *Neuropsychopharmacology 13(1),* 41-52.

43) Wesensten, N.J., Balkin, T.J., & **Belenky, G.** (1995) Effects of daytime administration of zolpidem and triazolam on performance. *Aviation, Space, and Environmental Medicine 67,* 115-120.

44) Braun, A. R., Balkin, T. J., Wesensten, N. J., Carson, R. E., Varga, M., Baldwin, P., Selbie, S., **Belenky, G.** & Herscovitch, P. (1997) Regional cerebral blood flow throughout the sleep-wake cycle. An H215O PET study. *Brain 120,* 1173-1197.

45) Braun, A. R., Balkin, T. J., Wesensten, N. J., Gwardry, F., Carson, R. E., Varga, M., Baldwin, P., **Belenky, G.** & Herscovitch, P. (1998) Dissociated pattern of activity in visual cortices and their projections during human rapid eye movement sleep. *Science 279(5347),* 91-5.

46) Wesensten, N.J., Balkin, T.J., and **Belenky G.L** (1999) Does sleep deprivation impact recuperation? A review and reanalysis. *Journal of Sleep Research, 8* 237-245.

47) Thomas, M L., Sing, H.C., **Belenky, G.,** Holcomb, H.H., Mayberg, H.S., Dannals, R.F., Wagner, Jr., H.N., Thorne, D.R. Popp, K.A., Rowland, L.M., Welsh, A.B., Balwinski, S.M.

and Redmond, D.P. (2000) Neural basis of alertness and cognitive performance impairments during sleepiness. I. Effects of 24 h of sleep deprivation on waking human regional brain activity. *J. Sleep Research, 9* 335-352.

48) Kamimori G.H., Penetar, D.M., Headley, D., Thorne, D.R., Otterstetter, R., and **Belenky, G.** (2000) Effect of three caffeine doses on plasma catecholamines and alertness during prolonged wakefulness. *Eur. J. Clin Pharmacol 56*, 537-544.

49) Kamimori, G.H., Karyekar, C.S., Otterstetter, R., Cox, DS, Balkin, T.J., **Belenky, G.L.,** and Eddington, N.D. (2002) The rate of absorption and bioavailability of caffeine administered in chewing gum versus capsules to normal healthy volunteers. *Int. J. Pharm. 234,* 159-167.

50) Balkin, T.J., Braun, A.R., Wesensten, N.J., Jeffries, K., Varga, M., Baldwin, P., **Belenky, G.,** and Herscovitch, P. (2002) The process of awakening: A PET study of regional brain activity patterns mediating the reestablishment of alertness and consciousness. *Brain, 125,* 2308-2319.

51) Wesensten, N.J., **Belenky, G.,** Kautz, M.A., Thorne, D.R., Reichardt, R.M., and Balkin, T.J. (2002) Maintaining alertness and performance during sleep deprivation: modafinil versus caffeine. *Psychopharmacology (Berl.) 159*, 238-47.

52) **Belenky, G.,** Wesensten, N.J., Thorne, D.R., Thomas, M.L., Sing, H.C., Redmond, D.P., Russo, B.M., Balkin, T.J (2003) Patterns of performance degradation and restoration during sleep restriction and subsequent recovery: a sleep dose-response study. *J. Sleep Res. 12,* 1-13.

53) Thomas, M.L., Sing, H.C., **Belenky, G.,** Holcomb, H.H., Mayberg, H.S., Dannals, R.F., Wagner, H.N., Thorne, D.R., Popp, K.A., Rowland, L.M., Welsh, A.B., Balwinksi, S.M., Redmond, D.P. (2003) Neural basis of alertness and cognitive performance impairments during sleepiness II. Effects of 48 and 72 h of sleep deprivation on waking human regional brain activity. *Thalamus & Related Systems 2,* 199-229.

54) Hursh, S.R., Redmond, D.P., Johnson, M.L., Thorne, D.R. **Belenky, G.,** Balkin, T.J., Miller, J.C., Eddy, D.R. (2004) Fatigue models for applied research in warfighting. *Aviation, Space and Environmental Medicine 75,* Supplement A44-A53.

55) Johnson, M.L., **Belenky, G.,** Redmond, D.P., Thorne, D.R., Williams, J.D., Hursh, S.R., and Balkin, T.J. (2004) Modulating the homeostatic process to predict performance during chronic sleep restriction. *Aviation, Space and Environmental Medicine, 75,* Supplement A141-A146.

56) Balkin, T.J., Kamimori, G.H., Redmond, D.P., Vigneulle, R.M., Thorne, D.R., **Belenky, G.** and Wesensten, N.J. (2004) On the Importance of Countermeasures in Sleep and Performance Models. *Aviation, Space, and Environmental Medicine, 75,* Supplement A155-A157

57) Wesensten, N.J., **Belenky, G.**, Thorne, D.R., Kautz, M.A., and Balkin, T.J. (2004) Modafinil versus Caffeine: Effects on Fatigue during Sleep Deprivation. *Aviat Space Environ Med, 75,* 520-525

58) Balkin T.J., Bliese P.D., **Belenky, G.**, Sing H., Thorne D.R., Thomas M., Redmond D.P., Russo, M., Wesensten, N.J. (2004) Comparative Utility of Instruments for Monitoring

Sleepiness-Related Performance Decrements in the Operational Environment. *Journal of Sleep Research, 13,* 219-227

59) McLellan T.M., Kamimori G.H., Bell D.G., Smith I.F., Johnson D., **Belenky G.** (2005) Caffeine Maintains Vigilance and Marksmanship in Simulated Urban Operations with Sleep Deprivation. *Aviat Space Environ Med 76,* 39-45.

60) LaJambe, C.M., Kamimori, G.H., **Belenky, G.**, Balkin, T. (2005) Caffeine Effects on Recovery Sleep Following 27 Hours Total Sleep Deprivation. *Aviation, Space, Environ Med 76,* 108-113.

61) Wesensten N.J., Balkin T.J., Reichardt R.M., Kautz M.A., Saviolakis G.A., **Belenky G.** (2005) Daytime sleep and performance following a zolpidem and melatonin cocktail. *Sleep 28(1),* 93-103.

62) Wesensten, N.J., **Belenky, G.** & Balkin, T.J. (2005) Cognitive readiness in network centric operations. *Parameters: U.S. Army War College Quarterly, 35 (1),* 94-105.

63) Thorne, D.R., Johnson, D.E., Redmond, D.P., Sing, H.C., **Belenky, G.** and Shapiro, J.M. (2005) The Walter Reed palm-held psychomotor vigilance test. *Behavior Research Methods, Instruments, & Computer, 37(1),* 111-118.

64) McLellan, TM, Kamimori, G.H. Bell, D.G. Smith, I.F. Johnson, D., **Belenky**, **G.** (2005) Caffeine Maintains Vigilance and Marksmanship in Simulated Urban Operations with Sleep Deprivation. *Aviat Space Environ Med 76,* 39-45.

65) Kamimori G.H., Johnson D, Thorne D, **Belenky G.L**. (2005) Multiple Caffeine Doses Maintain Vigilance During Early Morning Operations. *Aviat Space Environ Med 76,* 1046-1050.

66) Webber SR, Sherman MR, Tucker AM, Belenky G, Van Dongen HPA. Introversion, Type A personality, and resilience to cognitive impairment from sleep loss. *Sleep-Wake Research in The Netherlands* 2007; 18: 131–134.

67) Bender AM, Tucker AM, Knittle KA, Belenky G, Van Dongen HPA. Slow wave activity in the first NREM episode is a trait marker in addition to a homeostatic state marker. Sleep-Wake Research in The Netherlands 2007; 18: 33–36.

68) Oonk M, Tucker AM, **Belenky G**, Van Dongen HPA. Excessive sleepiness: determinants, outcomes, and context. *International Journal of Sleep and Wakefulness 2008*; 1(4): 141–147.

69) Luik AI, Tucker AM, Whitney P, Hinson JM, Belenky G, Van Dongen HPA. Inter-individual differences in performance on a letter verbal fluency task during sleep deprivation. *Sleep-Wake Research in The Netherlands* 2008; 19: 105–108.

70) Luik AI, Bender AM, Tucker AM, Belenky G, Van Dongen HPA. Systematic inter-individual differences in polysomnographic sleep variables. *Sleep-Wake Research in The Netherlands* 2008; 19: 109–112.

71) Krueger JM, Rector DM, Roy S, Van Dongen HPA, **Belenky G**, Panksepp J. Sleep as a fundamental property of neuronal assemblies. *Nature Reviews Neuroscience* 2008; 9: 910–919.

72) Smith AD, Genz A, Freiberger DM, **Belenky G**, Van Dongen HPA. Efficient computation of confidence intervals for Bayesian model predictions based on multidimensional parameter space. *Methods in Enzymology* 2009; 454: 213–231.

73) McCauley P, Kalachev LV, Smith AD, **Belenky G**, Dinges DF, Van Dongen HPA. A new mathematical model for the homeostatic effects of sleep loss on neurobehavioral performance. Journal of Theoretical Biology 2009; 256: 227–239.

74) McCauley P, Kalachev LV, Smith AD, **Belenky G**, Dinges DF, Van Dongen HPA. A new mathematical model for the homeostatic effects of sleep loss on neurobehavioral performance. *Journal of Theoretical Biology* 2009; 256: 227–239.

75) Van Dongen HPA, **Belenky G**. Individual differences in vulnerability to sleep loss in the work environment. *Industrial Health* 2009; 47(5): 518–526.

76) Smith AD, Genz A, Freiberger DM, **Belenky G**, Van Dongen HPA. Efficient computation of confidence intervals for Bayesian model predictions based on multidimensional parameter space. *Methods in Enzymology* 2009; 454: 213–231.

77) Rector DM, Schei JL, Van Dongen HPA, **Belenky G**, Krueger JM. Physiological markers of local sleep. *European Journal of Neuroscience* 2009; 29: 1771–1778.

78) Pruchnicki S., Wu L, Van Dongen, H.P.A., and **Belenky G**. Comair 5191: A fatigue analysis. In preparation.

Books:

1) **Belenky, G.** (Ed.) (1987) Contemporary Studies in Combat Psychiatry, Greenwood Press, Westport, CT.

2) Martin, J.A., Sparacino, L. & **Belenky, G.** (Eds.) (1966) The Gulf War and Mental Health: A Comprehensive Guide. Praeger, Westport, CT.

3) **Belenky G.** and Kryger, M. (Eds.) Textbook of Occupational Sleep Medicine, in preparation.

Technical Reports:

1) Balkin, T., Thorne, D., Sing, H., Thomas, M., Redmond, D., Williams, J., Hall, S., and **Belenky, G.** Effects of Sleep Schedules on Commercial Vehicle Driver Performance. Washington, DC, U.S. Department of Transportation, Report No. DOT-MC-00-133; 2000.

2) **Belenky G**, Hursh SR, Fitzpatrick J, Van Dongen HPA. Split sleeper berth use and driver performance: A review of the literature and application of a mathematical model predicting performance from sleep/wake history and circadian phase. *American Trucking Associations Technical Report*, Washington State University, Spokane, Washington; 2008

Book Chapters and Papers in Proceedings:

1) **Belenky, G.L.** & Holaday, J.W. Possible functions of b-endorphin. In B. Saletu et al (Eds.) Neuro-Psychopharmacology, Pergamon Press, Oxford (1979)503-514.

2) **Belenky, G.L.** & Holaday, J.W. Electroconvulsive shock (ECS) in rats: Naloxone modification of post-ECS behaviors provides evidence for functional endorphin release. In E.L. Way (Ed.) Endogenous & Exogenous Opiate Agonists & Antagonists, Pergamon Press, New York (1979)487-490.

3) Holaday, J.W., Tortella, F.C., & **Belenky, G.L.** Electroconvulsive shock results in a functional activation of endorphin systems. In H. Emrich (Ed.) Modern Problems in Pharmacopsychiatry, Vol 17: The Role of Endorphin in Neuropsychiatry, Karger, Basel, (1981)142-157.

4) **Belenky, G.L.** Training in military & combat psychiatry in the United States Army. In O. Adelaja & F.D. Jones (Eds.) War & Its Aftermath, John West Publishers, Lagos, (1983)129-135.

5) **Belenky, G.L.,** Tortella, F.C., Hitzemann, R.J. & Holaday, J.W. The role of endorphin systems in the effects ECS. In B. Lerer, R.D. Weiner, & R.H. Belmaker (Eds.), ECT: Basic Mechanisms, John Libbey & Company, Ltd., London, (1984)89-97; republished American Psychiatric Press, Inc., Washington, D.C., (1986)89-97.

6) **Belenky, G.L.,** Noy, S., Solomon, Z., & Jones, F.D. Psychiatric casualties (battle shock) in Israeli Defense Forces in the war in Lebanon, June-September 1982. In P. Pichot, P. Berner, R. Wolf, & K. Thau (Eds.), Psychiatry: The State of the Art, Volume 6: Drug Dependence & Alcoholism, Forensic Psychiatry, Military Psychiatry, Plenum Publishers, New York, (1985) pp479-484.

7) Crocq, L., Crocq, M.A., Barrois, C., **Belenky, G.L.,** & Jones, F.D. Low intensity combat psychiatric casualties. In P. Pichot, P. Berner, R. Wolf, & K. Thau (Eds.), Psychiatry: The State of the Art, Volume 6: Drug Dependence & Alcoholism, Forensic Psychiatry, Military Psychiatry, Plenum Publishers, New York, (1985) pp545-550.

8) Jones, F.D., Crocq, L., Adelaja, O. Rahe, R., Rock, N., Mansour, F., Collazo, C., & **Belenky, G.L.** Psychiatric casualties in modern warfare, I: Evolution of treatment. In P. Pichot, P. Berner, R. Wolf, & K. Thau (Eds.), Psychiatry: The State of the Art, Volume 6: Drug Dependence & Alcoholism, Forensic Psychiatry, Military Psychiatry, Plenum Publishers, New York, (1985) pp459-463.

9) Crocq, L., Jones, F.D., Adelaja, O., Rahe, R., Collazo, C., Mansour, F., & **Belenky, G.L.** Psychiatric casualties in modern warfare, II. In P. Pichot, P. Berner, R. Wolf, & K. Thau (Eds.), Psychiatry: The State of the Art, Volume 6: Drug Dependence & Alcoholism, Forensic Psychiatry, Military Psychiatry, Plenum Publishers, New York, (1985).

10) Jones, F.D. & **Belenky, G.L.** Warfare & the U.S. military family. In P. Pichot, P. Berner, R. Wolf, & K. Thau (Eds.), Psychiatry: The State of the Art, Volume 6: Drug Dependence & Alcoholism, Forensic Psychiatry, Military Psychiatry, Plenum Publishers, New York, (1985) pp527-531.

11) Jones, F.D., Stokes, J.W., Newhouse, P.A., **Belenky, G.L.,** & Crocq, L. Neuropsychiatric casualties in chemical, biological & nuclear warfare. In P. Pichot, P. Berner, R. Wolf, & K. Thau (Eds.), Psychiatry: The State of the Art, Volume 6: Drug Dependence & Alcoholism, Forensic Psychiatry, Military Psychiatry, Plenum Publishers, New York, (1985).

12) **Belenky, G.L.** Military psychiatry in the Israeli Defence Force. In R.A. Gabriel (Ed.) Military Psychiatry: A Comparative Perspective. Greenwood Press, Westport, CT, (1986) pp147-180.

13) **Belenky, G.,** Balkin, T., Krueger, G.P., Headley, D., Solick, R. (1986). Effects of continuous operations (CONOPS) on soldier and unit performance; Phase I: Review of the literature. Joint WRAIR/ARI report for TRADOC CONOPS Staff Study. Washington, D.C.: Walter Reed Army Institute of Research. Also, In: U.S. Army Combined Arms Combat Development Activity (1987). Continuous Operations (CONOPS) Final Report. (ACN 073194). Fort Leavenworth, KS: Headquarters, U.S. Army Training and Doctrine Command and U.S. Army Combined Arms Center.

14) **Belenky, G.L.** & Jones, F.D. Combat psychiatry: An evolving field. In **Belenky, G.L.** (Ed.) Contemporary Studies in Combat Psychiatry. Greenwood Press, Westport, CT, 1987.

15) **Belenky, G.L.,** Noy, S. & Solomon, Z. Battle stress, morale, cohesion, combat effectiveness, heroism, & psychiatric casualties: The Israeli experience. In **Belenky, G.L.** (Ed.) Contemporary Studies in Combat Psychiatry. Greenwood Press, Westport, CT, 1987.

16) **Belenky, G.L.** The future of combat psychiatry. In **Belenky, G.L.** (Ed.) Contemporary Studies in Combat Psychiatry. Greenwood Press, Westport, CT, 1987.

17) **Belenky, G.,** Penetar, D.M., Thorne, D.R., Popp, K., Leu, J., Thomas, M., Sing, H., Balkin, T.J., Wesensten, N.J., & Redmond, D.P. The effects of sleep deprivation on performance during continuous combat operations. In B.M. Marriott (Ed.), Food Components to Enhance Performance, National Academy Press, Washington, DC, (1994) pp 127-135.

18) Penetar, D.M., McCann, U., Thorne, D., Schelling, A., Galinski, C., Sing, H., Thomas, M., & **Belenky, G.** Effects of caffeine on cognitive performance, mood, and alertness in sleep-deprived humans. In B.M. Marriott (Ed.), Food Components to Enhance Performance, National Academy Press, Washington, DC, (1994) pp 407-431.

19) **Belenky, G.,** Sing, H., Thomas, M., Shaham, Y., Balwinski, S., Thorne, D., Redmond, D., & Balkin, T. Discrimination of rested from sleep-deprived EEG in awake normal subjects. In Proceedings of the IEEE International Conference on Neural Networks, IEEE, Piscataway, NJ, (1994) pp 3521-3524.

20) **Belenky, G.,** Marcy, S.C., & Martin, J.A. Debriefings and battle reconstructions following combat. In Martin, J.A., Sparacino, L. & **Belenky, G.** (Eds.) The Gulf War and Mental Health: A Comprehensive Guide, Praeger, Westport, CT, 1996.

21) **Belenky, G.** & Martin, J.A. Practicing combat psychiatry. In Martin, J.A., Sparacino, L. & **Belenky, G.** (Eds.) The Gulf War and Mental Health: A Comprehensive Guide, Praeger, Westport, CT, 1996.

22) McCarroll, E. & **Belenky, G.** Debriefings after return to the United States. In Martin, J.A., Sparacino, L. & **Belenky, G.** (Eds.) The Gulf War and Mental Health: A Comprehensive Guide, Praeger, Westport, CT, 1996.

23) **Belenky, G.,** Balkin, T.J., Redmond, D.P., Sing, H.C., Thomas, M.L., Thorne, D.R., Wesensten, N.J., and Hursh, S.R. Sustaining performance during continuous operations: The U.S. Army's Sleep Management System. In Proceedings of the Army Science Conference, Norfolk, Virginia, June 1996.

24) **Belenky, G.,** Balkin, T.J., Redmond, D.P., Sing, H.C., Thomas, M.L., Thorne, D.R., Wesensten, N.J., and Hursh, S.R. Sustaining performance during continuous operations: The U.S. Army's Sleep Management System. In Friedl, K., Lieberman, H., Ryan, D.H., and Bray, G.A. (Eds.) Pennington Center Functional Nutrition Series: Vol. 10, Countermeasures for Battlefield Stressors. Baton Rouge, LA: Louisiana State University Press, (2000) pp. 197-205.

25) Wesensten, N.J., Balkin, T.J., **Belenky, G.** Sleep sustains individual and organizational effectiveness. In WF Barko, MA Vaitkus (eds.), US Army War College Guide to Executive Health and Fitness. Carlisle, PA. Army Physical Fitness Research Institute, (2000) pp. 97-118.

26) Wesensten N.J., Comperatore, C.C., Balkin T.J., **Belenky, G.** Jet lag and sleep deprivation. In Kelley P.W., (Ed). Military Preventive Medicine: Mobilization and Deployment. In: Textbook of Military Medicine. Washington, DC: Office of the Surgeon General at TMM Publications, (2003) pp. 287-300.

27) Balkin T.J., Wesensten N.J., **Belenky G.** A system for monitoring operational effectiveness as a function of alertness. In: Hockey, Gaillard and Burov (Eds.) Operator Functional State: The Assessment and Prediction of Human Performance Degradation in Complex Tasks. Amsterdam: IOS Press (2003) pp. 121-130.

28) **Belenky, G.,** Balkin, T.J., Wesensten, N.J. Military operational effectiveness. In Kushida, C.A. (Ed.) Sleep Deprivation: Clinical Issues, Pharmacology, and Sleep Loss Effects. New York: Marcel Dekker (2005) pp. 289-312.

29) A. M. Bender, A. M. Tucker, K. A. Knittle, **G. Belenky**, H. P. A. Van Dongen (2007). Slow wave activity in the first NREM episode is a trait marker in addition to a homeostatic state marker. In Ruigt, G. S. F., DeBoer, T., Van Kasteel, V., Van Luijtelaar, G., Overeem, S. (Eds.). Sleep-Wake Research in the Netherlands, vol. 18. Dutch Society for Sleep-Wake Research, pp. 33-36.

30) S. R. Webber, M. R. Sherman, A. M. Tucker, **G. Belenky**, H. P. A. Van Dongen (2007). Introversion, Type A personality, and resilience to cognitive impairment from sleep loss. In Ruigt, G. S. F., DeBoer, T., Van Kasteel, V., Van Luijtelaar, G., Overeem, S. (Eds.). Sleep-Wake Research in the Netherlands, vol. 18. Dutch Society for Sleep-Wake Research, pp. 131-134.

31) M. Oonk, A. M. Tucker, **G. Belenky**, H. P. A. Van Dongen (2008). Excessive sleepiness: determinants, outcomes, and context. The International Journal of Sleep and Wakefulness, in press.

32) Van Dongen HPA, **Belenky G.** Alertness level. In Binder MD, Hirokawa N, Windhorst U (Eds.), Encyclopedia of Neuroscience, Springer, Berlin, Germany; 2008: 75–77.

33) Van Dongen HPA, Rector DM, **Belenky G**, Krueger JM. Sleep, a localized phenomenon of the brain. In Kryger MH (Ed.), *Atlas of Clinical Sleep Medicine*, Elsevier Saunders, Philadelphia, Pennsylvania; 2010: 27–29.

34) King AC, **Belenky G**, Van Dongen HPA. Performance impairment consequent to sleep loss: determinants of resistance and susceptibility. *Current Opinion in Pulmonary Medicine* 2009; 15: 559–564.

35) Van Dongen HPA, **Belenky G**. Alertness level. In Binder MD, Hirokawa N, Windhorst U (Eds.), *Encyclopedia of Neuroscience*, Springer, Berlin, Germany; 2008: 75–77.

36) **Belenky, G.** & Akerstedt, T., Introduction to occupational sleep medicine. In Kryger, M., Roth, T. and Dement, W.C. (Eds.) Principles and Practice of Sleep Medicine, 5th Edition; in press.

37) Gander, P.H, Graeber, R.C., and **Belenky, G.** Fatigue Risk Management. In Kryger, M., Roth, T. and Dement, W.C. (Eds.) Principles and Practice of Sleep Medicine, 5th Edition, in preparation; in press.

38) McDonald, J., Patel, D., **Belenky, G.** Monitoring Sleep and Performance in the Workplace. In Kryger, M., Roth, T. and Dement, W.C. (Eds.) Principles and Practice of Sleep Medicine, 5th Edition; in press.

39) Van Dongen HPA, **Belenky G**, Krueger JM. Investigating the temporal dynamics and underlying mechanisms of cognitive fatigue. In Ackerman P (Ed.), *Proceedings of the Cognitive Fatigue Conference*, American Psychological Association, Washington, D.C.; in press.

40) Van Dongen HPA, **Belenky G**, Krueger JM. Investigating the temporal dynamics and underlying mechanisms of cognitive fatigue. In Ackerman P (Ed.), *Proceedings of the Cognitive Fatigue Conference*, American Psychological Association, Washington, D.C.; in press.

Recent Abstracts (2006- present)

1) W. C. Clegern, H. Van Dongen, T. J. Balkin, N. J. Wesensten, **G. Belenky** (2006). Time on task effect of chronic sleep restriction. Sleep 29: A134.

2) H. Van Dongen, **G. Belenky** (2006). Replicability of the time-on-task effect during sleep deprivation. Sleep 29: A371.

3) **G. Belenky**, D. Thorne, N. Wesensten, H. Van Dongen, T. Balkin (2007). Sleep restriction degrades performance in a driving simulator in a sleep-dose dependent manner. Sleep 30: A143.

4) Bender, A. Tucker, K. Knittle, **G. Belenky**, D. Dinges, H. Van Dongen (2007). Slow wave activity in the first NREM episode is a trait marker in addition to a state marker. Sleep 30: A38.

5) P. McCauley, A. Smith, **G. Belenky**, H. Van Dongen (2007). Adapting to sleep loss: Dynamic properties of cognitive performance predictions based on the two-process model. Sleep 30: A123.

6) M. Sherman, S. Webber, A. Tucker, **G. Belenky**, H. Van Dongen (2007). Type A personality and resilience to neurobehavioral impairment from sleep loss. Sleep 30: A379.

7) Smith, P. McCauley, **G. Belenky**, H. Van Dongen (2007). Efficient computational procedure for individualization of sleep/wake model parameters. Sleep 30: A352.

8) L. Tompkins, A. Tucker, **G. Belenky**, H. Van Dongen (2007). Follicle stimulating hormone and sleep continuity in healthy women and men. Sleep 30: A37-A38.

9) S. Webber, M. Sherman, A. Tucker, **G. Belenky**, H. Van Dongen (2007). Does introversion/extraversion predict resilience to cognitive impairment from sleep loss? Sleep 30: A380.

10) A. Bender, K. Knittle, A. M. Tucker, **G. Belenky**, H. Van Dongen (2008). The range of trait individual differences exceeds the average effect of 36 hours of total sleep deprivation on total sleep time. Sleep 31, A27.

11) D. A. Grant, D. M. Rector, R. Short, H. Van Dongen, **G. Belenky** (2008). Correlation of psychomotor vigilance task performance with prefrontal BOLD signal measured by near-infrared optical topography. Sleep 31, A374-375.

12) J. L. McDonald, T. A. Lillis, L. A. Tompkins, H. Van Dongen, **G. Belenky** (2008). Effects of extended work hours on objectively measured sleep and performance in industrial employees. Sleep 31, A374.

13) A.D. Smith, A. C. Genz, **G. Belenky**, H. Van Dongen (2008). An efficient procedure for finding the 95% confidence interval of performance predictions based on the Two-Process Model. Sleep 31, A338.

14) L. A. Tompkins, A. M. Tucker, **G. Belenky**, D. F. Dinges, H. Van Dongen (2008). Generalizability of the relationship between follicle stimulating hormone and sleep discontinuity in healthy adults. Sleep 31, A24.

15) A. M. Tucker, P. Whitney, **G. Belenky**, J. M. Hinson, H. Van Dongen (2008). Performance on a letter verbal fluency task is better, not worse, after sleep deprivation. Sleep 31, A367.

16) H. Van Dongen, D. A. Grant, **G. Belenky** (2008). Systematic individual differences in circadian contribution to neurobehavioral impairment during sleep deprivation. Sleep 31, A43.

17) D.A. Grant, D.M. Rector, H.P.A. Van Dongen, **G. Belenky** (2009). Prefrontal hemodynamic signals measured by near-infrared optical topography are correlated with attentional lapses on a psychomotor vigilance test. Sleep 32, A24.

18) L. Swanson, J Arnedt, R. Rosa, M. Rosekind, **G. Belenky**, C. Drake (2009). Sleep, health, and work outcomes for shift workers: Results from the 2008 Sleep in America Poll. Sleep 32, A58.

19) P. McCauley, L.V. Kalachev, **G. Belenky**, D.F. Dinges, H.P.A. Van Dongen (2009). Cognitive performance predictions from a new biomathematical model of sleep/wake homeostasis. Sleep 32, A131.

20) A.C. King, **G. Belenky**, H.P.A. Van Dongen (2009). Homeostatic and circadian processes contribute jointly to the magnitude of systematic individual differences in performance impairment during sleep deprivation. Sleep 32, A145.

21) H.P.A. Van Dongen, P. McCauley, L.V. Kalachev, **G. Belenky** (2009). Modeling recovery after chronic sleep restriction: Sleep extension can provide recuperation of performance buy may me neither necessary nor sufficient. Sleep 32, A146.

22) A.K. Bowen, D. Patel, L.J. Wu, **G. Belenky** (2009). The effect of in-flight sleep on fatigue-risk in ultra-long-range (ULR) flight – comparison of 4-pilot ULR to 4-pilot non-ULR flights. Sleep 32, A155.

23) D. Patel, A.K. Bowen, L.J. Wu, **G. Belenky** (2009). The effect of in-flight sleep on estimated fatigue-risk in ultra-long-range (ULR) flight – comparison of 4-pilot with 2 to 3 pilot non-ULR flights. Sleep 32, A156.

24) A.M. Bender, A.M. Tucker, **G. Belenky**, H.P.A. Van Dongen (2009). General intellectual functioning does not predict performance impairment on the psychomotor vigilance test during total sleep deprivation. Sleep 32, A160.

25) J.M. Moore, H.P.A. Van Dongen, **G. Belenky**, C.G. Mott, L. Huang, B. Vila (2009). Use of a driving simulator to assess fuel inefficiency as a downstream effect of driver sleepiness in controlled laboratory experiments. Sleep 32, A387.

26) J.L. McDonald, L.A. Tompkins, T.A. Lillis, A.K. Bowen, D.A. Grant, H.P.A. Van Dongen, **G. Belenky** (2009). Work hours, sleep, and performance in medical residents working night float vs. day shift. Sleep 32, A394.

27) H.P.A. Van Dongen, R. Childers, **G. Belenky**, R. Ratcliff (2009). Sleep deprivation affects multiple distinct components of cognitive processing. Sleep 32, A406.

28) L.J. Wu, J.M. Hinson, A.M. Tucker, **G. Belenky**, P. Whitney, H.P.A. Van Dongen (2009). No significant effect of sleep deprivation on impulsivity in a delay discounting task. Sleep 32, A426.

CURRICULUM VITAE – GRAEBER, Raymond Curtis
October 2010

EDUCATION

1963-65 Canisius College, Buffalo, NY
1965-67 SUNY at Binghamton, NY; B.A. magna cum laude, Mathematics & Science (Psychology)
1967-70 University of Virginia, Charlottesville, VA; M.A. (Experimental Psychology)
1970-72 University of Virginia, Charlottesville, VA; Ph.D. (Neuro Psychology)

PROFESSIONAL EXPERIENCE

2009 - present: President, The Graeber Group, Ltd., human performance and aviation safety consultants with a global focus. Past or current clients include:
International Civil Aviation Organization, Montreal, Canada
Air New Zealand, Auckland, NZ
Air France, Roissy, FR
Cargo Airline Association, Washington, DC
National Air Carrier Association, Washington, DC

1990-2008: Boeing Commercial Airplanes, Seattle, WA (retired Dec. 31, 2008)
Senior Technical Fellow, 2003-2008 (Corporate STF Leadership Team 2005-2008)
Director, Regional Safety Programs, 2006-08.
Chief Engineer, Human Factors, 1997-2008
Chief, Crew Operations, 737-600/700/800 Program Engineering, 1994-97
Chief, Human Factors Engineering, 1993-94
Manager, Flight Deck Research, Avionics and Flight Systems, 1990-93

1981-90: Aerospace Human Factors Division, NASA Ames Research Center, Moffett Field, CA.
Chief, Flight Human Factors Branch (formerly Aviation Systems Research Branch) 1989-90;
Principal Scientist, Aviation Systems Research Branch, 1988-89;
Research Psychologist/Project Officer, Aeronautical Human Factors Research Office, 1981-87.

1986: Human Factors Specialist, Investigation Staff, The Presidential Commission on the Space Shuttle Challenger Accident, Washington, D.C.

1977-81: Research Psychologist, Department of Military Medical Psychophysiology, Neuropsychiatry Division, Walter Reed Army Institute of Research, Washington, D.C. 1980-81: Deputy Chief.

1972-76: Research Psychologist, Behavioral Science Division, Food Sciences Laboratory, U.S. Army Natick Research and Development Command, Natick, MA.

1970-71: Visiting Scientist, Lerner Marine Laboratory, American Museum of Natural History, Bimini Island, Bahamas.

INDUSTRY ACTIVITIES AND PROFESSIONAL SOCIETIES

Government Support

U.S. Federal Aviation Administration:

U.S. Industry Co-Chair, FAA-JAA ARAC Harmonization Working Group, Flight Crew Error & Performance in the Flight Deck Certification Process, FAR/JAR 25-1302, 1999-2005.
Co-Chair, FAA Certification Process Study, Phase II, Human Factors Team, Sept. 2002-04.
FAA Research, Development, and Engineering Human Factors Subcommittee, 1997-2004.
Co-Chair, Working Group 2 (Human Factors), RTCA Certification Task Force, 1998-99.
Chair, FAA ARAC Working Group for Controlled Rest on the Flight Deck, 1991-93.
Scientific Task Planning Group (cockpit) to develop Aviation Human Factors National Plan, 1990.

European Joint Airworthiness Authorities (JAA) and EASA Human Factors Steering Group, 1995-2008.

International Civil Aviation Organization (ICAO):

Leader, Fatigue Risk Management Task Force, 2009-10.
Flight Operations Panel – standards development: Chair, Fatigue Risk Management Subteam, 2005 - 2008. Chair, Flight Time Limitations Subteam, 2004-05.
Member, Industry Safety Strategy Group, co-author of Global Aviation Safety Roadmap, 2005- 2008.

U.S. National Aeronautics and Space Administration:

Airspace Systems Program Subcommittee, Aeronautics Research Advisory Committee, 2005.
Aeronautics Goals Subcommittee, Aero-Space Technology Advisory Committee, 1999-2001.
Human Factors Subcommittee, Aero-Space Technology Advisory Committee, 1996-2001.
NATO AGARD Advisory Panel on Aerospace Medicine (NASA representative), 1989-90.
Investigation Staff, The Presidential Commission on the Space Shuttle Challenger Accident, 1986.

U.S. Congress:

House Subcommittee on Aviation of the Committee on Public Works and Transportation:
Testified at June 2009 hearing on Regional Air Carriers and Pilot Workforce Issues.
Testified at May 1990 hearing on Language Issues in ATM Communication.
Office of Technology Assessment, Washington, DC. Human Factors in Aviation Safety Working Group, May 1987; Shift Work and Extended Duty Hours Workshop, May 1990.

U.S. National Transportation Safety Board:

NTSB Human Performance Seminar, Washington, DC, June 1987.

DOD Human Factors Engineering TAG, SUB TAG on Sustained/Continuous Operations, 1985-1990.

National Research Council Committee on Military Nutrition Research Workshop on Cognitive Testing Methodology, Washington, DC, June 1984.

Nuclear Regulatory Commission Shift Work Scheduling Project, Washington, DC, April 1984.

Department of State, Medical Department, 1981.

Office of Naval Research, Oceanic Biology Program, 1974 –79.

U.S. Department of Agriculture (Food for Peace Program), 1973.

<u>Industry Activities and Professional Societies:</u>

Air France, Chair, Independent Safety Review Team, 2009-10.

Flight Safety Foundation (FSF):

Chair, Icarus Committee (“think tank”), 2003-08, member since 2001.
Board of Governors and Executive Committee, 2003-08 (Ex Officio)
Organizer and Co-Chair, International Ultra Long-Range Crew Alertness Project, June 2001-05.

National Sleep Foundation, Board of Directors, 2008 – present.

Air New Zealand, Independent Alertness Advisory Panel, Chair 2006 – present, member since 1996.

Royal Aeronautical Society, Fellow 1997- present.
External Affairs Board, 2001- 2008;
The Boeing Company Technical Focal, 2001-08.
Founding Member, Seattle Chapter Executive Committee, 2000-09, Vice-Chair, 2003-06.

QANTAS/Civil Aviation Safety Authority/ AIPA: Fatigue Risk Management Steering Committee, 2000 - 2007.
Chair, Scientific Review Committee, 2000-06.

Joint United Airlines/ALPA Working Group on Long-Haul Crew Scheduling, Chicago, IL, 1988-2001.

LOSA (Line Operational Safety Audit) International Advisory Board, 2003-07.

International Air Transport Association, Human Factors Working Group, 1995-2005.
Air Transport Association (U.S.A.), Human Factors Task Force, 1988-1995.

Editorial Board, *Cognition, Technology and Work Journal,* Springer Publishing, 2002- present.

Associate Editor (N. America), *Human Factors and Aerospace Safety*, Ashgate Press, 1999- present.

Journal Manuscript Reviewer for: *International Journal of Cognition, Technology & Work; Work and Stress; Aerospace Safety &Human Factors; Sleep; Aviation, Space & Environ. Med.; J. Biol. Rhythms.*

Ohio State University, Institute for Ergonomics, Advisory Board, 1998-2002.
Aerospace Medical Association: Fellow 1990, member, 1981-95.
Human Factors and Ergonomics Society: member, 1991-2005.
International Society for Chronobiology: member, 1975-1992. Board of Directors, 1984-1992.
Sleep Research Society, member, 1986-1993, Governmental Affairs Committee, 1987-1992.
Society for Neuroscience: member, 1972-82.
American Psychological Association: member, 1972-75.

HONORS AND AWARDS

Elected Member, Washington State Academy of Science, 2010- present.

Fellow, Flight Safety Foundation, 2009.

Honorary Research Fellow, Massey University, Wellington, New Zealand, 2009-11.

International Council of Aeronautical Sciences (ICAS) Maurice Roy Medal for fostering international scientific cooperation in human factors, 2008.

Flight Safety Foundation – Airbus Human Factors in Aviation Safety Award, 2006.

Senior Technical Fellow, The Boeing Company, 2003.

Cumberbatch Trophy 2000, Guild of Aircraft Pilots and Air Navigators (GAPAN), for the Promotion of Flight Safety and Recognition as a World Authority in Aviation Human Factors, 2001.

Sir Frank Whittle Medal, International Federation of Airworthiness, MEDA Team Award, 2000.

1999 Aerospace Laurel Award, Commercial Air Transport, *Aviation Week and Space Technology.*

Fellow, Royal Aeronautical Society, 1997.

NASA Group Achievement Awards, 1986, 1994.

Fellow, Aerospace Medical Association, 1990.

The John Lane Visiting Lecturer, Aviation Medical Society of Australia and New Zealand, 1990.

Boothby-Edwards Memorial Award for Outstanding Research in Civil Aviation Medicine, Aerospace Medical Association, 1989.

Harold Ellingson Literary Award, Aerospace Medical Association, 1987.

Military Decorations:
- Legion of Merit, U.S. Army, 1989.
- U.S. Army Meritorious Service Medal, 1988.
- Department of Defense Meritorious Service Medal, 1986.
- U.S. Army Commendation medal, 1976, with oak leaf cluster, 1983.

Commander's Award in Science, U.S. Army Natick Research and Development Command, 1974.

National Defense Title IV Predoctoral Fellowship, University of Virginia, 1967-69

.

B. A. *magna cum laude*, SUNY Binghamton, 1967.

TEACHING:

Visiting Professor, Human Factors, College of Aeronautics, Cranfield University, UK, 2001- 2008.

Faculty, Aviation Safety and Security Management Certificate Program, The George Washington University Aviation Institute, Virginia Campus, 1998-2000.

Lecturer: Sleep Disorders Center, Stanford University School of Medicine, Stanford, CA. Course in Clinical Polysomnography, 1986-90. Physicians' Course in Sleep Disorders Medicine, 1988-89.

Lecturer: Trinity University, San Antonio, TX. Advanced Human Factors Short Course, 1986-90.

Lecturer: USAF School of Aerospace Medicine, Brooks, AFB, TX.
Basic Aerospace Physiology Course, 1986. Operational Problems in Aerospace Physiology, 1987.

Visiting Instructor, Psychology: Framingham State College, Framingham, MA, 1973-76; George Mason University, Graduate Div., Fairfax, VA, 1978; University of Maryland, College Park, MD, 1978-80.

MILITARY SERVICE

U.S. Army: Active duty, Medical Service Corps, July 1, 1969 to June 30, 1989.
Retirement Rank: Lieutenant Colonel

AERONAUTICAL RATINGS

Private pilot: airplane, single engine land (July 9, 1983).

CONSULTING:

Compa Corp., Nuclear Regulatory Commission Control Room Simulator Review Project, 1994.
Federal Highway Authority, Office of Motor Carrier Standards, U.S. Dept. Transportation, Sept. 1989.
SAE A-21 Aircraft Noise Committee (Interior Noise Subcommittee), San Antonio, TX, April 1989.
SAE G-10 Committee on Aerospace Behavioral Engineering Technology: consultant, 1985-1994.
Stanford Research Institute, Inc., Menlo Park, CA. 1986.
Westinghouse-Hanford Co., Fast Flux Test Facility, Hanford, WA. 1986-87.
DOD Uniform Services University of the Health Sciences: December 1986 & November 1987.
San Francisco “Forty-Niners” NFL Football Team, Redwood City, CA, 1986.
NATO AGARD Consultant Mission to FRG National delegation, DFVLR Institute of Aerospace Medicine, Cologne, W. Germany, May, 1985.

MEDIA INTERACTION:

“Cockpit Napping Endorsed”, CNN TV News, November 9, 2009.

“Working Nights”, Soundprint, Minnesota Public Radio/NPR, June 1997.

PBS “Discovery”, Cockpit Technology and Automation, 1996.

Swissair Flight Crew Training video, Flight Deck Automation, 1995.

Segment on Cockpit Rest, Medical World News, CNN, International Syndication, Nov. 1990.

“Sleep Alert”, PBS national syndication, March 1990.

“The Flying Computer Game”, MTV Finland, Helsinki, Finland, fall 1989.

“Pilot Fatigue”, eyewitness, LWT (London Weekend Television), London, England, May 1989.

“The Biological Clock”, Innovation, WNET-TV (PBS national syndication), New York, NY, Jan. 1989

“The Twenty-Five Hour Day”, Horizon, BBC2, London, U.K., Dec. 1986.

Landing of the “Voyager”, CNN, human factors of the “Voyager” round-the-world flight, Dec. 23, 1986.

MacNeil-Lehrer News Hour, PBS, live discussion with Congressman W. Nelson on Human Factors Aspects of the Space Shuttle Challenger Accident, Aug. 6, 1986.

PUBLICATIONS

Books

Boy, G., C. Graeber, and J-M. Robert (Eds.): *Proceedings of the HCI-Aero '98 International Conference on Human-Computer Interaction in Aeronautics*. Montreal: Editions de l'Ecole Polytechnique de Montreal, 1998.

Graeber, R.C. (Ed): Sleep and Wakefulness in International Aircrews. *Aviation Space, And Environmental Medicine*, Vol. 57, No. 12, Section II (Suppl.), 1986.

Brown, F. M. and R. C. Graeber (Eds): *Rhythmic Aspects of Behavior*. Hillsdale, N.J.: L. Erlbaum Associates, 1982.

Book Chapters

Balkin' T.J., Horrey, W.J., Graeber, R.C., Czeisler, C.A., and Dinges, D.F.: The Challenges and Opportunities of Technological Approaches to Fatigue Management. In: *Proceedings of Liberty Mutual Hopkinton Conference on Future Directions in Fatigue and Safety Research*, in press.

Gander, P., Graeber, R.C., and Belenky, G.: Fatigue Risk Management. In: M. Kryger, T. Roth, and W. C. Dement (Eds.), *Principles and Practice in Sleep Medicine,* 5th Edition, Elsevier, 2010, pp. 760-768.

Applegate, J.D., and Graeber, R.C.: Integrated safety system design and human factors considerations for jet transport aeroplanes. In D. Harris and H.C. Muir (Eds.), *Contemporary Issues in Human Factors and Aviation Safety.* Aldershot, Ashgate: 2005, pp. 3-23.

Graeber, R.C., and Mumaw, R.J.: Realizing the benefits of cognitive engineering in commercial aviation. 3rd International Conference on Engineering Psychology and Cognitive Ergonomics, Oxford, England, Oct. 1998. In D. Harris (Ed.), *Engineering Psychology and Cognitive Ergonomics, Vol. 3.* Aldershot, Ashgate: 1999, pp. 3-26.

Kovarik, L.E., Graeber, R.C., and Mitchell, P.R.: Human factors considerations in aircraft cabin design. In D. Garland, J. Wise, and V.D. Hopkin (Eds.), *Handbook of Aviation Human Factors*. Malwah, NJ, Lawrence Erlbaum Associates, 1999, pp. 389-403.

Graeber, R. C.: Integrating human factors and safety into airplane design and operations. In B.J. Hayward and A.R. Lowe, (Eds), *Applied Aviation Psychology: Achievement, Change, and Challenge*. Aldershot, UK, Avebury Aviation, 1996, pp. 27-38.

Marx, D. M., and Graeber, R. C.: Human error in aircraft maintenance. In N. McDonald, N. Johnston, and R. Fuller (Eds), *Aviation Psychology in Practice*. Aldershot UK, Ashgate Press, 1994, pp. 87-104.

Connell, L. J., and Graeber, R. C.: Ambulatory monitoring in the aviation environment. In L. Miles and R. Broughton (Eds), *Clinical Evaluation and Physiological Monitoring in the Home and Work Environment*. New York, Raven Press, 1989, pp. 175-185.

Graeber, R.C.: Long-range operations in the glass cockpit: Vigilance, boredom, and sleepless nights. In A. Coblentz (Ed), *Vigilance and Performance in Automatized Systems*. NATO Advanced Science Institutes Series. Dordrecht: Kluwer Academic Publ., 1989, pp. 67-76.

Graeber, R.C.: Jet lag and sleep disruption. In M. H. Kryger, T. Roth, and W. C. Dement (Eds): *Principles and Practice in Sleep medicine*. New York, W. B. Saunders, 1989, pp. 324-331. Also 2nd edition, 1994, pp. 463-470.

Graeber, R.C.: Aircrew fatigue and circadian rhythmicity. In E. L. Wiener and D. C. Nagel (Eds): *Human Factors in Aviation*. New York, Academic Press, 1988, pp. 305-343.

Appendix G: Human Factors Analysis. In Volume II, *Report of the Presidential Commission on the Space Shuttle Challenger Accident*. Washington, D.C., 1986, pp. G1-6.

Graeber, R.C., Foushee, H.C. and Lauber, J.K.: Dimensions of flight crew performance decrements: Methodological implications for field research. In J. Cullen, J. Siegrist, and H. M. Wegmann (Eds): *Break down in Human Adaptation to Stress, vol. 1*. The Hague, M. Nijhoff Publ., 1984, pp. 584-605.

Graeber, R.C.: Alterations in performance following rapid transmeridian flight. In F.M. Brown and R. C. Graeber (Eds), *Rhythmic Aspects of Behavior*. Hillsdale, L. Erlbaum Associates, 1982, pp. 173-212.

Graeber, R.C., H.C. Sing, and B.N. Cuthbert: The impact of rapid transmeridian flight on deploying Soldiers. In L. Johnson, D. Tepas, W. P. Colquhoun, and M. J. Colligan (Eds), *Biological Rhythms, Sleep, and Shift Work. Advances in Sleep Research, vol. 7*. New York, Spectrum, 1981, pp. 513-537.

Graeber, R.C.: Recent studies relative to the airlifting of military units across time zones. In L. Scheving and F. Halberg (Eds), *Chronobiology: Principles and Applications to Shifts in Schedules*. Alphen aan den Rijn, Sijthoff & Noordhoff, 1980, pp. 353-369.

Graeber, R.C.: Behavioral correlates of tectal function in elasmobranchs. In H. Venegas (Ed.), *Comparative Neurology of the Optic Tectum.* New York, Plenum Press, 1984, pp. 69-92.

Graeber, R.C.: Telencephalic function in elasmobranchs: A behavioral perspective. In S.O.E. Ebbesson (Ed.), *Comparative Neurology of the Telencephalon*. New York, Plenum Press, 1980, pp. 17-39.

Graeber, R.C.: Behavioral studies correlated with central nervous system integration of vision in sharks. In E.S. Hodgson and R.F. Mathewson (Eds.), *Sensory Biology of Sharks, Skates and Rays.* Arlington, VA, Office of Naval Research, 1978, pp. 195-225.

RESEARCH TECHNICAL REPORTS

Dinges, D.F., Graeber, R.C., Rosekind, M. R., Samel, A., and Wegmann, H.M.: Principles and Guidelines for Duty and Rest Scheduling in Commercial Aviation. NASA Technical Memorandum 110404, May 1996.

Gander, P.H., Gregory, K.B., Connell, L.J., Miller, D.L., Graeber, R.C., and Rosekind, M.R.: Crew Factors in Flight Operations VII: Psychophysiological responses to overnight cargo operations. NASA Technical Memorandum 110380 , 1996.

Gander, P.H., Graeber, R. C., Foushee, H. C., Lauber, J. K., and Connell, L. J.: Crew Factors in Flight Operations: II. Psychophysiological Responses to Short-Haul Air Transport Operations. NASA Technical Memorandum 108856, 1994.

Rosekind, M. R., Graeber, R.C., Connell, L. J., Dinges, D. F., Rountree, M. S., Spinweber, C.L., and Gillen, K. A.: Crew Factors in Flight Operations IX: Effects of preplanned cockpit rest on crew performances and alertness in long-haul operations. NASA Technical Memorandum 108839, 1994.

Gander, P. H., Barnes, R. M., Gregory, K. B., Connell, L. J., Miller, D. M., and Graeber, R. C.: Crew Factors in Flight Operations VI: Psychophysiological Responses to Helicopter Operations. NASA Technical Memorandum 108838, 1994.

Gander, P.H., Graeber, R.C., Connell, L. J., and Gregory, K. B.: Crew Factors in Flight Operations: VIII. Factors Influencing Sleep Timing and Subjective Sleep Quality in Commercial Long-Haul Flight Crews. NASA Technical Memorandum 103852, 1991.

Graeber, R. C. (Ed): Crew Factors in Flight Operations: IV. Sleep and Wakefulness in International Aircrews, NASA Technical Memorandum 88231, March 1986.

Gander, P. H., G. Myhre, R. C. Graeber, H. T. Anderson, and J. K. Lauber: Crew Factors in Flight Operations: I. Effects of 9-Hour Time-Zone Changes on Fatigue and Circadian Rhythms of Sleep/Wake and Core Temperature. NASA Technical Memorandum 88197, December 1985.

Graeber, R.C., Cuthbert, B.N., Sing, H.C., Schneider, R.J., Sessions, G.R.: Rapid Transmeridian Deployment: Cognitive Performance and Chronobiologic Prophylaxis for Circadian Dyschronism. Walter Reed Army Institute of Research, Washington, D.C., 15 pages. DTIC Accession No. ADA090393, June 1980.

Graeber, R.C., Gatty, R., Halberg, F.,and Levine, H.: Human Eating Behavior: Preferences. Consumption Patterns, and Biorhythms. U.S. Army Natick Laboratories Technical Report, 279 pages. DTIC Accession No. ADA073571, June 1978.

Siebold, J.R., Symington, L. E., Maas, D L , and Graeber, R.C.: Consumer and Worker Evaluation of Cash Food Systems: Loring Air Force Base (Part II Long Term Findings). U.S. Army Natick Laboratories Technical Report, 47 pages. DTIC Accession No. ADA032468, August 1976.

Siebold, J.R., Symington, L. E., Graeber, R.C., and Maas, D L.: Consumer and Worker Evaluation of Cash Food Systems: Loring Air Force Base Part I. U.S. Army Natick Laboratories Technical Report, 279 pages. DTIC Accession No. ADA022121, November 1975.

Rodier, Jr., W.I., Wetsel, W.C., Jacobs, H.L., Graeber, R.C., Moskowitz, H.R., Reed, T.J., and Waterman, D.: The Acceptability of Whey-Soy Mix as a Supplementary Food for Pre-School Children in Developing Countries. U.S. Army Natick Laboratories Technical Report, 21 pages. DTIC Accession No. AD0772930, December 1973.

PAPERS

Graeber, R.C.: SMS in the Global Aviation Safety Roadmap. The Inaugural South Pacific Aviation Safety Management Systems Symposium, Auckland, NZ, March 21, 2009.

Graeber, R.C.: Fatigue Risk Management. IFALPA Annual Conference, Auckland, NZ, March 20. 2009.

Graeber, R.C.: The Global Aviation Safety Roadmap: Regional Implementation Update. FSF, IFA, and IATA 61st Annual International Air Safety Seminar, Honolulu, Hawaii, October 27, 2008.

Graeber, R.C.: Fatigue Risk Management Systems within SMS. FAA Aviation Fatigue Management Symposium: Partnerships for Solutions, Tysons Corner, VA, June 17-19, 2008.

Graeber. R.C.: Managing Fatigue Risk in Commercial Air Transport. Royal Aeronautical Society NZ Division Symposium, Auckland, NZ, March 19, 2008.

Graeber, R.C.: Implementing the Global Safety Roadmap in Africa. AU/ATAG/ICAO/World Bank Air Transport Development Forum, African Union Headquarters, Addis Ababa, Ethiopia, 23-25 April 2007.

Graeber, R.C.: The safety benefits of LOSA: A manufacturer's perspective. International LOSA and TEM Workshop, Toulouse, France, Nov. 15-16, 2006.

Graeber, R.C.: The Global Safety Roadmap. 59th Annual FSF-IATA-IFA International Air Safety Seminar, Paris, France, Oct. 23-26, 2006.

Graeber, R.C.: Aviation Safety Trends: A Regional Perspective. Assoc. of Asia-Pacific Airlines Safety Symposium, Kuala Lumpur, Oct. 10, 2006.

Graeber, R.C.: LOSA as a collaborative safety tool. International LOSA and TEM Workshop, Rio de Janeiro, Brazil, June 23, 2005.

Graeber, R.C.: LOSA and the value of collaboration. 2nd ICAO-IATO Line Operational Safety Audit /Threat and Error Management Conference, Seattle, WA, Nov. 3-4, 2004.

Graeber, R.C.: Addressing crew alertness in ultra long-range operations. Association of Asia Pacific Airlines Air Safety Seminar, Kuala Lumpur, Malaysia, April 27-28, 2004.

Graeber, R.C.: Setting the standards for flight deck design: The next generation. 6th International Aviation Psychology Symposium, Sydney, Australia, Dec. 1-5, 2003.

Graeber, R.C.: The Boeing safety approach: The value of collaboration. 1st ICAO-IATA LOSA-TEM Conference, Dublin, Ireland, Nov. 5-7, 2003.

Graeber, R.C.: Crew alertness in ultra long-range operations. SAE-Flight Safety Foundation, N. American Aviation Safety Conference, Atlanta, GA, Feb. 4-6, 2003; and 56th FSF-IATA-IFA International Air Safety Seminar, Washington, DC, Nov. 10-13, 2003.

Graeber, R.C: The value of LOSA collaboration: Boeing UT/TLC. ICAO-Emirates 3rd LOSA Week Conference, Dubai, UAE, Oct. 14-16, 2002.

Castano, D.J. and Graeber, R.C.: Aviation safety collaboration: LOSA and Boeing, a manufacturer's perspective. *ICAO Journal*, *57 (4),* Pp. 10-11, 27-28, August 2002.

Applegate, J.D., and Graeber, R.C.: Integrated safety systems design and human factors considerations for jet transport airplanes. *Human Factors and Aerospace Safety*, 1(3), 201-221, 2001.

Graeber, R.C.: The role of human factors in improving aviation safety. Boeing *Aero* magazine, October 1999 (No.8), Pp. 23-28.

Graeber, R.C.: Tools developed by aircraft builder designed to help airlines manage human error. *ICAO Journal, 54* (5), Pp. 11-14, June 1999.

Graeber, R.C.: Design, human performance, and safety: The opportunities. Invited keynote, ICAO 4th Global Safety and Human Factors Symposium, Santiago, Chile, April 12-15, 1999. (*ICAO Journal*, 54: 11-14, June 1999.)

Graeber, R.C.: Airplanes, safety, and culture: A manufacturer's perspective. Paper presented at the ICAO 1st Regional Seminar on Cross-Cultural Issues in Aviation Safety, Bangkok, Thailand, August 12-14, 1998.

Graeber. R.C., and Moodi, M.M.: Understanding flight crew adherence to procedures: The procedural event analysis tool (PEAT). Paper presented at the Flight Safety Foundation/International Federation of Airworthiness, International Air Safety Seminar, Capetown, So. Africa, Nov. 17-19, 1998.

Gander, P.H., Gregory, K.B, Miller, D.L., Graeber, R.C., Connell, L.J., and Rosekind, M.R.: Flight crew fatigue V: Long-haul air transport operations. *Aviation, Space & Environ. Med., 69*, (9, Section II, Suppl.), B37-B48, 1998.

Gander, P.H., Gregory, K.B, Connell, L.J., Graeber, R.C., Miller, D.L., and Rosekind, M.R.: Flight crew fatigue IV: Overnight cargo operations. *Aviation, Space & Environ. Med., 69*, (9, Section II, Suppl.), B26-B36, 1998.

Gander, P.H., Barnes, K.B., Gregory, K.B, Graeber, R.C., Connell, L.J., and Rosekind, M.R.: Flight crew fatigue III: North sea helicopter air transport operations. *Aviation, Space & Environ. Med., 69*, (9, Section II, Suppl.), B16-B25, 1998.

Gander, P.H., Gregory, K.B, Graeber, R.C., Connell, L.J., Miller, D.L., and Rosekind, M.R.: Flight crew fatigue II: Short-haul fixed-wing air transport operations. *Aviation, Space & Environ. Med., 69*, (9, Section II, Suppl.), B8-B15, 1998.

Gander, P.H., Graeber, R.C., Connell, L.J., Gregory, K.B., Miller, D.L., and Rosekind, M.R.: Flight crew fatigue I: Objectives and methods. *Aviation, Space & Environ. Med., 69*, (9, Section II, Suppl.), B1-B7, 1998.

Graeber, R.C.: Applying human factors to airplane maintenance operations. Paper presented at the Tunisian Ministry of Transport Aviation Human Factors Conference, Tunis, Tunisia, March 3-5, 1997.

Graeber, R.C.: Human factors challenges: The key to safe flight in the 21st century. Paper presented at the Tunisian Ministry of Transport Aviation Human Factors Conference, Tunis, Tunisia, March 3-5, 1997.

Graeber, R.C.: Enhancing aviation system safety through improved human factors. White House International Conference on Aviation Safety and Security in the 21st Century. Washington, DC, Jan. 13-15, 1997.

Graeber, R.C.: Accident prevention strategies. Invited paper presented at the IATA Human Factors in Aviation Seminar, Warsaw, Poland, Oct. 1996.

Graeber, R.C.: The value of human factors for airline management. Invited paper presented at the Royal Aeronautical Society Conference, Human Factors for Aerospace Leaders, London, England, May 1996.

Graeber, R.C.: Integrating human factors and safety into airplane design and operations. Invited paper presented at the 3rd Australian Aviation Psychology Symposium, Sydney, Australia, Nov. 1995.

Graeber, R.C.: Human factors challenges: The key to safe flight in the 21st Century. Invited paper presented at the Registro Aeronautico Italiano Int'l. Conference on "The Human Factor in Civil Aviation," Rome, Sept. 1995.

Graeber, R.C.: Flight crew accident and incident human factors. Proceedings of the FAA Office of System Safety Workshop on Flight Crew Accident and Incident Human Factors, pp. A64-67, June 21-23, 1995.

Gander, P.H., Gregory, K.B., Miller, D.L., Connell, L.J., Graeber, R.C., and Rosekind, M.R.: Flight crew sleep and circadian rhythms during overnight cargo operations. Paper presented at the Annual Meeting of the Aerospace Medical Assoc., Anaheim, CA, May 1995.

Graeber, R.C.: Accident prevention strategies. Invited paper presented at the IATA Human Factors in Aviation Seminar & Workshops, Bahrain, March 1995.

Graeber, R.C.: Mutual assurance: Technological opportunity and human responsibility. Invited paper presented at the ANAE/Flight Safety Foundation International Symposium, The Air Transport System: Aircrew and Air Traffic Management Integration, Toulouse, France, Nov. 1994.

Graeber, R.C.: Integrating human factors knowledge into advanced flight deck design. Paper presented at the 6th Regional ICAO Flight Safety & Human Factors Seminar, Amsterdam, Netherlands, May 1994.

Graeber, R.C., and Marx, D.A.: Reducing human error in aircraft maintenance operations. Paper presented at the Flight Safety Foundation 46th Annual International Air Safety Seminar, Kuala Lumpur, Malaysia, Nov. 1993.

Graeber, R.C.: Safer skies for tomorrow: A manufacturer's perspective on future aviation safety improvements. Invited paper presented at the Scandinavian Safety Symposium, Oslo, Norway, Feb. 1993.

Sasaki, M., Kurosaki, Y.S., Spinweber, C.S., Graeber, R.C., and Takahashi, T.: Flight crew sleep during multiple layover polar flights. *Aviat., Space, & Environ. Med.*, *64*:641-647, 1993.

Graeber, R.C.: Design challenges for 21st century flight decks: Human factors implications. Invited paper presented at the Australian Aviation Psychology Symposium, Sydney, Australia, Nov. 1992. (In B.J. Hayward and A.R. Lowe (Eds.), *Towards 2000: Future directions and new solutions*. Albert Park: Australian Aviation Psychology Assoc., 1993, pp. 153-163.)

Kelly, B.K., Graeber, R.C., and Fadden, D.M.: Applying crew-centered concepts to flight deck technology: The Boeing 777. Paper presented to the Flight Safety Foundation 45th International Air Safety Seminar, Long Beach, CA., Nov. 1992.

Graeber, R.C.: Defining 21st Century transport flight decks: A human-centered approach. Invited paper presented to 3rd Seminar in Transportation Ergonomics: The Pilot/Aircraft System. Montreal, Canada, Oct. 1992.

Braune, R.J., and Graeber, R.C.: Human-centered designs in commercial air transport aircraft. Paper presented at the Annual Meeting of the Human Factors and Ergonomic Society, Oct. 1992, Atlanta, GA.

Graeber, R.C.: Defining 21st Century transport flight decks: Revolution or evolution? Invited paper presented to Guild of Airline Pilots and Air Navigators. Royal Aeronautical Society, London, April 1992.

Rosekind, M.R., Connell, L.J., Dinges, D.F., and Graeber, R.C.: Preplanned cockpit rest: Effects on physiological alertness in long-haul flight crews. Paper presented at the Annual Meeting of the Aerospace Medical Assoc., Cincinnati, OH, May 1992. (Abstr.: *Avia., Space, Environ. Med*., 62:482, 1991).

Graeber, R.C., Hudson, D., and Kohn, G.: The jet lag dilemma, Part II. *Airline Pilot*, Feb. 1991, pp. 23-25, 50.

Graeber, R.C.: The jet lag dilemma, Part I. *Airline Pilot*, Jan. 1991, pp. 18-22.

Samel, A.L., Gander, P.H., Graeber, R.C., and Wegmann, H.M.: Response of the circadian system to shifted sleep-wake cycles and bright light exposure during head-down tilt (HDT). Paper presented at the Annual Meeting of the Aerospace Medical Assoc., Cincinnati, OH, May 1992. (Abstr.: *Avia., Space, Environ. Med*., 62:476, 1991).

Connell, L.C., Samel, A.L., and Graeber, R.C.: The impact of eastbound flight on sleep and circadian rhythms in military transport crews. Paper presented at the Annual Mtg. of the Aerospace Med. Assoc., Cincinnati, OH, May 1992. (Abstr.: *Avia., Space, Environ. Med*., 62:455, 1991).

Dinges, D.F., Connell, L.J., Rosekind, M.R. and Graeber, R.C.: Preplanned cockpit rest: Effects on vigilance performance in long-haul flight crews. Paper presented at the Annual meeting of the Aerospace Medical Assoc., Cincinnati, OH, MA 1992. (Abstr.: *Avia., Space, Environ. Med*., 62:451, 1991).

Graeber, R.C.: Fatigue and the body clock in long-haul operations. Paper presented at “Managing the Modern Cockpit”, 3rd SAE-AREF Human Error Avoidance Techniques Conference, Dallas, TX, Dec. 1990.

Graeber, R.C.: Fatigue in long-haul operations: Sources and solution. Paper presented at the 43rd FSF International Air Safety Seminar, Rome, Italy, Nov. 1990.

Graeber, R.C.: Sleep loss and jet leg: Implications for cabin crew health and performance. Assoc. of Flight Attendants Conference on Flight Attendant Occupational Health, Washington, D.C., Nov. 1990.

Graeber, R.C.: Fatigue in long-haul operations: Sources and solutions. Proc. 43rd Annual International Air Safety Seminar, Arlington: Flight Safety Foundation, 1990, pp. 246-257.

Graeber, R.C., Rosekind, M.R., Connell, L.J., and Dinges, D.F.: Cockpit napping. *The ICAO Journal*, 45, 6-10, Oct. 1990.

Graeber, R.C.: NASA’s sleep/fatigue study: Alertness management of the flight deck. Invited paper presented at the Triennial Boeing 747 Flight Operations Symposium, Seattle, WA, Oct. 1990.

Gander, P.H., and Graeber, R.C.: Factors controlling sleep timing and subjective sleep quality in long-haul flight crews. Paper presented at the 38th Int'l. Congress of Aviation and Space Med., Paris, France, Sept. 1990.

Graeber, R.C.: Improved alertness through preplanned cockpit rest in long-haul operations. Invited paper presented at the Triennial Combined Conference of the Aviation Medical Society of Australia and New Zealand, Auckland, NZ, Sept. 1990.

Graeber, R.C.: Circadian rhythms and sleep loss in transmeridian flight. Invited paper presented at the Triennial Combined Conference of the Aviation Medical Society of Australia and New Zealand, Auckland, NZ, Sept. 1990.

Graeber, R.C.: Long-range flying and flight crew performance factors. Invited paper presented to the Japan Aircraft Pilot Association, Tokyo, Japan, July 1990.

Moline, M.L., Pollak, C., Wagner, D.R., Zendell, S.M., Monk, T.H., Graeber, R.C., Lester, L.S., Salter, C.A., and Hirsch, E: Effects of age on the ability to sleep following an acute phase advance. Paper presented at the Annual Meeting of the Assoc. of Professional Sleep Societies, Minneapolis, MN, June 1990. (Abstr.: *Sleep Research*, 19:400, 1990).

Rosekind, M.R., Townsend, B.T., Rountree, M., Connell, L.J., Yost, D., Graeber, R.C., Spinweber, C.S., Dinges, D.F., and Dement, W.D.: Modification of the Medilog 9000-II recorder to reduce 400 Hz noise in the cockpit environment. Paper presented at the Annual Meeting of the Assoc. of Professional Sleep Societies, Minneapolis, MN, June 1990. (Abstr.: *Sleep Research*, 19:403, 1990).

Dinges, D.F., Graeber, R.C., Connell, L.J., Rosekind, M.R., and Powell, J.W.: Fatigue-related reaction time performance in long-haul flight crews. Paper presented at the Annual Meeting of the Assoc. of Professional Sleep Societies, Minneapolis, MN, June 1990. (Abstr.: *Sleep Research*, 19:117, 1990).

Graeber, R.C.: Pilot/Air Traffic Controllers Communications Issues. Testimony to Subcommittee on Aviation of the Committee on Public Works and Transportation, U.S. Congress, May 24, 1990. (Congressional Record, 101-77, 1991, pp. 16-19, 50-52)

Connell, L.J., Graeber, R.C., and Schreiber, H.G.: Overnight cargo operations: aircrew sleep, fatigue, and circadian rhythmicity. Paper presented at the Annual meeting of the Aerospace Medical Assoc., New Orleans, LA, May 1990.

Gander, P.H., and Graeber, R.C.: Circadian timing of sleep in long-haul flight crews. Paper presented at the 2nd Annual Meeting of the Society for Research on Biological Rhythms, Amelia Is., FL, May 1990.

Graeber, R.C.: Research on the flight deck - - lessons in fatigue. Panel presentation at the Annual Meeting of the Aerospace Med. Assoc., New Orleans, LA, May 1990.

Graeber, R.C., and Dinges, D.F.: Flight crew fatigue: underlying causes and operational factors. Invited paper presented at the Royal Jordanian/Flight Safety Foundation 1st Arab Regional Aviation Safety Conference, Amman, Jordan, March 1990. (Proceedings., pp. 161-174.)

Graeber, R.C.: Integration of field, simulator, and laboratory approaches to crew fatigue. Paper presented at "Challenges in Aviation Human Factors: The National Plan", AIAA/NASA/FAA/HFS Conference, Washington, DC, Jan. 1990.

Moline, M.L., Pollak, C.P., Wagner, D.R., Zendell, S.M., Monk, T.H., Graeber, R.C., Lester, L.S., Salter, C.A., and Hirsch, E. Age differences in the ability to adjust to simulated jet lag. *J. Biol. Rhythms*, 1990.

Graeber, R.C.: Multinational studies – lessons from flight crew field research. Invited paper presented at the Royal Aeronatical Society's Conference on Flight Time Limitations: A Review of the Current Situation, London, U.K., November 1989.

Dinges, D., and Graeber, R.C.: Flight crew fatigue monitoring,. *Flight Safety Digest*, 8:65-75, 1989

Dinges, D., Graeber, R.C., Carskadon, M.A., Czeisler, C.A., and Dement, W.C.: Attending to Inattention (Letter). *Science*, 245: 342, 1989

Connell, L. J., and Graeber, R.C.: Aircrew scheduling on transmeridian flights. Invited paper presented at Symposium on Circadian Rhythmicity, XXXI Int'l. Congress of Physiological Sciences, Helsinki, Finland, July 1989.

Gander, P.H., Myhre, G., Graeber, R.C., Andersen, H.T., and Lauber, J.K.: Adjustment of sleep and the circadian temperature rhythm after flights across nine time zones. *Aviation, Space, & Envir. Med., 60*, pp. 733-743, 1989.

Sasaki, M, Kurosaki, Y., Onda, M., Yamaguchi, O., Nishimura, H., Kashimura, K., and Graeber. R.C.: Effects of bright light on circadian rhythmicity and sleep after transmeridian flight. Paper presented at the Annual Meeting of the Assoc. of Professional Sleep Societies, Washington, D.C., June 1989. (Abstr.: *Sleep Research*, 18:442, 1989).

Kurosaki, Y., Sasaki, M., Tamira, M., Masumo, H., Sugiura, K., Kabashima, T., Nonaka, K., and Graeber, R.C.: Mood changes of flight crew during multiple layover polar flights. Paper presented at the Annual Meeting of the Assoc. of Professional Sleep Societies, Washington, D.C., June 1989. (Abstr.: *Sleep Research*, 18:426, 1989).

Glotzbach, S.F., Rowlett, E.A., Connell, L. J., Graeber, R.C., and Ariagno, R.L.: Biological rhythmicity in preterm infants prior to hospital discharge. Paper presented at Annual Mtg, Assoc. of Professional Sleep Societies, Washington, D.C., June 1989. (Abstr.: *Sleep Research*, 18:420, 1989).

Graeber, R.C.: Sleep and circadian rhythmicity after transmeridian flight. Invited paper presented via satellite at Annual Meeting on the Japanese Sleep Research Society, Tokyo, Japan, June 1989.

Connell, L. J., Graeber, R.C., and Barnes, R.M.: Fixed-wing vs. Rotary-wing operations: Comparisons of sleep and fatigue among pilots. Paper presented at Annual Mtg, Aerospace Medical Assoc., Washington, D.C., May 1989. (Abstr.: *Avia., Space, Environ. Med*., 60:496, 1989).

Graeber, R.C., Schreiber, H.G., and Connell, L. J.: Sleep in aircrew flying sequential transatlantic crossings. Paper presented at Annual Mtg. Aerospace Medical Assoc., Washington, D.C., May 1989. (Abstr.: *Avia., Space, Environ. Med*., 60:496, 1989).

Graeber, R.C.: Translocation: Movement to Europe. Invited plenary paper presented at the 40th Annual Military Medical Surgical Clinical Congress, Garmisch, W. Germany, May 1989.

Graeber, R.C.: Sleep in the long-range environment. Invited paper presented at the International Operators Committee Conference, National Business Aircraft Assoc., Washington, D.C., March 1989.

Dinges, D., and Graeber, R.C.: Flight crew fatigue monitoring. Invited paper presented at the Crew Performance Monitoring and Training Regional Safety Workshop, Flight Safety Foundation, Taipei, Taiwan, Republic of China, March 1989.

Graeber, R.C.: Cockpit automation and fatigue. Invited paper presented at Symposium on “Fitness for Duty”. SAE Aerotech ’88, Anaheim, CA, Oct. 1988.

Graeber, R.C.: The management of sleep/wakefulness in airline transport long-haul operations: The sleep research perspective. Invited paper presented at the XXXVI International Congress of Aviation & Space Medicine, Brisbane, Australia, Oct. 1988.

Graeber, R.C.: Long-range operations in the glass cockpit: Vigilance, boredom, and sleepless nights. Invited paper presented at NATO Advanced Research Workshop on Vigilance and Performance in Automatized Systems, Universite Rene Descartes, Paris, France, Sept. 19-23, 1988.

Graeber, R.C.: Flight crew fatigue research. Invited paper presented at the SAE and Aviation Research & Education Foundation's Conference on Human Error Avoidance Techniques, Herndon, VA, Sept. 1988.

Schreiber, H.G., Graeber, R.C., and Connell, L. J.: Flight crew sleep during repeated transatlantic crossings. Presented at Annual Mtg. Assoc. of Professional Sleep Societies, San Diego, CA, June 1988. (Abstr.: *Sleep Research*, 17:397, 1988).

Connell, L.J., Graeber, R.C., and Schreiber, H.G.: Sleep and fatigue among commercial north sea helicopter pilots. Presented at Annual Mtg. Assoc. of Professional Sleep Societies, San Diego, CA, June 1988. (Abstr.: *Sleep Research*, 17:365, 1988).

Barnes, R.M., and Graeber, R.C.: Flight deck environment and working North Sea helicopter operations. Presented at the Annual meeting of the Aerospace Medical Association, New Orleans, LA, May 1988. (Abstr.: *Avia., Space, Environ. Med*., 59:483, 1988).

Graeber, R.C.: The Challenger accident: The human element in decision making. Invited seminar presented at the Center for International Security and Arms Control, Stanford University, CA, April 1988.

Mitler,M.M., Carskadon,M.A., Czeisler, C.A., Dement, W.C., Dinges, D.F., and Graeber, R.C.: Catastrophes, Sleep, and Public Policy: Consensus Report**,** *Sleep* 11(1): 100–109, February 1988.

Graeber, R.C.: Aircrew sleep and fatigue in long-haul flight operations. Presented at the 40th Flight Safety Foundation International Air Safety Seminar, Tokyo, Japan, October, 1987.

Graeber, R.C.: Fatigue sleep loss and the body clock. Invited address presented at the CMPATWING TEN Safety Symposium, Moffett Field NAS CA, September, 1987. Also presented at the U.S. Coast Guard Air Station (Sacramento) Safety Symposium, Oct. 1987, and at the USCG Air Station (San Diego) Jan. 1988.

Sasaki, M., Kurosaki, Y., Takahashi, Tl, Mori, A., Spinweber, C.S., and Graeber, R.C.: Flight crew sleep after multiple layover polar flights Presented at 5th International Congress of Sleep Research, Copenhagen, Denmark, July 1987. (Abstr.: *Sleep Research*, 16:637, 1987)

Graeber, R.C.: External factors affecting pilot decisions. Invited paper presented at the Orient Airlines Association's 9th flight Safety Seminar, Manila, Philippines, May 1987.

Hudson, D.E., Graeber, R.C., Schreiber, H.G., Connell, L. J. And Demitry, P.P.: Circadian rhythms, sleep and fatigue in strategic airlift: Pacific theater. Presented at 58th annual Meeting, Aerospace Medical Association, Las Vegas, NV, May 1987. (Abstr.: *Avia., Space, Environ. Med*., 58:512, 1987).

Graeber, R.C.: The space shuttle Challenger accident: Human factors and training and implications. Invited address presented at the Committee on Safety of Nuclear Installations' International Specialist Meeting on Training of Nuclear Reactor Personnel, Orlando, FL, April 1987.

Graeber, R.C.: Sleep in space. Invited paper presented at the NATO DRG Seminar "Sleep and Its Application for the Military", Ecole du Service de Sante des Armees, Lyon, France, March 1987.

Graeber, R.C.: Sleep and fatigue in international flight operations. Invited paper presented at the National Business Aircraft Association's 14th Annual International Operators Seminar, San Diego, CA, Feb. 1987.

Graeber, R.C.: Behavioral responses of commercial aircrew to short-haul flying. Invited paper presented at 2nd CEC Workshop on Irregular and Abnormal Hours of Work, University of Sussex, Brighton, UK, January 1987.

Graeber, R.C.: Management of fatigue and sleep deprivation. Invited paper presented at Symposium on "Fitness for Duty". SAE Aerotech '86, Long Beach, CA, October 1986.

Graeber, R.C.: Human factors aspects of the space shuttle Challenger accident. Invited address presented at the Electricite de France and Institute of Nuclear Power Operations' Human Performance Workshop, Lyon, France, September 1986.

Graeber, R.C., Lauber, J.K., Connell, L.J., and Gander, P.H.: International aircrew sleep and wakefulness after multiple time zone flights: A cooperative study. Presented at Annual Meeting, Assoc. Prof. Sleep Societies, Columbus, OH, June 1986. (Abstr.: *Sleep Research*, 15:273, 1986)

Monk, T.G., Moline, M., and Graeber, R.C.: The effect of a brief post-lunch nap on circadian adjustment to a 6-hour phase advance in routine. Presented at the Annual Meeting, Association of Professional Sleep Societies, Columbus, OH, June 1986. (Abstr.: *Sleep Research*, 15:278, 1986)

Graeber, R.C.: Field studies of sleep and circadian rhythms in flight crews. Presented at Annual Meeting, Assoc. Professional Sleep Societies, Columbus, OH, June 1986.

Dement, W.C., Siedel, W.F., Cohen, S.A., Bliwise, N.G., Graeber, R.C., Carskadon, M.A., and Connell, L.J.: Sleep and wakefulness in aircrew operating eastward or westward transoceanic flights. Presented at Annual meeting, Assoc. Prof. Sleep Societies, Columbus, OH, June 1996. (Abstr.: *Sleep Research*, 15:269, 1986)

Graeber, R.C., Gander, P.H., Foushee, H.C. and Lauber, J.K.: Sleep and fatigue in short-haul commercial flight crews. Presented at Annual Meeting, Assoc. Prof. Sleep Societies, Columbus, OH, June 1986. (Abstr.: *Sleep Research*, 15:272, 1986)

Gander, P.H., G. Myhre, R. C. Graeber, H.T. Andersen, and J. K. Lauber: Effects of 9-hour time zone changes on fatigue and the circadian rhythms of sleep/wake and core temperature. Presented at 57th Annual Meeting, Aerospace Medical Association, Nashville, TN, April 1986. (Abstr.: *Avia., Space, Environ. Med*., 57:504, 1986).

Monk, T.H., M. Moline, R.C. Graeber, J. Lauber and P. Gander: Jet lag: Changes in sleep, mood and performance after a 6-hour advance shift in routine. Presented at 57th Annual Meeting, Aerospace Medical Association, Nashville, TN, April 1986. (Abstr.: *Avia., Space, Environ. Med*., 57:504, 1986).

Graeber, R.C.: International aircrew sleep and wakefulness after multiple time zone flights: A cooperative study. Presented at 57th Annual Meeting, Aerospace Medical Association, Nashville, TN, April 1986.

Graeber, R.C., P.H. Gander and J.K. Lauber: Sleep and fatigue in short-haul flight operations. Presented at 57th Annual Meeting, Aerospace Medical Association, Nashville, TN, April 1986. (Abstr.: *Avia., Space, Environ. Med*., 57:504, 1986).

Connell, L.J., R. C. Graeber, and P.H. Gander: Morning and evening administration of theophylline: Effects on circadian temperature, sleep-wake, and cognitive performance in man. Presented at 57th Annual Meeting, Aerospace Medical Association, Nashville, TN, April 1986. (Abstr.: *Avia., Space, Environ. Med*., 57:504, 1986).

Gander, P.H., Connell, L.J., and Graeber, R.C.: Masking of the Circadian Rhythms of Heart Rate and Core Temperature by the Rest-Activity Cycle in Man. *Journal of Biological Rhythms*, 1:2, 119-135 (1986)

Graeber, R.C.: Sleep and fatigue in short-haul flight operations. Presented at 38th International Air Safety Seminar, Flight Safety Foundation, Boston, MA, November, 1985.

Gander, P.H., Graeber, R.C., and Kronauer, R.E.: Phase shifting two coupled circadian pacemakers: implications for jet lag. Presented at IEEE Annual Meeting, Chicago, IL, September 1985. (also *Amer. J.Physiology, 249*:R704-R719, 1985)

Graeber, R. C., Foushee, H. C., Gander, P.H., and Noga, G. W.: Circadian rhythmicity and fatigue in flight operations. Invited paper presented at 4th UOEH International Symposium on Occupational Health in Aviation and Space Work, Kitakyushu-shi, Japan, October 1984. (*J. of UOEH*, 7 (Suppl):122-130, 1985)

Graeber, R.C., Foushee, H.C., and Lauber, J.K.: Dimensions of flight crew performance decrements; Methodological implications for field research. Invited paper presented at the CEC-Workshop on Human Performance in Transport Operations, DFVLR Institute for Flight Medicine, Cologne, FRG, January 1983.

Graeber, R.C.: Altered sleep-wake schedules associated with transmeridian flight. Invited paper presented at Annual meeting of Association of Psychophysiological Study of Sleep, Satellite Symposium “Chronobiology: Physiology and Pathology”, San Antonio, TX, June 16, 1982.

Graeber, R.C.: When to teach what to whom. *Today's Education*, 71:3, 35-37, 1982.

Graeber, R.C., Schroeder, D.M., Jane, J.A., and Ebbesson, S.O.E.: Visual discrimination following partial telencephalic ablations in nurse sharks (Ginglymostoma cirratum). *The Journal of Comparative Neurology,* 180:2, 325-344, 1978.

Tisinger, J.L. and Graeber, R.C.: Use of oral antibiotics in studies of ingestive behavior in rats. *Physiology & Behavior*, 17:5, 861-864, 1976.

Graeber, R.C.: Food Intake Patterns in Captive Juvenile Lemon Sharks, *Negaprion brevirostris*. *Copeia*, Vol. 1974, No. 2 (Jun. 13, 1974), pp. 554-556.

Graeber, R.C., Ebbesson, S.O.E., and Jane, J.A.: Visual Discrimination in Sharks without Optic Tectum. *Science*, *180*:4084, 413-415, 1973.

Graeber, R.C., and Ebbesson, S.O.E: Retinal Projections in the Lemon Shark (*Negaprion brevirostris*). *Brain, Behavior, and Evolution*, *5*:461, 1972.

Graeber, R.C., and Ebbesson, S.O.E: Visual discrimination learning in normal and tectal-ablated nurse sharks (*Ginglymostoma cirratum). Comparative Biochemistry and Physiology, 42A*: 131, 1972.

Graeber, R.C., Schroeder, D.M., Jane, J.A., and Ebbesson, S.O.E.: The importance of telencephalic structures in visual discrimination learning in nurse sharks. *Proc. Society of Neuroscience 2nd Annual Mtg*,, pg. 100, 1972

Comments of the Cargo Airline Association

Flightcrew Member Duty and Rest Requirements; Proposed Rule, FAA-2009-1093

November 15, 2010

Attachment G

Economic Assessment of FAA's Regulatory Impact Analysis:

FLIGHTCREW MEMBER DUTY AND REST REQUIREMENTS

FAA Docket No. 2009-1093

Prepared For:

THE CARGO AIRLINE ASSOCIATION
The Voice of the Air Cargo Industry

Prepared By:

Campbell-Hill Aviation Group, LLC

Dr. Brian M. Campbell
Mr. Rex J. Edwards
Prof. John Z. Imbrie

Alexandria, Virginia
November 15, 2010

Table of Contents

Table of Contents

ECONOMIC ASSESSMENT OF THE FAA'S REGULATORY IMPACT ANALYSIS: FLIGHT CREWMEMBER DUTY AND REST REQUIREMENTS[1]

1.0 Introduction

The Cargo Airline Association ("CAA") has retained Campbell-Hill Aviation Group ("Campbell-Hill")[2] to analyze and evaluate the methodology and findings in the FAA's Regulatory Impact Analysis report ("RIA"), or the Benefit-Cost Analysis ("BCA"). In performing this analysis Campbell-Hill worked closely with the CAA and its member airlines. The firm supplemented its professional staff by the addition of Dr. John Imbrie to the team.[3]

The FAA has provided very little input data, few methodological assumptions and empirical justifications, and only a scant amount of the analytical findings that are most important to the cargo airlines. In addition to the fact that the FAA's analysis is fatally flawed methodologically, it falls far short on its face of justifying the enormous cost and burden the proposed rules would impose upon the cargo airlines with little or no public benefit. The FAA also refused CAA's request for additional substantive information and supporting documents that it filed on October 15, 2010.

2.0 Summary and Conclusions

The FAA's Regulatory Impact Analysis ("RIA") is fatally flawed on every conceptual dimension and in every significant analytical respect:

- FAA ignored every requirement for benefit-cost analysis studies.
- FAA invented fatigue-related accidents in order to project at least some benefits.
- FAA contrived an empirical base case which bears little resemblance to the current or proposed rules, or to current operating conditions.

---

[1] Dated September 3, 2010 and submitted in Docket No. 2009-1093.
[2] The firm's experience and qualifications are presented in Appendix A.
[3] Dr. Imbrie is a professor of mathematics and statistics at the University of Virginia.

- FAA's methodology is fraught with errors in design, application, and interpretation.

- FAA created cost estimates based on faulty reasoning and without obtaining airline assistance.

- FAA failed completely to divulge key data, data sources, methodological assumptions and empirical support or validation, and it failed to articulate and evaluate any reasonable alternatives to the one set of rules it proposes in this docket.

- Without just cause, FAA refused to provide details, backup documents, and clarifications when CAA submitted its timely requests on October 15, 2010.

- FAA's resulting analysis is patently erroneous and if not rejected it could lead to false conclusions with devastating financial consequences to the all-cargo industry.

- The cost of FAA's proposed rules to the U.S. economy would be $1.4 Billion in annual output, $0.3 Billion in annual wages and salaries, and 7,000 lost jobs (one-time permanent loss). The 10-year loss in output (sales in the U.S. economy) would be $9.6 Billion (NPV) as a consequence of the FAA's proposed rule. Moreover, the negative impact of FAA's proposed rule would fall disproportionately on small businesses.

2.1 Benefit-Cost Summary

Campbell-Hill's analysis of the RIA and its adjusted benefits and costs are compared to FAA's findings in Tables 2-1 and 2-2 below.

Table 2-1

Ten-Year Projection of Benefits and Costs
Cargo Aircraft Operations
(NPV, in Millions of 2010 Dollars)

	10-Year Benefits	
	FAA[4]	Campbell-Hill
Lives saved	0.6	0.0
Benefits (millions)	$20.9	$0.7
Cost (millions)	<$803.5[5]	$2,666.1[6]
Benefit-Cost Ratio	~0.1 to 1.00[7]	<0.0003 to 1.00

FAA's own study fails any reasonable benefit-cost test by a wide margin – 10 cents of projected benefits per dollar of cost. Campbell-Hill's analysis shows benefits of just three one-hundredths of a cent per dollar of costs; or *$3,800 of cost for $1 of benefits*.

While Campbell-Hill did not investigate the defects in FAA's passenger accident analysis to the same degree as it did on the cargo side, nevertheless its findings serve to inform decision-makers about the entire airline industry. Table 2-2 below summarizes Campbell-Hill's industry level results.

[4] Based on FAA's "Lower" estimate which is its only "baseline case." Its "upper estimate" and "best estimate" are both based upon erroneous extrapolations which have nothing to do with fatigue-related accidents, and so they must be discarded.
[5] FAA's estimate for all 92 Part 121 airlines.
[6] One CAA member provided revised cost estimates too late to be incorporated into this analysis. This adjustment would increase the 10-year nominal cost to the cargo carriers from $4,253 million to $4,608 million. The increase in NPV terms is from $2,666 million to $2,885 million.
[7] For the limited purpose of this calculation Campbell-Hill assigned 25% of FAA's cost to the all-cargo industry.

Table 2-2

Ten-Year Projection of Benefits and Costs:
Cargo and Passenger Operations Combined
(NPV, in Millions of 2010 Dollars)

	FAA-Total Industry[8]	Campbell-Hill		
		Cargo	Passenger	Total
Lives saved	16.8	0.0	5.0[9]	5.0
Benefits (millions)	$120.3	$0.7	$29.5	$30.2
Costs (millions)	$803.5	$2,666.1	$11,771.9[10]	$14,438.0
Benefits-Cost Ratio	0.15 to 1.00	<0.0003 to 1.00	<0.003 to 1.00	0.002 to 1.00

Whether the FAA's flawed analysis is examined separately for cargo operations, or for the entire passenger and cargo industry as a whole, its RIA fails by a wide margin to support the proposed rule. Campbell-Hill estimates less than three-one hundredths of a cent of benefits per dollar of costs for the cargo sector, and two-tenths of one cent of benefits per dollar of cost at the total industry level. To put this interpretation another way, *$3,800 of costs must be incurred to produce one $1 of benefits in cargo operations; and $478 of costs would be incurred to produce $1 of benefits across the entire industry of 92 Part 121 carriers*.

2.2 FAA Ignored All the Requirements for a Sound Benefit-Cost Analysis

The FAA's RIA fails every requirement for a sound benefit-cost analysis, including its own published guidelines and those of the Office of Management and Budget. OMB requires analysis of alternative policy prescriptions or regulatory devices, complete transparency of the study report, and full disclosure of all sources of data, documentation of models and methodology, and sensitivity tests. FAA did none of this.

[8] Based on FAA's "Lower" estimate which is its only "baseline case." Its "upper estimate" and "best estimate" are both based upon erroneous extrapolations which have nothing to do with fatigue-related accidents, and so they must be discarded.

[9] Estimated in proportion to Campbell-Hill's passenger benefit adjustment. ($29.5 ÷ $99.4) x 16.8 = 5.0.

[10] Computed by subtracting $2,666.1 million cargo cost from Oliver Wyman's preliminary industry cost estimate of $14,438.0 million (NPV). This net number includes many smaller all-cargo carriers that are included in Oliver Wyman's industry total but they are not part of Campbell-Hill's seven-carrier cargo total.

FAA violated every one of its own BCA guidelines:

- It did not define the objective of the proposed rule.
- It did not specify and describe all the key analytical assumptions.
- It did not identify the base case by purifying its historical data.
- It did not identify, articulate or evaluate reasonable alternatives.
- It compared the estimated benefits and costs erroneously.
- It performed no sensitivity analysis.
- It did not accurately determine which accidents could be prevented by the proposed rule, nor did it assess the extent of damage mitigation occasioned by the proposed rule.
- It strayed from a true BCA denominated only in financial terms. When it realized how far its claimed benefits are below its claimed costs, it shifted to an emotional appeal for saving even one life.

Just as the FAA rejected the City of Chicago's first BCA in support of federal funding for the O'Hare Modernization Program, so too should FAA discard this RIA and start over with assistance from the airline industry.

2.3 The FAA's Benefits Analysis Is Contrived to Produce a Desired Result

The FAA's benefits analysis is fatally flawed as to methodology, process, and data manipulation. A summary of the major flaws and shortcomings includes the following:

- The foundation of FAA's benefits analysis rests on eight fatigue related cargo accidents in the 1990-2009 20-year period. However, for various reasons seven of the eight years are irrelevant to this inquiry. They do not belong in the "base case" for analysis.

- FAA's extrapolation of the consequences (cost and fatalities) from the eight study accidents to 49 total "pilot error" accidents must be ignored because none of the 49 were related to fatigue. As a consequence, the FAA's "Upper Estimate" and "Best Estimate" scenarios are fallacious and have no valid place in this inquiry.

- Statistical correlation analysis of the type used in Appendix B of the RIA shows *there is no correlation between risk (probability) of accident and length of duty period for all periods below 15 hours*.

- *There is no increased accident rate with late night flying by the cargo carriers*.

- FAA erroneously discounted the benefits over the 2011-2020 time period while it discounted the costs over the 2013-2022 time period. This is completely illogical. The expenditure of costs must precede the realization of benefits, not lag the benefits by two years. This device is simply a trick to inflate the benefits erroneously – by a minimum of 13%.

- The FAA incorrectly used 20 years of accident history to project the probable outcome over the next 10 years. During the past 20 years rules and regulations have changed and technology has improved, all of which would have avoided many of the earlier accidents. Only 31% of the FAA's claimed fatigue-related accidents in the past 20 years occurred in the most recent decade. Only one of these was a cargo aircraft accident and there was no loss of life.

- During the past seven years there has not been a single cargo aircraft accident or a single fatality that FAA alleges was fatigue-related. Yet, during the past seven years (2003-2009) five U.S. all-cargo carriers (FedEx, UPS, Atlas, Polar and Kalitta) conducted 7.6 million mainline flight operations (take-offs and landings).[11]

[11] From DOT, Form 41 reports.

- The RIA is replete with methodological and computational errors, as detailed in Section 4.0.

The U.S. all-cargo industry, operating under current rules, has an unblemished record of safety in regard to pilot fatigue since 2002. FAA's flawed benefits analysis fails to make the case for any change to flight crew member duty and rest requirements.

2.4 FAA's Costs Are Seriously Understated

The CAA conducted a survey among its members to determine the added costs that the proposed rule would impose on their company. Complete results were received from six members[12] and one non-member all-cargo carrier.[13] Unfortunately, the FAA did not engage the carriers to jointly produce the best possible cost estimates. Instead, it obtained a little bit of sample data from a couple of all-cargo carriers and proceeded to invent its own methodology for estimating the impacts of the proposed rules. Crew scheduling is far too complex for any agency to work intelligently without intimate involvement with the carriers. As a result, FAA developed a very static analysis that excludes the significant constraints imposed by collective bargaining agreements, standards of customer service, slot and ramp parking restrictions, etcetera. In the process FAA simply assumed that major schedule optimization techniques would reduce incremental pilot requirements by 61%. This is completely unfounded and undocumented; but as a consequence, FAA estimated the airlines would require only 2% more crew members. The all-cargo carriers' estimate is 20.2%.

FAA made many other errors as well, including the following:

- FAA understated the true payroll cost of pilots by approximately 65%.

- FAA ignored all rest facility costs and associated revenue loss for the all-cargo carriers.

- FAA assumed a 5% reduction of reserve pilots and there is no basis for this.

---

[12] FedEx. UPS, Atlas/Polar, ABX, Kalitta and Capital.
[13] National Airlines.

- FAA assumed its fatigue training costs rather than asking the airlines for their best estimates. It is the airlines, not the FAA, that have the expertise in crew training.

Since the FAA refused to segregate its cost estimates between cargo and passenger operations Campbell-Hill has been unable to adjust the FAA costs for cargo operations. Instead the firm has relied upon the cost analyses provided by the CAA members and National Airlines. The seven all-cargo carriers project a 10-year total increase in their costs of $4,253 million (in nominal value),[14] or $2,666 million discounted at 7% to net present value.[15] A significant portion of these costs relates to the imperative to hire 1,731 additional pilots at the seven all-cargo airlines. By comparison, the FAA's NPV of costs for the entire passenger and cargo industry is only $803.5 million over the next 10 years.

In brief, the FAA has completely failed to justify its proposed rule. The projected benefits are minimal and illusory. The prospective costs to the industry are staggering. The impacts are so great that the proposed rule would endanger the survival of some carriers and negatively impact U.S. economic output ($1.4 Billion per year) and cause 7,000 jobs to be lost permanently in the U.S. economy.

[14] $310 million one-time costs plus $394.3 million annual on-going costs.
[15] See footnote 6 above.

3.0 The Regulatory Impact Analysis Does Not Meet the Requirements for BCA Analysis Established by OMB and the FAA

3.1 The Regulatory Impact Analysis Fails Every Significant Requirement Articulated in OMB Circular A-4

The OMB circular issued on September 17, 2003 to all the heads of executive agencies articulates the key requirements for a sound BCA.

i. Analysis of Alternatives

According to OMB a good regulatory analysis should include an "examination of alternative approaches."[16] The FAA's BCA analyzed only one set of potential rule changes, and that set was crafted entirely by FAA. The agency subjected no alternative sets of possible rule changes to benefit-cost analysis. The CAA submitted a well articulated and carefully researched proposed set of rules on September 1, 2009 and the FAA dismissed it without analysis or careful consideration. This one dimensional approach with a singular biased objective undermines a significant purpose of performing a BCA in the first place. The whole structure of BCA methodology is designed to assist a government regulatory agency, or a business corporation, in its evaluation of alternative decisions or courses of action, when each alternative presents a unique set of expected future benefits and costs. The FAA presented only one set of potential rules in its analyses - a set of rules that it alone designed. The FAA's BCA fails to adhere to the OMB's directive.

ii. Transparency

OMB states that a "good analysis" should be transparent. At page 2 of the Circular it says, "It should be possible for a qualified third party reading the report *to see clearly how you arrived at your estimates and conclusions.*" (Emphasis supplied). The FAA's BCA fails to meet any reasonable threshold of transparency. The input data are largely hidden from view. The analytical

[16] OMB Circular A-4, at page 2.

assumptions and empirical bases of the assumptions, the FAA's assessment of sets of historical accidents relied upon in its BCA, and key elements of the analytical framework and key outputs (results) are not divulged or explained in the FAA report. There are material items that must be disclosed so any third party could evaluate the reasonableness and fairness of the FAA's BCA. The CAA requests for information, documents, and explanation submitted on October 15, 2010 were designed to address transparency deficiencies in the FAA report. Only with complete responses to these requests will it be possible to conduct a full assessment of the BCA as it would impact the cargo airlines. Nevertheless, the FAA's response dated October 22, 2010 was silent with respect to every substantive request.

iii. Full Disclosure

The OMB directive states that "A good analysis provides specific references to all sources of data, appendices with documentation of models (where necessary), and the results of formal sensitivity and other uncertainty analysis."[17] As demonstrated by CAA's list of clarification and substantive requests, the BCA report makes little effort to disclose fully its analysis of either the claimed benefits or costs. Moreover there are no sensitivity analyses which are supposed to permit a reader to understand the sensitivity of results to changes in key assumptions or input factors. The FAA's BCA fails this OMB requirement along with all the others.

3.2 The Regulatory Impact Analysis Fails The FAA's Own Requirements For Benefit-Cost Analysis

On December 15, 1999 the FAA published the report FAA Airport Benefit-Cost Analysis Guidance. The FAA guidelines are intended to assist airports when applying for federal funding of projects, and for its own staff to support funding requests and regulatory initiatives.[18] The

[17] OMB Circular A-4, at page 3.
[18] See, for example, the O'Hare Modernization Program and the FAA's BCA study in support of new crew training rules (Docket FAA-2008-0677).

FAA guidelines discuss the principle of full disclosure in a BCA study. At page 3 the guidelines state:

> "Analysis of benefits, costs and uncertainty associated with a project or action *must be guided by the principle of full disclosure*. Data, models, inferences, and assumptions should be identified explicitly, together with adequate justifications for choices made, and assessments of the effects if these choices on the analysis." (Emphasis supplied).[19]

The FAA's Regulatory Impact Analysis fails to meet this reasonable standard of disclosure. The data are not provided, the analytical assumptions are not articulated or evaluated fully, and the inferences drawn by the FAA are not evaluated explicitly nor are they justified. Since there were no alternative regulatory solutions posited, there was no assessment of alternatives. Yet, the assessment of alternatives for meeting the objectives of the initiative are deemed crucial to the process. According to the FAA guidelines, "Alternatives represent the broad range of possible actions that could be undertaken to achieve the objectives identified by the sponsor. *A valid BCA must have at least one alternative identified for each possible course of action.*" (Emphasis supplied).[20]

The FAA guidelines specify the analytical considerations required in a BCA study. They are as follows:

(a) Define Project Objective

The FAA has not defined the objectives in complete terms. Is the goal of proposed rule to reduce by 50% accidents caused by fatigue? Is it some other objective or desired outcome? No one knows because FAA has not stated its objective. This is essential for any BCA to assess reasonable alternatives.

(b) Specify Assumptions

The BCA suffers throughout from a lack of stated and justified assumptions. A prime example is the lack of disclosure on the issue of how, or why, FAA inferred pilot fatigue in hundreds of aircraft accidents when no such cause or contributing factor was stated by the NTSB.

[19] Ibid, page 3.
[20] Idib, at page 18.

(c) Identify the Base Case

The FAA failed to properly define the base case. Analytically, it assumed the operations and accident profile of the past 20 years would repeat itself in the future. Nothing could be further from the truth. Regulatory changes since 1990 would have prevented a number of the historical accidents from occurring, and modernization of aircraft and air traffic control technology has prevented other accidents. In fact, 69% of the accidents analyzed by FAA occurred in the first 10 years of the series (1990-1999), and only 31% occurred during the most recent 10 years (2000-2009). Nevertheless, the FAA projects a repeat of all the past accidents for all the same causes, and this is patently erroneous.

(d) Identify and Screen Reasonable Alternatives

As stated above, FAA considered no alternative regulatory or voluntary program alternatives. The CAA offered an effective alternative that had the support of all the major U.S. all-cargo airlines and the FAA rejected it without sound reason, even though CAA's proposal would impose significant additional annual costs on the cargo carriers.. This defeats a primary purpose of benefit-cost analysis which has the virtue of providing a consistent analytical structure for choosing objectively between competing alternatives.

(e) Determine the Appropriate Evaluation Period

FAA considered neither an appropriate historical period for its analysis, nor an appropriate future period for projection and evaluation of benefits and costs. The choice of a 20 year history without adjustment for significant regulatory and technology improvements gives a distorted and biased forecast of the future. FAA never attempted to purify its historical database and it should have.

(f) Identify, Quantify and Evaluate Benefits and Costs

This step requires the quantification of all benefits and costs that lend themselves to quantification year-by-year going forward in time. The FAA failed to identify all the relevant annual costs to the airlines over the next 10 years. Obviously the cost stream is front-loaded and this has significant impact on the NPV calculations and the FAA's analysis does not fully represent the true distribution of costs over time. In fact the FAA's erroneous NPV calculations assume the benefits will be fully realized at least two years before any expenditures are made by the airlines. This is not only a fatal conceptual flaw in FAA's thinking, but it overstates the benefits by at least 13%.

(g) Compare Benefits and Costs of Alternatives

The expected future benefit and cost streams must be discounted and summarized in net present value terms. This procedure, according to FAA, establishes whether or not benefits exceed costs for any of the *alternatives* (thus indicating whether or not the objectives should be undertaken).[21] (Emphasis supplied). The ratio of benefits to costs and the absolute magnitude of benefits over costs are used to select between competing alternative projects or, in the instant matter, between alternative sets of rules.

FAA's BCA contains no consideration of alternatives. Even so, on its face the BCA fails the benefit-cost test by a wide margin. The FAA's claimed benefits are only 57.5% of its estimated cost. After adjusting for the erroneous two year head start that FAA granted the benefits stream, its claimed benefits are only 50.0% of its estimated costs. As discussed later, the FAA benefits are overstated and its cost estimates are dramatically understated.

(h) Perform Sensitivity Analysis

According to the FAA, a complete understanding of decision uncertainty can be developed only if key assumptions are allowed to vary. It is important to examine how the ranking of alternatives and the benefit-cost ratios might

---

[21] FAA, op.cit, page 8.

change. However, there are no alternatives to test by sensitivity analysis. The FAA's scant amount of sensitivity analysis dealt only with generally agreed upon factors like the statistical value of life. No inputs that would alter the shape of the probability distribution, such as discarding irrelevant and/or unsubstantiated fatigue-related accidents in the historical databases, were tested using different data sets or assumptions.

3.3 FAA's Regulatory Impact Analysis Fails Its Own BCA Requirements for New Regulations

Quite apart from the FAA's general guidelines for BCA requirements to support airport funding requests and other investments, the FAA has issued a guide for benefit-cost analysis as it pertains directly to regulatory initiatives.[22] In its discussion of the evaluation of benefits from the expected safety improvements occasioned by new regulations, the FAA states that … "the evaluation of the benefits of such activities requires determination of the extent to which deaths, injuries and property damage resulting from preventable accidents will be reduced, and that these reductions are valued in dollars."[23] The FAA's guide lists three requirements of the BCA:

(a) determination of which accidents could be prevented by the proposed regulation,
(b) assessment of the extent of death, injury and/or damage mitigation occasioned by the proposed regulation, and
(c) the benefits must be valued in dollar terms (and not in terms of emotional appeal).

The FAA's RIA in the instant proceeding simply assigns a high effectiveness judgment (58%) to the prevention of the accidents it considers to involve pilot fatigue as a contributing factor. After applying the 58% discount factor it assumed that 100% of deaths, injuries and damages would be mitigated by the proposed rule. There is no basis for this assumption and FAA does not discuss it, even though it is required by its own published guidelines.

---

[22] See FAA, Economic Analysis of Investment and Regulatory Decisions – Revised Guide, January, 1998.
[23] Ibid., page 1.

At the end of the FAA's BCA when it finds that its projected costs exceed its claimed benefits by 73.2%,[24] it shifts the focus to the emotional level. First it urges consideration of a significantly higher VSL than what is standard for FAA and OMB; and secondly, it shifts to describing the potential benefits from preventing a very low probability event. This is nothing more than an attempt by FAA to avoid its own disappointing statistical finding with respect to the expected benefits. This is a clear violation of the FAA's own stated intent, purpose and use of benefit-cost analysis in previous FAA rulemaking proceedings. The emotional appeal, or justification, is a clear violation of well-established principles for assessing FAA regulatory initiatives.

The FAA Guide discusses the judgmental method for assessing benefits. Most of the key assumptions and drivers in the FAA's RIA, are based largely on judgments and not facts or empirical analysis. The Guide states that the judgmental method … "has the disadvantage of almost always overstating the benefits of any proposed activity."[25] FAA goes on to conclude that … "a proposed activity which *fails to muster benefits in excess of costs* when the judgmental method is used *is probably not worth undertaking*." (Emphasis supplied.)[26]

As stated above, the FAA's own numbers unadjusted by Campbell-Hill demonstrate the clear conclusion that the proposed rule does not come close to producing benefits equal to the costs claimed by FAA. For this reason alone it should be rejected on its face.

The next two major sections of this report address the failures and shortcomings in the FAA's analysis of benefits (Section 4.0), and costs (Section 5.0). Section 6.0 examines the adjusted benefit-cost relationship.

[24] FAA, Regulatory Impact Analysis, this docket, page 2.
[25] FAA, op.cit., page 3.
[26] FAA, op.cit., page 3.

<u>4.0 The FAA's Benefits Analysis For All-Cargo Operations is Fatally Flawed And Minimal Benefits Can Be Attributed To The Proposed Rule</u>

4.1 Summary of Analysis

The FAA estimated a total of $463.8 million of benefits for the proposed duty time rule (measured in NPV terms) including $61.3 million for cargo operations. These benefit estimates are based on a projected number of "avoided" accidents and associated personal and property damage. A thorough and unbiased review of the FAA's methodologies and assumptions leads to the conclusion that at most cargo benefits are minimal – $0.7 million over ten years in NPV terms. In part, this is because only one of the FAA's claimed cargo accidents during the past 20 years has any relevance to the rule's impact, and that accident involved minor damages.

The key failures of the FAA's estimate of cargo-related benefits (as presented in the RIA and subsequent documents filed in the docket) include:

- A careful examination of each of the cargo accidents that were used by the FAA as a basis for all benefits predicted for its proposed rule reveals that *seven of the eight accidents have no relevance to the inquiry*. While inclusion in the list of avoided accidents implies a close correlation with fatigue and it assumed there would be benefits from the proposed rule, these seven accidents either (1) do not have fatigue as a stated factor, (2) would not occur under current rules, or (3) would not be affected by the proposed rule. It is questionable whether the remaining accident would likely occur in the future (and therefore be affected by the rule), but even assuming it might, the avoided damages over ten years would be minor.

- Without regard to the validity of including any or all of the "avoided" accidents, the FAA's estimate of avoided "Duty Time" and "Late Night" accidents is based on faulty statistical analysis. When corrected, this analysis shows *there are no benefits for duty time restrictions of less than 15 hours and there is no increased late-night accident rate for all-cargo operating patterns*. This simple correction eliminates more than half of the total avoided accidents with a proportional impact on measured benefits.

- The FAA's overstated benefits based on an inflated accident count, were then erroneously extrapolated by a factor of 4.9 to an "Upper Estimate" scenario that has no basis. The "Best Estimate" benefits used in the final benefit-cost analysis is merely an artificial average of the "Lower" and "Upper" benefits and is equally invalid. Eliminating the "Upper" and "Best" simulation results and limiting the cargo benefits to the "Lower" case (however wrongly estimated) reduces the NPV benefits by 66% to $20.9 million (NPV).

- The FAA admits that the rule would not be fully "effective" in eliminating accidents that it includes as fully "avoided" in the simulation runs. It tries to correct for this fact by adjusting benefits on the back-end in an artificial way. The adjustment is based on a weighted average that does not match the FAA's own unsupported assessment of effectiveness for individual cargo accidents. A reasonable correction to the FAA's effectiveness adjustment would reduce benefits by one-quarter to one-third for all forecast scenarios.

- While the costs are assigned to specific future years (2013-2022) and discounted to 2010, benefits are calculated for an unspecified future 10-year period and discounted to an unknown year. However, the NPV adjustment used in the simulation model effectively assigns benefits to 2011-2020 (with discounting to 2010), fully 2 years before costs occur. Using the same ten-year period for both costs and benefits would reduce the NPV benefits by 13% and a reasonable lag of two years between when costs and benefits start would lead to a 24% reduction in benefits.

As shown in the table below, the FAA's estimated benefits of $61.3 million for cargo operations are significantly diminished by making any or all of the necessary corrections described above. Most importantly, the elimination of 7 of the FAA's avoided accidents reduces benefits to just $0.7 million (NPV) over ten years.

Table 4-1

Cargo Operations: Adjusted Benefits

	NPV Amount (million $)	% Reduction of FAA Estimate
FAA Estimate - "Best Case"	$61.3	
After Adjustments (Cumulative)		
Eliminating "Upper" Estimate[27]	$20.9	-66%
Benefits Start in 2015	$16.0	-74%
Corrected Effectiveness Rating	$10.5	-83%
"Duty Time"/"Late Night" Correction	$5.0	-92%
Adjustment to Avoided Accidents	$0.7	-99%

In addition to these specific corrections to the FAA's benefit estimates, there are numerous problems with the general methodology utilized and the supporting information provided to reviewers. These include:

- A failure to provide any of the source data that was utilized, much less to identify what sources were used and how the data sets were manipulated.

- The analysis is replete with errors and undocumented assumptions resulting in illogical results.

- The analysis lacks adequate information for replicating and verifying the results, including having no sources on any of the produced tables, undefined time periods, and no detailed source data.

- There are a number of inconsistencies and errors in the characterization of historical accidents in terms of key fatigue factors.

[27] This is the same as FAA's "Lower Estimate" scenario.

- The FAA provided no information in the RIA on any of the accidents used to (1) make adjustment to "Duty Time" and "Late Night" accidents or (2) extrapolate the number of "avoided" accidents for the "Upper Estimate". A subsequent submittal of accident lists[28], while admittedly adjusting for "double-counting" (uncorrected for in the RIA results), also revealed inconsistencies and errors that should have been explained and corrected by FAA.

- In many cases, the criteria used to select data for particular analyses are not explained (particularly in regard to time periods) and they do not appear to be based on eliminating statistical bias. In some cases (e.g., analysis of Late Night accidents), the FAA chose to use a small data set when a more representative set was available.

- While the benefits for passenger and cargo operations are modeled separately, some of the analysis concerning future accidents is done on a combined basis thereby overstating cargo benefits.

- The RIA ignores some key elements mandated by FAA for benefit-cost analysis, including the lack of a "Base Case", a failure to base future accident savings on historical safety performance under future conditions, and a lack of reasonable alternatives to the proposed rule, including a cargo-specific rule that CAA had provided in September, 2009.

- The FAA utilizes a variety of statistical techniques which rather than support the analysis, serve as an attempt to disguise underlying flaws.

- Similarly, the use of simulation modeling gives the appearance of sophistication and a false level of precision, but in reality it merely generates results that are pre-determined by a few broad assumptions. This modeling is also skewed to produce an appearance of a high probability of catastrophic damages without the rule. It is presumed that the FAA's motive for doing this is to make an appeal to emotional instincts because its economic benefit-cost analysis is such an obvious failure.

[28] Provided by FAA on October 22, 2010.

In conclusion, a careful review of the cargo accidents selected by FAA for its justification of the proposed rule reveals that, at the very most, just one such accident is relevant to this inquiry. Every other one fails to qualify by the terms of FAA's own flight duty time and rest rules. Notwithstanding this essential finding, even if one granted relevance to at least some of the accidents, fatal flaws in FAA's methodology reveal a de minimis 10-year benefits number that is overwhelmed by FAA's own cost estimates.

4.2 Review of FAA's Fatigue-Related Cargo Accidents

The FAA's projection of benefits that can be associated with the proposed rule depends on the assumption that (1) pilot fatigue has been and would continue to be a determining factor in certain aircraft accidents, and (2) the conditions that cause that significant level of pilot fatigue would continue into the future without the proposed rule. This assumption clearly does not apply to Part 121 all-cargo operations based on a careful review of the accidents cited by FAA as "fatigue-related" and therefore likely to be "avoided" with the proposed rule. Campbell-Hill's review of the cited accidents leads to the conclusion that (1) there is no basis for including seven of the eight cargo accidents as relevant to the proposed rule and (2) the most optimistic estimate of damages avoided for the remaining accident is insignificant relative to the FAA's estimate. Each of the eight accidents is discussed below, and it is clear that the FAA's benefits are greatly overstated.

The FAA based the cargo benefits on eight accidents occurring between 1990 and 2009. Each accident was associated with a particular type of fatigue (see Section 4.3 for a full description of the FAA methodology and its basis for categorizing accidents). The FAA's benefits are based entirely on these accidents and its assumption is that these historical accidents would be fully or partially replicated in the future without the rule. As shown below, the FAA failed to consider (1) whether rule-affected fatigue was truly a contributing factor for these past accidents; and (2) whether the conditions under which the accident occurred would be possible in the future (due to regulatory, technology or operating changes). Seven of the eight accidents failed one or both of these criteria, while the remaining one would result in minimal benefits at best.

- The Guantanamo 1993 accident (DT1) resulted in specific rule changes that were implemented in response to that event. In the current environment, and with current equipment, the flight in question was long enough to require augmented crew. If this flight were operated today with the current aircraft, it would require an augmented crew due to flight time of over 8 hours. Furthermore, the current rule requires this type of Part 91 ferry flight to operate under part 121 rules that would have prevented the crew from operating the flight at all. Therefore, there is no basis for using that accident to justify further restrictions on duty time. Furthermore, the extended duty time shown (nearly 18 hours) is overstated by one hour based on a time zone error by FAA.

- The ATI 2/16/95 flight (RT2) was also a Part 91 ferry flight and would not be permitted under current rules.

- The FAA claims the 12/16/2004 Air Cargo Carrier's accident in Ontario (DT5) was fatigue-related even though there is no mention of fatigue in the Canadian report (runway was of insufficient length given the operating conditions). The captain had been on duty for exactly ten hours and did not have duty time "over" ten hours. The new rule would not effect this accident and so it cannot be used in determining benefits of the rule.

- For the Ryan Airlines 2/17/1991 accident (LN1), while the NTSB stated pilot error as the probable cause for not detecting wing ice contamination, it also stated that this was largely a result of a lack of appropriate response by the FAA, Douglas Company and Ryan to the known critical effect of wing ice contamination. This would now be categorized as an "operational error" since the pilots were not provided necessary information, procedures and training. This accident cannot be justified for inclusion in the FAA's cargo accident study group related to fatigue.

- The Swanton, OH flight on 2/15/1992 (LN2) was wrongly identified as a passenger flight in the most recent list of accidents and apparently was considered as such in the calculation of "avoided" accidents. In the NTSB findings, the following conclusion was reached "However, it is unable to conclude that the cited deviations from standard operating procedures are primarily attributable to flight crew fatigue." Therefore, this accident is not relevant to the inquiry.

- For the Newark, NJ accident on 7/31/1997 (LN4), the operation occurred at 9:30 p.m. based on the pilot's acclimated base and should not have been included as "late night." The crew conditions would not violate the existing rule, and so it must be discarded from the benefits analysis.

- For the Florence, KY accident on 8/13/2004 (LN5), the operation occurred at 11:49 p.m. based on the pilot's acclimated base and should not have been included as "late night." The crew conditions would not violate the proposed rule, and so it must be discarded from the benefits analysis.

- For the Tallahassee 7/26/2002 accident (RT4), fatigue was merely a "factor" not a "cause" and fatigue did not apply to the captain who had over 48 hours of off duty time prior to reporting for the flight. His rest would have satisfied the requirements of both the current and proposed rule. He failed to show fit for duty because his rest was interrupted by events at home. The rest time reported for the first officer would exceed the limit under the proposed rule. While the FAA has failed to analyze whether this flight that occurred over nine years ago would likely occur in the future, Campbell-Hill has assigned minor benefits in its adjusted totals. Those benefits are based on actual damages from the accident, as estimated previously by FAA.

Campbell-Hill's rationale for eliminating the seven cargo accidents from FAA's benefits analysis are summarized in Table 4-2 below (with details in Exhibit 4-1):

Table 4-2

Summary of Campbell-Hill's Assessment of FAA's Eight Cargo Accidents

Date	Location	Group Identifier	No NTSB Finding On Fatigue	FAA's Impact from Rule = 0 Percent	Wrong Fatigue Classifi-cation	Prohibited With Current Rule	Allowable With Proposed Rule	Impact Of Proposed Rule	Comment
8/18/1993	Guant. Bay	DT1			X	X		None	Wrong duty time shown
12/16/2004	Ontario, Canada	DT5	X	X	X			None	Duty time not over 10 hours
2/17/1991	Cleveland, OH	LN1	X		X			None	Operational Not Pilot Error
2/15/1992	Swanton, OH	LN2	X					None	
7/31/1997	Newark, NJ	LN4	X	X	X			None	Pre-midnight at crew base
8/13/2004	Florence, KY	LN5	X	X	X		X	None	Pre-midnight at crew base
2/16/1995	Kansas City, MO	RT2				X		None	
7/26/2002	Tallahassee, FL	RT4						Minor	Pilots not affected by rule

From a careful examination of each of the cargo accidents that were used by the FAA to project the benefits of its proposed rule, only one accident has any conceivable relevance to the inquiry, and the associated benefits are minor. Once it is understood that the benefits based on an adjusted number of avoided accidents are minimal, then the rest of Campbell-Hill's evaluation of FAA's benefits analysis is somewhat academic. However, it is essential that all of the major methodological and empirical infirmities in the FAA's analysis be uncovered and disclosed in any event.

4.3 Overview of FAA Methodology and Results

The RIA provides an estimate of rule-related benefits on pages 11 through 72 with some supporting materials in Appendices A, B and C. The methodology used to estimate benefits is summarized in the following sections.

4.3.1 Identification of Pilot Error Accidents with Fatigue as a Factor (1990-2009)

The FAA identified 22 accidents for the period 1990 to 2009 that (1) involved pilot error, (2) were considered by FAA to have fatigue as a factor, and (3) occurred on Part 121 carrier flights[29]. The FAA grouped these accidents into five categories of fatigue. While not specifically defined in all cases, the caterogies can be described as follows:

- Lack of Adequate Rest Time – Less than eight hours of sleep during rest period prior to accident.
- Extended Duty Time – Duty time of more than ten hours prior to accident.
- Extended Time Awake – 17 or more hours awake.
- Chronic Fatigue – Several days of (a) night flying, (b) multiple time zone changes, or (c) heavy schedule.
- Late Night Duty – Operations occur during "circadian low" period (midnight to 4:00 a.m.).

The accidents were described in narrative form in the original RIA report and subsequently identified in materials submitted to the docket on October 22, 2010. There were 14 accidents involving passenger aircraft and 8 accidents involving cargo aircraft which were assigned as shown in Table 4-3 below.

Table 4-3

Distribution Of FAA's Claimed Fatigue-Related Accidents (1990-2009)

	Cargo	Passenger	Total
Lack of Adequate Rest Time (RT)	2	3	5
Extended Duty Time (DT)[a]	2	5	7
Extended Time Awake (TA)	0	3	3
Chronic Fatigue (CF)	0	2	2
Late Night Duty (LN)[b]	4	1	5
	8	14	22

[a]One of these accidents also qualified as "late night" but was analyzed in this group.

[b]One of the cargo accidents was wrongly identified as a passenger accident in the October 22, 2010 submission but is shown correctly here.

[29] Two of the cargo accidents involved Part 91 ferry flights operated by carriers holding Part 121 certificates.

These 22 accidents were assumed to represent the 20-year history of pilot error accidents where, according to FAA, fatigue could have been a contributing factor.

4.3.2 Identification of Fatigue-Related Cargo Accidents 1990-2009: Adjustment to Predicted Impact of Rule on Cargo Accidents Over A Future 10 Year Period

The FAA reduced the number of historical accidents where fatigue could have been a factor (22) to the number of historical accidents where pilot fatigue was a factor (18.8) and would be "avoided" with the rule. There was no adjustment to accidents in three of the fatigue categories: Lack of Adequate Rest Time (RT), Extended Time Awake (TA) and Chronic Fatigue (CF). This presumably indicates that the FAA believes each of these accidents would not have occurred in the absence of fatigue.

In the two other categories, the number of "avoided" accidents was based on a comparison between "actual" accidents for a particular time period (based on length of duty time or time of day) and an estimate of "normal" accidents (or accidents that would normally occur without fatigue as a factor). These comparisons used a larger set of 43 accidents that were compiled by FAA and includes the 22 fatigue-related accidents plus 21 other crew-related accidents meeting the following criteria:

- Human factor-related accidents occurring between 1990 and 2009,
- Substantial damage to the aircraft or serious injuries to on-board persons,
- Did not involve turbulence, and
- Available history of pilot activity for 72 hours prior to accident.

These adjustments were as follows:

- Extended Duty Time: The 7 identified accidents occurred during a period where the captain's duty period was beyond 10 hours. Based on a distribution of pilot hours by hour of duty time (as derived from a survey of six carriers for two months in 2009), an expected, or "normal" frequency of accidents of 3.69 per 100,000 captain hours was estimated and applied to the number of captain hours occurring during the "extended" time period (11^{th} or more hours of duty). The difference between "actual" and "normal" yields 4.6 accidents that "could be avoided" with a duty time limit of ten hours, according to FAA.

Table 4-4

FAA's Adjustment To "Duty Time" Accidents (1990-2009)

Duty Time = < 10 Hours	
Actual Accidents	36.0
Captains Hours	975,337
Accidents per 100,000 Hours	3.69
Duty Time = 10 Hours+	
Actual Accidents	7.0
Captains Hours	64,624
"Normal" Based on <10 Hours	2.4
Accidents Avoided	4.6

- Late Night Operations: A similar adjustment was applied by FAA to late night operations but using a distribution based on operations (from an unspecified source, for an unspecified time period, and based on unspecified selection criteria). In this case, the "normal" frequency of accidents was determined based on operations and accidents occurring between 8 a.m. and 4 p.m., and it was estimated at 1.19 accidents per million operations. The "normal" number of accidents predicted for "Late Night" (defined as midnight to 4 a.m.) was 0.8 which yields a total of 4.2 accidents avoided when compared to the actual number of 5.[30]

[30] The FAA's calculations were based on comparing a total of 6 "Late Night" accidents that included one accident also classified (and adjusted for) under the "Duty Time" category. This accident was subtracted from the initial estimate of 5.2 avoided accidents to yield the same "net" value of 4.2 accidents.

Table 4-5

FAA's Adjustment To "Late Night" Accidents (1990-2009)

8 a.m. to 4 p.m.	
Actual Accidents	13.0
Number of Operations	10,940,283
Accidents per million operations	1.19
Midnight to 4 a.m.	
Actual Accidents	5.0
Number of Operations	708,610
"Normal" Based on 8 a.m.-4 p.m.	0.8
Accidents Avoided	4.2

The resulting total number of "avoided" accidents for the 20-year period is shown below. In the cases of "Duty Time" and "Late Night" accidents, there was no explanation of how the adjustments were applied separately to passenger and cargo accidents. A proportional allocation is the most likely method, although the allocation was apparently based on mis-identification of one of the "Late Night" accidents.[31] However derived, the estimated total of 5.8 cargo accidents and 13.0 passenger accidents agree with the FAA values used to predict the likely reduction of accidents and associated damages in the future as a result of the proposed rule.

[31] See Section 4.5.3.4 for a description of how this conclusion was reached.

Table 4-5

FAA's Estimate of "Avoided" Accidents (1990-2009)

	Cargo	Passenger	Total
Lack of Adequate Rest Time (RT)	2.0	3.0	5.0
Extended Duty Time (DT)	1.3	3.3	4.6
Extended Time Awake (TA)	0.0	3.0	3.0
Chronic Fatigue (CF)	0.0	2.0	2.0
Late Night Duty (LN)	2.5	1.7	4.2
	5.8	13.0	18.8

4.3.3 Simulation Model of Future Impact on Accidents, Fatalities and Damages

The predicted level of avoided accidents, fatalities and other damages for an unspecified future 10-year period were estimated using a simulation model that was based on historical accident patterns for 1990-2009. The simulation model was run separately for passenger and cargo accidents under three scenarios: Lower, Upper and Best. The model was run for 5,000 trials in all six cases (i.e, 3 scenarios for both passenger and cargo). While only summary results of the model were provided in the report, the model was apparently based on the following assumptions:

Lower Estimate

- The estimated number of "avoided" accidents (5.8 cargo and 13 passenger) for the 1990-2009 period was assumed to represent the average number of accidents for the "Lower Estimate" scenario over a future 10-year period by dividing by 2 (2.9 cargo and 6.5 passenger).

- The probability of having a specified number of accidents during the 10-year period was assumed to be represented by a Poisson distribution using the mean value of avoided accidents.[32] The number of accidents for each of the 5,000 trials was apparently generated for the 10-year period rather than separately for individual years.

- The number of fatalities associated with the predicted number of accidents is based on an unspecified set of data and probability functions that produces a "not normal" distribution that is skewed to the right.[33]

- The predicted "costs" (or more correctly damages) from the predicted number of accidents is then calculated based on an average value of life of $6 million[34] applied to fatalities plus additional costs that are not identified, but presumably include aircraft damages and, perhaps, damages associated with other types of personal injuries (most probably "serious injuries" as measured in the accident reports). The cargo estimates also are identified as including damages associated with "cargo carried" with no information on how those damages were calculated.

- The net present value of future "costs" from accidents is calculated assuming a 7 percent discount rate, but no specified pattern by year is generated by the model. Based on Campbell-Hill's analysis of the results, it appears that "costs" were distributed equally over the 10-year period and discounted to the beginning of the forecast period.[35]

---

[32] A Poisson probability distribution measures the probability of some discrete number of events occurring over a fixed time period. The function is fully specified by the mean estimate (i.e., all probability functions using the same mean estimate are exactly the same). In this case, the function provides the probability of the occurrence of one or more accidents over the 10-year period up to a maximum number as determined by the mean (and including the possibility of zero accidents. For cargo accidents, the probabilities range from 23.14% for 2 accidents to 0.02% for 11 accidents, while the passenger probability ranges from 15.75% for 6 accidents to 0.01% for 18 accidents. In both cases, the "maximum" number of accidents specified by the Poisson distribution is exactly the same as the maximum results generated in the "Lower Estimate" simulation modeling.

[33] Presumably, the cargo and passenger fatality functions were based on some historical relationship, but that relationship is not described in the report. It is unknown whether average fatalities per accident (or other damage factors) were based solely on the fatigue-related accidents or some larger set of accidents.

[34] The report specifies the "value of statistical life" (VSL) as $6.0 million per fatality and cites 2009 guidance from DOT. This apparently is a rounded-up value based on the $5.8 million VSL that was actually published by DOT.

[35] While the results are not consistent over all scenario runs, the ratio of NPV to nominal "costs" based on the mean results mostly are in the range from 70.1% to 70.5%. The discounting of an even distribution of nominal costs assigned to Years 1 through 10 (at 7 percent to Year 0) yields a ratio of 70.2%.

- A summary of the 5,000-trial simulation shows mean, median, minimum and maximum values for accidents, fatalities and damages, as well as a distribution graph for each statistic (see Exhibit 4-2). The "mean" value of damages ("costs") is ultimately used in the benefits calculations, but the summary narrative describes the probability that high damage results would occur strictly for emotional appeal.

- The mean estimates for the "Lower Estimate" are shown in Table 4-7.

Table 4-7

FAA's "Lower Estimate" Benefits (Mean Average)

	Passenger	Cargo	Total
No. of Accidents	6.5	2.9	9.4
No. of Fatalities	42.1	1.0	43.1
Nominal Damages (mil. $)	$352.5	$51.5	$404.1
NPV Damages (mil. $)	$248.5	$36.1	$284.6

Upper Estimate

- The only stated difference between the "Lower Estimate" and "Upper Estimate" scenario simulation runs is the assumption of average number of "avoided" accidents over the 10-year period. The historically-based estimates of 2.9 cargo accidents and 6.5 passenger accidents are increased under the assumption that the impact of fatigue (and, by extension, the proposed rule) on the group of 43 accidents (meeting criteria described above) is representative of the impact on all pilot error accidents[36]. FAA provides no basis for this critical assumption.

- The number of passenger accidents that would be avoided under this assumption is calculated by assuming 90.2 of 229 pilot error accidents would be avoided which is 39.4% (and equal to the 13 avoided accidents compared to 33 passenger accidents in

[36] In the RIA, the number of all pilot error accidents was stated at 278 (229 passenger and 59 cargo). The FAA documents released on October 22, 2010 modified this total to 250 based on duplicates (although the original list was not provided and duplicates could not be identified). As shown in Section 4.5.2, the totals which are based on the lists provided are different.

the “43 accident” subset). This is an increase of 594% over the “Lower Estimate” accident average.

- The number of cargo accidents that would be avoided under this assumption is calculated by assuming 28.4 of 49 pilot error accidents would be avoided which is 58% (and equal to the 5.8 avoided accidents compared to 10 cargo accidents in the “43 accident” subset). This is an increase of 390% over the “Lower Estimate” accident average.

- The resulting damage estimates are shown in Table 4-8 below. Note that the ratio of the mean number of accidents for this scenario closely matches the ratio of “avoided” accidents under the “Lower Estimate” scenarios for both passenger and cargo with similar ratios for the other statistics (probably reflecting variances generated by the simulation rather than changes to the underlying assumptions).

Table 4-8

FAA’s “Upper Estimate” Benefits

	Passenger		Cargo		Total	
	Mean	Mean As % of Lower Average	Mean	Mean As % of Lower Average	Mean	Mean As % of Lower Average
No. of Accidents	45.1	591%	14.2	389%	59.3	528%
No. of Fatalities	298.0	608%	4.8	385%	302.8	603%
Nominal Damages (mil. $)	$2,482.8	604%	$251.8	389%	$2,734.6	577%
NPV Damages (mil. $)	$1,746.0	603%	$176.6	389%	$1,922.6	575%

Best Estimate

- As with the “Upper Estimate” scenario, the “Best Estimate” scenario only varies from the “Lower Estimate” runs in terms of the assumed number of avoided accidents over the 10-year period. In this case, the number of avoided passenger accidents (26) is the average of the Lower and Upper values (6.5 and 45.1 apparently rounded to a whole number) with the cargo accidents (8.5) similarly calculated by averaging the low and high estimates (average of 2.9 and 14.2).

- The simulation results are shown in Table 4-9 below. While this simulation was run separately using the average of the avoided accidents, the results are very close (within 1%) to the simple average results for the "Lower Estimate" and "Upper Estimate".[37]

Table 4-9

FAA's "Best Estimate" Benefit

	Passenger		Cargo		Total	
	Mean	Mean As % Lower/Upper Average	Mean	Mean As % Lower/Upper Average	Mean	Mean As % Lower/Upper Average
No. of Accidents	26.0	1%	8.5	-1%	34.4	0%
No. of Fatalities	172.0	1%	2.9	0%	174.9	1%
Nominal Damages (mil. $)	$1,430.0	1%	$150.5	-1%	$1,580.5	1%
NPV Damages (mil. $)	$1,006.0	1%	$105.7	-1%	$1,111.7	1%

4.3.4 Partial Mitigation based on "Effectiveness Scores"

The final benefit estimate contains an adjustment based on the assumption that "it is seldom the case that a rule is 100 percent effective", and "fatigue is rarely a primary or sole cause of an accident", and the rule "is not likely to prevent all future accidents that include fatigue as a factor" (page 65). A weighted average of judgmental "effectiveness" scoring was derived by the FAA for both passenger and cargo accidents. The estimates were based on an internal review of the NTSB reports for the 22 "fatigue" accidents with an estimated "likelihood of rule avoiding accident" assigned to each accident.[38] The factors ranged from a high score of 90% where prevention is "very likely" (with a benefit based on 90% of estimated damages) to the lowest level of 0% where the rule "would not reduce the risk". Intermediate scores are 75%, 50%, 35% and 15%, each reflecting the expected effect of the rule on future occurrence and associated damages. The distribution of rating level by type is shown in Table 4-10.

[37] The NPV of cargo damages is shown as $114.5 million in the "Best Estimate" descriptions (page 63), but $105.7 million in the effectiveness adjustments (page 68). The latter value is consistent with the other NPV calculations and is assumed to be correct.

[38] The specific factors for each accident were not provided in the original RIA, but were released in a spreadsheet dated July 20, 2010. This spreadsheet lists each of the 22 accidents along with materials copied from the NTSB summary and detailed reports, a count of on-board persons, fatalities and serious injuries, and the assigned effectiveness factor. The spreadsheet includes an additional accident (Lexington, KY on 8/27/2006) that was not included in the set of 22 accidents, but was referenced in the discussion of Late Night accidents (page 37).

Table 4-10

FAA's Effectiveness Rating by Operation Type

Effectiveness Rating	Cargo	Passenger	Total
90%	2	2	4
75%	1	1	2
50%	0	3	3
35%	1	2	3
15%	1	5	6
0%	3	1	4
	8	14	22

Note: Excludes one accident not included in 22 accidents and uses correct cargo designation.

The adjustments to damages are based on a weighted effectiveness factor of 40% for passenger accidents and 58% for cargo accidents. As shown in Section 4.6.5, the basis for these calculations was not provided and is inconsistent with logical possibilities.

4.3.5 Summary of Benefit Estimates

The FAA's final benefits combined the "Best Estimate" scenario results and the effectiveness factors as shown in Table 4-11.

Table 4-11

FAA's "Best Estimate" Benefits With Effectiveness Adjustment

	Best Estimate	Effectiveness Factor	Final Estimate
Nominal Damages (mil. $)			
Passenger	$1,430.0	40%	$571.1
Cargo	$150.5	58%	$87.3
	$1,580.5		$658.4
NPV Damages (mil. $)			
Passenger	$1,006.0	40%	$402.5
Cargo	$105.7	58%	$61.3
	$1,111.7		$463.8

4.3.6 Additional Qualitative Benefits

The FAA presents other benefits that are not quantified, including:

- Minor Ramp Damage – Based on an estimate of ramp incidents and accidents at $3 billion per year, and an assumed percentage of 3% that are "caused by pilot fatigue", the FAA posits that losses of $90 million per year could be avoided with the rule. Neither of these assumptions are sourced or supported, so these types of benefits must be eliminated. In fact, a review of the FAA source document reveals air traffic controller fatigue and errors, ground worker errors, and airport facility deficiencies as contributing causes of ground accidents, but pilot fatigue is not mentioned in the report. All references to this trumped-up source of potential benefits must be deleted from any consideration.

- Increased Pilot Competency – The assumption in this case is that there are "real and significant" damages that cannot be directly attributed to pilot fatigue, but that better rested pilots would be more competent in avoiding accidents with "quick action". There is no evidence that this occurs or is a valid basis for quantifying any benefits, and therefore should be eliminated from consideration. In fact, the example given for "quick action" is the Flight 1549 Hudson River accident where the crew would have qualified as "fatigued" under the proposed rules. In its requests for information issued to FAA on October 15, 2010, CAA asked for details about this 4-day crew trip and FAA refused to comply.

4.3.7 Sensitivity Analysis (Value of Life)

As described above, the damages associated with fatalities were based on the OMB value of statistical life ($5.8 million rounded up to $6.0 million in the simulation runs). The FAA presents damages assuming a VSL of $8.4 million increasing the NPV benefits to $589 million. The calculations used to create these estimates are not provided and the results are inconsistent with the final benefits. In any case, the $8.4 million VSL has been rejected by the OMB and should not be considered.

4.4 RIA Methodologies Are Flawed And Lead To Erroneous Results

The FAA's analysis of benefits attributable to the proposed rule is incomplete, flawed and inconsistent with standard procedures for safety-related benefit estimates. A fundamental problem is the unsupported presumption that the rule will reduce accidents in the future without demonstrating a causal relationship based on relevant historical data. All of the benefits derive from an assumption that future fatigue-related accidents will exactly replicate historical accidents dating back to 1990 many of which are either (1) not directly associated with fatigue, (2) not allowable under current rules, or (3) not affected by the new rule. The following sections describe specific elements of the benefit estimation that should be modified or eliminated, as well as a general critique of the RIA that brings into focus the erroneous results and misguided conclusions.

In addition to specific areas where the FAA's methodologies, assumptions and data sources have produced invalid and/or unsupportable results (see Section 4.5), the RIA benefits analysis has some general problems that undermine confidence in the final estimates and conclusions. These general problems include:

- The analysis is replete with errors and undocumented assumptions resulting in illogical results.

- The analysis lacks adequate information for replicating and verifying the results, including the fact that there are (1) no sources on any of the produced tables, (2) undefined time periods, and (3) no detailed input data.

- There are a number of inconsistencies and errors in the characterization of historical accidents in terms of key fatigue factors.

- In many cases, the criteria used to select data for particular analyses is not explained (particularly in regard to time periods) and does not appear to be based on eliminating statistical bias. In some cases (e.g., analysis of Late Night accidents), the FAA chose to use a small data set when a more representative set was available.

- While the benefits for passenger and cargo operations are modeled separately, some of the analysis concerning future accidents is done on a combined basis thereby overstating cargo-related benefits.

- The RIA ignores some key elements mandated for FAA benefit-cost analysis including:
    - No Base Case – The future level of accidents without the rule is not a projection based on analysis of likely trends and conditions, past safety improvements and other key forecast elements, but rather it merely replicates historical patterns. However, everyone knows that current regulations and technology are better and safer than was the case 10 to 20 years ago.

    - The projection of future accidents is not based on a reasonable correlation between historical accidents and the specific factors affected by the rule.

    - No Alternatives – The FAA and OMB BCA guidelines require the FAA to compare the base case with a set of reasonable alternatives and the FAA has only considered a single "one size fits all" rule. The FAA was provided with an alternative "cargo-specific" rule from the Cargo Airline Association but did not consider it, despite evidence of significant differences in operating characteristics and fatigue-related accidents. The FAA also failed to consider alternative combinations of rules based on the various fatigue categories.[39]

- The FAA utilizes a variety of statistical techniques which, rather than support the analysis, serve to obscure underlying flaws. In particular, the statistical analysis used to infer that any accident that occurs during a late night hour or involves a pilot with a duty period exceeding 10 hours is, by definition, fatigue related. This is false.

[39] Cargo operations demonstrate a benefit-cost relationship that is completely different from passenger operations. The simple fact that only a handful of lives are at risk on a cargo flight implies that the potential benefits of implementing a rule are considerably reduced. This will shift the point at which costs and benefits are traded off in equal portions. Ultimately, this may necessitate a separate set of rules for operations that are characteristic of the all-cargo carrier business.

- Similarly, the use of simulation modeling gives the appearance of sophistication and a false level of precision, but in reality it merely generates results that are pre-determined by a few broad assumptions. This modeling is also skewed to produce an appearance of a high probability of catastrophic damages without the rule. It is presumed that the FAA's motive for doing this is to make an appeal to emotional instincts because its economic benefit-cost analysis is such an obvious failure.

- The model's calculated damages are based on undocumented assumptions about fatalities and non-fatality damages per accident. The values utilized do not appear to have any relationship to the "avoided" accidents.

- Finally, the benefits that are associated with a historical pattern of fatigue-related accidents, however wrongly estimated, are then assumed to be a "Lower Estimate" with an "Upper Estimate" generated by assuming fatigue is a cause in accidents for which fatigue is not mentioned in the NTSB investigation files. This unsupported extrapolation assumes the NTSB wrongly concluded that fatigue was not a factor in many of its highly detailed accident reviews. Yet, the extrapolation accounts for nearly three-quarters of the final calculated benefits used in the benefit-cost comparison (according to the "Best Estimate" scenario).

4.5 Analysis of FAA's Benefit Estimates for Cargo Operations

The benefit estimates developed in the RIA are based on analysis and assumptions in the following areas:

- Historical level of accidents associated with pilot fatigue,

- Projected level of future accidents that could be avoided with the proposed rule, and

- Projected level of future damages that could be avoided with the proposed rule

The following sections evaluate the methods and results produced in the RIA.

4.5.1 Historical Accidents Used to Project Future Benefits

The primary basis for estimating the "Lower Estimate" benefits associated with cargo operations is the identification of eight accidents that occurred between 1990 and 2009 which were deemed to be fatigue-based and therefore would be partially or entirely "avoided" with the rule. The eight accidents are described in separate sections devoted to the various groups of fatigue factors.[40]

Table 4-12

FAA's Eight Cargo Accidents Used In RIA Study

Date	Takeoff/ Landing	Location	Carrier	Aircraft	Group Identifier
8/18/1993	L	Guantanamo Bay	Kalitta	DC-8-61	DT1
12/16/2004	L	Ontario, Canada	Air Cargo Carriers	SD3-60	DT5
2/17/1991	TO	Cleveland, OH	Ryan	DC-9-15	LN1
2/15/1992	L	Swanton, OH	ATI	DC-8-63	LN2
7/31/1997	L	Newark, NJ	FedEx	MD-11	LN4
8/13/2004	L	Florence, KY	Air Tahoma	CV-340 (580)	LN5
2/16/1995	TO	Kansas City, MO	ATI	DC-8-63	RT2
7/26/2002	L	Tallahassee, FL	FedEx	727-200	RT4

The process that was used to identify these specific accidents is not described by the FAA and admittedly several of them were not considered fatigue-related by the NTSB, the agency specifically designated to determine causes and related factors for aircraft accidents. There are a number of specific problems with FAA's identification process:

- The number of cargo accidents far exceeds the number of accidents that NTSB determined to have any relationship to fatigue.

- Some of the characterizations within specific fatigue categories were marginal and/or based on errors (and one of the accidents was apparently mis-identified as a passenger operation in some of the calculations).

[40] Accidents are identified by the (1) fatigue category and (2) the order listed by FAA in the narrative section for each of the fatigue categories as identified using the following: Extended Duty Time (DT), Lack of Rest Time (RT), Chronic Fatigue (CF), Late Night Operations (LN) and Extended Time Awake (TA).

- While inclusion in the list implies a close correlation with fatigue and therefore benefits from the proposed rule, 7 of the 8 accidents either (1) do not have fatigue as a cause or factor, (2) would not occur under current rules, or (3) would not be affected by the proposed rule (including 3 of the 8 accidents that the FAA assigns zero effectiveness to the rule).

In addition to detailed accident reports and summaries of findings, the NTSB maintains a database of historical aircraft accidents that provides information on the details of the accidents (operator, aircraft type, location, date, time, etc.), the level of damages (fatalities, serious and other injuries, and level of aircraft damage), and, most importantly, the factors and causes of the accidents (correlated with the personnel responsible if a human factor). The NTSB distinguishes the relative importance of various factors in three categories: causes (top importance), factors, and findings (lowest importance).

Of the 8 cargo accidents in the 1990-2009 time period, the NTSB identified just one cargo accident where fatigue was a cause (DT1), one accident where fatigue was a factor (RT4), and one accident with fatigue as a finding (RT2).[41] Combined, the 3 accidents accounted for 3 fatalities and 6 serious injuries. Of the three, only one occurred during the last 10 years (RT4 in 2002) and that accident accounted for 3 serious injuries and no fatalities. It is important to note that 5 of the 8 cargo accidents cited as fatigue-related did not have fatigue mentioned in any way in the NTSB findings. These include the one "Duty Time" accident (DT5) for which the assignment is highly marginal since the pilot's duty time (10 hours) was at the bare minimum based on the FAA's own criteria.

The four "Late Night" accidents also did not have any mention of fatigue as even a finding. This exposes the fact that the FAA's criteria for this category was not based on evidence of fatigue but rather an arbitrary FAA accident selection process supported by questionable statistical analysis (see below). As further evidence for Campbell-Hill's conclusion, it is important to note that three of the four "Late Night" cargo accidents occurred in the first hour of the circadian period (midnight to 1 a.m.). It is important to note that the non-

[41] One other cargo accident (CHI96LA266) shows fatigue as a finding but was not included in any of the FAA accident lists. The accident occurred on 8/3/1996 and was a Part 135 operation with one serious injury.

fatigue "Duty Time" accident (DT5) and two of the "Late Night" accidents (LN4 and LN5) were essentially determined to have no relation to fatigue by the FAA because it assigned a 0% effectiveness rating for the rule (see Section 4.6.5 below).

A key omission in the FAA's analysis of cargo accidents is the clear fact that any accident used to justify the new rule must satisfy the following criteria:

- The flight in question must be permitted under current rules, and not permitted under the proposed rules. Only in these cases would the proposed rule make a difference in preventing a recurrence of the same accident.

- The proposed rule must have a significant mitigating effect on the future probability (and damages) for a forecast accident.

- Pilot error must be at least a contributory factor in the crash. This was one of FAA's stated criteria but was not applied uniformly. Note that not all pilot errors are due to fatigue. But if pilot error is not involved, then clearly fatigue is not an issue.

The first criterion is especially important because crash investigations going back 20 years have uncovered numerous safety issues that have been addressed either with newer technology or with new rules. Safety improvements over the last 20 years invalidate many of the incidents used to justify the new rules.[42] But once old problems have been addressed, it is wrong to continue using them to justify further regulatory changes. A proper analysis of the benefits of proposed new rules requires establishing a baseline incident rate. The baseline has to represent current safety-related technology and current rules and regulations. Otherwise the benefits will appear to be much greater than they really will be.

The FAA uses "effectiveness analysis" to assess the likelihood that the proposed rule would have prevented an accident. However, its methodology does not eliminate cases where the

[42] One technological example related to a passenger accident included in the benefit calculations has to do with terrain awareness warning systems (TAWS/EGPWS) which are now required but were not on AA965 in its 1995 crash in Columbia (one of the accidents cited in the report). A current terrain awareness warning system would almost certainly have prevented that crash and its 160 fatalities. "Since 2002, all planes with more than six passengers are required to have an advanced terrain awareness warning system. No U.S. registered aircraft fitted with a TAWS/EGPWS has suffered a controlled flight into terrain accident.

flight would not have been allowed under current rules. Furthermore, even though some accidents do receive low "effectiveness scores," the FAA applies the effectiveness analysis on an average basis, which means that many irrelevant accidents remain in the analysis, creating false accident mitigation scores.

4.5.2 Problem Accident Data Sets

While the 22 accidents identified by FAA from the 20-year history were the basis for the "Lower Estimate" benefits (as adjusted to "avoided" accidents), the larger set of human factor accidents cited in the report was critical to the FAA's final benefit estimates. Errors and inconsistencies in the definition of these various accident sets have a significant impact on the FAA's conclusions and undermine the credibility of the overall analysis.

In the original RIA, the FAA cited three sets of accidents occurring from 1990 to 2009:

- 22 fatigue-related accidents associated with the five fatigue categories ("Fatigue-Related"),
- 43 accidents (presumably including the 22 above) for which adequate information was available to determine whether fatigue was a factor, and
- 278 accidents (presumably including the 43 above) for which pilot error was a cause.

The accident counts as determined from the RIA are shown in Table 4-13 (including correct assignment of LN2 as a cargo flight).

Table 4-13

FAA's Accident Totals from RIA (Uncorrected)

	Cargo	Passenger	Total
Fatigue-Related	8	14	22
Other Human Factor (Non-Fatigue)	2	19	21
	10	33	43
Other Pilot Error	39	196	235
	49	229	278

Other than the descriptive accounts of the 22 accidents, the RIA did not provide any backup on any of the other accidents. In a subsequent filing, the FAA provided a list of codes for the 43 accident data set ("43 accidents" list) and a separate one for the total set of accidents (purportedly corresponding to the 278 accident total but modified to a list of 250 accidents due to "double-counting"). The following discussion illustrates many problems with these data sets.

22 Fatigue-Related Accidents

In addition to the inaccuracies concerning the claimed importance of fatigue for these accidents (and, by extension, the proposed rule), there are a number of general problems with the FAA's classification and supporting evidence including the following:

- Two of the "Late Night" accidents (LN4 and LN5) were incorrectly associated with the local time rather than the pilot's base time.

- One of the "Duty Time" accidents (DT1) added one hour to the duty time (17:56 hours vs. 16:56 hours) probably due to using an incorrect time zone, although the actual duty time was reported in the NTSB report, and supposedly it was reviewed by FAA for the basis of its "fatigue" determination.

- One of the "Late Night" cargo accidents (LN2) was incorrectly identified as a passenger flight in the 43 accident list. This error apparently resulted in erroneous values for the "avoided" accidents by type.

- One of the "Rest Time" accidents (RT2) was not included in either the 43 accident list or the total accident list ("250 accident list").

- A separate spreadsheet provided after the RIA was issued contained the effectiveness rating for each of the 22 accidents. It included an additional passenger accident (Lexington, KY 8/27/2007) that was assigned a relatively high effectiveness (35%), but it was evidently not deemed to be fatigue-related.

43 Accidents With Sufficient Data for Fatigue Determination

The FAA used this set of accidents to somehow represent the universe of all accidents where fatigue could have been a factor with the 22 accidents being the share where fatigue was a factor. This is a critical but unsupported assumption as the FAA uses this relationship as the probability of fatigue being the cause for the much larger set of all pilot error accidents (250 accidents[43]). As discussed below, this has a major impact on the final benefit calculations. As shown above, there were only four cargo accidents where the NTSB cited fatigue as a factor (including one Part 135 flight that should be excluded in any count of relevant accidents). The same source identified only 9 passenger accidents from 1990 to 2009 with fatigue as a factor (only 6 of which were included in the FAA's list of 14 fatigue-related accidents). At most, there would be 13 accidents that are fatigue-related, and without explanation or justification the FAA expanded that to 22 accidents. In any case, these accidents represent all of the fatigue-related accidents when compared to either the list of 43 or the list of 250. Extrapolation of fatigue as a cause of accidents not included in the list of 43 is erroneous and unjustified. This fact alone eliminates both the "Upper Estimate" and "Best Estimate" benefit estimates as relevant measures of benefit.

Similarly, the list of 43 accidents was used to create a set of "normal" accidents to estimate the number of "avoided" accidents for both "Duty Time" and "Late Night" categories. As described previously, the FAA compared the actual number of accidents occurring during a particular time frame (midnight-to-4 a.m. or after 10 hours of duty time) to the "predicted" number of accidents that would have occurred based on the "normal" rate of expected accidents (i.e., accidents where that type of fatigue was not a factor). The underlying assumption is that the 21 non-fatigue accidents in the group of 43 are representative of all non-fatigue pilot error accidents.[44] The justification for this assumption is that the 21 non-fatigue accidents are the only ones for which "adequate information" is available. This is clearly not true in the case of the "Late Night" analysis since the time of accident is easily available from the FAA's own accident database or the NTSB data sources. Similarly, the length of duty time is available in all of the NTSB reports (at least for any accident where duty time was a relevant consideration) and it could have been collected for this critical analysis. In fact, the NTSB data base contains information on duty time for crew members for the 24 hours prior to the accident which could have been used to identify all accidents where duty time may have been a factor. In summary,

[43] As is shown below, the FAA's count of 250 accidents for the "total accident" set is wrong.
[44] From 1990 to 2009, there were upwards of 200 accidents depending on how they are counted.

the list of 43 accidents appears to have been arbitrary, possibly including accidents reviewed for this or some other analysis at the FAA.

As with the other lists, the group of 43 accidents provided by the FAA has several other problems including the following:

- Although critical to the benefit analysis, the only information available for the non-fatigue accidents was the accident identifier codes provided after the RIA, some of which were NTSB accident codes and some of which were NTSB accident report numbers.

- The lack of information on duty time and other accident characteristics makes it impossible to determine how the FAA assigned the non-fatigue accidents for the "Duty Time" and "Late Night" analyses or, more importantly, to find and correct errors that have been made by FAA.

- Two of 22 accidents were not included in the list of 43.

- As with the list of 22 accidents, one passenger accident (DCA94MA022) was wrongly shown as "cargo" and several are shown with the wrong date or airport.

In conclusion, there can be little confidence in how the non-fatigue accidents in this list were used, whether the list was modified throughout the analysis, or what may be the impact of all the FAA errors. The FAA's failure to provide key statistics relevant to its calculations of "avoided" accidents is particularly negligent and self-serving.

Total List of Pilot Error Accidents

This list presumably identifies all of the 1990-2009 accidents based on "pilot error" and presumably they meet the same criteria used for the other lists (i.e., Part 121 plus Part 135 operated[45]). The FAA only provided a list of NTSB codes well after the original RIA was released, but no other relevant data including the criteria and source(s) for the list. As this data

[45] The lists includes accidents there were operated as Part 135 at the time, but would be Part 121 currently and in the future.

set was used to increase the "Lower Estimate" benefits by a factor of almost 4 to derive the final "Best Estimate" of benefits, this is a critical omission by FAA.

The primary problem with this data set is that it is not what it was supposed to be – a list of all accidents including the 22 fatigue-related, the 21 other accidents in the list of 43, and supposedly 235 other pilot error accidents to make up the original count of 278 accidents. First of all, the released list was acknowledged to only include 250 accidents due to unexplained "double-counting". As no information was provided to identify accidents which were double-counted, it is possible that some included in the original 43 accidents were double-counted. The new list of 250 accidents also excludes many of the accidents in the other lists. In fact, combining the list of 22 fatigue-related accidents with the 23 non-fatigue accidents in the adjusted 43 accident list (yielding 45 accidents) with all other accidents included in the total set yields a total of 280 accidents.[46]

The most glaring problem is that the "Upper Estimate" benefits were based on a total of 118.6 accidents (90.2 passengers and 28.4 cargo). This includes 96 accidents that were not included in the "Lower Estimate" model. A simple analysis of the NTSB data available for all 280 accidents reveals that fatigue was not cited as a "cause", a "factor" or a "finding" in any of the 258 non-fatigue related accidents (i.e.. 280 – 22 accidents). The extrapolation used for the non-fatigue accidents (from 0 to 118) is unjustified and fallacious. It has no empirical basis in reality and it should be accorded no consideration whatsoever. Both the FAA's "Upper Estimate" and "Best Estimate" are erroneous and must be discarded from the analysis.

4.5.3 Future Projection of Accidents

A fundamental assumption for deriving benefits from the proposed rule is that the historical frequency of fatigue-caused accidents over the last 20 years would be replicated in a theoretical future 10-year forecast period. As detailed above, this assumption ignores the following:

- There have been significant improvements in aircraft safety over the past 20 years in terms of general advancement in airline safety programs (e.g., AQP, ASAP, FOQA, Whitlow, EGPWS, TAWS, TCAS), changes in operating procedures (e.g., increased

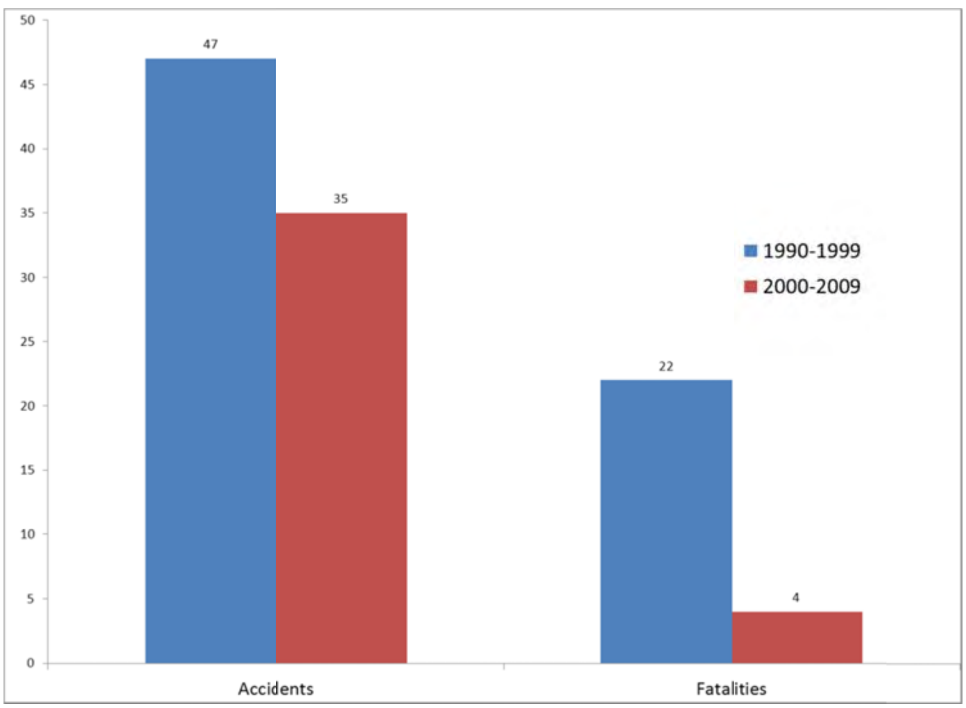
[46] It is possible that some of the codes provided were incorrect so the lists could not be directly correlated. The FAA also did not identify how it handled multi-aircraft accidents. Campbell-Hill made every attempt to correct all codes and develop the best list possible.

use of augmented crew for long-haul flights), and regulatory policies that have addressed past accidents (e.g., operating Part 91 ferry flights and Part 135 flights under Part 121 rules).

- The improvement in Part 121 airline safety can be demonstrated by the declining accident rates over the last 20 years. The number of accidents involving cargo aircraft declined from 43 between 1990 and 1999 to 35 from 2000 to 2009 – a 26 percent decline. The rate of fatalities dropped by 82 percent from 22 to 4 over the same two time periods.

Chart 4-1

Number of Cargo-Related Accidents by Part 121 Carriers: 1990-1999 vs. 2000-2009



Source: NTSB Accident Database system (eADMS)

- The general trend in improved safety is evident in the FAA's own list of fatigued-based accidents. Of the 22 fatigue accidents, 14 occurred during the first 10 years with 8 in the second 10 years – a 43% decrease in pilot fatigue accidents in the past 10 years. The decrease in the cargo accidents identified by FAA was similar at 40%

with fatalities dropping from nine for the 1990-1999 decade to just one fatality in the most recent 10 years (2000-2009) – an 89% drop.

- During the past seven years (2003-2009), five U.S. all-cargo carriers[47] operated a total 7.6 million take-offs and landings. During that same period, there were no fatigue-related accidents by any of these airlines.

It is reasonable to expect that this trend will continue even without the proposed rule, but at the very least, the forecast of future cargo accidents using the FAA model should have been based only on the 3 accidents and 1 fatality that occurred during the last ten years. This adjustment alone would obliterate much of the FAA's claimed benefits.

4.5.3.1 Adjusted Number of Avoided Accidents

To establish a baseline, Campbell-Hill reviewed the methodology that FAA used to calculate the number of accidents *due to fatigue* ("avoided accidents").

Table 4-14

FAA's Number of Avoided Accidents by Fatigue Category and Type

	FAA's Inclusion of Accidents due to Fatigue	
	Passenger and Cargo	Cargo Only
Inadequate Rest Between Duty Periods (RT)	5.0	2.0
Extended Duty Time Fatigue (DT)	4.6	1.3
Late Night Fatigue (LN)	4.2	2.5
Extended Time Awake (TA)	3.0	0.0
Chronic Fatigue (CF)	2.0	0.0
Total	18.8	5.8

In each case, individual accidents were assigned to one of five causes. For three of the categories (rest time, chronic fatigue and time awake), the FAA assumed that all of the accidents would be avoided. For "Duty Time" and "Late Night" accidents, an adjustment was made to account for some projected "normal" expectation of accidents. The FAA did not indicate the distribution of this allocation between cargo and passenger accidents, but it is possible to estimate it based on a proportional allocation.

[47] FedEx, UPS, Atlas, Polar and Kalitta.

There were seven accidents attributed to extended duty fatigue, but only those accidents above a baseline rate were claimed by FAA, hence the figure of 4.6. Two of the seven accidents were cargo, and the same rate (4.6/7) was applied to them, leading to the figure of 1.3 cargo accidents due to extended duty fatigue. A similar procedure was applied to the accidents due to late night fatigue. There were five total accidents, but only those above a baseline rate of 0.8 were claimed, hence the figure of 4.2. Applying the same percentage to the four cargo accidents yields a total of 3.2 accidents, which, when combined with the other categories, does not agree with the 4.6 total cargo accidents cited in the RIA. It does compute if there were just three cargo accidents (3 x 4.2/5 = 2.5). The only possible explanation for this inconsistency is that the one cargo accident that was wrongly identified as a passenger accident in the "List of 43" (LN2) was eliminated from the computation.

Although there may be problems with the determination of passenger accidents in this table, Campbell-Hill focused on the cargo accidents. The following sections examine the process used to estimate avoided accidents from the historical fatigue-related accidents.

Duty Time

Campbell-Hill's first adjustment deals with the claimed extended duty-time accidents. As shown above, neither of the accidents would have been prevented by the proposed rules (one is not allowed under current rules, and the other would not be restricted under the new rules). Hence it is wrong for FAA to claim them for this analysis, and the 1.3 extended duty time cargo accidents should be eliminated.[48] FAA's effectiveness rating for the Guantanamo accident is 0.9, despite the fact that a similar flight today would require an augmented crew, thereby eliminating problems with fatigue. Even assuming that the accidents should be included, there are a number of problems with how the adjustment to avoided accidents was calculated on the one hand, and then justified based on flawed statistical analysis presented in RIA Appendices on the other.

As described in Section 4.3.2 above, the calculation of avoided "Duty Time" accidents compared the actual accidents occurring in periods when the pilot has more than 10 hours of duty time, to the predicted number based on the frequency of accident occurrence during the "normal"

[48] The FAA's methodology is to include all accidents, even those where the new rules would have had little or no preventative effect. The FAA assigns "effectiveness ratings" to account for the likelihood that the new rules would have prevented the accident. However, as effectiveness adjustments are applied on an average basis, the procedure creates false signals and gives the appearance problems where none exists.

period (i.e., when duty time is less than 10 hours). There are a number of inherent weaknesses or faults with this approach and many of these problems pertain equally to the FAA's passenger benefits analysis.

- The association of accidents with duty time periods as detailed in Appendix B appears wrong on three levels: (1) the assignment based on duty times as specified in the report on pgs. 24-27 is wrong; (2) no explanation is given for how an accident was classified when it fell on a whole hour[49]; and (3) there are at least two errors created by not adjusting for the time zone. The seven extended duty time accidents are shown in Table 4-15. . Obviously, this would affect the results as it moves 4 of the accidents into earlier time periods. (Note that the two duty time accidents adjusted for time zone differences have the adjusted values stated in the associated NTSB accident reports).

Table 4-15

FAA's Seven "Duty Time" Accidents Used In Its Study

				RIA Values		Adjusted Values		
Date	Location	Group Identifier	Passenger /Cargo	Duty Time (HH:MM)	Time Period	Duty Time (HH:MM)	Time Period	Comment
5/10/1994	Guantanamo Bay	DT1	C	17:56	17 to 18	**16:56**	**16 to 17**	Time Zone Adjustment
6/22/2000	Hyannis, MA	DT2	P	11:46	11 to 12	11:46	11 to 12	
5/28/2002	Little Rock, AR	DT3	P	13:12	13 to 14	13:12	13 to 14	
1/24/2006	Kirksville, MO	DT4	P	14:31	14 to 15	14:31	14 to 15	
6/22/2000	Ontario, Canada	DT5	C	10:00	10 to 11	10:00	**9 to 10**	
11/12/2008	Traverse Cy., MI	DT6	P	15:43	15 to 16	**14:43**	**14 to 15**	Time Zone Adjustment
12/20/2007	Laramie, WY	DT7	P	11:00	11 to 12	11:00	**10 to 11**	

- The statistical basis for the FAA's assumption that fatigue is a factor for all accidents where duty time exceeded ten hours (as detailed in Appendices A and B) was highly dependent on the FAA's classification of these seven "Duty Time" accidents and the analysis should be corrected making the following three adjustments: (1) using the

[49] One accident (DT5) had 10 hours of duty time, while another (DT7) had 11 hours of duty time. The appropriate method should be to define the time periods using the rounded hour as the maximum (e.g., 10 to 11 should be 10 hours 1 minute to 11 hours 0 minutes).

FAA's duty time estimates as specified in the report[50], (2) using the NTSB-reported duty time value (adjusting for time zone errors), and (3) correctly defining the duty time periods (e.g., not including an accident with 10 hours of duty in a category for "more than 10 hours"). As shown in Table 4-16, up to six of the eight "over 10-hour" time periods should have adjusted accident accounts, and the total number of accidents should be reduced to six "Duty Time" accidents.

Table 4-16

FAA's Seven "Duty Time" Accidents Used In Its Study

Duty Time Period	FAA Table B-4	Time Cited in Narrative	Time Zone Adjustments	Time Period Adjustments
10 to 11	1	1	1	1
11 to 12	1	2	2	1
12 to 13	1	0	0	0
13 to 14	1	1	1	1
14 to 15	0	**1**	2	2
15 to 16	2	**1**	0	0
16 to 17	0	0	1	1
17 to 18	1	1	0	0
	7	7	7	6

- The frequency of accidents is based on the number of total captains' hours distributed into two-hour periods starting with the 2nd duty hour (based on the assumption that the first hour is not flight time operations). There is no direct correlation between the accidents and the pilot duty time in particular. They are based on widely different time periods (two months in 2009 vs. a 20-year period). It is important to note that no accidents related to duty time fatigue occurred during the actual period when the more than 64,000 hours of duty time cited in the analysis actually took place (in 2009). It is also unknown whether the distribution of hours would have been representative of what was occurring when the seven accidents actually happened, and it may reflect changes in the distribution of duty time, over time.

[50] The basis on which FAA made the assignments in Appendix A and B was not provided, and there are inconsistencies with the Appendices when the FAA's own duty time estimates are used.

- As described below, the distribution of captains' hours is used to represent the distribution of operations occurring during various duty time periods.

- There is no differential between cargo and passenger despite vastly different operating patterns, including time of day.

- There are also some calculation errors in the main text and the Appendices dealing with duty time:
  - The accident counts by duty time period presented in Table B-1 and Table B-2 differ as follows (with Table B-4 matching Table B-2):
    - 9 to 10: 3 vs. 2
    - 13 to 14: 1 vs. 2
  - Table B-3 adds an extra accident in the "4th & 5th" duty period (7 vs. 6) for a total of 44 accidents.
  - The 70%-adjusted duty hours for the "4 to 5" block is slightly off (which is why the grand total is off by 277).

The underlying rationale for applying the duty time adjustment is developed by FAA in the RIA appendices, and close examination reveals significant problems.

One of the key components of the analysis in the RIA report is the claim that accident rates are correlated with length of duty time. The extent of the correlation is the primary input to a computation of benefits of the proposed rules. As stated in the introduction, a good regulatory analysis should include an "analysis of possible alternatives." The FAA's report only presents its preferred regulatory outcome. It is vitally important to analyze the sensitivity of benefit estimates to changes in the basic parameters of the rules. One key parameter is the length of duty time that is permitted. Is there an evidentiary basis for limiting duty time to 15 hours? To 12 hours? To 9 hours? To 6 hours? At some point there will be a diminished return associated with incremental reductions in allowed duty time. Costs will necessarily grow exponentially as constraints on duty time increase. It is the task of the regulator to find the point at which costs outstrip benefits.

To assess this issue Campbell-Hill began by using FAA's methodology on the duty time data, while making adjustments in its procedures to shed light on the important question of when benefits of further reductions in duty time are not justified.

4.5.3.2 RIA Appendix B: Chi-square test for Duty Time Inference

The report uses Chi-square analysis to test for statistical significance of differences between accident rates at different times within the pilot's duty period. The test gives an accurate picture with the following proviso: when there is a near zero expected cell count the statistic tends to acquire exceptionally large values. The Yates correction is often recommended in such cases. Here it reduces the chi-squared statistic to 99 from 131.5. However, the critical value for the statistic at 5% confidence is 12.59, so the data still indicate that there is a statistically significant increase in accident frequency in the last bin (14^{th} hour and above).

Note that the chi-squared statistic for the six bins up through the 13^{th} hour is only 4.62. The critical value of the statistic for 5% confidence with five degrees of freedom is 11.07. In fact this test is not significant even at the 25% level. So it must be concluded that, up through the 13^{th} duty hour, there is no statistical correlation of accident risk with time on duty.

One can go further and analyze the accident distribution from Table 1, where the bins are shifted by one hour, so that bin 1 consists of hour 2, bin 2 consists of hours 3-4, and so on. If one considers the data up through the 14^{th} duty hour, the chi-square statistic is 7.8, which is also not significant even at the 25% level.

Because the data indicate an increase in accidents only in the 15^{th} hour and beyond, it is important to realize that restrictions on duty hours below this point are not justified by the evidence presented by FAA. From the point of view of benefit-cost analysis, there is no benefit to limiting duty time below the 15^{th} hour of duty. FAA is proposing duty limitations of 9-13 hours (see RIA Table 6) despite the fact that there is no significant increase in risk through the 14^{th} hour of duty.

4.5.3.3 RIA Appendix B: Kolmogorov-Smirnov Test for Duty Time Inference

The report uses the nonparametric Kolmogorov-Smirnov test to measure the statistical significance of the variations in accident rates with duty time. The test confirms the chi-square results, in that significant differences are found. However, it is important to note that the test, as performed, does not indicate where in the duty period the accident rate rises. In order to clarify this question, Campbell-Hill repeated the procedure using only the data up through the 14th duty hour, as it did above with the chi-squared test. In this case the computed K-S test statistic is 0.167 which does not reach significance even at the 20% level (K-S critical value of 0.169 for P=.2). In other words, *there is no statistical evidence that the accidents in the first 14 duty hours were distributed other than in proportion to the exposure hours.*

FAA's methodology assumes a constant accident risk throughout a flight segment. However, all of the accidents discussed in the report occurred during landings[51]. Since risk is entirely landing-related, the real accident risk has to be shifted forward on the time-of-duty axis. This means that the true measure of exposure risk is a rising function, which measures the number of landings per exposure hour for each duty hour. It stands to reason that in, say, the 10th hour of duty there is a considerably greater likelihood that the plane will be landing than in the 2nd hour. Most flights will have only just begun in the 2nd hour of duty. But by the 10th hour, most pilots will be reaching the end of their duty period, which means that a landing is much more probable.

The statistical analysis should be redone, taking into account time of landing data rather than duty time data. Without adequate data on number of landings in each duty hour, one needs to approximate the size of the effect in order to understand how the statistics may be skewed. It should be clear that on each flight segment all of the exposure risk is at the end of the flight (landing) whereas FAA's methodology spreads it out over the whole flight segment. Hence the true exposure risk needs to be shifted to the right (later in the pilot's duty period) by an amount that corresponds to half the average duration of a flight. Assuming the average flight lasts 2 to 4 hours, this means the true accident risk needs to be shifted to the right by 1 to 2 hours.

This rightward shift of the true accident risk (as measured by number of landings instead of time in flight) implies that the correct comparison distribution for the chi-squared and Kolmogorov-Smirnov tests is not the uniform distribution but a right-skewed one which is proportional to the number of landings in each duty hour. This means that the FAA's computed statistics overstate the significance of increased accident risk late in the duty cycle. The effect of the rightward shift can be seen in the graph on page 137 of FAA's report, which is a

[51] The lone exception is the 1991 Cleveland icing accident, which was not pilot error, and therefore should not have been included in the data set in any event. The NTSB report found that inadequate de-icing guidelines caused this particular accident.

visualization of the computation of the Kolmogorov-Smirnov test statistic. The rightward shift will move the curved line (empirical distribution of duty hours) to the right by 1 to 2 hours, in order to obtain the empirical distribution of landings. The result will be a closing of the gap between the two curves in the middle of the graph. Only at the top, above the 90% level, where the curves are more than 2 hours apart, will there be a significant gap. The maximum vertical separation between the curves will be reduced to about 0.1, so the K-S test statistic will be approximately half of the reported value of 0.2107. At this point the test is no longer significant at any reasonable level of significance.

This analysis demonstrates clearly the sensitivity of the statistics used in the FAA's RIA to assumptions about where the accident risk lies within the range of duty periods. The separation between the empirical distributions of exposure risk and accidents appears to be mainly a function of FAA's flawed assumptions about where the risk occurs. Campbell-Hill concludes that the analysis must be corrected with real data on number of landings by duty hour before any conclusions can be drawn about the excess risks associated with longer duty periods. Based on the Chi-squared analysis above and on the shape of the empirical distribution curves, Campbell-Hill expects that no significant differences will appear until after the 14th hour of duty.

The FAA report provides very little evidence for duty time limitations. When passenger and cargo operations are combined, there is no evidence for any increase in risk through the 14th hour of duty. Beyond that point, there may be some evidence of an increase in risk, but a proper analysis using landings as the basic risk factor needs to be performed. *There is no evidence whatsoever that there is an increase in accident risk associated with duty time for cargo operations.*

4.5.3.4 Late Night Avoided Accidents

The FAA employs a method similar to the "Duty Time' adjustment in adjusting 5 "Late Night" fatigue-related accidents to 4.2 avoided accidents. As discussed above, it appears the FAA estimated that 2.5 cargo accidents would be avoided with its proposed rule. The following points are faults of the FAA's methodology.

<u>General Problems</u>

The following general criticisms are reasonable and valid:

- The source, content and time period of the operations statistics are not provided for testing or counter-analysis.

- As with the duty time analysis, the comparison of accidents occurring over a 20-year period with operations presumably occurring during one year is invalid.

- The comparison of accident rates for the "Late Night" period with "normal" rates derived for the other accidents out of the 43 list was not justified or necessary. There was absolutely no reason to use this limited data set for the "Late Night" analysis because time of accident was available for all of the accidents.

- The FAA defines the normal period as 8 a.m. to 4 p.m. with no justification. The accident rate during this period is 1.19 per million operations compared to 1.62 for the entire non-"Late Night" period. This skewed definition of "normal" reduced the number of predicted accidents and therefore increases the number of avoided accidents. It also suggests a significant number of avoided accidents for the periods of 4 a.m. to 8 a.m. and 4 p.m. to midnight.[52]

- The failure to separately analyze passenger and cargo operations lends particular distortion to the data because of the high percentage of cargo operations that occur between midnight and 4 a.m. (see below).

<u>FAA's statistical analysis of late night operations is flawed</u>

The FAA's RIA report examines the extent to which the 43 accidents in its study correlate in time with periods of "circadian low." The precise meaning of "circadian low" is somewhat flexible, but in the end the report uses the period of 12am to 4am in which an elevated accident rate was found. At first glance, it would appear that the six accidents[53] in this time period (14% of the 43 accidents) constitute a significantly elevated risk as they occur in a time

[52] A total of 24 accidents occurred during these periods for a rate of 2.0 per million operations. The calculated "normal" accident rate (i.e., without fatigue) would be 14.2 yielding a potential for avoiding 9.8 accidents if a similar rule was applied to these time periods.

[53] The analysis include the 5 "Late Night" accidents plus one of the "Duty Time" accidents that was later removed from the "avoided" estimate.

period with only 3% of the total number of operations. However, four of the six accidents occurred between 12am and 1am local time, and so the preponderance of the elevated rate is coming from accidents shortly after midnight. In addition, no allowance is made for crew base time, which may be several hours earlier for eastbound flights. For example, the Newark accident in 1997 occurred at 0130 local time but 2130 crew base time, so it more properly belongs in the 8pm to midnight category. The same applies to the Cincinnati accident in 2004, which occurred at 0049 local time but at 2349 crew base time. Insofar as the FAA is making the case for an increased risk during circadian low, it is essential that the analysis be recalibrated to account for crew base time and not local time of the accident. Crew base time is the relevant time for the circadian clock of the pilot. Finally, the Cleveland accident in 1991 (0019 local time) should not have appeared in the list of 43 accidents at all, because it was not pilot error (NTSB report found that inadequate de-icing guidelines caused the accident). Eliminating these three erroneously categorized accidents, the proportion drops to 3 out of 42, or 7%.

Another major flaw in the analysis is the assumption that correlation implies causation. FAA assumes there is likely to be an increased risk of accident during nighttime operations, and this could be responsible for the observed effect. A proper analysis of the benefits of the proposed rule would entail a calculation of the late night accident rate for flights that would have complied with the proposed rule, and comparing it with the rate for flights that would not have complied.

The report does not attempt a statistical analysis of the late night data. Campbell-Hill checked the significance by doing a Chi-squared test on the question of whether the 2am-6am time period has an elevated accident rate in comparison to all other time periods.[54] The test statistic is 2.56, which does not reach the 10% level of significance (critical value for Chi-squared with one degree of freedom is 2.71). While this comes close to statistical significance, it does not relate directly to the question of whether the rules would positively impact the situation. It is highly likely that in a better-designed study that compares accident rates for flights allowed by the new rules with those prohibited, there would be no significant effect at any reasonable level.

[54] This time period avoids the worst of the problems cited above with borderline events and crew base time errors.

No Elevated Accident Rate for Late-Night Cargo Operations

Late night operations are much more common for cargo carriers than for passenger carriers. Many airlines, like overnight express carriers, conduct a substantial portion of their operations late at night. Cargo operators manage the problem of late night duty as a routine, everyday issue—it is not an exceptional or atypical situation as it is for many passenger airlines. It is obvious that this operational difference results in a completely different accident profile by time of day for the cargo carriers. *In fact, there is no elevated accident rate for late-night cargo operations.*

Campbell-Hill began its analysis by segregating the 10 cargo accidents from the 43 considered in the FAA report. As noted above, one of these (Cleveland 1991) was not pilot error, so should not be in the list. Of the 9 remaining cargo accidents, only 2 (22%) occurred within FAA's 12am to 4am window for circadian low. Seventeen percent (17%) of cargo operations occur between 12am and 4am (source: FAA ASPM/ETMS activity data for CY2009). So the accident rate is almost the same as the fraction of operations in that time period. In fact, the two cargo accidents that occurred between 12am and 4pm local time, are the Newark and Cincinnati accidents cited above. In these cases crew base time was between 8am and midnight, so these should be excluded in any event, leaving an accident rate of zero.

If the relevant time period is shifted to 2am-6am, there are 2 cargo accidents (22%) and the fraction of cargo operations in that time period is 25%. Both of these accidents occurred close to 6am, so it is arguable whether they would still fall within "circadian low." Also, for one of the accidents fire was the primary cause and it is doubtful whether the crew could have handled the situation any better even if they had only been awake for six hours and the incident occurred at 12 noon.

It is abundantly clear that the data demonstrate that the accident rate for late-night cargo operations is no worse than for other times of day (and may even be better).

The FAA report fails to support any inference that an elevated late night accident rate is due to fatigue, or that it can be mitigated with the new rules. Looking at cargo operations by themselves, there is no increased late-night accident rate in the empirical data, and any such assertion by FAA is patently false.

Adjustment Based on Cargo Operations Only

The FAA provides no details on the source of its operations data but it is clear that passenger and cargo operations are combined, despite the fact that most of the "Late Night" accidents (4 out of 5) are cargo operations.[55] FAA did not use its own database with hour of day data that combines the FAA's ETMS data (for a limited number of airports) with FAA's more comprehensive OPSNET database ("ETMSC – Distributed OPSNET"). It is also impossible to correlate the distributions developed by the FAA for their analysis with their own data.

The detailed ASPM/ETMS data (by the quarter hour) was analyzed by Campbell-Hill for CY 2009. Focusing on the 0000-0400 time period (which was the basis for "Late Night" accident damages), the 77-airport data set for CY 2009 shows 1.9% of all operations (cargo and passenger combined) compared to 3.0% for the FAA dataset. This compares to 2.2% in the OPSNET-based ETMS dataset available online, so either there is another dataset or the FAA used a different time period than CY 2009.

The key statistic is that the share of all-cargo operations during 0000-0400 is 17.0% which is significantly different than either the 3.0% or 2.2% shares based on all commercial operations. As a high share of all accidents occurred during landing, so the more appropriate statistic should be arrivals. In this case, 18.3% of all-cargo aircraft landings occur during 0000-0400.

Based on these results, the "Late Night" cargo accidents (without regard to whether they should be included) were adjusted as follows:

- The FAA assumed that 3.0% of all operations occurred during 0000-0400 including a proportional share of cargo operations.[56] The difference between the 3 actual cargo accidents and the expected normal accidents of 0.5 results in the FAA estimate of 2.5 avoided cargo accidents.

- Proportionally adjusting the FAA estimate of normal accidents based on the much higher share of all-cargo operations that actually occur during 0000-0400 generates

[55] Using the correct assignment of LN2 as a cargo accident.

[56] The FAA did not provide any details on the all-cargo share of the operations used for the "Late Night" adjustment (despite a request by CAA). The FAA's proportional allocation of "avoided" accidents between cargo and passenger operations must be based on an assumption that operations are similarly proportioned.

proportionally higher expected accidents (2.8) and a significant reduction in avoided accidents (0.2 net of 3 actual accidents).[57]

- A similar adjustment based solely on the distribution of all-cargo landings shows that the actual number of accidents is less than the expected number of normal accidents (3.1).[58]

As shown in Table 4-17, the FAA method when adjusted for actual cargo operating patterns yields just 0.2 avoided accidents using total operations, and a negative number using the more appropriate pattern for arrivals. Based on Campbell-Hill's conclusion that none of these accidents should be included as fatigue-related, the avoided accidents would be zero in any case, but the elimination of just one of the FAA's identified accidents eliminates benefits however activity levels are applied.

Table 4-17

Campbell-Hill's Adjustment to Avoided "Late Night" Accidents

	FAA Takeoffs & Landings	All-Cargo Takeoffs & Landings	All-Cargo Landings Only
Actual Accidents	3.0	3.0	3.0
minus Expected Accidents	0.5	2.8	3.1
Avoided Accidents	2.5	0.2	-0.1
Share of Activity (0000-0400)	3.0%	17.0%	18.3%
Ratio to FAA Activity Share		5.67	6.11

4.5.3.5 Avoided Accidents for Other Fatigue Categories

The FAA's assumption regarding accidents in the other fatigue categories (Rest Time, Chronic Fatigue and Time Awake) is that the historical rate of accidents over 20 years would be replicated for the future 10 year period. As one of these cargo accidents (RT2) was

[57] Any proportional increase in operations would result in a proportional increase in expected accidents based on the FAA's assumption for "normal" accident frequency of 1.19 accidents per million operations. The net increase in the expected accidents results in a comparable net decrease in "avoided" accidents.

[58] Assuming "Late Night" accidents are solely related to landings, the FAA's "normal" accident frequency would be doubled (assuming one take-off for every landing) and can be applied to an estimate of "Late Night" all-cargo landings derived by calculating the total operations dividing by two and applying the all-cargo share of landings.

eliminated from occurring in the future, the only possible accident is RT4 which accounted for no fatalities.

4.5.3.6 Expected Damages from Future Avoided Accidents

Despite the appearance of detailed simulation modeling (see below), the FAA's estimated benefits under the "Lower Estimate" scenario can be constructed using the following simple assumptions:

- Future cargo accidents = 2.9 per 10-year period (or 5.8 historical accidents over 20 years)

- Average fatalities per accident = 0.34 (for which the basis is unknown)

- Average damages per fatality = \$6.0 million (rounded up from the OMB-approved \$5.8 million)

- Average non-fatality damages per accident = \$15.7 million (for which the basis is unknown but it is slightly higher than value used for passenger scenarios)

- Ratio of NPV Benefits to Nominal Benefits = 70% (equivalent to assigning one-tenth of benefits to the years 2011 to 2020 and discounting at 7 percent to 2010).

Combining these five assumed values yields the mean value of \$36.1 million of cargo benefits shown in Figure 8 of the RIA.

Table 4-18

<u>Calculation for FAA's Lower Estimate Benefits for Cargo Operations</u>

No. of Cargo Accidents (10-Year Total)	2.9
Fatalities per Accident	0.34
Estimated Fatalities	0.99
Damages per Fatality (mil. $)	$6.0
Non-Fatal Damages per Accident (mil. $)	$15.7
Nominal Damages (mil. $)	$51.5
Ratio of NPV to Nominal Damages	70%
NPV Damages (mil. $)	$36.1

As will be shown below, the Upper Estimate and Best Estimate cargo benefits must be based on the exact same assumed values, only varying in terms of the number of future cargo accidents (which are merely extrapolations of the 2.9 value used in the Lower Estimate scenario). In other words, the FAA's projected benefits are directly proportional to the estimate of future cargo accidents <u>without regard to how that number is derived.</u>

In terms of FAA's High Estimate of "avoided" cargo accidents, the key points are that (1) eliminating any of the 5.8 accidents that form the basis for the simulation "forecast" would necessarily have a proportional impact on the FAA's calculated benefits and (2) the level of damages associated with any avoided accidents should be based on actual historical damages.

Campbell-Hill has concluded that rather than 5.8 avoided accidents over 20 years, there could at most be 1.0 accidents (or 0.5 accidents for the future ten-year period). *This conclusion alone reduces the FAA's calculated benefits for cargo operations by 83 percent for all scenarios.*

FAA did not conclude that the RT4 accident would be fully avoided, but rather that the rule would be effective in eliminating 25% of the damages (based on an effectiveness rating of 75%). Based on the circumstances of the accident itself (i.e., no impact on the captain and only a slight possibility that a similar crew would be utilized on this type of flight in the future), the FAA's effectiveness rating is overstated. Of the 22 accidents rated by the FAA, only six received ratings of 75% or higher. As the FAA provided no backup for how individual accidents were rated, the use of the average for all cargo accidents (38%) is more appropriate.

The FAA also provides no justification for the assumption that non-fatal damages would be $15.7 million per cargo accident in general, and that value is much too high for the accident involved. In a previous NPRM on crew training, the FAA estimated total accident damages of

$5.12 million in 2004 dollars which is equal to $5.61 million in 2010 (based on an inflation adjustment to aircraft portion of damages).[59] This estimate combines both aircraft damage and damages from personal injuries.

Using the same calculations that are implicit in the FAA's modeling and appropriately adjusting for effectiveness in determining "avoided" accidents and damages, the calculated cargo benefits would be $1.1 million in nominal terms and $0.7 million in NPV terms – a 98 percent reduction from the FAA's Lower Estimate benefits.

Table 4-19

Adjustment to FAA's Lower Estimate Benefits for Cargo Operations

No. of Cargo Accidents (10-Year Total)	0.5
Effectiveness Rating	38%
Adjusted for Effectiveness Rating	0.19
Fatalities per Accident	0.00
Estimated Fatalities	0.00
Damages per Fatality (mil. $)	$5.8
Non-Fatal Damages per Accident (mil. $)	$5.61
Nominal Damages (mil. $)	$1.1
Ratio of NPV	70%
NPV Damages (mil. $)	$0.7

4.5.3.7 Conclusions

The methods used by the FAA to estimate future avoided accidents with the proposed rule have significant problems beyond the fact that only one of the cargo accidents in its study is partially relevant and that the projection of avoided cargo accidents in the future is greatly overstated. The "Duty Time" adjustment by FAA is based on statistical analysis, that when corrected, shows there is no benefit to limiting duty time below the 15th hour of duty. As the only cargo accident that occurred during that duty time category (DT1) would not occur under current rules, there can be no "avoided" accidents based on extended duty time fatigue.

[59] FAA, Draft Regulatory Evaluation, Initial Regulatory Flexibility Determination, International Trade Impact Assessment, and Unfunded Mandates Assessment, Appendix G (May 2008). Adjustment between 2004 and 2010 based on GDP price deflator.

This is also true with the "Late Night" adjustment that accounted for most of the FAA's estimate of avoided cargo accidents. The FAA's conclusion that the cargo accident rate for late night cargo operations is significantly higher and must be based on fatigue, is overstated based on Campbell-Hill's corrections to the FAA's methodology, and it is eliminated completely when cargo accidents are correctly associated with cargo aircraft activity levels. As concluded previously, none of the "Late Night" accidents should have been considered fatigue-related, but even if they could be, the number of avoided accidents would be zero.

One of two "Rest Time" accidents was determined not to be relevant to the proposed rule, and the other yields only minor benefits when correctly analyzed. In conclusion, the number of cargo accidents and damages that would be avoided with the proposed rule is minimal.

4.6 FAA'S Future Benefit Estimates

The FAA's benefit estimates combine a projected level of accidents "avoided" due to the proposed rule with an estimating model that translates avoided accidents into monetized benefits. As described in detail in Sections 4.2 and 4.5, only minimal accident savings (or associated benefits) can be attributed to the rule. Nevertheless, the methodologies used by FAA to monetize the benefits have severe problems including:

- The use of "simulation" modeling that gives false appearance of analytical sophistication while merely producing pre-ordained results including artificially high "maximum" estimates intended for emotional appeal.

- No explanation or supporting evidence is provided for most of the factors used to translate past accidents into future benefits.

- The use of an undefined future 10-year period for the "forecast" ignores the fact the cost impacts would precede benefits by several years.

- The creation of artificial and unsubstantiated "Upper" and "Best" benefit estimates that are statistically derived and have no empirical validity, and which are clearly intended to overcome the low level of benefits that FAA generated with its faulty baseline (low) estimate.

- A back-end intuitive adjustment for rule "effectiveness" acknowledges the limited effect that the proposed rule would actually have and, which should have been incorporated in estimating "avoided" accidents (some of which would not be affected at all by the rule).

- An inference that the quantified benefits are conservative by (1) the exclusion of "qualitative" benefits that have no demonstrated relevance, and (2) the suggested use of an inflated statistical value of life that is well above the OMB's sanctioned VSL.

4.6.1 FAA's Simulation Modeling Adds No Value To Benefit Calculations

The RIA report has a lengthy section detailing Monte-Carlo simulations of various scenarios over time, assuming a Poisson distribution of accidents. It uses historical data to approximate the probability distribution for loss of life or property in each accident. To estimate the expected loss of life or property, the simulations are completely unnecessary since it is a well-known theorem in probability statistics that the expectation of a random number of random variables is the product of the expectations. In the present case, the expected loss can be computed directly by multiplying the expected number of accidents by the expected loss in each accident.

4.6.2 The Simulation Model Inputs and Results Are Not Documented or Supported

As described in Section 4.3, the FAA's benefits translate an assumed number of future "avoided" accidents into a predicted number of fatalities and level of damages (provided in both nominal and net present value terms). The FAA did not provide any supporting data and only limited explanation of inputs and assumptions for the model results. It provided incomplete "screen captures" of the model's summary page and narrative summaries of the results. No interested party has been granted an ability to test the model's validity or examine the impact of the underlying inputs and assumptions on the results. Based on the limited information that was available, it is possible to identify several major problems with the simulation modeling including the following:

- Nature of the Simulation – The only information provided by the FAA is that the model was run 5,000 times ("trials") for each scenario, but there is no explanation of what constituted a single run. Based on the results, it is clear that each run generated a 10-year total for the avoided accidents, but otherwise it is not known how the benefits were calculated (e.g., were fatalities "simulated" for each accident, or were they "simulated" as a 10-year aggregate).

- Projected Number of "Avoided" Accidents – As shown above, there is no basis for assuming that any future cargo accidents would be "avoided" with the rule. Even if there were valid accidents in the historical database, the FAA merely halved the historical accidents of a 20-year period to estimate future avoided accidents over some undefined future ten years making no accommodation for the current status of regulations and safety programs or known changes in operating patterns that would in themselves mitigate future accidents relative to historical occurrence.

- Projected Number of Fatalities – The FAA provides no explanation of the assumptions used to generate future "avoided" fatalities. While presumably based on some analysis of past levels of fatalities per accident, there is absolutely no backup information on how the model generated an average of 6.4 fatalities per passenger accident or 0.34 fatalities per cargo accident, either in terms of an underlying average or the probability functions used (if any).[60] While the FAA characterizes the distribution of fatalities skewed to the right, there is no explanation of the function or process that produced those estimates.

- Furthermore, the underlying data used to generate the probabilities of catastrophic loss is flawed. The results are highly sensitive to the assumptions on probabilities of catastrophic loss in a particular accident. Due to regulatory and technological advances over time, the chances of catastrophic loss are dramatically lower now than

[60] Although it is impossible to fully know what inputs and assumptions were used without more backup information, a comparison of the "mean" results can be used to determine broad assumptions. For example, dividing the "mean" fatalities by "mean" accidents for the cargo simulation yields 0.34 fatalities per accident which can be assumed to represent the underlying function however it was defined.

ten or twenty years ago. If more accurate distributions were used which reflect current conditions, the probabilities of these sorts of events (involving loss of life or property at rates substantially higher than historical averages) would be dramatically less than claimed in the FAA report.

- Average Damages per Accident – Other than identifying the use of $6 million for the statistical value of life[61] assigned to fatalities, there is no other information on how total damages were generated, or, for that matter, what was included. It appears that aircraft damage was somehow measured, but it is unclear whether damages are assigned for non-fatal injuries[62], or how "loss of cargo" damages may have been calculated. It is possible to estimate the average non-fatal damages at $15.3 million per accident for the passenger simulation runs and $15.7 million per accident for the cargo runs. As these ratios are consistent over all three "scenarios" (Lower, Upper and Best), it is clear that these damages were proportional to the number of accidents (i.e., based on an assumed value per accident), but there is no supporting evidence for what those values actually were, or how they were derived.

- Forecast Period - The simulations are based on an undefined future 10-year period for the "forecast". As noted in Section 4.3, it appears from the NPV calculations that future benefits were assumed to be equally distributed over ten years (Years 1 to 10) and discounted at 7 percent back to the year prior to the first year of benefits (Year 0). Based on the ultimate comparison of the NPV benefits to the NPV of costs that were discounted to 2010, it can be concluded the FAA has projected benefits for the years 2011 through 2020 and compared them to costs that occur from 2013 to 2022. This is a complete reversal of reality. Costs should precede benefits by several years. *Adjusting benefits to the same time period as costs would reduce theoretical benefits*

[61] This value is rounded up from the OMB-approved value of $5.8 million for unexplained reasons.
[62] Serious injuries are identified in the spreadsheet showing the effectiveness ratings and describe in the accident narratives but otherwise are not discussed.

by 13 percent and assuming benefits would occur 2 years after costs reduces them by 24%.[63]

- Other Problems – As described above, the FAA presents two estimates for the mean value cargo benefits (NPV) under "Best Estimate" scenario, one of which is obviously wrong.

4.6.3 "Upper Estimate" and "Best Estimate" Benefits Are Irrelevant and Erroneously Conceived

FAA develops a simulation procedure in order to justify extrapolating data for 33 passenger accidents to an additional 196 accidents where "enough information in the accident report to make a judgment about the presence or absence of pilot fatigue" is not available (page 50 of the BCA report). For cargo operations, the FAA extrapolates from 10 accidents to an additional 39 where that information is not available. In order to make this extrapolation, the FAA presumes that the same proportion of fatigue-related accidents is present in the additional accidents, and that the same rate of loss of life and property applies to the additional accidents. However, the accidents studied in the report are not a random sample from the set of all accidents. CAA performed a detailed survey of the 45 accidents[64] studied in detail and of the 235 additional accidents with the following conclusions:

There were 11 accidents in the list of 45 for which NTSB lists fatigue as a factor or a contributing factor (the FAA claims that 22 are fatigue-related). None of the remaining 235 accidents had fatigue listed as a factor or a contributing factor. It is understandable that fatigue-related accidents would be selected for study in the FAA's RIA report. However, once the 45 accidents have been culled from the files, it should be clear that the balance of the 235 accidents would have a much lower percentage of fatigue-related accidents—*in actuality the percentage is zero*.

[63] The simulation model discounted nominal benefits by 70.2% to derive NPV benefits. This ratio is equivalent to discounting 10% of the aggregate benefits for Years 1 to 10 by 7 percent to Year 0. Shifting the 10 years of benefits to Year 3 (2013) yields a ratio 87.3% with a ratio of 76.3% for Year 5 (2015).

[64] Two accidents with detailed information were discussed in the report but were dropped from the list of 43 without explanation. Campbell-Hill included these in its survey.

Table 4-20

FAA's Accident and Fatality Counts by Type

	Passenger and Cargo Accidents		
	Accidents	Fatalities	Fatalities per accident
FAA's group of accidents with "enough information to make a judgment about the presence or absence of pilot fatigue"	45	436	9.69
FAA's extrapolation group "where that information is not available" 1990-2009	235	64	0.27
FAA's extrapolation group 2000-2009	112	4	0.04

- Table 4-20 demonstrates, the high-profile accidents with larger aircraft and considerable loss of life and property, are disproportionately represented in the 45 study cases. *In particular, the rate of fatalities in the study cases is 35 times the rate in the extrapolation group.* It is understandable that the high-profile accidents would receive the greatest attention from NTSB investigators, and hence more information would be available. However, the FAA assumes incorrectly that the same rate of accidents and the same rate of loss of life and property occurs in the 235 accidents as for the 45. This is clearly a gross overestimate. In fact, if one looks at the more recent history, one finds an even smaller rate of fatalities: 0.04 per accident for the 112 accidents from 2000-2009 in FAA's extrapolation group. *The FAA extrapolations assume a rate of between 5 to 10 fatalities per accident, which is 100 to 200 times the actual rate in the last decade in the extrapolation group.*

All of the fatigue-related accidents, and the vast majority of loss of life and property, are accounted for in the 45 accidents studied in detail. However, in its "upper estimate" the BCA report revised the original estimate of 0.65 fatigue-related passenger aircraft accidents per year to 4.51 fatigue-related accidents per year—a factor of 7. FAA revised the original estimate of 0.29 fatigue-related cargo accidents per year to 1.42—an increase of nearly 400%. Such large increases in accident rates reflect only the fact that the FAA is extrapolating from a stacked deck of 43 well-documented cases to a large number of accidents where fatigue was not a factor. Furthermore, FAA's increase of almost 600% in its projection of loss of life and property is without any empirical basis or validation whatsoever, and it is considerably out of line with historical losses, especially those in recent years.

Simply eliminating the "Upper" and "Best" simulation results and limiting the cargo benefits to the "Lower" case (however wrongly estimated) reduces the NPV benefits by 41% (from $61.2 million to $36.1 million).

4.6.4 FAA's Use of Maximum Simulation Results Is Statistically Incorrect and Done Only for Emotional Appeal

The result of the Monte-Carlo analysis is a complete probability distribution for loss of life or property, which is subsequently used to estimate the probability of very catastrophic occurrences. Campbell-Hill observed that the majority of loss of life occurs in just 3 or 4 of the accidents in the study (with 58% due to the 1995 AA965 crash, which would not have occurred with modern instrumentation). The FAA's report draws attention to extremely unlikely events involving multiple catastrophic accidents at rates of occurrence significantly higher than historical averages. FAA's projected rate of catastrophic loss becomes even more out of line with historical rates after elimination of the irrelevant accidents in the historical database. This is merely a tactic designed to prey on emotional responses—the tendency to want to prevent a catastrophic occurrence regardless of the regulatory costs. Furthermore, the underlying data used to generate the probabilities of catastrophic loss is flawed. The results are highly sensitive to the assumptions about the probabilities of catastrophic loss in a particular accident. Due to regulatory and technological advances over time, the chances of catastrophic loss are dramatically lower now than ten or twenty years ago and FAA never purified its data set prior to analysis. If more accurate distributions were used which reflect current conditions, the probabilities of these sorts of events (involving loss of life or property at rates substantially higher than historical averages) would be dramatically less than claimed in the FAA report.

The proper way to do benefit-cost analysis is to use expected values, and for that analysis the tail probabilities computed with the Monte Carlo analysis are completely irrelevant. This speculation is tantamount to using "worst-case analysis." It cannot be used to claim that the proposal passes any reasonable benefit-cost test.

In an ideal setting one would spare no expense to save a life. But the real world imposes constraints on what is feasible or financially, commercially or socially practical. The point of benefit-cost analysis is to make a dispassionate assessment of where to draw the line on life-saving expenses. The OMB and DOT has established a VSL of $6,000,000 as a reasonable metric for benefit-cost assessment of public policy and regulatory initiatives. The FAA report suggests several ways to circumvent its own findings that the benefits are less than the costs using a $6 million VSL. On page 71 it invites decision-makers to increase the figure to $8,400,000 in order to bring benefits a little more in line with costs.

On pages 119-120, (after finding that expected benefits are considerably less than costs, the FAA report suggests that there is a 10% probability that benefits would exceed costs on an undiscounted basis and a 7% probability that the benefits would exceed costs on a discounted basis. But such considerations cut against the core principle of benefit-cost analysis, which is that expected benefits should reasonably approximate or exceed the costs, or else the proposal can only be accepted for reasons other than economic benefits. If an event occurs with 10% probability, then the corresponding cost is multiplied by 0.1. The FAA report goes on to suggest that $12.6 million might be a better figure for VSL, at which point its claimed benefits would equal its claimed costs.

The report furthermore suggests the possibility of preventing a catastrophic accident with 300 fatalities. At this point it is a purely emotional and speculative appeal; the FAA is clearly advocating its preferred outcome from this proceeding, rather than laying out facts of the analysis objectively and dispassionately. Even if one uses FAA's effectiveness coefficients and counts all the lives lost over 20 years in the accidents cited in the report as fatigue-related, one finds only 102 lives saved over 20 years. If one discards the 1995 AA965 crash, which would have been prevented with current technology, one finds only 46 lives saved over 20 years. If one looks only at cargo accidents, there were only 10 lives lost over 20 years in the accidents cited in the report, and these adjust down to 4 lives using FAA's effectiveness coefficients. The historical accident record does not support the catastrophic scenarios posited in the FAA report.

It is important to note that increases in costs are ultimately borne by shippers and passengers in the form of higher rates and fares, which would negatively impact the economy and cause the loss of jobs (See Appendix B). If the FAA forces passengers to pay more for safety than passengers think it is worth, it will cause them to use more dangerous, modes of travel. When costs reach a level of $15 or $20 million per statistical death avoided, another factor dominates the outcome: the health-wealth effect. Even without any mode-switching, lives could be lost simply because the public has lower disposable income. The statistical association between income and mortality is strong. It is a small effect, but at some point a regulation can kill more people than it saves, just by imposing excessive costs. The FAA's proposal may be beyond that point.

4.6.5 FAA's Effectiveness Adjustments Are Unsupported, Inconsistent And Incorrectly Applied to the "Best Estimate" Results at the Back-End

As described in Section 4.3, the FAA acknowledged the limited impact of the rule on the so-called "avoided" accidents by applying an "effectiveness" rating to the final "Best Estimate" benefits.[65] The problems with this process include:

- Although attributed to a "technical report" in the RIA[66], the only evidence for the subjective ratings for the rule's effectiveness was a spreadsheet produced on October 22, 2010 that shows the ratings with no explanation of the process used to derive them. The spreadsheet only provides some summary information on the accidents that appear to have been copied from NTSB documents. It also includes one accident with a relatively high effectiveness (0.35) that was not even included as an avoided accident.

- The illogical identification of "avoided" accidents is demonstrated by the fact that four of the 22 accidents used to determine those accidents are assumed to have 0% effectiveness ratings (i.e., no relation to the rule). Three of the four are cargo accidents including half of the "Late Night" accidents. Nearly half of the cargo accidents had effectiveness ratings of 15% or less, and a slightly less share for passenger accidents (6 out of 14 total accidents).

[65] The effectiveness rating or factor is a percentage that converts the nominal benefits to expected benefits. For example, a 90% effectiveness rating would reduce benefits by 10%.
[66] A report that was not produced and may not exist.

- The FAA utilizes these accident-specific effectiveness ratings to generate "average" effectiveness of 40% for passenger accidents and 58% for cargo accidents, but it provides no backup or explanation of how those values were derived. Taking a straight average of the ratings yields an average of 39% for the 14 passenger accidents and 38% for the 8 cargo accidents that is 20% below what FAA used.[67] *This correction alone would reduce cargo benefits by one-third.*

- There is no explanation or possible justification for applying this effectiveness adjustment to the projected benefits rather than appropriately adjusting the "avoided" accidents assumed in the model. Applying the average effectiveness ratings by fatigue category to the presumed 5.8 "avoided" accidents reduces the number of accident to 2.5 accidents over 20 years or 1.25 accidents over 10 years. Without regard to the legitimacy of including these accidents, this correction would reduce the avoided accidents by 56%, in sharp contrast to the FAA's 42% reduction applied on the back-end to the simulation results.

- Without regard to the inappropriate use of the "Upper" and "Best" simulations, the application of the "Lower" average effectiveness ratings to these results is completely unfounded. The fact is that half of the very limited number of cargo accidents where fatigue was assumed by FAA had effectiveness ratings of 15% or less (i.e., the rule would have little or no effect). The FAA then assumes that a vastly larger pool of accidents added in the "Upper" and "Best" simulations should be assigned an effectiveness rating of 58%. This is absurd and implies the rule would have a greater impact on accidents where fatigue could not even be considered as a minor factor than on accidents in which the FAA believes fatigue was a factor.

Ignoring the problems with accident estimates or other modeling problems, a reasonable application of the FAA's own effectiveness ratings to calculate avoided accidents and eliminate

[67] While not the responsibility of reviewers, it appears that the FAA averages excluded all accidents where there was a 0% effectiveness and no fatalities but included ones with fatalities. FAA also included the mis-identifed accident (LN2) in the passenger calculation.

non-fatigue accidents would reduce the NPV benefits by two-thirds (from $61.3 million to $20.9 million)

4.6.6 Qualitative Benefits And Value of Life Sensitivity Analysis Should Not Be Considered

As discussed in Section 4.3, the inclusion of unfounded and unsupported qualitative benefits and an expansion of benefits based on an unauthorized value of life estimate should be ignored.

4.7 Adjusted Estimate of Benefits

Based on Campbell-Hill's conclusion that the rule would have a minimal impact on future cargo accidents, there would be minimal benefits derived from the proposed rule. However, even assuming the FAA's erroneous set of cargo accidents, a number of adjustments to the FAA results all but eliminate its claimed benefits in any event (Table 4-21).

FAA's estimate of the present value of the ten-year benefits associated with fatigue-related cargo accidents is $105.7 million. It assumes that with adjustment for "effectiveness", 58% of these costs ($61.3 million) could be avoided with the new rules. But these figures are inflated as discussed above. A straightforward estimate would start with the "Lower Estimate" of $36 million (page 49). If the FAA's effectiveness ratio of 58% is applied to this, then $20.9 million is the benefit, which is one-third of the FAA's estimate.

Table 4-21

The Adjusted Cargo Benefits Are Insignificant

	Using Lower Estimate		Using Best Estimate	
	NPV Amount (million $)	% Reduction of FAA Estimate[a]	NPV Amount (million $)	% Reduction of FAA Estimate[b]
	(1)	(2)	(3)	(4)
FAA Benefits (NPV) with Effectiveness Adjustment	$20.9	-66%	$61.3	0%
1. Timing of Benefits				
Benefits Start in 2013	$18.3	-70%	$53.5	-13%
Benefits Start in 2015	$16.0	-74%	$46.8	-24%
2. Effectiveness Rating				
Rating = 44%	$15.9	-74%	$46.5	-24%
Rating = 38%	$13.7	-78%	$40.2	-34%
Benefits Start in 2013	$12.0	-80%	$30.6	-50%
3. Adjusted Accidents				
No Other Adjustments				
"Duty Time" Correction	$18.7	-11%		
"Late Night" Correction	$12.3	-41%		
Combined	$10.1	-52%		
With Effectiveness/2013 Start Date				
"Duty Time" Correction	$10.7	-83%		
"Late Night" Correction	$7.0	-89%		
Combined	$5.8	-91%		
Adjustment to Avoided Accidents				
Benefits Start in 2011 (FAA Assumption)	$0.7	-99%		
Benefits Start in 2013	$0.7	-99%		

[a]Percent Column (1) is lower than Column (3)

[b]Percent lower than $61.3 million

The other identified adjustments when applied both to the FAA's benefit estimate ("Best Estimate") and the more appropriate "Lower" estimates have significant impacts as follows:

- Timing of Benefits – As described in Section 4.1, the FAA failed to correctly align the occurrence of benefits with costs that are necessary for those benefits to occur. Assuming that benefits would begin two years after the 2013 implementation year, the "Best" benefits would be just $46.8 million and the "Lower" benefits would be just $16.0 million – 74% less than the FAA's estimate.

- Corrected Application of Effectiveness Rating – Applying the effectiveness rating in the estimate of "avoided" accidents reduces the effectiveness rating from 58% to 44%, while using an un-weighted average for all 8 cargo accidents yields a rating of 38%. The adjusted benefit estimates for the "Best" scenario would be $40.2-$46.5 million – a reduction of 24-36% with no adjustments. When combined with a 2015 start date, the benefits would fall to $30.6 million or half of the FAA estimate. Using the "Lower" estimate, the benefits of $10.5 million are 83% less than FAA's estimate.

- Adjusted Accidents – Even assuming there is some merit to the "avoided" accidents, necessary adjustments to the "Duty Time" and "Late Night" accidents would significantly reduce benefits. Based on the conclusion that duty time impacts would only occur for duty time beyond 15 hours, the "Duty Time" portion of avoided accidents would be halved. This would reduce the "Best" benefits by 11% to $54.8 million and "Lower" benefits to $18.7 million. A correction to the "Late Night" accidents using all-cargo operations rather than a mix of passenger and cargo operations would reduce "Best" benefits by 41% to $36.0 million and "Lower" benefits to $12.3 million (which is an 80% reduction from the FAA estimate). Combining both adjustments with the other adjustments (timing and effectiveness) "Best" benefits would be 76% less than the FAA estimate, and "Lower" benefits would 92% lower.

Trumping all of these adjustments is Campbell-Hill's conclusion that the FAA's "avoided" accidents are demonstrably overstated and should be limited to a minor impact using a single accident with no fatalities. The total benefits based on a reasonable projection of "avoided" accidents is $0.7 million at most.[68]

[68] Assuming benefits lags costs by two years reduces benefits to $0.6 million.

5.0 FAA's Cost Estimates Are Seriously Understated

In this section of the report Campbell-Hill reviews the errors, omissions, and significant unsubstantiated or undocumented assumptions in the FAA's projection of added costs to the cargo airlines. Section 5.6 presents the true costs that the proposed rule will impose upon the members of CAA.

5.1 The FAA's Cost Estimates Are Largely Undocumented and Unsupported by Disclosure of Empirical Analyses

On October 15, 2010 CAA provided the FAA with a clear and unambiguous set of requests for clarification, documentation, and the empirical support for its assumptions and costs estimates. Other than a listing of accident case numbers for the accidents considered by FAA, the agency ignored every substantive matter raised by CAA. At the same time it refused to grant any extension of time for preparation of Campbell-Hill's report and CAA's comments which rely in part on Campbell-Hill's analysis and findings.

Given the FAA's recalcitrance and its complete lack of interest in a full and factual analysis of the central issues that frame the NPRM, Campbell-Hill's cost analysis proceeds on two dimensions: (1) this report assesses the evidentiary weaknesses in the cost analysis presented in the RIA, and (2) it provides the true costs imposed on the cargo airlines by the proposed rule.

The FAA's NVP Calculations Are Seriously Flawed

The RIA distributes future airline cost increases over the 2013 through 2022 time period and it discounts those costs at 7% to obtain a 10-year Net Present Value (NPV) expensed in 2010. It set t_0 = 2010 even though it shows that no costs would be incurred until 2013. Yet, on the benefits side it also set t_0 = 2010 with benefits starting in 2011. It is completely illogical and nonsensical that benefits from a major expenditure program would begin at least two years before any cost is incurred. If the benefits and costs both begin in the same year then the FAA's computed benefits must be discounted by 13%. More realistically, if the benefits lag the costs by two years then FAA's benefits must be discounted by 24% so the adjusted benefits and its projected costs will be in logical time sequence. The FAA's discounting procedure is clearly erroneous.

5.2 The FAA's Estimated Flight Operations Crew Schedule Costs Are Understated

The FAA obtained two months of crew schedule data from six unnamed carriers. This data was for historical (2009) periods operated in accordance with current rules. The real question is how the carriers' crew scheduling would change under the proposed rules and FAA did not address this with the carriers. Instead it took historical data and tried to answer complex "what if" questions by itself. In essence, it tried to estimate system crew costs with complex rule changes. As will be shown in Section 5.6 when "real-world" crew scheduling analyses and simulations were run by the cargo airlines, the costs of the proposed rule are much greater than FAA estimates.

One significant failure by the FAA was its use of crew schedule data for one month in the spring and one month in the summer of 2009. This ignores the crew scheduling complexities, and overtime costs and sub-service contract costs associated every year with peak season in the U.S. air cargo industry (November and December). This crew scheduling complexity is particularly acute at the largest express/cargo carriers, FedEx and UPS. Of greater significance is the fact that FAA did not consider all the crew scheduling constraints imposed by each carrier's collective bargaining agreement ("CBA"). The provisions of a CBA cannot be violated simply because the FAA tells a carrier to operate differently. If each carrier needs relief from its pilot union in order to comply with the proposed rule, it may get it, but it will pay a dear price elsewhere in the CBA. FAA should have engaged the carriers in developing its estimates (simulations) of crew requirements under the proposed rule. Instead, FAA did its own independent analysis without the benefit of carrier inputs to this fundamental issue which drives the majority of the costs.

FAA also ignored the realities of the competitive marketplace. The cargo carriers, especially FedEx and UPS, cannot sacrifice customer service requirements. Their next-day express products in particular, are competevely designed to provide maximum logistical benefits in meeting customer needs. They cannot do away with their 10:30 AM overnight product simply because of new crew scheduling rules. They would hire many more pilots, and possibly purchase more aircraft, just to maintain the integrity of their current product time and service standards.

FAA states at page 76 of its RIA that "Only limits relating to individual flight duty periods were applied. Cumulative limits were not applied due to data limitation." Yet the proposed rule introduces new flight time and rest period constraints which would add significantly to crew costs. FAA simply ignored the costs of these facets of its proposed rule because the historical crew schedule data was too difficult to work with. Campbell-Hill believes FAA underestimated the number of noncompliant flight hours for each carrier. FAA's average estimate of 4.8% noncompliant hours, before FAA's adjustments for "optimization," is significantly less than the carriers' estimates of additional crew requirements. After short and long run "optimization" adjustments the FAA reduced its estimate of additional crew requirements to 2.0%.[69] As shown in Section 5.6 below, the estimates developed by the cargo airlines using real-world facts is 20.2%.

Since the FAA worked with data from only six (unnamed) airlines, the integrity of its research is seriously compromised by its unwillingness to show how it extrapolated key statistics from the sample of six to the entire air transport industry (92 Part 121 carriers).

The FAA's method of estimating the added crew costs ignores the employee benefits associated with salaries. For health insurance, vacation, FICA taxes and other benefits this can easily reach 30% of salary costs. FAA appears to have ignored it because its report refers only to "salary, hotel and per diem" costs. It also erred seriously in its estimate of crew salaries. For the large cargo carriers FAA used $121 per pilot hour. Campbell-Hill believes that DOT Form 41 analysis shows it is approximately $350 per pilot hour. Survey evidence from CAA members supports this level of salary plus benefits and taxes.

In sum, FAA's additional head count for the cargo carriers is 9.9% of what it should be,[70] and its fully-burdened rate of pay is 35% of true costs.

5.2.1 Crew Scheduling (Resource Cost Only)

FAA's understated total crew scheduling costs (NPV) is $2,075.6 million over the 2013-2022 time period. FAA proceeds to discount this cost by 25% without documentation or empirical evidence, and according only to its "belief" that substantial opportunity exists to re-optimize crew scheduling.[71] FAA states that it has developed a "methodology"[72] to adjust

[69] 4.8% x 75.0% x 54.9% (FAA, op.cit; Tables 12, 13 and 17).
[70] The seven participating all-cargo carriers estimate they will need to hire 1,731 additional pilots to comply with FAA's proposed rule.
[71] FAA, op.cit., page 83.

noncompliant hours (and costs) to a more realistic representation after re-optimization, yet it keeps the so-called methodology hidden from view. First, FAA arbitrarily assumed the airlines would achieve a 25% savings in the short run by re-optimizing their flight schedules. FAA provided no empirical basis for its hunch, nor did it provide any documentation that it should be so. It ignored every demand-side constraint, CBA constraint, slot time constraint, and fuel burn constraint in its assumptions about re-optimization.

As if the 25% discount of costs is not enough guesswork for FAA, it goes further and assumes that "long-term optimization factors" will deliver further cost mitigation of major proportion; and once again FAA provided no evidence or documentation for such an assumption. Finally, the FAA makes a few salary adjustments to account for the fact that with new pilots required to be hired the average salary per pilot would decline somewhat.

At the end of this series of unwarranted and unsupported adjustments, FAA eliminated $1,221.4 million (NPV), or 58.8% of the understated costs that it began with ($2,075.6 million).[73] This adjustment is 152.0% of the FAA's net cost figure of $803.5 million covering all cost categories. The integrity of FAA's research and analysis is very dubious when an interested party discovers unsupported adjustments of this magnitude, and when the carriers' internal analyses produce dramatically different results.

5.2.2 Augmented – Supplement Fee

FAA's estimate of $40.9 million (NPV) for additional pilots to supplement flight engineers is understated. First, the FAA's methodology suffers from the same infirmities noted above for crew scheduling costs. Second, it estimated costs using average carrier flight engineer salaries instead of B747 salaries.[74] Finally, it appears the FAA ignored payroll benefits as an added cost and it should have included them.

[72] FAA, op.cit., page 84.
[73] After the arbitrary adjustments FAA ends up with crew scheduling costs (resource cost only) of $854.2 million.
[74] The B727 cannot operate flights in excess of eight hours.

5.2.3 Reduced Reserves

The FAA's claim of cost savings from reduced crew requirements stands without empirical support, analysis or justification. There is no evidence that under the proposed rule there will be a lower incidence rate of calling in sick when fatigue is the issue. The FAA admits it does not know what the cost savings should be, if any, but is *assumes* a reduction of 5% of calls for sickness and then extrapolates this claimed benefit to a cost savings of $142.1 million (NVP). FAA made no attempt to obtain estimates from the carriers so it simply made up its number with no empirical support or evidence whatsoever. This is clearly an example of biased and heavy-handed rulemaking at its worst.

5.2.4 Augmented – Eliminate Flight Time Limit

Finally, FAA has estimated crew cost savings it believes would occur due to elimination of flight time limits for augmented operations. As a practical matter, flight time limits would be imposed by duty time limits. To determine cost savings FAA relied upon data provided by six carriers, and there is no way of knowing how representative this data is for the major cargo carriers with long haul operations like FedEx, UPS, and Atlas. In fact, the FAA went so far as to say "Due to the limited sample size the FAA needed to make several assumptions and *the resulting potential cost estimate is highly uncertain*." (Emphasis supplied.)[75] Further uncertainty is introduced by FAA's assumptions about representativeness when it extrapolates from the 6-carrier (2 months of data) sample to the annual totals for all 92 Part 121 airlines. The amount of savings attributable to the cargo airlines is $4.9 million according to the FAA.[76]

5.3 FAA's Estimates of Fatigue Training Costs Ignore Airline Realities

FAA attempted to establish a basis for determining the fatigue training costs that the proposed rule would impose on the carriers. Its analytical method is replete with assumptions. No one knows more about the costs and methods for crew training than the airlines themselves. Why the FAA did not solicit training cost estimates from the carriers is perplexing. The FAA's cost estimate is driven by salary costs which ignore employee benefits and payroll taxes, and use only one-third of the true crew costs in any event. As in all of the FAA's salary-driven cost

[75] FAA, op.cit., page 97.
[76] ($0.8 ÷ $45.1) x $276.9 million = $4.9 million. From Tables 24 and 25.

estimates, payroll burden must be included because the proposed rule would result in the hiring of almost 1,731 more pilots by the cargo carriers.

The same criticism can be made of the FAA's method of estimating fatigue training costs for dispatchers and management. Without a sound evidentiary basis from actual carrier operations and procedures, the FAA numbers are little more than a guess.

5.4 FAA Wrongly Assumed There Would Be No Rest Facility Costs for the Cargo Airlines

It is remarkable that the FAA excluded entirely the rest facility costs that would be incurred by the cargo airlines. FAA's discussion and cost estimates deal only with the cost of facility installation by the passenger carriers and the loss of passenger revenue. Nowhere in the RIA does FAA acknowledge the same costs (installation and revenue loss) for the cargo airlines. So FAA's assumption of $0 in costs for cargo airline rest facilities and loss of cargo revenue is patently wrong. Once again this omission demonstrates how divorced from reality is the FAA's estimating procedure throughout the RIA.

5.5 The FAA Should Segregate Its Estimates of Passenger and Cargo Carrier Costs

In order for Campbell-Hill and the Cargo Airline Association to fully evaluate the FAA's cost estimating methodology, and to appraise the reasonableness of its proposed rule, they must be able to examine the benefits side-by-side with the costs FAA expects the proposed rule to produce for cargo operations. The RIA provides a clear separation of the benefits estimates between passenger and cargo operations, but it does not segregate the majority of the costs. For example, the FAA's estimate of $854.7 million (NPV) for crew scheduling (resource cost only) comingles the passenger and cargo operations and sufficient details are not provided for Campbell-Hill to separate the cargo carriers' costs. Other examples of comingled costs are found throughout the RIA report.

CAA has asked the FAA for this breakdown of costs and the agency refused to do so. So it is unclear how FAA thinks CAA could evaluate its work and comment fully on a proposed rule that would impose more than $400 million annually on the cargo industry.[77] This is a clear failure of the RIA and the FAA's rulemaking process and procedure. Absent cooperation by

[77] Undiscounted. See Section 5.6.

FAA, the cargo carriers are left with no alternative but to offer and defend their own cost estimates. The carriers' analyses and cost estimates are the subject of the next section.

5.6 Cargo Airline Cost Estimates

The members of CAA were asked by the Association to develop the expected costs they would incur initially ("one-time costs") and annually on a continuing basis. The largest carriers have prepared simulation studies to introduce accurately all the constraints that would be imposed by the proposed rule, and to provide accurate crew scheduling outcomes in terms of numbers of pilots and expected payroll, training, hotel, per diem and other costs. The crew costs are determined on an incremental basis so the lower entry level wages are reflected in the carriers' estimates.

5.6.1 Carrier Cost Survey

Campbell-Hill and CAA designed a questionnaire for distribution to each of the Association members and any other all-cargo airline that wished to participate. Campbell-Hill received detailed cost data from seven airlines, six CAA members[78] and one non-member.[79] The carriers were asked to provide the expected costs of FAA's proposed rule at the level of detail shown in the RIA. In their cost submissions the carriers segregated the one-time front-end costs from the continuing annual operating costs. To be consistent with the FAA's methodology no growth or inflation was introduced into the 10-year operating cost projection. All costs were defined in terms of constant 2010 dollars.

In preparing their cost analyses some carriers were able to use sophisticated simulation models. Others depended primarily upon their current experience and methods. All carriers used the substantial expertise of their crew scheduling departments and computer models. Moreover, all carriers incorporated the constraints and compromises that exist in their current CBA's. The knowledge, process, crew scheduling models, and comprehension of real-world constraints and market demands make the carriers' cost submissions far more credible than the FAA's unrealistic method of estimating incremental costs associated with its proposed rule.

The costs projected by the seven named cargo airlines are presented in total in Table 5-1.

---

[78] FedEx, UPS, Atlas/Polar, ABX, Kalitta and Capital Cargo International.
[79] National Airlines.

Table 5-1

Projected Ten-Year Cargo Airlines Costs
Attributable to the FAA's Proposed Rule

	Cost In Millions of Constant 2010 Dollars[80]	
	Nominal Value	NPV – Discounted At 7%
2013	$596.2	$486.7
2014	502.4	383.3
2015	394.3	281.1
2016	394.3	262.7
2017	394.3	245.5
2018	394.3	229.5
2019	394.3	214.5
2020	394.3	200.4
2021	394.3	187.3
2022	394.3	175.1
10-Year Total[81]	$4,253.0	$2,666.1

The undiscounted 10-year cost is comprised of $310.0 million in one-time costs plus on-going costs of $394.3 million per year. The discounted costs for the 10-year period total $2,666.1 million which is 3.32 times the FAA's projected costs for the entire industry of 92 Part 121 carriers.[82]

In order to comply with the proposed rule the seven cargo airlines estimate they will need to hire 1,731 additional pilots. This represents an 20.2% increase over the current crew work force of 8,571 pilots. Using a base (current) crew level of 8,571 pilots, the FAA's estimate of

[80] Includes the costs of FedEx, UPS, Atlas/Polar, ABX, Kalitta, Capital and National.
[81] One CAA member provided revised cost estimates too late to be incorporated into this analysis. This adjustment increases the 10-year nominal cost to the cargo carriers from $4,253 million to $4,608 million. The increase in NPV terms is from $2,666 million to $2,885 million.
[82] FAA, op.cit., page 2.

additional crew would be 171 pilots[83] for FedEx, UPS, Atlas and four other airlines. This is simply not credible considering the far reaching constraints that would be imposed by FAA's rule.

[83] 2% of 8,571.

6.0 Benefit-Cost Relationships

There is no validity to FAA's "Upper Estimate" or "Best Estimate" of benefits because there is no legitimate basis for the extrapolation it required to obtain these numbers from its base case ("lower estimate"). Only the "lower estimate" is relevant to this inquiry. With all of its assumptions and faulty analysis, the best FAA could do was to forecast $20.9 million[84] of benefits (NPV) for the next 10 years. Furthermore it projected that 1.7 cargo aircraft accidents and 0.6 fatalities would be avoided with full implementation of its proposed rules.[85]

Campbell-Hill's detailed analysis in Section 4.0 shows conclusively that seven of FAA's eight cargo accidents that form the entire basis of its analysis are not relevant to this inquiry and should have been excluded from the baseline data by FAA. The one accident that arguably could be included had relatively minor damage and no loss of life. Campbell-Hill concludes that the FAA's proposed rule would produce $0.7 million in benefits (NPV) over the next 10 years and no savings of life. For infinitesimal benefits the FAA's proposed rule would impose a cost of close to $2.7 billion (NPV) on the cargo carriers (Table 6-1).

Table 6-1

Neither the FAA Nor Campbell-Hill Cost-Benefit Ratios Come Close To Justifying the Proposed Rule for the All-Cargo Carriers

	10-Year Benefit-Cost Profile (NPV)	
	FAA "Lower Estimate"[86]	Campbell-Hill Projection
Lives saved	0.6	0.0
Benefits (millions[87])	$20.9	$0.7
Costs (millions	<$803.5[88]	$2,666.1
Benefit-Cost Ratio	~0.1 to 1.00[89]	<0.0003 to 1.00

[84] FAA, op.cit., pages 49 and 68: $36.1 million x 58% effectiveness = $20.9 million.
[85] 2.9 accidents and 1.0 fatality (FAA op.cit., pages 46, 47 and 68) multiplied by 58% effectiveness.
[86] After applying FAA's 58% effectiveness factor.
[87] Including value of life saved.
[88] FAA's estimate for all 92 Part 121 airlines.
[89] For the limited purpose of this calculation Campbell-Hill assigned 25% of FAA's cost to the all-cargo industry.

As shown in Table 6-1 above, Campbell-Hill's estimate of the benefit-cost ratio is three one-hundredths of a cent per dollar of cost; or $700,000 of benefits for almost $2.7 billion in costs. Alternatively, it is $3,800 of cost per $1 of benefits (NPV). The FAA's own analysis fails to come close to justifying its proposed actions. While FAA did not segregate its cargo costs from the passenger costs, one could assume a 75:25 division for this purpose. This would assign $200.9 million in cost to the cargo airlines. Matched against FAA's $20.9 million of benefits produce a ratio of 1 to 10. That is, $1 of benefits from $10 of costs according to FAA's own findings.

7.0 Passenger Benefit Adjustments

Although not subjected to the same level of detailed examination as cargo benefits, the FAA's estimate of benefits for passenger operations exhibit all of the same problems including the lack of source data and critical information needed to evaluate the results, as well as obvious errors and omissions in the analysis. In terms of how the FAA's final passenger benefits were calculated, the methodology incorporates the same problems as occurred with the cargo analysis including:

- An inflated number of "avoided" accidents that form the basis for future benefits modeling.
- A final benefit estimate that is heavily dependent on an artificial and unjustified extrapolation of avoided accidents (the "Upper Estimate" and "Best Estimate" scenarios).
- An NPV calculation that has benefits preceding costs by two years rather than the reverse.

Correcting for just those mistakes identified with a cursory evaluation by Campbell-Hill reduces the FAA's estimate of benefits from $402.0 million (NPV) to $25.8 million (NPV) – a 94 percent reduction.

7.1 FAA's Projection of Future "Avoided" Accidents

As described in Section 4.0, the FAA's estimate of the benefits attributable to the proposed rule is directly proportional to the number of historical accidents that would theoretically re-occur in the future without the proposed rule and the extent to which those accidents could be "avoided" based on the rule. The FAA's process for estimating the number of future "avoided" accidents was the same as it applied for cargo: (1) identify accidents that are fatigue-related and (2) estimate the portion of these accidents that would be avoided after adjusting for "normal" accident occurrence rates with "Duty Time" and "Late Night" accidents.

The FAA identified 22 accidents that it deemed to be fatigue-related, of which the 14 listed in Table 7-1 were passenger aircraft accidents.[90]

Table 7-1

FAA's 14 Passenger Accidents Used In The RIA Study

Date	Takeoff/ Landing	Location	Carrier	Aircraft	Group Identifier
4/29/1993	L	Pine Bluff, AR	Continental Express	EMB-120	RT1
5/8/1999	L	Jamaica, NY	American Eagle	Saab 340B	RT3
2/18/2007	L	Cleveland, OH	Shuttle America	ERJ-170	RT5
1/22/1999	L	Hyannis, MA	Colgan	Beech 1900D	DT2
6/1/1999	L	Little Rock, AR	American	MD-82	DT3
10/19/2004	L	Kirksville, MO	Corporate Airlines	Jetstream 32	DT4
4/12/2007	L	Traverse City, MI	Pinnacle	CL-600-2B19	DT6
6/20/2007	L	Laramie, WY	Great Lakes	Beech 1900D	DT7
7/2/1994	L	Charlotte, NC	USAir	DC-9-31	TA1
12/20/1995	L	Buga, Colombia	American	Boeing B757	TA2
2/12/2009	L	Clarence Ctr., NY	Colgan	DHC-8-402	TA3
4/14/1993	L	Dallas/FW, TX	American	DC-10-30	CF1
8/25/1996	L	Jamaica, NY	TWA	L-1011-100	CF2
11/12/1995	L	East Granby, CT	American	MD-83	LN3

As shown in Table 7-2, three were designated as related to a lack of rest time, five were based on extended duty time, three were due to extended time awake, two are based on chronic fatigue, and one accident related to a late night operation. All 14 accidents occurred on landing and just four occurred in the 2000-2009 timeframe (representing a 60% decline over the previous decade).

[90] As previously described, one of the cargo accidents was incorrectly identified as a passenger operation in some of the FAA calculations.

Table 7-2

FAA's 14 Passenger Accidents By Fatigue Category

	Actual	Avoided[a]	Reduction
Lack of Adequate Rest Time (RT)	3.0	3.0	100%
Extended Duty Time (DT)[b]	5.0	3.3	66%
Extended Time Awake (TA)	3.0	3.0	100%
Chronic Fatigue (CF)	2.0	2.0	100%
Late Night Duty (LN)[c]	1.0	**1.7**	168%
	14.0	13.0	93%

[a]FAA determination as to which accidents could be avoided with its proposed rule.
[b]One of these accidents also qualified as "late night" but was analyzed in this group.
[c]One of the cargo accidents was wrongly identified as a passenger accident in the October 22, 2010 submission but is shown correctly here.

As with the cargo accidents, the FAA made adjustments to the historical accidents to account for some "Duty Time" and "Late Night" accidents that may not be attributable to fatigue (and therefore designated "normal" as described in Section 4.5.3). The FAA did not provide supporting details for these adjustments that would enable a reviewer to determine the distribution between cargo and passenger accidents, but the aggregate totals for "avoided" accidents (5.8 cargo and 13.0 passenger) had to have been based on a proportional allocation within the two categories. For the "Duty Time" accidents, the 5 passenger accidents were converted to 3.3 "avoided" accidents (using the same adjustment for both cargo and passenger accidents). However, the estimate of avoided "Late Night" passenger accidents evidently included the one cargo accident (LN2) wrongly identified as passenger. In the narrative descriptions, the FAA identified just one passenger accident involving the late night factor and yet the proportional allocation required 1.7 avoided accidents.[91]

Although time did not permit as thorough an examination of the individual accidents by Campbell-Hill as it did for the cargo accidents (with the support of CAA members), the identification of the 14 fatigued-related accidents and 13 avoided accidents is flawed for many of the same reasons. Seven of the eight cargo accidents were removed from consideration of prospective benefits due to one or more of the following reasons: (1) the accident was not

[91] The FAA also included one passenger accident in both its Duty Time and Late Night adjustments, but removed it from the Late Night category at the end. It is possible that the error in avoided accidents is due to double-counting of this accident, but, in any case, the number of avoided "Late Night" passenger accidents is overstated.

directly associated with fatigue (NTSB), (2) the operation would not be permissible under current rules, or (3) the operation would not be affected by the new rule. Campbell-Hill's preliminary evaluation revealed the following similar deficiencies with the FAA's passenger accident analysis (shown in Table 7-3):

- The NTSB made no finding of fatigue for 8 of the 14 accidents (as identified in its comprehensive accident database), and there is only a finding that fatigue was a "factor", not a "cause" for the 6 other accidents.

- One of the "avoided" accidents (LN3) was deemed by the FAA to have an effectiveness rating of 0% meaning the rule would have no impact on avoiding future damages. Five of the remaining accidents were determined to have effectiveness ratings of 15% meaning the rule would eliminate just 15% of future damages.

- Although a detailed cross-reference to NTSB accident reports was not conducted, at least one accident's duty time was not correctly identified (and presumably not considered correctly in the statistical analysis supporting the FAA's conclusions about duty time impacts).

- One accident (DT2) was a Part 91 flight that now would fall under Part 121 regulations, although it is unknown whether the current rule would prohibit operation with the same crew.

- Six of the accident flights would be allowable under both the current and proposed rules and the FAA's determination of effectiveness ratings over 0% for all six (including one with a 90% rating and two with 50% ratings) is unsupportable. For another accident (TA1), the proposed rule would not affect the captain's availability, but it might affect that of the first officer.

- Three of the five "Duty Time" accidents occurred at a level of duty time prior to the 15th hour. As described in Section 4.5.3, there is no statistical evidence supporting the FAA's assumption that duty time fatigue would occur prior to the 15th hour and so these accidents are incorrectly designated by FAA as fatigue-related. The other two accidents barely exceeded this 14-hour limit and so the benefits impact would be expected to be marginal at best.

As a result, the FAA's estimate of 13 avoided accidents is more correctly limited to 4 avoided accidents over 20 years (RT5, DT4, DT6 and TA1). Correctly adjusting for the effectiveness rating, the "avoided" accidents in a future 10-year period should be 0.8 accidents[92] – an 88% reduction which translates directly into reduced benefits in all of the FAA's scenarios.

Table 7-3

Summary of Campbell-Hill's Assessment of FAA's Fourteen Passenger Accidents

Date	Location	Group Identifier	No NTSB Finding On Fatigue	FAA's Impact from Rule = 0 Percent	Error in Fatigue Classification	Prohibited With Current Rule	Allowable With Proposed Rule	Impact Of Proposed Rule	Comment
4/29/1993	Pine Bluff, AR	RT1					X	None	Part 135 flight
5/8/1999	Jamaica, Ny	RT3					X	None	
2/18/2007	Cleveland, OH	RT5						Minor	
1/22/1999	Hyannis, MA	DT2	X			X		None	Pre-15 hour + Part 91 flight
6/1/1999	Little Rock, AR	DT3						None	Before 15th hour
10/19/2004	Kirksville, MO	DT4						Minor	15th hour
4/12/2007	Traverse City, MI	DT6			X			Minor	15th hour with correction
6/20/2007	Laramie, WY	DT7	X					None	Before 15th hour
7/2/1994	Charlotte, NC	TA1	X				*	Minor	*Only FO not legal
12/20/1995	Buga, Colombia	TA2	X				X	None	
2/12/2009	Clarence Ctr., NY	TA3	X				X	None	
4/14/1993	Dallas/FW, TX	CF1	X				X	None	
8/25/1996	Jamaica, Ny	CF2	X				X	None	
11/12/1995	East Granby, CT	LN3	X	X				None	1st Circadian Hour

92 $\frac{\text{4 accidents over 20 years}}{2}$ X 40% effectiveness = 0.8 accidents in 10 years.

7.2 Adjustments to FAA's Passenger Benefits

As previously stated, the FAA's use of "simulation modeling" masks results that are based on a few simple (if unsupported) assumptions and which are directly proportional to the number of avoided accidents. In the case of the passenger benefits, the mean value for "Lower Estimate" benefits can be constructed using the following values:

- Future passenger accidents = 6.5 per 10-year period (based on 13 avoided accidents over 20 years)
- Average fatalities per accident = 6.44 (for which the basis is unknown)
- Average damages per fatality = $6.0 million (rounded up from the OMB-approved $5.8 million)
- Average non-fatality damages per accident = $15.3 million (for which the basis is unknown but it is slightly lower than value used for cargo scenarios)
- Ratio of NPV Benefits to Nominal Benefits = 70% (equivalent to assigning one-tenth of benefits to the years 2011 to 2020 and discounting at 7 percent to 2010).

Combining these five assumed values yields a mean estimate of $248.5 million of passenger benefits as shown in Figure 4 of the RIA.

Table 7-4

<u>Calculation for FAA's Lower Estimate Benefits for Passenger Operations</u>

No. of Passenger Accidents (10-Year Total)	6.53
Fatalities per Accident	6.44
Estimated Fatalities	42.08
Damages per Fatality (mil. $)	$6.0
Non-Fatal Damages per Accident (mil. $)	$15.3
Nominal Damages (mil. $)	$352.5
Ratio of NPV	70%
NPV Damages (mil. $)	$248.5

As was shown in Section 4.0 of this report, the Upper Estimate and Best Estimate passenger benefits must be based on the exact same assumed values, only varying in terms of the number of future cargo accidents (which are merely extrapolations of the 6.5 value used in the Lower Estimate scenario). In other words, the projected benefits are directly proportional to the estimate of future cargo accidents <u>without regard to how that number is derived.</u>

In terms of FAA's high estimate of "avoided" passenger accidents, the key points are that (1) eliminating any of the 13.0 accidents that form the basis for the simulation "forecast" would necessarily have a proportional impact on the FAA's calculated benefits and (2) the level of damages associated with any avoided accidents should be based on actual historical damages.

Campbell-Hill has concluded that rather than 13 avoided accidents over 20 years, there could at most be 4.0 accidents (or 2.0 accidents for the future ten-year period). *This conclusion alone reduces the FAA's calculated benefits for passenger operations by 69 percent for all forecast scenarios.*

Using the same calculations that are implicit in the FAA's modeling and adjusting for effectiveness in determining "avoided" accidents and damages, the calculated passenger benefits would be $42.2 million in nominal terms and $29.5 million in NPV terms – a 88 percent reduction in the FAA's Lower Estimate benefits.

Table 7-5

Adjustment to FAA's Lower Estimate Benefits for Passenger Operations

No. of Passenger Accidents (10-Year Total)	2
Effectiveness Rating	40%
Adjusted for Effectiveness Rating	0.8
Fatalities per Accident	6.44
Estimated Fatalities	5.16
Damages per Fatality (mil. $)	$5.8
Non-Fatal Damages per Accident (mil. $)	$15.32
Nominal Damages (mil. $)	$42.2
Ratio of NPV	70%
NPV Damages (mil. $)	$29.5

Other identified adjustments (developed in Section 4.0) can be applied as follows:

- Elimination of Upper Estimate and Best Estimate – There is no basis for the FAA's extrapolation from an estimate of avoided accidents which represent all of the accidents with any possible relationship to fatigue, to a larger universe of "pilot error" accidents where fatigue was specifically not a factor. The six-fold increase in passenger benefits for the "Upper Estimate" scenario is based entirely on an extrapolation from 13.0 to 90.2 avoided accidents (a 590% increase).[93] The "Best Estimate" is merely a straight average between the unsupportable "Upper Estimate" and the "Lower Estimate" results and should be similarly discarded. The so-called "Lower Estimate" should have been the FAA's "Best Estimate" however overstated. Using effectiveness-adjusted benefits of $99.4 million (in NPV terms) for the "best" case reduces the FAA estimate by 75 percent.

- Timing of Benefits – As described in Section 4.1, the FAA failed to correctly align the occurrence of benefits with costs that are necessary for those benefits to occur.

[93] The fallacy of the implicit assumption underlying this extrapolation is clear if one considers that 1 of the 13 "avoided" passenger accidents was the 2/12/2009 Colgan accident that accounted for enormous loss of life and a destroyed aircraft. The FAA's "Upper Estimate" assumes that nearly six more identical accidents occurred over the last 20 years, but that the NTSB failed to identify fatigue as even a finding. The same ratio applies to each of the 13 accidents and demonstrates how contrived both the Upper and Best scenarios are.

Assuming that benefits would begin two years after the 2013 implementation year, passenger benefits would drop to $75.8 million – 81% less than the FAA's estimate for this adjustment alone.

- Adjusted Number of Avoided Accidents – Using the adjusted number of avoided accidents, passenger benefits would be just $29.5 million over 10 years. Assuming benefits would start the same year as costs begin (2013), the benefits are reduced to $25.8 million.[94]

Table 7-6

The Adjusted Passenger Benefits Are Insignificant

	Using Lower Estimate		Using Best Estimate	
	NPV Amount (million $)	% Reduction of FAA Estimate[a]	NPV Amount (million $)	% Reduction of FAA Estimate[b]
	(1)	(2)	(3)	(4)
FAA Benefits (NPV) with Effectiveness Adjustment	$99.4	-75%	$402.4	0%
1. Timing of Benefits				
Benefits Start in 2013	$86.8	-78%	$351.5	-13%
Benefits Start in 2015	$75.8	-81%	$307.0	-24%
2. Adjusted Accidents				
Benefits Start in 2011 (FAA Assumption)	$29.5	-93%		
Benefits Start in 2013	$25.8	-94%		

[a]Percent Column (1) is lower than Column (3)

[b]Percent lower than $402.4 million.

[94] Assuming benefits would lag two years behind costs results in benefits of $22.5 million.

E X H I B I T S:

SUMMARY OF CARGO ACCIDENTS USED TO ESTIMATE BENEFITS

		C-H IdentificationNumber								
		RT2	RT4	DT1	DT5	LN1	LN2	LN4	LN5	Total
	A. Accident Details									
A-1	Date	2/16/1995	7/26/2002	8/18/1993	12/16/2004	2/17/1991	2/15/1992	7/31/1997	8/13/2004	
A-2	Takeoff (TO)/Landing (L)	TO	L	L	L	TO	L	L	L	
A-3	Time of Accident	2227	0537	1656	2000	0019	0327	0130	0049	
A-4	Location	Kansas City, MO	Tallahassee, FL	Guantanamo Bay, Cuba	Ontario, Canada	Cleveland, OH	Swanton, OH	Newark, NJ	Florence, KY	
A-5	Airline	ATI	FedEx	Kalitta	Air Cargo Carriers	Ryan	ATI	FedEx	Air Tahoma	
A-6	Make / Model	DC-8-63	727-200	DC-8-61	SD3-60	DC-9-15	DC-8-63	MD-11	CV-340 (580)	
	B. FAA Report Information									
B-1	NTSB Accident Number	DCA95MA020	DCA02MA054	DCA93RA060	DCA05WA019	DCA91MA021	DCA92MA022	DCA97MA055	DCA04MA068	
B-2	FAA Basis for Inclusion	Lack of Rest Time	Lack of Rest Time	Extended Duty Time (17:56 hrs.)	Extended Duty Time (10:00 hrs.)	Late Nite (0019)	Late Nite (0327)	Late Nite (0130)	Late Nite (0049)	
B-3	Campbell-Hill Comment on Basis			Time Zone Adj. = 16:56 DT	Should be 9-10 time period	1st Circadian Hour		2130 at local base	2349 at local base	
B-4	Number of Accidents for 20-Year Period									
B-4a	FAA's Nominal Count	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	8.00
B-4b	With Adjustment for Duty Time/Late Night	1.00	1.00	0.66	0.66	0.63	0.63	0.63	0.63	5.80
B-4c	Effectiveness Rating	0.90	0.75	0.90	0.00	0.35	0.15	0.00	0.00	0.38
B-4d	With Both Adjustments	0.90	0.75	0.59	0.00	0.22	0.09	0.00	0.00	2.56
B-5	NTSB Finding on Fatigue	Finding	Factor	Cause	None	None	None	None	None	
B-6	Allowable Under Current Rule	N	Y*	N	Y	Y	Y	Y	Y	
B-7	Allowable Under New Rule	N	N	N	Y	N	N	Y	Y	
B-8	C-H Adjusted Savings	0	0.38	0	0	0	0	0	0	0.38
B-9	C-H Justification	Ferry flight must operate under Part 121 rest time rules	*Rest period for FO not allowed	Ferry flight must operate under Part 121 rest time rules	Fatigue not cited/Not <u>more</u> than 10 hours	Operational not pilot error	Fatigue not cited/low level duty time	Rule will have no effect	Rule will have no effect	
	C. FAA Damage Estimates for 10-Year Period									
C-1	Aircraft Damage (mil. $)									
C-1a	FAA Average per Aircraft	$15.67	$15.67	$15.67	$15.67	$15.67	$15.67	$15.67	$15.67	
C-1b	Total Adjusted for Duty Time/Late Night	$7.84	$7.84	$5.16	$5.16	$4.90	$4.90	$4.90	$4.90	$45.58
C-2	Human Damages (mil. $)									
C-2a	Fatalities per Accident	0.34	0.34	0.34	0.34	0.34	0.34	0.34	0.34	2.72
C-2c	Total Adjusted for Duty Time/Late Night	$1.02	$1.02	$0.67	$0.67	$0.64	$0.64	$0.64	$0.64	$5.93
C-3	Estimated Total Damages (mil. $)									
C-3a	FAA Estimate	$8.86	$8.86	$5.83	$5.83	$5.53	$5.53	$5.53	$5.53	$51.51
C-3b	Adjusted for Effectiveness Rating	$7.97	$6.64	$5.25	$0.00	$1.94	$0.83	$0.00	$0.00	$22.63
C-3c	Percent Difference	-10%	-25%	-10%	-100%	-65%	-85%	-100%	-100%	-56%
	D. Campbell-Hill Damage Estimates for 10-Year Period									
D-1	Aircraft Damage (mil. $)									
D-1a	Using Updated FAA "Crew Training" Estimate	$15.67	**$3.38**	$15.67	**$0.16**	$15.67	**$14.53**	$15.67	**$0.49**	
D-1b	Total Adjusted for Duty Time/Late Night	$7.84	$1.69	$5.16	$0.05	$4.90	$4.54	$4.90	$0.15	$29.23
D-1c	Percent Difference from FAA Estimate	0%	-78%	0%	-99%	0%	-7%	0%	-97%	-36%
D-2	Human Damages (mil. $)									
D-2a	Adjusted at OMB's $5.8 Million VLS	$0.99	$0.99	$0.65	$0.65	$0.62	$0.62	$0.62	$0.62	$5.74
D-2c	Percent Difference from FAA Estimate	-3%	-3%	-3%	-3%	-3%	-3%	-3%	-3%	-3%
D-3	Total Damages with FAA's Accidents (mil. $)									
D-3a	Adjusted for Damage Factors	$8.82	$2.68	$5.81	$0.70	$5.51	$5.16	$5.51	$0.77	$34.96
D-3b	Adjusted for Effectiveness Rating	$7.94	$2.01	$5.23	$0.00	$1.93	$0.77	$0.00	$0.00	$17.88
D-3c	Percent Difference from FAA Estimate	-10%	-77%	-10%	-100%	-65%	-86%	-100%	-100%	-65%
D-4	Total Damages with Adjusted Accidents (mil. $)									
D-4a	Adjusted Aircraft Damages	$0.00	$0.64	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.64
D-4b	Adjusted Fatality-Based Damages	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00
D-4c	Combined Total	$0.00	$0.64	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.64
D-4d	Percent Difference from FAA Estimate	-100%	-93%	-100%	-100%	-100%	-100%	-100%	-100%	-99%

SUMMARY OF CARGO ACCIDENTS USED TO ESTIMATE BENEFITS

		Source
A. Accident Details		
A-1	Date	FAA/NTSB
A-2	Takeoff (TO)/Landing (L)	FAA/NTSB
A-3	Time of Accident	FAA/NTSB
A-4	Location	FAA/NTSB
A-5	Airline	FAA/NTSB
A-6	Make / Model	FAA/NTSB
B. FAA Report Information		
B-1	NTSB Accident Number	FAA/NTSB
B-2	FAA Basis for Inclusion	FAA RIA
B-3	Campbell-Hill Comment on Basis	Campbell-Hill Analysis
B-4	Number of Accidents for 20-Year Period	
B-4a	FAA's Nominal Count	FAA RIA
B-4b	With Adjustment for Duty Time/Late Night	FAA RIA based on proportional allocation
B-4c	Effectiveness Rating	FAA spreadsheet
B-4d	With Both Adjustments	B-4b X B-4c
B-5	NTSB Finding on Fatigue	NTSB Accident Database system (eADMS)
B-6	Allowable Under Current Rule	CAA analysis
B-7	Allowable Under New Rule	CAA analysis
B-8	C-H Adjusted Savings	CAA/Campbell-Hill analysis using average effectiveness rating
B-9	C-H Justification	
C. FAA Damage Estimates for 10-Year Period		
C-1	Aircraft Damage (mil. $)	
C-1a	FAA Average per Aircraft	Based on RIA "Lower Estimate" model results
C-1b	Total Adjusted for Duty Time/Late Night	C-1a X B-4a / 2 (for 10-years)
C-2	Human Damages (mil. $)	
C-2a	Fatalities per Accident	Based on RIA "Lower Estimate" model results
C-2c	Total Adjusted for Duty Time/Late Night	$6 million X C-2a X B-4a / 2 (for 10-years)
C-3	Estimated Total Damages (mil. $)	
C-3a	FAA Estimate	C-1b + C2-c
C-3b	Adjusted for Effectiveness Rating	C-3a X B-4c
C-3c	Percent Difference	C-3b / C-3a - 1
D. Campbell-Hill Damage Estimates for 10-Year Period		
D-1	Aircraft Damage (mil. $)	
D-1a	Using Updated FAA "Crew Training" Estimate	Replace FAA average with "crew training" accident-specific estimates updated to 2010 based on GDP inflator
D-1b	Total Adjusted for Duty Time/Late Night	D-1a X B-4a / 2 (for 10-years)
D-1c	Percent Difference from FAA Estimate	C-1b / D-1b - 1
D-2	Human Damages (mil. $)	
D-2a	Adjusted at OMB's $5.8 Million VLS	$5.8 million X C-2a X B-4a / 2 (for 10-years)
D-2c	Percent Difference from FAA Estimate	C-2c / D-2a - 1
D-3	Total Damages with FAA's Accidents (mil. $)	
D-3a	Adjusted for Damage Factors	D-1b + D-2c
D-3b	Adjusted for Effectiveness Rating	D-3a X B-4c
D-3c	Percent Difference from FAA Estimate	D-3b / C-3a - 1
D-4	Total Damages with Adjusted Accidents (mil. $)	
D-4a	Adjusted Aircraft Damages	D-1a X B-8 / 2 (for 10-years)
D-4b	Adjusted Fatality-Based Damages	$5.8 million X Actual Fatalities X B-8 /2 (for 10 years)
D-4c	Combined Total	D-4a + D-4b
D-4d	Percent Difference from FAA Estimate	D-4c / C-3a - 1

FAA'S SIMULATION RESULTS

	Passenger						Cargo						Total
	Base Accidents			All Accidents			Base Accidents			All Accidents			
	Fatigue	Total	Share	Fatigue	Total	Share	Fatigue	Total	Share	Fatigue	Total	Share	
1990-2009 Accidents	13	33	39.4%	90.21	229	39.4%	5.8	10	58.0%	28.42	49	58.0%	
Adjusted Based on 11/?? Data	14	34	41.2%	79.47	193	41.2%	8	11	72.7%	38.55	53	72.7%	
				-12%		593.9%				36%		390.0%	

	Passenger						Cargo						Total
	Lower		Upper		Best		Lower		Upper		Best		Best
	Mean	Maximum	Mean	Maximum	Mean	Maximum	Mean	Maximum	Mean	Maximum	Mean	Maximum	Mean
10-Year Benefits Estimates													
No. of Accidents	6.53	18.00	45.1	70.00	25.96	66.00	2.91	11.00	14.22	31.00	8.47	26.00	34.43
No. of Fatalities	42.08	828	298.00	1,357.00	172	1081	0.99	11	4.80	22.00	2.89	19.00	174.89
Fatalities per Accident	6.44	46.00	6.61	19.39	6.63	16.38	0.34	1.00	0.34	0.71	0.34	0.73	5.08
Nominal Damages (mil. $)	$352.5	$5,079.6	$2,482.8	$8,823.9	$1,430.0	$7,225.0	$51.5	$368.2	$251.8	$752.2	$150.5	$614.8	$1,580.5
Fatality (@ $6 mil.)	$252.5	$4,968.0	$1,788.0	$8,142.0	$1,032.0	$6,486.0	$5.9	$66.0	$28.8	$132.0	$17.3	$114.0	$1,049.3
Non-Fatality	$100.0	$111.6	$694.8	$681.9	$398.0	$739.0	$45.6	$302.2	$223.0	$620.2	$133.2	$500.8	$531.2
Average per Accident	$53.98	$282.20	$55.05	$126.06	$55.08	$109.47	$17.71	$33.47	$17.71	$24.26	$17.77	$23.65	$45.90
Non-Fatality	$15.32	$6.20	$15.40	$9.74	$15.33	$11.20	$15.67	$27.47	$15.68	$20.01	$15.72	$19.26	$15.43
NPV Damages	$248.52	$3,592.18	$1,746.00	$6,839.00	$1,006.00	$5,322.00	$36.10	$258.06	$176.60	$533.40	$105.70	$475.30	$1,111.70
Ratio to Nominal Estimate	70.5%	70.7%	70.3%	**77.5%**	70.3%	**73.7%**	70.0%	70.1%	70.1%	70.9%	**70.2%**	**77.3%**	70.3%
Ratio to Lower Damages			7.03	1.90	4.05	1.48			4.89	2.07	2.93	1.84	
Effectiveness Adjustments													
Effectiveness Factor	40%	40%	40%	40%	40%	40%	58%	58%	58%	58%	58%	58%	
Damages (mil. $)													
Nominal	$141.0	$2,031.9	$993.1	$3,529.5	$572.0	$2,890.0	$29.9	$213.5	$146.0	$436.3	$87.3	$356.6	**$659.29**
NPV	$99.4	$1,436.9	$698.4	$2,735.6	$402.4	$2,128.8	$20.9	$149.7	$102.4	$309.4	$61.3	$275.7	**$463.71**

Source: RIA

OPERATIONS AT 77 U.S. ASPM AIRPORTS (CY 2009)

Hour of Day	Passenger	% of Total	Air Taxi	% of Total	Freight	% of Total	Combined Total	% of Total
Total Operations								
0000-0100	109,045	0.8%	7,919	0.3%	36,708	6.0%	153,672	1.0%
0100-0200	46,307	0.4%	2,362	0.1%	14,998	2.5%	63,667	0.4%
0200-0300	25,106	0.2%	817	0.0%	17,693	2.9%	43,616	0.3%
0300-0400	18,371	0.1%	372	0.0%	33,592	5.5%	52,335	0.3%
0400-0500	29,319	0.2%	645	0.0%	53,169	8.8%	83,133	0.5%
0500-0600	85,737	0.7%	8,648	0.3%	46,072	7.6%	140,457	0.9%
0600-0700	400,465	3.1%	68,136	2.7%	39,905	6.6%	508,506	3.2%
0700-0800	661,798	5.1%	139,107	5.6%	35,468	5.8%	836,373	5.2%
0800-0900	740,538	5.7%	136,943	5.5%	24,356	4.0%	901,837	5.6%
0900-1000	787,423	6.1%	167,871	6.7%	17,906	2.9%	973,200	6.1%
1000-1100	838,949	6.5%	164,531	6.6%	12,949	2.1%	1,016,429	6.3%
1100-1200	802,916	6.2%	155,823	6.3%	11,906	2.0%	970,645	6.0%
1200-1300	785,145	6.0%	170,638	6.9%	9,499	1.6%	965,282	6.0%
1300-1400	798,940	6.2%	172,839	6.9%	6,758	1.1%	978,537	6.1%
1400-1500	785,149	6.0%	168,755	6.8%	6,900	1.1%	960,804	6.0%
1500-1600	808,103	6.2%	170,461	6.9%	17,770	2.9%	996,334	6.2%
1600-1700	813,210	6.3%	155,832	6.3%	25,615	4.2%	994,657	6.2%
1700-1800	836,948	6.4%	173,417	7.0%	24,922	4.1%	1,035,287	6.4%
1800-1900	839,736	6.5%	148,775	6.0%	26,014	4.3%	1,014,525	6.3%
1900-2000	818,372	6.3%	153,620	6.2%	26,849	4.4%	998,841	6.2%
2000-2100	712,583	5.5%	130,942	5.3%	21,789	3.6%	865,314	5.4%
2100-2200	576,155	4.4%	97,704	3.9%	21,536	3.5%	695,395	4.3%
2200-2300	407,411	3.1%	63,966	2.6%	35,866	5.9%	507,243	3.2%
2300-2400	251,229	1.9%	28,174	1.1%	39,332	6.5%	318,735	2.0%
	12,978,955	100.0%	2,488,297	100.0%	607,572	100.0%	16,074,826	100.0%
0000-0400	198,829	1.5%	11,470	0.5%	102,991	17.0%	313,290	1.9%

OPERATIONS AT 77 U.S. ASPM AIRPORTS (CY 2009)

Hour of Day	Passenger	% of Total	Air Taxi	% of Total	Freight	% of Total	Combined Total	% of Total
Departures								
0000-0100	40,235	0.6%	2,435	0.2%	3,732	1.2%	46,402	0.6%
0100-0200	23,167	0.4%	712	0.1%	2,796	0.9%	26,675	0.3%
0200-0300	13,056	0.2%	209	0.0%	11,661	3.8%	24,926	0.3%
0300-0400	10,051	0.2%	108	0.0%	28,177	9.1%	38,336	0.5%
0400-0500	10,205	0.2%	492	0.0%	38,061	12.3%	48,758	0.6%
0500-0600	37,469	0.6%	4,786	0.4%	21,517	7.0%	63,772	0.8%
0600-0700	299,942	4.6%	40,306	3.2%	22,819	7.4%	363,067	4.5%
0700-0800	403,289	6.2%	52,393	4.2%	26,860	8.7%	482,542	5.9%
0800-0900	416,812	6.4%	66,989	5.3%	13,878	4.5%	497,679	6.1%
0900-1000	420,466	6.4%	105,146	8.4%	7,266	2.4%	532,878	6.6%
1000-1100	435,513	6.7%	89,317	7.1%	4,922	1.6%	529,752	6.5%
1100-1200	426,336	6.5%	80,668	6.4%	4,024	1.3%	511,028	6.3%
1200-1300	399,351	6.1%	79,379	6.3%	1,806	0.6%	480,536	5.9%
1300-1400	399,279	6.1%	80,159	6.4%	1,904	0.6%	481,342	5.9%
1400-1500	378,128	5.8%	97,095	7.7%	4,405	1.4%	479,628	5.9%
1500-1600	392,033	6.0%	83,000	6.6%	15,929	5.2%	490,962	6.1%
1600-1700	392,497	6.0%	76,675	6.1%	19,913	6.4%	489,085	6.0%
1700-1800	413,365	6.3%	82,991	6.6%	6,607	2.1%	502,963	6.2%
1800-1900	406,511	6.2%	62,517	5.0%	5,193	1.7%	474,221	5.8%
1900-2000	405,840	6.2%	80,104	6.4%	11,071	3.6%	497,015	6.1%
2000-2100	324,681	5.0%	67,696	5.4%	7,426	2.4%	399,803	4.9%
2100-2200	259,694	4.0%	51,046	4.1%	12,582	4.1%	323,322	4.0%
2200-2300	163,815	2.5%	38,478	3.1%	24,171	7.8%	226,464	2.8%
2300-2400	76,860	1.2%	11,093	0.9%	12,241	4.0%	100,194	1.2%
	6,548,595	100.0%	1,253,794	100.0%	308,961	100.0%	8,111,352	100.0%
0000-0400	86,509	1.3%	3,464	0.3%	46,366	15.0%	136,339	1.7%

OPERATIONS AT 77 U.S. ASPM AIRPORTS (CY 2009)

Hour of Day	Passenger	% of Total	Air Taxi	% of Total	Freight	% of Total	Combined Total	% of Total
Arrivals								
0000-0100	68,810	1.1%	5,484	0.4%	32,976	11.0%	107,270	1.3%
0100-0200	23,140	0.4%	1,650	0.1%	12,202	4.1%	36,992	0.5%
0200-0300	12,050	0.2%	608	0.0%	6,032	2.0%	18,690	0.2%
0300-0400	8,320	0.1%	264	0.0%	5,415	1.8%	13,999	0.2%
0400-0500	19,114	0.3%	153	0.0%	15,108	5.1%	34,375	0.4%
0500-0600	48,268	0.8%	3,862	0.3%	24,555	8.2%	76,685	1.0%
0600-0700	100,523	1.6%	27,830	2.3%	17,086	5.7%	145,439	1.8%
0700-0800	258,509	4.0%	86,714	7.0%	8,608	2.9%	353,831	4.4%
0800-0900	323,726	5.0%	69,954	5.7%	10,478	3.5%	404,158	5.1%
0900-1000	366,957	5.7%	62,725	5.1%	10,640	3.6%	440,322	5.5%
1000-1100	403,436	6.3%	75,214	6.1%	8,027	2.7%	486,677	6.1%
1100-1200	376,580	5.9%	75,155	6.1%	7,882	2.6%	459,617	5.8%
1200-1300	385,794	6.0%	91,259	7.4%	7,693	2.6%	484,746	6.1%
1300-1400	399,661	6.2%	92,680	7.5%	4,854	1.6%	497,195	6.2%
1400-1500	407,021	6.3%	71,660	5.8%	2,495	0.8%	481,176	6.0%
1500-1600	416,070	6.5%	87,461	7.1%	1,841	0.6%	505,372	6.3%
1600-1700	420,713	6.5%	79,157	6.4%	5,702	1.9%	505,572	6.3%
1700-1800	423,583	6.6%	90,426	7.3%	18,315	6.1%	532,324	6.7%
1800-1900	433,225	6.7%	86,258	7.0%	20,821	7.0%	540,304	6.8%
1900-2000	412,532	6.4%	73,516	6.0%	15,778	5.3%	501,826	6.3%
2000-2100	387,902	6.0%	63,246	5.1%	14,363	4.8%	465,511	5.8%
2100-2200	316,461	4.9%	46,658	3.8%	8,954	3.0%	372,073	4.7%
2200-2300	243,596	3.8%	25,488	2.1%	11,695	3.9%	280,779	3.5%
2300-2400	174,369	2.7%	17,081	1.4%	27,091	9.1%	218,541	2.7%
	6,430,360	98.2%	1,234,503	98.5%	298,611	96.7%	7,963,476	98.2%
0000-0400	112,320	1.7%	8,006	0.6%	56,625	18.3%	176,951	2.2%

Source: FAA, ETMS Counts by Quarter Hour database (online)

A P P E N D I X A:

Study Team Qualifications and Resumes

Campbell-Hill's Experience in Economic Impact Analysis of Regulatory Policy and Aviation Activity

Campbell-Hill provides a unique blend of general economic impact experience with extensive expertise in analyzing and measuring passenger, cargo and general aviation activity for aviation clients. The economic impact experience varies from traditional airport, or airport system-level studies to analyses that are specific to a particular policy, service enhancement, or facility/infrastructure investment. Campbell-Hill is well-versed and experienced in applying FAA data and methodologies and has had recent involvement in two FAA-funded Environmental Impact Studies. Specific experience of note includes:

- <u>Impact of Proposed Regulation of Lithium Ion Battery Transport by Air</u> – For the an association of major U.S. manufacturers of products using lithium batteries, Campbell-Hill evaluated the direct impacts of a DOT proposed rule restricting air transport of those products. The study included a survey of cost impacts anticipated by seven large manufacturers and an extrapolation of those impacts for all related products moving in U.S. domestic and foreign trade. The cost impacts were compared to a review of the DOT's estimate of benefits.
- <u>Review of O'Hare Modernization Program</u> - In support of two local communities (City of Bensenville and Elk Grove Village), Campbell-Hill conducted a detailed review and critique of all relevant documents dealing with the forecasts, efficiency and impact of the planned expansion at O'Hare including the EIS, the LOI, and two benefit-cost analyses. Campbell-Hill developed data and models based on FAA data and methodologies for forecasting and estimating costs and benefits including detailed review of delay model results, financial sources, and regional aviation operations.
- <u>Analysis of the Effect of Congestion Related Delay on the Value of Scheduled Commercial Passenger Air Transportation to the U.S. Economy</u> - Campbell-Hill was retained by a group of the major U.S. aviation industry groups and the Boeing Company to develop a database and a model to estimate the amount and costs of delay in the U.S. air passenger system measured with and without proposed capacity expansion. Passenger and flight delays were analyzed and projected based on FAA passenger/activity forecasts and activity/delay statistics under various airport runway and airways technology investment scenarios (developed based on the FAA's Aviation Capacity Enhancement Plan). Campbell-Hill also calculated the approximate cost of delay to the passenger in terms of extra travel time and allocated airline costs. The analysis was conducted for the top 55 OPSNET airports using derived delay curves and TAF-based forecasts.
- <u>Environmental Modeling</u> – As noted above, Campbell-Hill has been the primary consultant to the Air Transport Association since 2000 for a portion of various international environmental regulatory proceedings, much of which has involved coordination with the FAA as the lead agency in these proceedings. As part of efforts to develop a worldwide fleet database of environmental characteristics, Campbell-Hill has

worked with FAA personnel to both obtain data on individual aircraft and to assure that the database is designed to match the needs of the multi-million dollar environmental model that will use the database. Campbell-Hill is currently modeling the impact of proposed "cap and trade" emissions proposals on U.S. passenger and cargo airlines.

- FAA Rulemaking – Campbell-Hill has also supported the ATA in developing comments on FAA-proposed rules covering widespread fatigue damage and other safety matters. This work has entailed extensive review of the FAA's data and analytical methods and analysis and forecasting that is within the FAA guidelines.

- Impact of EU-U.S. Open Aviation Agreement - Campbell-Hill was a major subcontractor to Booz Allen Hamilton Ltd in London for the "EU-U.S. Open Aviation Area Study" for the Directorate General Energy and Transport of the European Commission. The study included an analysis of the potential impact of the Open Aviation Area on the US domestic market and an in-depth investigation of the economic effects of increasing foreign ownership limits for US carriers. Our firm was specifically chosen because of our expertise and recognition as experts in the U.S. aviation industry, and our work included a survey of U.S. carriers (and their association representatives) concerning the likely impact of the agreement (that was approved in early 2003).

- Economic Impact of Civil Aviation on the U.S. Economy – Campbell-Hill developed a model and supporting data that measured the economic impact of civil aviation on individual U.S. congressional districts and states for use in generating political support for policies of interest to U.S. airlines.

- Friedman Memorial Airport EIS: Campbell-Hill provided economic analysis on the probable impact from relocating the local airport in Sun Valley, Idaho including an intensive interview program with current and prospective airlines. The economic analysis included estimating the direct impact of the new airport on aircraft operating costs, weather-related delays and closures, and passenger drive times and the net effect on service and traffic levels. This study was funded and managed by the FAA's Northwest Mountain Regional Office in Renton, WA.

- Other Benefit/Cost Studies – In addition to the O'Hare work, Campbell-Hill has produced benefit-cost analyses submitted to the FAA for the purpose of (1) the decommission of Richards Gebauer Airport in Kansas City and (2) AIP funding for the Global TransPark in Kinston, NC.

- Other Economic Impact Studies – Campbell-Hill performed economic impact analysis for the following:
    - Planned new international flights for Hartford and Fresno airports and proposed international cargo services as part of route case proceedings.
    - The re-location of FedEx routes on Toronto Pearson Airport and the surrounding community.
    - New intra-Asia hubs for two U.S. cargo airlines.
    - Air express liberalization's effect on the China and Hong Kong economies.
    - NAFTA impact on U.S.-Mexico air trade.
    - Expanded low-cost carrier activity and associated security gate delays;
    - Analyzed the cost of TSA's proposed cargo screening policies on the air express industry.

BRIAN M. CAMPBELL

CHAIRMAN
CAMPBELL-HILL AVIATION GROUP

3630 Louisa Road (PO Box 430)
Keswick, VA 22947
(434) 293-5043

PROFESSIONAL EXPERIENCE

Dr. Campbell's career has been heavily concentrated in the economic elements of commercial air transportation. After graduating from the Columbia University Graduate School of Business Administration in 1968, he was employed for seven years by Simat, Helliesen & Eichner, Inc., a transportation consulting firm. Prior to his resignation from that firm in 1975, he held the position of Vice President of the Washington office.

Between 1976 and 1982, Dr. Campbell was a co-founder and senior executive of two new-entrant (post-U.S. deregulation) airlines, with primary responsibilities for planning and finance. The first of these new companies was Midway Airlines, Inc., where he held the position of Vice President of Finance and Administration from 1977 to 1980. After resigning from Midway, Dr. Campbell formed Air Chicago, Inc. and served as its Chairman and Chief Executive Officer through the planning and initial capitalization period.

Dr. Campbell returned to the consulting profession in 1982, and from 1987 until December 1993 he was a founding member of Leeper, Cambridge & Campbell, Inc. He held the position of President from 1991 to 1993. In December 1993 he formed The Campbell Aviation Group, Inc., the predecessor to the Campbell-Hill Aviation Group.

Dr. Campbell's particular expertise is in the economic analysis of aviation issues and opportunities. This includes financial, marketing, planning, and operational aspects of airlines, airports, and equipment manufacturers. Dr. Campbell's experience is well developed from both the research and executive viewpoints. He has served numerous clients in problem diagnosis, specification and analysis of alternative courses of action, development of strategic action plans, and implementation procedures and controls.

Throughout his career, Dr. Campbell has developed various analytical models and procedures for a broad variety of clients in all major sectors of the industry. For instance, in his airport economic forecasting practice, he led the development of the only comprehensive airport activity and passenger forecasting model that realistically accounts for inter-airport competition within a single region. He also has developed and implemented detailed costing, budgeting, and financial forecasting models for airlines.

Dr. Campbell's aviation expertise includes extensive consulting in air cargo and air express operations. He directed the firm's research and analysis for the Global Transpark (GTP) in North Carolina applying the system in other parts of the U.S. and elsewhere in the world. Along with Rex Edwards, Vice President, he directs the firm's consulting services for air cargo and air express carriers including the Cargo Airline Association.

As a consultant, Dr. Campbell has appeared as an expert witness in more than 75 adversarial proceedings before regulatory boards or commissions, representing private as well as government and non-profit organizations. This cross-section of cases includes routes, fares, mergers, initial certification, and industry performance evaluations. The majority of these case appearances were before the U.S. Civil Aeronautics Board and the U.S. Department of Transportation, and several occurred before the Canadian Transport Commission and the European Commission. Dr. Campbell has testified in U.S. federal courts, state administrative tribunals, the U.S. Congress, the Canadian Parliament. During the course of his consulting engagements he has made numerous presentations to U.S. DOT, DOJ and OMB staff on behalf of airline clients.

As a senior airline executive, Dr. Campbell raised millions of dollars of venture capital and several times that amount for lease and debt financing of used aircraft. He has managed an SEC registration for a public stock offering by a new-entrant airline; negotiated and successfully concluded purchase agreements for new and used flight equipment, spare parts inventories, training services, and airport and maintenance facilities; and managed the finance and accounting, purchasing/stores, planning, and administration departments of new operating carriers.

AREAS OF SPECIALIZATION

- Route system development and market planning
- Financial and economic impact analysis of environmental regulations
- Aircraft evaluations and fleet planning
- Marketing, sales, promotion, advertising, and pricing strategies
- Demand forecasting (passenger, property, activity/operations)
- Proforma financial statements and measures of performance
- Corporate organization structure and planning
- Development and preparation of business plans for targeted purposes
- Presentations to financial institutions and boards of directors
- Financial services (equity and debt)
- Merger and acquisition analyses, recommendations, and integration plans
- Litigation support and expert testimony
- Small community air service problems and plans for improvements
- Federal and local airport and airways policy issues
- Airport access, capacity, and noise regulation
- Airport planning (economic forecasting and air service marketing issues)

EDUCATION

Bachelor of Commerce, McGill University

M.B.A., University of Western Ontario

Ph.D. Business Administration, Columbia University

REX J. EDWARDS

VICE PRESIDENT
CAMPBELL-HILL AVIATION GROUP

700 N. Fairfax Street, Suite 300
Alexandria, VA 22314
(703) 470-4988

PROFESSIONAL EXPERIENCE

Rex Edwards has over 30 years of experience in the economic analysis, forecasting and modeling of existing and proposed transportation systems and facilities. He is proficient in creating transportation databases for market development strategies, infrastructure development planning and transportation systems analysis. He produces an annual data base of current and forecast air trade flows by market, commodity type, and U.S. state of origin/destination, and supplies extracts of these data for airport market analysis and route case proceedings. Mr. Edwards was the principal air and maritime specialist for a study for freight transportation demand forecasting for the Transportation Research Board. He has been the primary modeling and data specialist for environmental analysis by the Air Transport Association within the ICAO/CAEP process and has conducted multiple studies examining the industrial impacts of airport development in the U.S. and Asia. He frequently provides demand and flow forecasts for market studies, infrastructure financing, and court proceedings. He is a developer and programmer of software for transportation costing, systems modeling, and database management.

- Campbell-Hill Aviation Group, Vice President (July 2010 to Present)
- TranSystems/Campbell-Hill, Managing Director (December 2006 to July 2010)
- Independent Consultant (October 1996 to December 2006)
- Leeper, Cambridge & Campbell, Inc., Vice President/Founding Partner (1987 to 1996)
- Phillips Cartner & Co., Inc., Principal (1985 to 1987)
- Simat International, Ltd., Senior Analyst, (1983 to 1985)
- Exploration Services, Inc., Logging Engineer (1981 to 1983)
- Simat, Helliesen & Eichner, Inc., Analyst/Senior Analyst (1978 to 1981)

PROJECT DESCRIPTIONS

Aviation

- Developed a model and analysis for estimating the impact of a new express cargo hub on China's economy and transportation sector (FedEx).

- Responsible for traffic analysis, forecasting and modeling for the States of North Carolina, Ohio and Arizona and (2) cargo market development studies for Reno, Hartford, San Jose, Kansas City, Pittsburgh, Washington Dulles, Raleigh-Durham, Phoenix, Gary, San Diego and Toledo airports.

- Developed models, data and analysis for the air cargo section of the Washington-Baltimore Regional Airport System Plan including detailed forecasts of associated ground trucking activities.

- Provided detailed analysis of potential impact from liberalization of U.S.-EU air cargo markets for European Commission study.

- Primary analyst and forecaster for feasibility studies of industrial airports for North Carolina and Thailand.

- Developed a model and analysis for estimating air trade flows and the impact of air rights liberalization on economic development in China and Hong Kong (FedEx).

- Developed and updated model and supporting data to measure economic impact of commercial aviation on U.S. congressional districts and states (Air Transport Association).

- Developed data, methodologies and programs for an impact model relating airport and airspace capacity expansion to U.S. passenger delay levels and costs (for a group of U.S. aviation interests).

- Developed a worldwide aircraft database (currently being updated for use in future efforts), models and analysis to estimate the economic impact of proposed CAEP4 noise regulations on the world airline industry for the Air Transport Association (ATA), subsequently used by the FESG working group in its final analysis.

- Developed economic analysis of delays and capacity at Chicago O'Hare relative to proposed runway expansion including development of benefit-cost analysis and a review of airfield simulation modeling results.

- Developed models and data to measure the regional economic impact of: (1) US Airway's hub operations at Pittsburgh, (2) the Houston Airport System, (3) Fresno-Yosemite Airport and (4) FedEx's proposed operations at Toronto's Pearson International Airport.

Aviation (continued)

- Developed operational and economic impact analysis of air service expansion at Washington Dulles relative to capacity of passenger screening system.

- Developed economic impact analysis of proposed cargo screening policies on the air express industry and the economic impact analysis of NAFTA on U.S. air trade (FedEx).

- Developed a model and databases for measuring and forecasting emissions generated by commercial airlines for the ATA and the CAEP6 working group.

- Developed cost-benefit analysis of airport development and conversion for Federal Aviation Administration applications.

- Developed data and analysis for litigation on FedEx's Priority Mail contract with the U.S Postal Service.

- Developed data and exhibits in support of applications for USDOT international route authority by FedEx, UPS and Gemini Air Cargo.

Maritime/Intermodal

- Principal air and maritime specialist for Characteristics and Changes in Freight Transportation Demand, a freight transportation demand and forecasting study performed for TRB's National Cooperative Highway Research Program

- Wrote commissioned paper evaluating current status of the CDC Quarantine Station System at U.S. seaports including an extensive survey of industry and government participants (Institute of Medicine)

- Developed cost analysis models to evaluate new passenger/cargo ferry services, intermodal centers, and the efficiency of Defense Logistics Agency freight depots

- Developed cargo flow analysis, cargo forecasts and economic impact analysis for market studies or strategic plans for various U.S. and foreign ports.

- Developed market forecasts for proposed trailer/container-on-barge services for U.S. domestic trades and automated handling facilities at various U.S. and international ports.

- Primary economist in evaluation of new transportation technologies including fast Sealift ships, automated cargo handling systems, AutoStack rail cars, and port of entry cargo screening devices

Software Development

Developer and/or primary programmer for:

- required freight rate, transportation system and economic impact models;
- worldwide operational and fleet forecasting model measuring the impact of noise and emissions policies on airline revenues and costs;
- Waterway Efficiency Evaluation Model (WEEM) for analyzing impact of efficiency measures on the Upper Mississippi River and a cargo forecasting, costing and route allocation model (RIOCARG) for Orinoco-Apure River development in Venezuela;
- multi-port selection and cargo allocation model for studies designed to measure the market impact of new port terminals;
- Air Cargo Forecasting and Multiple Airport Allocation Model which forecasts air cargo production and consumption for a multi-airport region;
- Multi-terminal simulation model for analysis of intermodal/rail capabilities at Defense Logistics Agency depots;
- Inland Transportation Economic Impact Model for examining the potential impact of new highway and rail investment on coastal port development;

EDUCATION
B.A., Mathematics and Economics, College of William and Mary

CURRICULUM VITAE

JOHN Z. IMBRIE

Department of Mathematics
P. O. Box 400137
University of Virginia
Charlottesville, VA 22904-4137
434-924-4910

Degrees:

1980 Ph. D. in Physics, Harvard University
1979 A. M., Harvard University
1978 A. B., Magna Cum Laude, Harvard University

Positions:

1991- Professor of Mathematics, University of Virginia
1986-91 Associate Professor of Mathematics and of Physics, Harvard University
Spring 1986 Visiting Member, Courant Institute of Mathematical Sciences
1984-86 Assistant Professor of Physics, Harvard University
1981-84 Junior Fellow, Society of Fellows, Harvard University
Fall 1983 Eidgenössische Technische Hochschule, Zürich, Switzerland
Fall 1981 Institut des Hautes Études Scientifiques, Bures-sur-Yvette, France
1980-81 Post-Doctoral Fellow in Physics, Harvard University

Awards:

1986-88 Alfred P. Sloan Foundation Fellowship
1988-93 Presidential Young Investigator

Memberships:

International Association for Mathematical Physics, American Mathematical Society, American Geophysical Union

Research Interests:

Mathematical Physics, probability, and statistical mechanics. Mathematical models of climate and global ice volume.

Statistics work:

Taught courses in statistics and probability at the University of Virginia
Statistical consulting for Cargo Airline Association and Air Transport Association
Statistical consultant for research in medicine

Other professional activities:
Member of the editorial board of *Communications in Mathematical Physics*, 2002-7
Director of the Institute of Mathematical Science at the University of Virginia.
Department of Education grant: Graduate Assistantships for Areas of National Need (3 years)

Selected Publications:

"Modeling the Climatic Response to Orbital Variations," J. Imbrie and J. Z. Imbrie. *Science* **207**, 943-953 (1980).

"Lower Critical Dimension of the Random-Field Ising Model," J. Z. Imbrie. *Phys. Rev. Lett.* **53**, 1747-1750 (1984).

"Improved Perturbation Expansion for Disordered Systems: Beating Griffiths Singularities," J. Fröhlich and J. Z. Imbrie. *Commun. Math. Phys.* **96**, 145-180 (1984).

"Diffusion of Directed Polymers in a Random Environment," J. Z. Imbrie and T. Spencer. *Jour. Stat. Phys.* **52**, 609-622 (1988).

"Effective Action and Cluster Properties of the Abelian Higgs Model," T. Balaban, J. Z. Imbrie, and A. Jaffe. *Commun. Math. Phys.* **114**, 257-315 (1988).

"A Unified Approach to Phase Diagrams in Field Theory and Statistical Mechanics," C. Borgs and J. Z. Imbrie. *Commun. Math. Phys.* **123**, 305-328 (1989).

"Crossover Finite-Size Scaling at First-Order Transitions," C. Borgs and J. Z. Imbrie. *Jour. Stat. Phys.* **69**, 487-538 (1992).

"The Mechanics Underlying Laparoscopic Intra-Abdominal Surgery for Obese Patients," S. P. Robinson, M. Hirtle, J. Z. Imbrie, M. Moore. J. Laparoendosc. *Adv. Surg. Tech.* A **8**,11-18 (1998).

"Interventions to Reduce Decibel Levels on Patient Care Units," M. M. Moore, N. Diem, P. N. Stanton, S. P. Robinson, B. Ryals, J. Z. Imbrie, W. Spotnitz. *Am. Surg.* **64**, 894-899 (1998).

"Association of Infiltrating Lobular Carcinoma with Positive Surgical Margins After Breast-Conservation Therapy," M. M. Moore, G. Borossa, J. Z. Imbrie, R. Fechner, J. Harvey, C. Slingluff, R. Adams, and J. Hanks. *Ann. Surg.* **231**, 877-882 (2000).

"Intraoperative Ultrasound is Associated with Clear Lumpectomy Margins for Palpable Infiltrating Ductal Breast Cancer," M. M. Moore, L. A. Whitney, L. Cerilli, J. Z. Imbrie, M. Bunch, V. B. Simpson, J. B. Hanks. *Ann. Surg.* **233**, 761-768 (2001).

"Branched Polymers and Dimensional Reduction," D. C. Brydges and J. Z. Imbrie. *Ann. Math.* **158**, 1019-1039 (2003). arXiv:math-ph/0107005.

"Dimensional Reduction and Crossover to Mean-Field Behavior for Branched Polymers," J. Z. Imbrie. *Ann. Henri Poincaré* **4**, S445-S458 (2003). arXiv:math-ph/0303015.

"Dimensional Reduction Formulas for Branched Polymer Correlation Functions," D. C. Brydges and J. Z. Imbrie. *Jour. Stat. Phys.* **110**, 503-518 (2003). arXiv:math-ph/0203055.

"Dimensional Reduction for Directed Branched Polymers," J. Z. Imbrie, *J. Phys. A: Math. Gen.* **37**, L137-L142 (2004). arXiv:math-ph/0402074.

"Functional integral representations for self-avoiding walk," D. C. Brydges, J. Z. Imbrie, and G. Slade, *Probability Surveys*, **6**, 34-61 (2009), arXiv:0906.0922.

APPENDIX B:

Economic Impacts of Increased Cargo All-Airline
Cost on the U.S. Economy

Appendix B

Economic Impacts of Increased All-Cargo Airline Costs on the U.S. Economy

The proposed rule's cost and operational impacts on the U.S. all-cargo industry are significant and will result in negative economic effects throughout the U.S. economy. The direct effects can be categorized as follows:

- increased operating costs that will proportionally increase domestic and international all-cargo freight and express rates
- flight delays will increase point-to-point delivery times and network disruptions will severely hamper the reliability and value-added demanded by air shippers
- the combination of increased rates and potentially deteriorated service will increase the delivered price of air-dependent products leading to:
    - reduced demand for air-cargo services provided by U.S. all-cargo carriers (including trade between two foreign countries),
    - reduced sales for air-dependent products and associated financial and economic impacts, and
    - induced impacts (multiplier effect) throughout the U.S. economy due to direct impacts on the air transportation and manufacturing sectors.
- the competitive cost and service disadvantage of U.S. all-cargo airlines relative to foreign flag carriers will impact in the following sectors:
    - U.S. import and export markets,
    - overseas foreign-to-foreign markets (for express and general freight), and
    - non-scheduled charter activity.
- the rule will have a disproportionate impact on many small businesses that are critical to the all-cargo sector, and vice versa.

B.1 Direct Impact on Air Freight Rates and Service Levels

The proposed rule will directly affect the aircraft operating costs for U.S. all-cargo airlines, and those additional costs will be passed on to shippers and ultimately to consumers of products shipped by air or containing components that are shipped by air. The U.S. all-cargo sector is composed of specialized airlines each of which satisfies a particular market niche for which substitute service in not easily available. The integrated carriers (FedEx and UPS) have developed highly sophisticated and managed networks that provide expedited transport between almost every origin and destination in the world. The scheduled general freight carriers provide capacity on key trade lanes where passenger-based belly capacity is not sufficient, while the non-scheduled charter operators provide quick-response services for military and other specialized needs. Air cargo shippers that depend on these services will necessarily absorb the costs resulting from this rule.

The level of cost impact was estimated by comparing the projected costs developed in the CAA airline survey (using an average of the first two years) to YE Q2 2010 operating expenses inclusive of air and ground costs as reported by the carriers.[1] On average, the projected annual rule-related costs would increase total operating costs by 1.7 percent. It is assumed that a commensurate rate increase would be required by the carriers.

The increased cost of transporting goods will translate into higher prices for selected air-shipped commodities and thereby cause a reduced level of sales (proportional to the cost increase assuming an elasticity of -1.0). Reduced sales will result in direct reductions in employment and payroll for the shipper, as well as indirect impact based on multiplier effects that ripples throughout the economy. The reduced sales for affected commodities will also reduce demand for U.S. all-cargo air services with proportional impacts on sales, payroll and employment. This demand impact will be particularly evident in markets where U.S. airlines compete with foreign flag carriers, particularly for overseas foreign-to-foreign trade.

An important element of the all-cargo services delivered by CAA and other U.S. airlines is the high level of reliable, expedited and secure transport that justifies the high freight rates relative to other modes. While air transport is the only option for some shipments, in most cases

[1] An adjustment was made to reported costs to account for some carriers that do not report ground-related costs in their Form 41 filings.

shipments move by air based on a positive tradeoff between service level and price when compared to ground modes. In addition to increasing the cost of air services, the proposed rule will significantly disrupt the distribution networks that are used to deliver high value services. Delayed and cancelled flights will not only extend delivery times but they will seriously degrade the value of these services to shipper supply chains. While the short response period did not permit a full investigation of these impacts, it should be noted that a USAID study[2] estimated that one day of delay for high-value products, such as those typically transported by air, is worth up to 1 percent of the total shipment value. The costs of delay could easily overwhelm the projected increased costs (rates) for air transport.

The impact would disproportionally fall on U.S. small business. The U.S. Department of Commerce estimates that 91% of all exporters are small businesses and a similar relationship should apply to shippers affected by this rule.[3]

B.2 Estimated Economic Impacts

The annual economic impact of the increased air transport costs can be estimated by comparing traffic patterns with projected rate increases and various economic variables for the shipper and airline sector. The impact estimates are based on the following assumptions:

Traffic Profile

- Annual ton-miles of freight traffic (domestic and international) for U.S. all-cargo airlines were based on CY 2009 Form 41 statistics (T-1 schedule).
- Value and shipment weight characteristics for U.S. domestic traffic were based on the 2007 BTS Commodity Flow Survey. Factors for average shipment distance and average value per ton were applied separately to "Under 100 Pound" and "Over 100 Pound" shipment size categories in order to estimate total tons and total shipment value.[4]

[2] Calculating Tariff Equivalents for Time in Trade, U.S. Agency of International Development (March 2007).
[3] U.S. Department of Commerce, International Trade Administration based on 2008 data.
[4] The CFS assigns air shipment over 100 pounds to its "Air (included truck and air)" category and shipments under 100 pounds to the "Parcel, U.S.P.S. or courier" category that also includes ground traffic. The ratio applied to the U.S. carrier traffic combined 100% of the "Air" category with a portion of the other category using 2007 traffic statistics for the integrated carriers.

- Value and shipment weight characteristics for U.S. import and export traffic were based on average shipment distance (based on BTS "Air Freight Summary Data" for CY 2009) and average value per ton derived as an average of all U.S. foreign trade for CY 2009 (based on Bureau of the Census Foreign Trade Statistics).

Revenue/Rate Profile

- Average all-cargo rates (or yield) per ton-mile for air transport were derived as an average of all U.S. all-cargo carriers filing Form 41, P-11 schedule data.
- Total rates (inclusive of ground charges) were estimated based on a ratio comparing total revenues to air freight revenues for carriers filing P-11 schedule data (with some adjustments for carriers that do not file ground transport data).
- Total all-cargo revenues (domestic and international) are based on the traffic levels and average yields and compared to total commodity value (5% for domestic and 3% for international).

Trade Impact Profile

- Increased yields are based on a 1.7% increase in costs as derived above.
- The net increase in transport costs is compared to total shipment value and a revenue impact derived assuming a -1.0 elasticity (i.e., a 1% increase in commodity price due to increased cost results in a 1% decline in sales). Domestic revenue impacts assume 100% of the impact, while international impacts were assumed at 60% as a combination of export sales and value-added from import trade.
- Earnings impacts for domestic trade assume a 20% share of total revenue impact while the employment impact is based on $45,000 per employee.
- International impacts assume a 20% earnings-to-sales ratio and $35,000 per employee (to account for a higher share of trade-related services).
- Total trade-related impacts are calculated from direct impacts assuming a 2.50 multiplier.

Transportation Impacts on U.S. All-Cargo Carriers

- The resulting impact on U.S. all-cargo carrier revenues assumes a decline proportional to the domestic and international shipment sales impact, plus an assumption of foreign-to-foreign impacts equal to that based on U.S. international trade.
- Earnings and employment impacts are derived based on the average earnings-to-sales ratio and average earnings per employee calculated from the 2007 Economic Census for the following industries (based on 6-digit NAICS classification):
    - Scheduled freight air transportation
    - Nonscheduled chartered freight air transportation
    - Couriers and express delivery services
- The multipliers applied to the direct revenue, earnings and employment impacts were based on relationships derived for the air cargo industry in the FAA study, The Economic Impact of Civil Aviation on the U.S. Economy (October 2008).

The resulting impacts are summarized in Table B-1. Annual direct revenue impacts to U.S. businesses would be $541 million with $110 million in lost earnings and 2,700 lost jobs. Total annual impacts (after the multiplier effect) would be $1.4 billion in lost revenues, $283 million in lost earnings, and there would be 7,000 jobs permanently lost.

Table B-1

Summary of Annual Economic Impacts

	Revenue Impact (million $)	Earnings Impact (million $)	Employment Impact (job)
Trade Impact			
U.S. Domestic	$384	$77	1,705
U.S. Imports and Exports	$125	$25	758
	$509	$102	2,463
Transportation Impact			
U.S. Domestic	$20		
U.S. Imports and Exports	$6		
Foreign-to-Foreign	$6		
	$32	$8	236
Combined Impacts			
Direct Impacts	$541	$110	2,699
Induced Impacts[5]	$821	$173	4,307
Total Impacts	$1,362	$283	7,006

In terms of total impacts over a ten-year period, the direct revenue impact would $8.4 billion in NPV terms using the FAA's assumption that starts costs in 2013. Based on an assumption that the rule's effects would start in 2011, the revenue impacts would be $9.6 billion over ten years (in NPV terms). The one-time job loss for the entire period is 7,000.

[5] Induced impacts are calculated as the difference between total impacts and direct impacts. Total impacts are estimated from direct impacts using the following multipliers:

	Revenue	Earnings	Employment
Trade	2.50	2.50	2.50
Transportation	2.84	3.47	3.59

Comments of the Cargo Airline Association

Flightcrew Member Duty and Rest Requirements; Proposed Rule, FAA-2009-1093

November 15, 2010

Attachment H

In the course of setting forth its proposed regulations, the FAA has posed 35 questions for members of the aviation community to answer. Following are the comments of the Cargo Airline Association with respect to these questions:

1. **Please comment on adopting maximum FDPs. Should the maximum FDP vary based on time of day? Should it vary based on the number of scheduled flight segments? Should the proposed limits be modified up or down, and to what degree? Please provide supporting data.**

The Association submitted a detailed proposal as part of the ARC process for the FAA on behalf of the all-cargo industry. [1] That proposal included specific maximum flight duty periods for domestic operations, with lower FDPs during the Window of Circadian Low (WOCL) and a reduction after the fourth flight segment. The Association firmly believes that the key to mitigating fatigue in an aviation context is providing adequate rest prior to a duty period. CAA supports an expanded rest period (see Question 19) and with such expanded rest there is no need to overly restrict the flight duty period. The CAA proposal reflects this philosophy. Additionally, the Association would like to emphasize that any FDP limits for U.S. air carriers should not be more restrictive than the most restrictive international standards. Any deviation from this approach puts U.S. air carriers at an economic and competitive disadvantage to foreign air carriers.

2. **Please comment on permitting flight crew members and carriers to operate beyond a scheduled FDP. Is the proposed 2-hour extension appropriate? Is the restriction on a single occurrence beyond 30 minutes in a 168-hour period appropriate? Should a flightcrew member be restricted to a single occurrence regardless of the length of the extension? Please provide supporting data.**

Operating beyond a scheduled FDP should be permitted in all cases, provided that such extension does not exceed to maximum limits for FDPs that are finally enacted. If duty periods need to be extended beyond maximum FDP limits due to circumstances beyond the control of the carrier, such extensions should be permitted so long as increased rest is provided at the end of the FDP. Such a regulatory scheme, which permits carriers to complete its planned operations, is important to enable carriers to provide the service requested by its customers. Moreover, restricting extensions to one occurrence in any consecutive 168-hour period is not scientifically based, does not increase safety and simply puts U.S. carriers at a distinct competitive disadvantage.

[1] *See* Attachment A.

3. **Please comment on the proposed schedule reliability reporting requirements. Should carriers be required to report on crew pairings that exceed the scheduled FDP, but not the maximum FDP listed in the FDP table?**

The Association opposes the FAA proposal for schedule reliability as outlined in § 117.9. The FAA offers little rationale for requiring reports to be submitted by the carrier, unless such extensions go beyond the maximum FDP. Indeed, any regulation within the allowable maximum FDP is an unnecessary and unwarranted intrusion into an area that is better left to the collective bargaining process.

4. **Should carriers be required to report on more parameters, such as cumulative duty hours or daily flight time? If so, why?**

No, carriers should not be required to report on more parameters such as cumulative duty or daily flight time. As noted above, FAA should only require reports when the actual limits are exceeded. It is important to also note that FAA inspections and enforcement actions would also serve to ensure compliance.

5. **What should be the interval between reporting requirements?**

The Association does not support any reporting requirements. However, if the FAA moves forward with their approach, the interval between reporting requirements should be no more than on a quarterly basis.

6. **How long after discovering a problematic crew pairing should the carrier be afforded to correct the scheduling problem?**

The FAA is aware of the airline's complex crew scheduling system, staffed by entire departments within a company. The crew pairing decisions are made at varying times for any one company. Therefore, FAA should require the carrier correct any deficiencies no more than on a quarterly basis.

7. **Is a 3-day adjustment to a new theater of operations sufficient for an individual to acclimate to a new theater?**

As noted in the foregoing Comments, there is no scientific rationale for requiring a 3-day adjustment to a new theater of operations. In fact, the concept of acclimatization is truly variable person to person. One flightcrew member may be properly acclimatized sooner than another and other factors do also contribute to acclimatization. The one constant which is supported by science is that preceding rest is the key to mitigating fatigue. For some, a 2-day adjustment may be more than sufficient for the safe operation of a flight.

8. Is a 36-hour break from duty sufficient for an individual to acclimate to a new theater?

The Association's proposal recommends 30 hours free from duty to become acclimatized. The 30 hours allows for one night's sleep. There is no scientific reason provided to require more. Moreover, the appropriate break from duty may also be dependent on the number of time zones crossed and what time the particular flightcrew member is entering his/her WOCL.

9. Should flightcrew members be given a longer rest period when returning to home base than would otherwise be provided based on moving to a new theater?

The Association is unclear on the intent of this question. However, any difference in rest availability is not sufficient to warrant different treatment for a crewmember returning home,

10. Should the FAA have different requirements for flightcrew members who have been away from their home base for more than 168 hours? If so, why?

No. As long as proper rest is provided, fatigue will be sufficiently mitigated.

11. Should the FAA require additional rest opportunities for multiple pairings between two time zones that have approximately 24-hour layovers at each destination? What if the scheduled FDPs are well within the maximum in the applicable FDP table or augmentation table?

No. The FAA's prescribed FDP limits will take care of this particular scenario. Also, additional rest should allow for acclimatization.

12. If the FAA adopts variable FDP limits, is there a continued need for daily flight time limits?

No, the Association opposes any flight time limits. The key to preventing and combating fatigue in aviation operations is the opportunity for adequate rest. Such rest can be protected by effective duty time limitations and rest period requirements with no need to establish limits on flight time. Such an approach is wholly consistent with current science. In addition, it is important to note that any imposition of flight time limits would be contrary to the regulatory schemes in the rest of the world. See, for example, CAP 371 and EASA Subpart Q.

13. If the FAA retains daily flight time limits, should they be higher or lower than proposed? Please provide data supporting the answer.

Although the Association opposes any flight time limits as unnecessary from a safety perspective (see answer to Question 12, above), **if** such limits are established, they should be based on an established reduction from the FDP limits and mirror the approach taken by the Association in its proposal submitted to the ARC and the FAA. By limiting the FDP and including segment reductions on those limits, the FAA has already placed the burden on the air carrier to impose on itself limits on a flighcrew member's flight time.

14. Should modifications be made to the proposed flight time limits to recognize relationship between realistic flight time limits and the number of flight segments in an FDP?

Again, the Association feels strongly that **no** flight time limits are necessary or appropriate. Please note, however, that the Association's contingent proposal set forth in the answer to Question 13, above, does contain modifications of any regulated flight times based on the number of segments flown in line with the FDP limits and segment reductions after the fourth flight segment.

15. Should augmentation be allowed for FDPs that consist of more than three flight segments? Does it matter if each segment provides an opportunity for some rest?

Any limit on the number of segments for augmentation purposes should be scientifically based. That being said, augmentation should be allowed for FDPs that consist of more than three flight segments provided adequate rest is provided. The opportunity for on-board sleep should be given proper credit in accordance with science.

16. Should flight time be limited to 16 hours maximum within an FDP, regardless of the number of flightcrew members aboard the aircraft, unless a carrier has an approved FRMS?

No. As noted above, flight time should not be limited, provided adequate rest is provided through augmentation on long haul flights. The industry supports the notion of FRMS provided the criteria is clear and the approval process within the FAA firmly established prior to the implementation of this rule.

17. Should some level of credit be given for in-flight rest in a coach seat? Is so, what level of credit should be allowed? Please provide supporting data.

The all-cargo industry is a different type of operation from the passenger airline component. We operate aircraft that do not have traditional "coach seats" installed within the cabin for in-flight rest opportunities. However, some all-cargo aircraft do have lay flat sleep accommodations for in-flight rest, but the definitions in the proposed rule do not appear to give credit for such sleep accommodations.. The definitions of rest facilities all refer to the passenger cabin. Additional analysis is needed on in-flight sleep accommodations before moving forward with the rule as proposed**.**

18. Is there any reason to prohibit augmentation on domestic flights assuming the flight meets the required in-flight rest periods proposed today?

No, it should not matter whether the flight is domestic or international. Assuming the proper rest opportunities are provided and limits on FDP are followed, augmentation should be allowed domestically.

19. Are the required rest periods appropriate?

The Association's proposal provided for longer rest opportunities than what is required under the current rules and we continue to support that approach. If FAA is seeking comment on the proposed required in-flight rest periods, the Association opposes the concept of regulating in-flight rest especially the two-hour requirement to rest prior to landing.

20. Should credit be allowed if a flightcrew member is not type-rated and qualified as a PIC or SIC?

Yes, credit should be given for the Flight Engineer on a three/four-person operation. The addition of the third person allows other flightcrew members the opportunity to rest or engage in other scientifically-proven methods to mitigate fatigue, such as light exercise.

21. Please comment on whether a single occupancy rest facility provides a better opportunity for sleep or a better quality of rest than a multiple occupancy facility such as a multi-bed living quarters. Please provide supporting data.

While single occupancy facilities may be better, multi-bed quarters, if appropriately managed, are sufficient to provide restorative rest. Other factors are also important such as temperature control, ambient noise and the amount of light when evaluating rest accommodations. Moreover, individual variables can also impact a person's ability to sleep even more so than whether they are in a single occupancy rest facility or multi-bed quarters. That being said, the Association does not support the FAA mandating a single occupancy rest facility because that is not the only factor to whether adequate rest will result.

22. Should there be any restriction on consecutive nighttime operations? If not, why?

No. Placing restrictions on consecutive nighttime operations results in the presumably unintended consequence of working every week and having sequences of flights where there is a day off in between, thereby creating more fatigue. More "first nights" are created under such a scenario as flightcrew members would have to shift between typical daytime wakefulness to then flying during nighttime hours. FAA is also concerned about the creation of such a scenario, ". . . taking an approach that may appear safer in modeling could lead to adverse safety impacts in the real world".[2]

23. If the nighttime sleep opportunity is less than that contemplated under the split duty provisions of this notice, should a carrier be allowed to assign crew pairing sets in excess of three consecutive nights?

Yes. If a split duty period provides for a rest opportunity then extensions to FDPs and continued night operations past the third consecutive nights are possible. A crewmember will sleep during the day and the ensuing sleep obtained during the hub turn prevents the onset of cumulative fatigue. With no relief from this proposal our operation will develop into a monthly

[2] 75 Fed. Reg. at 55867.

line of numerous 'first night' operations compared with our current operation. This will result in the unintended consequence of more 'first night' operations – typically the most difficult night to operate - and the buildup of cumulative fatigue in our crewforce. Additionally, the current operation results in longer periods of time off resulting in higher alertness levels.

Split duty and consecutive night operations should be allowed as follows:

Any period of at least one hour of rest 'behind the door' can be considered for credit towards extending FDPs. Rest behind the door is defined as the total time in the sleep facility minus 30 minutes. The 30 minutes allows time to fall asleep as well as recover from sleep prior to reporting.

Duty Start	Credit to FDP limit
1700-0359	1 to 1
0400-0659	2 to 1
0700-1659	3 to 1

In no case through the use of split duty extensions should a FDP exceed 15 hours operational. Nor should split duty apply to augmented operations.

24. If the nighttime sleep opportunity meets the split duty provisions of this notice, should the carrier be allowed to extend the flight duty period as well as the number of consecutive nighttime flight duty periods? Why or why not?

See response to Question 23 above.

25. Should a fourth night of consecutive nighttime duty be permitted if the flightcrew member is provided a 14-hour rest period between nights three and four?

From operational experience in the all-cargo environment and with the proper mitigations based on the sleep science, no additional restrictions or accommodations are necessary beyond the current limits and rest requirements proposed in the rule. Provided that at least the minimum rest required are met for the FDP assigned, no additional rest for consecutive nighttime duty should be required.

26. Please comment on whether a 16 maximum hour FDP for long call reserve is appropriate when the maximum FDP for a lineholding flightcrew member is 13 hours.

The question posed is improperly worded and cannot be answered as the Association sees no connection between FDP and long call reserve because long call reserve is not considered duty.

27. Please comment on whether the proposed maximum extended FDP of 22 hours for an augmented flightcrew member is appropriate. If not, provide an alternative maximum FDP.

We support the maximum extended FDP of 22 hours for an augmented crew that is operating within its reserve duty period during short call reserve.

28. Please comment on whether a certificate holder should receive credit for not calling a flightcrew member during the WOCL while on reserve.

Yes, a certificate holder should receive credit for not calling a flightcrew members during their WOCL while on reserve. It can reasonably be assumed that the flightcrew member would be resting during this time.

29. Should minimum required rest while on reserve status be greater than the amount required for a lineholding flightcrew member? If so, please provide supporting data; if not, please provide rationale.

Greater required rest is not necessary for flightcrew members on reserve. Sleep science does not make distinctions between those on reserve and lineholding flightcrew members. Moreover, those flightcrew members on reserve, especially short call reserve should be resting even more in anticipation of being called to fly.

30. Please comment on the level of complexity of the proposed reserve system.

The system proposed by the FAA is extremely complex and unnecessarily limiting with regard to the use of reserve flightcrew members. If the proposed rule were finalized as written, air carriers would be unable to use reserve crew for the purpose originally contemplated. For the first time, FAA is regulating reserve. The industry deserves a system that is logical and safe, but appropriately utilizes the reserve crew. With regard to the specific proposed provisions, the Association opposes classifying short call reserve as duty. Moreover, unscheduled carriers, by the very nature of their operations utilize reserve crewmembers much more frequently than scheduled carriers. It is crucial that FAA establish a reserve regime that can fit into the model for unscheduled/on-demand operations and that is not overly complex.

31. The FAA seeks input on the appropriate cumulative limits to place on duty, flight duty periods and flight time. Is there a need for all the proposed limits? Should there be more limits (e.g., biweekly, or quarterly limits)?

As previously stated, the Association believes that limits on flight times are not necessary. Regarding whether other limits are necessary, the Association would refer the FAA back to its original proposal on cumulative duty limits.

32. The FAA also asks for comments on measuring limits on an hourly rather than daily or monthly basis. Does this approach make sense for some time periods but not for others?

For simplicity sake and to avoid confusion in implementation, the hourly rate for measuring limits makes the most sense. The look back provision of 168-hours also makes sense as the body clock operates in hours, not days or months.

33. If transportation is not considered part of the mandatory rest period, is there a need for a longer rest period for international flights?

No. However, as offered in the Association's proposal, the rest time calculation should begin at time of release after the flight. Also, FAA has proposed additional protections for international operations for acclimatization and fatigue mitigation.

34. The FAA requests comments on whether some elements of an FRMS, such as an incident reporting system, would be better addressed through a voluntary disclosure program than through a regulatory mandate.

The Association supports FAA's efforts to put forward voluntary disclosure programs aimed at enhancing safety. This particular question is difficult to answer without knowing what elements will be required through a regulatory mandate for a FRMS. For instance, whether incident reporting should be part of a voluntary program or a regulated program depends upon FAA's purpose and use of the data on incidents.

35. Are there other types of operations that should be excepted from the general requirements of the proposal? If so, what are they, and why do they need to be accommodated absent an FRMS?

Any emergency/life-saving operations, humanitarian/aid and military or government charter operation should be exempted. "One Size" does not fit all carriers operating currently under Subparts Q, R and S. CAA expects language within the NPRM to support non-scheduled, on-demand and critical AMC missions.

TAB 11

BEFORE THE
FEDERAL AVIATION ADMINISTRATION
WASHINGTON, D.C.

Flightcrew Member Duty and Rest Requirements

Docket No. FAA-2009-1093

Comments of Federal Express Corporation, d/b/a FedEx Express

Inquiries concerning these Comments should be addressed to:

J. Mark Hansen
FedEx Express
3620 Hacks Cross Road
Building B, 3rd Floor
Memphis, TN 38125
901-434-8583

November 15, 2010

TABLE OF CONTENTS

1. Introduction / Preamble

FedEx welcomes the opportunity to contribute its comments to the proposed changes to the Federal Aviation Regulations (FARs) and supports the FAA's efforts to update long overdue changes to Flight and Duty Time rules. FedEx has been an active participant in these efforts from the A-332 (Ultra-Long Range Flight) discussions and as a primary member on the Aviation Rulemaking Committee in the summer of 2009. Fatigue and crew-member alertness is a major concern at FedEx due to our round the clock operations. We have been conducting night operations for 30+ years and have a deep respect for the hazards of fatigue and their impact on flight safety. Our flight operations department has already implemented many fatigue mitigating policies and created facilities to enable pilots to obtain rest during their duty period which improves their overall alertness. Our pilot scheduling improvement group is an in house organization which reviews all preliminary trips to ensure the best combination of crew alertness, current sleep science and company goals. Our relationship with the ALPA and our current contract have also evolved to emphasize our understanding of fatigue and resulted in many progressive improvements to our operation. Additionally 2 years ago FedEx began the development of an alertness model based on known science and operational experience of sleep patterns to be utilized as a tool to combat fatigue by addressing and revising problematic flight sequences.

A review of current regulations and the implementation of science based improvements will result in a more physiologically sound set of rules and an overall increase in aviation safety. While this is complex, it is vital that the resulting changes to regulations be simple to understand and most importantly result in safer operations.

FedEx is an active member of both the Airline Transport Association of America (ATA) and the Cargo Airline Association (CAA). As such, we were instrumental in aiding them in drafting their response to the FAA's NPRM. We strongly support their recommendations (with minor clarifications / concerns listed here). Our recommendations to the proposed rules will result in improvements that will protect flightcrew members, the general public, and the FedEx business model.

One major concern of FedEx is the fact that all-cargo operations are significantly different than the passenger carrier model. Our service provides a critical component to the national economy and we have developed a system that safely operates in this time critical /unpredictable business. The FAA has proposed a one-dimensional system that is modeled around the domestic passenger structure and has ignored the differing characteristics of the cargo industry. Successfully mitigating flightcrew member fatigue is the goal of the NPRM, but there seems to be a rush to action that ignores appropriate scientific data and a company's operational specifics to improve the regulatory scheme.

With regards to references to the FedEx sleep model, please consider the following statement from sleep expert Hans P.A. Van Dongen, PH.D. "In the absence of a validated model for predicting fatigue in aviation, FedEx has taken multiple proactive steps to produce fatigue-friendly schedules. Fatigue mitigation strategies currently in place include a series of scheduling policies that are more conservative than present FAA guidelines, active pre-scheduling and schedule-maintenance evaluation of fatigue risk with a mandate for schedule re-optimization, hub-based sleep facilities, a current and relevant fatigue education program, a science-based fatigue prediction model in development to capture the wide range schedules flown in FedEx operations (with fatigue prediction experts from Washington State University), and a roadmap for field data collection for the purpose of validation and refinement of this model. All this, combined with broad recognition of the challenges of fatigue across the breadth of FedEx operations and a commitment to continuing improvements in this area, puts FedEx at the forefront of fatigue risk management in aviation."

2. 35 Questions Posed by the FAA and Responses

1) Please comment on adopting maximum FDPs. Should the maximum FDP vary based on time of day?

Yes, a varying FDP based on the time of day is appropriate. The key to mitigating fatigue is providing adequate rest prior to the duty period. For crews of less than 4, the FDP should be based on the crew show time. If the crew consists of 4 crewmembers then the FDP limit should be 18 hours providing a Class 1 Rest Facility is available. None of the cited accidents in the FAA regulatory impact analysis were conducted by augmented crews. Additionally, please reference the attachment "Scientific Issues Regarding NPRM by Drs Belenky and Graeber (point 7) for info regarding the understanding of show time and its impact on duty limits.

Should it vary based on the number of scheduled flight segments?

Yes, however the graph on page 143 (Table B) should be changed to allow a minimum 11 hours of FDP for up to 4 segments. No degradation to the FDP tables should occur for up to 4 flight segments.

Should the proposed limits be modified up or down, and to what degree? Please provide supporting data.

This is a major concern of FedEx: split duty operation is a large part of the FedEx business model. Split duty operations occur between flights while our cargo is being offloaded, sorted, and reloaded. This type of operation represents over 60% of our flying. During this time crewmembers are afforded the opportunity to obtain quality sleep. Recognition of our night operations, our efforts in fatigue mitigation, and consideration of the science of sleep warrant an increase in the FDP for our split duty operations.

The report "Scientific Issues Regarding NPRM by Drs. Belenky and Graeber (comment #3) supports split duty operations by recognizing the recuperative value of resting between flights within the same duty period. In this report Dr Belenky suggests a 1 to 1 recovery for sleep episodes of as low as 20 minutes. During the night time operation both the circadian rhythm and the homeostatic sleep pressure are conducive to sleep and support our desire for a 1 to 1 extension.

Dr Hursh's study "Consecutive Night Duty Periods with Mid-duty Sleep Opportunities" also supports the feasibility of extending FDPs following rest opportunities because of increased alertness levels. The duties analyzed in his paper did not count the rest period towards the total FDP; in effect his analysis reflects an alertness that represents a one to one credit for split duty rest periods.

The inability to allow split duty operations will result in the unintended consequence of actually increasing fatigue in our crewmembers (due to fragmented line construction and multiple 'first night' flights). Our own sleep model illustrates that the crewmember is actually more rested while operating week on / week off night hub turns than the proposed rules would allow. (1) The *overall FAA recommended rules are actually a step backwards for FedEx operations with regards to our historical use of split duty flying and overall crew alertness. The analysis of our Airbus domestic fleet revealed that while the reconstruction of our trips under the proposed rules produced a slightly higher alertness the resulting lines indicated an overall reduction in alertness levels. The FAA proposal resulted in 37% more night duties infringing on the WOCL and 60% more 'first night' operations. Our recommendation concerning split duty and FDP for non-augmented operations is:*

Given the appropriate opportunity for rest, FDPs should be extended to 14 hours. For example, during the 0000 to 0359 diurnal the maximum scheduled flight duty period is 9 hours. For that crewmember to extend to 14 hours they would need 5+30 hours behind the door. Typically, this would only be a factor during a major weather event. This aligns with the flight duty period of an augmented crew. In no case do we recommend an operational limit to exceed 15 hours. Rest during a split duty is defined as any period of at least one hour of rest 'behind the door'. This rest can be considered for credit towards extending FDPs. Rest behind the door is defined as the total time in the sleep facility minus 30 minutes. The 30 minutes allows time to fall asleep as well as recover from sleep prior to reporting.

Duty Start	*Credit to FDP limit*
1700-0359	*1 to 1*
0400-0659	*2 to 1*
0700-1659	*3 to 1*

In no case through the use of split duty extensions should a FDP exceed 15 hours operational. Nor should split duty apply to augmented operations.

2) Please comment on permitting flight-crew members and carriers to operate beyond a scheduled FDP. Is the proposed 2-hour extension appropriate?

We object to the proposed limits to an extension to the scheduled flight duty period. An extension past the scheduled FDP should be allowed provided that extension does not violate the maximum FDP limit. The PIC already has the authority and responsibility to ensure safety throughout the operation.

Is the restriction on a single occurrence beyond 30 minutes in a 168-hour period appropriate?

No, there is no scientific data to support the 168 hour standard. It is unnecessary and too restrictive. We agree that there should not be two consecutive extensions, but with an adequate rest period for recovery (reset of rest bank) more than one extension event is possible during a 168 hour period. An ensuing rest period of at least as long as the preceding duty should allow for adequate recovery and alertness.

Should a flight-crew member be restricted to a single occurrence regardless of the length of the extension? Please provide supporting data.

No. With adequate intervening rest periods complete recovery is possible and results in a return to normal alert levels and performance. Please reference attached "Sleep Issues Regarding NPRM (attachment #1).

FedEx went to great lengths in considering the implications of this requirement. FedEx enlisted the help of the Seabury Group to independently analyze our proposed operation under the new rule. To maintain operational reliability under the new rules FedEx needed to incorporate FDP limit buffers. The Seabury Group agreed with our proposal that using limit buffers was a valid approach. This approach would significantly alter our operation resulting in more 'first night' operations with a resulting degradation in overall alertness.

3) **Please comment on the proposed schedule reliability reporting requirements. Should carriers be required to report on crew pairings that exceed the scheduled FDP, but not the maximum FDP listed in the FDP table?**

No. We operate in a very fluid environment and do our best to schedule realistically – however we should not have to report for the occasional deviation from the schedule – especially if it falls within the maximum allowable FDP. The proposed FDP and rest schedule are sufficient to ensure alertness and rest/recovery even if operated at the maximum levels.

It's important to realize the differences between scheduled passenger carrier operations and cargo operations. Our business model necessitates that we have the ability to accommodate the fluctuations in freight volumes on any given night. This manifests itself in additional landings and schedule changes compared to regularly scheduled duty periods. Use of sweep aircraft, standby periods, and rerouting allow us to accommodate our customers. As such, a FedEx pilot realizes and prepares for the flexibility required to operate to the max allowable flight duty period to assist in the movement of our products.

4) **Should carriers be required to report on more parameters, such as cumulative duty hours or daily flight time? If so, why?**

No, FDP limits and ensuing rest periods are adequate to insure alertness and mitigate fatigue. We propose that the FAA incorporates this reporting into its ATOS surveillance program. This avenue would result in a more realistic finding of the true characteristics of the operation.

5) **What should be the interval between reporting requirements?**

See above answers for questions 3 and 4. We oppose the additional reporting proposal. However, if required to report we suggest that 3 months is adequate. When reporting on deviations from duty hours or flight times it is important to make comparisons to similar historical flights/pairings due to seasonal winds.

6) **How long after discovering a problematic crew pairing should the carrier be afforded to correct the scheduling problem?**

See above answers for questions 3 and 4. Again, if required we suggest that the next pairing build cycle should be adequate to correct the pairing. Recommend no greater than 3 months (or 90 days).

7) **Is a 3-day adjustment to a new theater of operations sufficient for an individual to acclimate to the new theater?**

The concept of acclimatization varies from individual to individual and situation to situation. However, the 3 day adjustment may help acclimate when rest is during the new theater's physiological night. Even if not acclimated, the crew will have ample opportunity to sleep (2 rest periods at least) and significantly increase their alertness level.

8) **Is a 36-hour break from duty sufficient for an individual to acclimate to a new theater?**

From a strictly scientific perspective it may not allow acclimatization. However it provides for 2 sleep opportunities and time to prepare for the next duty. Additionally if we want to provide for 2 sleep opportunities 32 hours is the ideal rest period and is less intrusive to trip design.

9) **Should flight-crew members be given a longer rest period when returning to home base than would otherwise be provided based on moving to a new theater?**

No, considering the other proposed mitigating factors.

10) **Should the FAA have different requirements for flight-crew members who have been away from their home base for more than 168 hours? If so, why?**

No, provided that the crew has the time to adjust if they crossed more than 4 time zones (international flying).

11) **Should the FAA require additional rest opportunities for multiple pairings between two time zones that have approximately 24-hour layovers at each destination? What if the scheduled FDPs are well within the maxima in the applicable FDP table or augmentation table?**

No, not required due to other mitigations in the NPRM.

12) If the FAA adopts variable FDP limits, is there a continued need for daily flight time limits?

No, FDP Limits (with the landings criteria) provide adequate fatigue controls. Flight time limits within a FDP limit are redundant and not supported by sleep science. Any new FDP based regulations have done away with daily flight time limits.

13) If the FAA retains daily flight time limits, should they be higher or lower than proposed? Please provide data supporting the answer.

Reference answer 12.

14) Should modifications be made to the proposed flight time limits to recognize the relationship between realistic flight time limits and the number of flight segments in an FDP?

No, allow the FDP to govern.

15) Should augmentation be allowed for FDPs that consist of more than three flight segments? Does it matter if each segment provides an opportunity for some rest?

We agree with the proposal of the CAA.

16) Should flight time be limited to 16 hours maximum within an FDP, regardless of the number of flight-crew members aboard the aircraft, unless a carrier has an approved FRMS?

No, it could be higher with certain stipulations. Recommended: a one segment limit, prescribed preceding rest, class one rest facility, 20 hour FDP limit and prescribed in-flight rest scheme that could be utilized any time of day subject to the PIC's adjustments. Reference FedEx appendix on Ultra Long Range.

17) Should some level of credit be given for in-flight rest in a coach seat? If so, what level of credit should be allowed? Please provide supporting data.

Not Applicable to FedEx Operations.

18) Is there any reason to prohibit augmentation on domestic flights assuming the flight meets the required in-flight rest periods proposed today?

No, the science is the same.

19) Are the proposed required rest periods appropriate? (in the context of augmentation)

We agree with the CAA response regarding rest periods.

20) **Should credit be allowed if a flight-crew member is not type-rated and qualified as a PIC or SIC?**

Yes, Cruise Pilots can allow other crew members to get sleep.

21) **Please comment whether a single occupancy rest facility provides a better opportunity for sleep or a better quality of rest than a multiple occupancy facility such as multi-bed living quarters.**

Assuming the question is referring to ground rest facilities, single occupancy is better, with less variables to cause an interruption.

22) **Should there be any restriction on consecutive nighttime operations? If not, why?**

No, the NPRM remedy is worse than the current operation. The proposed flight duty chart and resulting restrictions would prevent FedEx from operating as it currently does with split duty pairings and more than 3 consecutive nights of flying. It is a significant detriment to safety if FedEx loses the week on/week off capability. It would also increase the number of 'first night' flights – flights proven to be the most demanding in the night cargo operation. We propose a restructured FDP chart, split duty provisions, and the ability to operate more than 3 nights in succession. We do this based on our experience and the support of the scientific community that has studied the effects of night flying. (Attachment 2)

According to the article, "Fatigue Study of Consecutive Nights" by QinetiQ, there is no evidence in these operations of an increase in fatigue.

23) **If the night time sleep opportunity is less than that contemplated under the split duty provisions of this notice should a carrier be allowed to assign crew pairing sets in excess of 3 consecutive nights? Why or why not?**

Yes. If a split duty period provides for a rest opportunity then extensions to FDPs and continued night operations past the third consecutive nights are possible. A crewmember will sleep during the day and the ensuing sleep obtained during the hub turn prevents the onset of cumulative fatigue. With no relief from this proposal our operation will develop into a monthly line of numerous 'first night' operations compared with our current operation. This will result in the unintended consequence of more 'first night' operations – typically the most difficult night to operate - and the buildup of cumulative fatigue in our crewforce. Additionally, the current operation results in longer periods of time off resulting in higher alertness levels.

Split duty and consecutive night operations should be allowed as follows:

Any period of at least one hour of rest 'behind the door' can be considered for credit towards extending FDPs. Rest behind the door is defined as the total time in the sleep facility minus 30 minutes. The 30 minutes allows time to fall asleep as well as recover from sleep prior to reporting.

Duty Start	*Credit to FDP limit*
1700-0359	*1 to 1*
0400-0659	*2 to 1*
0700-1659	*3 to 1*

24) If the nighttime sleep opportunity meets the split duty provisions of this notice, should the carrier be allowed to extend the flight duty period as well as the number of consecutive nighttime flight duty periods? Why or why not?

Yes, reference answers #1 and# 23.

25) Should a fourth night of consecutive nighttime duty be permitted if the flightcrew member is provided a 14-hour rest period between flight nights three and four?

From our experience and sleep modeling, a 14 hour rest will not help the 4th duty period. See consecutive night comment above. We feel, based on 30+ years of experience and the supporting Split Duty data, that it is safer to fly 5 consecutive nights than limiting it to 3 consecutive nights but flying more of them. This proposal also would increase the number of 24 hour type layovers resulting in more body clock swaps. With proper mitigation, consecutive night flights can be safely operated with the suggested limits. Regulations should be based on science and in the absence of science – we do not recommend any further limitations.

26) Please comment on whether a 16 maximum hour FDP for long call reserve is appropriate when the maximum FDP for a lineholding flight-crew member is 13 hours.

We are in agreement with the CAA response.

27) Please comment on whether the proposed maximum extended FDP of 22 hours for an augmented flight-crew member is appropriate. If not, please provide an alternative maximum FDP.

Yes, 22 hours is appropriate for an augmented crew operating within its reserve period.

28) Please comment on whether a certificate holder should receive credit for not calling a flight-crew member during the WOCL while on reserve.

Yes, this suggestion makes sense and is our goal. By having multiple reserve periods staggered around the clock FedEx has the option of selecting crewmembers outside their acclimatized WOCL.

29) Should minimum required rest while on reserve status be greater than the amount of rest required for a lineholding flight-crew member? If so, please provide supporting data, if not, please provide rationale.

No, we agree with the CAA response.

30) Please comment on the level of complexity on the proposed reserve system.

The proposal is overly complex and severely limits the safe and logical use of crews. The FedEx reserve system has evolved into an outstanding system which provides round the clock coverage and the opportunity for reserve pilots to get rest. An explanation and documentation of our reserve system is available upon request.

31) The FAA seeks input on the appropriate cumulative limits to place on duty, flight duty periods and flight time. Is there a need for all the proposed limits?

No, only an FDP limit is appropriate not Flight Time limit. Short call reserve should not be considered as duty.

Should there be more limits (e.g., biweekly, or quarterly limits)?

No other limits are needed.

32) The FAA also asks for comments on measuring limits on an hourly rather than daily or monthly basis. Does this approach make sense for some time periods but not for others?

FedEx agrees with the CAA response.

33) If transportation is not considered part of the mandatory rest period, is there a need for a longer rest period for international flights?

As another example of 'one size doesn't fit all': cargo type operations allow for 10 and 12 hours rest periods (from post flight debrief to the ensuing show).

34) The FAA requests comments on whether some elements of an FRMS, such as an incident reporting system, would be better addressed through a voluntary disclosure program than through a regulatory mandate?

Yes, we support the use the Aviation Safety Action Program (ASAP) as a suitable example of a voluntary disclosure program.

35) Are there other types of operations that should be excepted from the general requirements of the proposal? If so, what are they, and why do they need to be accommodated absent an FRMS

Humanitarian aid, national emergencies, military/government charters, exigency situations, and life saving operations should be exempted. FAR 119 director of operations should be able to approve these types of operations with a follow on FAA report (similar to a mechanical irregularity report)

3. FedEx Concerns

A. Split Duty Definition

1. FedEx has been flying 'night hub turns' for 30+ years and we realize that night hub turn operations are demanding. In the overnight delivery business it is the only way to get a package from its origin to destination in one day. We have gained a tremendous amount of practical experience from our operation and have implemented many suggestions from our crewmembers and the sleep science community that have improved overall alertness and safety.

One of the most important fatigue mitigating factors that FedEx has developed is the sleep room. Typically a crew operates from an outlying city into a major HUB and then waits in the HUB while the freight is offloaded, sorted, and reloaded (night HUB turn). This wait time is anywhere from 2 to 4.5 hours. Many crewmembers adjust to the night flying and use the downtime to flight plan, catch up on company business, or just relax. They can also eat a nutritious meal at the cafeteria while others wish to rest. For them FedEx has incorporated 'sleep rooms'. FedEx currently has over 90 sleep rooms in its main HUB in Memphis, TN.

Our sleep rooms are environmentally conducive to quality sleep. They are individual rooms and are temperature controlled, quiet, dark, and have beds (with sheets, pillows and blankets). Crewmembers have a great opportunity to get sleep between shifts. Guided by our experience and sleep modeling, FedEx has shown that this arrangement has increased alertness for our crewmembers.

The effectiveness of the sleep rooms strongly support our continued use of split duty operations. We feel the proposed regulations needs to be adjusted to show an extended FDP for crewmembers that get at least 60 minutes of sleep opportunity between flights in a split duty period. In fact, our sleep model shows that "HUB turning" crewmembers with at least a 60 minute sleep opportunity are better suited to fly into the extended FDP than crewmembers flying a single long flight.

Also, if no provisions are made then our crewmembers will face more trips per month which will result in more 'first nights' – scientifically and historically the hardest night of flying to adjust to for crewmembers.

Future improvements to the sleep facility include the addition of more rooms. In addition, a wake up / alert system will be implemented. This will relieve the crewmember from concern of oversleeping and further enable them to get quality sleep.

B. Augmented flight opportunities.

1. For the purposes of operational reliability, flexibility and safety; FedEx wishes to have the right to augment any flight that would not otherwise require and/or qualify for augmentation.

C. Ultra Long Range Flying

1. FedEx proposal for Ultra Long Range Flying

Currently the FAA allows for a duty period of up to 18 hours. FedEx proposes to increase that limit to a scheduled limit of 20 hours (and an operational limit of 23 hours) providing specific crew rest opportunities are provided for pre trip, mid trip, and post trip operations. FedEx needs this flexibility as its operation is less conducive to specific city pairs. We believe that this proposal is safe, smart, and supported by current sleep science knowledge. This proposal provides a backstop for ULR flying that does not exceed 20 hours. It contains more restrictive limits that may otherwise be gained through FMRS.

Prior to any ULR duty unless otherwise required a crewmember will need a minimum of 24 hours of pre mission rest. If the crewmember is not acclimatized to the local theater, then 48 hours of pre mission rest is required. This extra time will allow the crewmember to recover from any previous sleep debt and provide for uninterrupted sleep opportunity in preparation for the ULR flight.

Upon receiving this ULR pre-mission rest, the crewmember is capable of a scheduled 20 hour flight duty period (23 hours operationally). During this flight period a Class 1 rest facility is required and each crewmember is given the opportunity for in-flight sleep. Current science shows that the operating crew's alertness for landing is highest when their long rest period occurs in the last segment of cruise. FedEx has developed an in-flight rest scheme that can apply to any duty start time. This report is available upon request and is developed during A332 committee work.

Upon arrival the minimum post ULR rest period is 18 hours. For any period between 18 and 30 hours, the ensuing FDP is limited to 11 hours. If the post ULR rest period is between 30 and 48 hours, the ensuing FDP is 12.5 hours. For any post ULR rest period over 48 hours, another ULR flight is possible.

Post ULR flight rest

Post ULR Flight Rest Period	Ensuing FDP
18-30 hours	11 hours
30-48 hours	12.5 hours
> 48 hours	20 hours (23 operational)

Upon returning to domicile after a ULR trip the crewmember receives a minimum of 48 hours free from duty to acclimatize to the local theater.

This suggested regulation is only 2 hours above limits proposed in the Table C. The current process, which is city pair specific, does not meet the needs of cargo carriers where trip design and segments fluctuate more regularly.

4. Cost Analysis

The NPRM rules result in significant costs to FedEx Express. The increases are mainly driven by schedule reliability and the lack of operational flexibility associated with lower flight duty period limits. In reaction FedEx will require buffers, additional reserve and a decrease in operational reliability resulting in increased cancellations. While there are some rules that provide flexibility our CBA (collective bargaining agreement) restricts their use. The estimated costs included vendor supplied re-optimization that attempted to account for the rules in the NPRM.

Cost Summary

Rule	Total Heads	Annual Cost Millions (USD)	One Time Cost Millions (USD)
(1) Schedule Reliability	240	48.0	
(2) Flight Duty Time Domestic (including required buffers)	168	33.6	
(2A) Flight Duty Time International (including required buffers)	140	28.0	
(3) Flight Time Limits	28	5.5	
(4) Consecutive Nights (no more than 3)	26	5.1	
(5) 1 Duty Extension over Scheduled in 168 hrs (unlimited today)	68	13.5	
(6) Fatigue Training	-	8.3	
(7) FRMS	-	-	
(8) Augmentation	27	5.4	
(9) Cumulative	-	-	
(10) Rest	-	-	
(11) Ongoing Training Cost est.	-	4.2	
(12) 36 in 168 (require 36 hrs rest in 168 hrs when crossing 4 time zones)	37	7.4	
(13) Reserves/Buffers (ensure system reliability)	78	15.6	
TOTAL Heads and Annual costs	812	178.6	
(14) Automation			2.4
(15) Estimated carrying costs			70.8
(16) Adding Crew Bunk to MD11/MD10-30 Fleet			30.7
(17) Training Cost (one time to position the crew force 2 to 3 yrs)			150.1
TOTAL	**812**		**254.0**

(1) Schedule Reliability: Required additional block to provide for 95% schedule reliability

(2,2A) Flight Duty Times: 12% of domestic duties and 8% of international duties are impacted with new FAR limits. Will need large buffers to prevent service failures. Use of buffers will result in degradation of hub-turning and impact reserve utilization. Degrades crewmember ability to commute.

(3) Flight Time Limits: Includes cost of buffer on block for operational reliability due to the strong penalty for exceeding a block limit for any given duty.

(4) Consecutive Nights: Weeklong night trips will have to be redesigned with added costs. Degrades crewmember ability to commute.

(5) 1 Duty Extension over Scheduled in 168 hrs: Adds significant pairing design, additional standby and reserve cost to protect service failures. Will still result in service failures. Can only exceed limits with concurrence of the PIC (pilot in command).

(6) Fatigue Training: Annual requirement for training Pilots and other operational staff

(7) FRMS: In theory these costs are offset by gaining the use of less restrictive prescriptive rules.

(8) Augmentation: Increases due to the use of block buffers and the creation of augmentation imbalances resulting in additional credit hours and crew positioning costs.

(9) Cumulative Duty Limits: Showed additional cost in reserve for this rule. Some aspects of this rule are difficult to quantify.

(10) Rest: Negligible …. International layover limit less than CBA.

(11) Ongoing Training Costs: The annual overhead in ITU training of 812 additional Pilots.

(12) 36 in 168: This becomes a hard layover requirement for international trips.

(13) Reserves/Buffers: This addition is for stand-by crews in the field as well as additional reserves to ensure system reliability.

(14) Automation: 8 stand alone applications need significant enhancements.

(15) Carrying costs: The payroll expense for having to carry additional Pilots required until new rule is effective.

(16) Adding Crew Bunk to MD11/MD10-30 Fleet: For Max duty limits, 41 MD11's / 17 MD10-30's will require the crew rest module.

(17) Training: This assumes a 2 to 3 year period of time for implementation. Training capacity will need to be addressed.

Other Risks (not quantified)

- Little flexibility to manage major disruptive event, no longer able to go to 16 hours of duty by declaring an Ops emergency (currently is rarely invoked and normal fatigue rules still apply). Other recovery strategies will have to be explored.

- Alert calls may begin duty, limited ability to revise, extend or assign duties without a legal crew rest.

- Infrastructure costs and unintended consequences not quantified; sleep room facilities, transportation, commuting.

- The amount of training required to position 812 heads will take 33 months at current maximum training capacity. FedEx would not have enough training capacity to accommodate retirements and/or growth. This would a result in a need to increase throughput at a premium or not be able to sustain or grow the Airline.

Projected 10 year FedEx Cost Nominal value
(million USD)

	YR 1	YR 2	YR 3	YR 4	YR 5	YR 6	YR 7	YR 8	YR 9	YR 10	TOTAL
***Annual (ongoing)**	$179	$179	$179	$179	$179	$179	$179	$179	$179	$179	$1,786
Onetime Costs	$85	$85	$85								$255
Total Annual	$264	$264	$264	$179	$179	$179	$179	$179	$179	$179	$2,041

FedEx enlisted the help of the Seabury Group to independently analyze the FAA's Regulator Impact Analysis. They communicated to us the following concerns:

- FAA did not incorporate an annual inflationary factor which significantly understates future cost

- FAA did not include soft pay, payroll taxes and benefits that are directly tied to pilot salary and or headcount increases

- FAA assumes static number of pilots while most experts expect modest low single-digit growth

- FAA did not include cost of incremental training events stemming from incremental headcount requirements

- FAA assumed a 25% optimization gain through a limited sampling of carriers. This assumption reduced PV value by approximately $500 million – a material cost reduction. It is Seabury's opinion that a material cost reduction warrants a greater study than anecdotal evidence based on an alternative plan. At a minimum, FAA should provide additional information on the alternative plan so that carriers can validate whether it was warranted that the FAA should use a 25% optimization factor

- Transfer costs (valued at $78M PV by FAA) represents real cash to the airlines and should be included in FAA cost analysis

- FAA used understated average hourly salary

- FAA also fails to account for benefits / taxes as new pilots will need to be hired. FAA also fails to take into account additional personnel expense such as additional hotel nights and per diem FAA fails to account for additional training events as a result of increased line pilots

- In Seabury's extensive labor experience, any potential savings during contract negotiations may require the company to compromise in other areas of the contract, resulting in minimal to no savings

5. Conclusion

FedEx applauds the FAA's desire to alter the current regulations in order to mitigate fatigue and we appreciate the opportunity to provide input into their development. It is an issue that FedEx has dealt with for over the past 30 years. As a result we continuously evolve our operation based on experience and the development of the science of sleep. Our desire is to prove that our current operation provides for adequate rest opportunities for our crew members within the confines of our business model. We request that the FAA withdraw its NPRM and recommence the effort to revise the current regulations, based upon scientific principles act the operational needs of the various segments of the industry.

Attachments

1. "Sleep Issues Regarding NPRM" Drs. Belenky and Graeber
2. "Fatigue Study of Consecutive Nights" QinetiQ
3. " Dr Hursh Mid Duty Sleep Analysis" Dr Hursh

Respectfully submitted,

J. Mark Hansen
Lead Counsel
Regulatory Affairs
FedEx Express

Attachment 1.

Scientific Issues Regarding NPRM

Gregory Belenky, M.D. and R. Curtis Graeber, Ph.D.
November 5, 2010

General Comments:

While the principles of sleep science are generally well understood and accepted, their practical application to any operational environment, including aviation, is very much a work in progress. The reason is that such environments typically involve extended work hours, work through the circadian trough, and/or 24x7 operations. Because fatigue is the result of the interaction of sleep/wake history, circadian rhythm, and workload as well as individual factors, the precision of any predictions for a specific scheduled or non-scheduled operation is challenging and limited in accuracy.

The interaction of these three variables is complex. For example, in the first 24 hours of an operation where no sleep is possible the circadian rhythm in alertness and performance is dominant. With time awake extending beyond 24 hours, the homeostatic drive for sleep (the effect of sleep/wake history) gradually becomes more dominant displacing the importance of the circadian rhythm. Both homeostatic sleep drive, increasing with time awake, and circadian rhythm, waxing and waning in a 24 hour cycle, modulate performance and amplify the effect of workload (time on task) which can vary in intensity and complexity based on a number of operational factors. Thus, fatigue is not simply the result of sleep loss but rather the interaction of sleep loss, time of day and workload. For these reasons, the specific application of sleep science in aviation is far from settled.

This is not to say that a limited number of very practical, scientifically robust, studies have been carried out in commercial flight operations by NASA and other laboratories. These studies have enabled some application of sleep science principles to specific industry uses. However, there are a significant number of practical fatigue related questions for which the science is currently limited to extrapolations and application of general sleep science principles based primarily on non-aviation research. A good example of this is the current attempt to develop mathematical models to predict performance from the three interacting factors that underlie fatigue. Integration of such models into today's "industrial strength" rostering and scheduling software will likely enable turn-key fatigue risk management as they are validated by actual flight crew data in the future.

The operational environment is one in which the performance of the human in the loop is critical. Adequate sleep, working at a favorable circadian phase and bearing a reasonable workload will sustain nominal performance. We know that fatigue degrades performance and (in the words of the USAF fighter pilot, John Boyd) the operator's ability to "observe, orient, decide, and act." The goal of the NPRM is to put together a system of regulations or, alternatively, a framework to enable the implementation of an FRMS, to manage the complex interaction between sleep loss, circadian rhythm phase, and workload in order to reduce fatigue risk by preventing error, incident, or accident. The complex interaction of three factors causing fatigue is not easily captured in a set of prescriptive rules and is in our opinion much more amenable to management by an FRMS.

In this regard it is important to note that the NPRM's definition of Fatigue is inconsistent with ICAO's proposed definition: "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." The ICAO definition captures the fatigue inducing effects of the interaction of sleep loss, circadian phase and workload and provides the scientific basis for FRM. Managing the interactive effects of sleep loss, circadian phase, and workload in commercial aviation is the purpose of the NPRM.

Comments on Specific Provisions of the NPRM:

1. FDP Extension 117.15(c)(2) restricts carriers to only one extension of 30 minutes or more in each 168 hour period.

Comment: There is clear scientific evidence that extended work hours over consecutive work days reduces the opportunity for sleep and can lead to cumulative sleep loss and fatigue. However, there is no clear scientific evidence to support restricting an extension of greater than 30 minutes and less than or equal to 2 hours to once in 7 days. A more sensible rule would be to ban extensions over consecutive duty days in order to allow recovery from a prior extension and to not allow more than two extensions within any one 168 consecutive hour period. It is our understanding that this is similar to the recommendation of the ARC.

2. Short Call 117.21(c) & 117.23(d)

Comment: Being on short-call reserve is not being on duty. Short-call reserve does not entail any significant work load. The only task the pilot has while on short-call reserve is to answer the phone and acknowledge information. Further, a short-call reserve pilot has the same, predictable rest and sleep opportunities as a regularly scheduled pilot. A short-call reserve pilot, even if he or she thought a call unlikely, would take advantage of these opportunities. Even if called while sleeping, we expect that all but the most inexperienced would fall right back to sleep as is the case in other professionals, e.g., physicians, who are on call and are called without the immediate need to do something beyond acknowledging receipt of information.

The effect of anticipating a phone call in creating anxiety and disturbing sleep we expect would be minimal. Actually receiving a call would reduce to zero any uncertainty ensuring a rapid return to good sleep subsequent to the call. By declaring being on short-call reserve as being on duty, the FAA is effectively claiming that being on short-call reserve, i.e., being available at home or in a hotel to answer the phone, is as fatiguing as flying an airplane. There is no scientific much less operational support for the claim that flight duty and short-call reserve are equivalent in terms of fatigue. In addition, there appears to be an inconsistency between the NPRM position on deadheading pilots and its position on short-call reserve pilots. For deadheading pilots with adequate on board sleeping accommodations, the NPRM allows extending the cumulative duty period limitations by up to 10 hours. In contrast, short-call reserve pilots who also have adequate sleep accommodations (home or hotel) are not allowed a similar extension.

3. Split Duty 117.17 –

Comment: In actuality the science suggests that any sleep longer than 20 min provides full minute-by-minute recuperative value (Bonnet and Arand, 2003); see Figure 2). For napping during night operations, assuming the normal adult sleep latency for that time of day of between 5 and 10 minutes, any time behind the door of more than 30 minutes would have recuperative value. The requirement that the sleep opportunity must be at least 4 hours in duration before granting an extension of duty of 50% of the time spent behind the door is not supported by the science. Any time behind the door beyond 30 min should be given the time behind the door extension credit. The 50% of the time behind the door extension credit is especially conservative for sleep obtained in a suitable rest facility on the ground during usual bedtime hours but may be warranted for split duties that require daytime sleep.

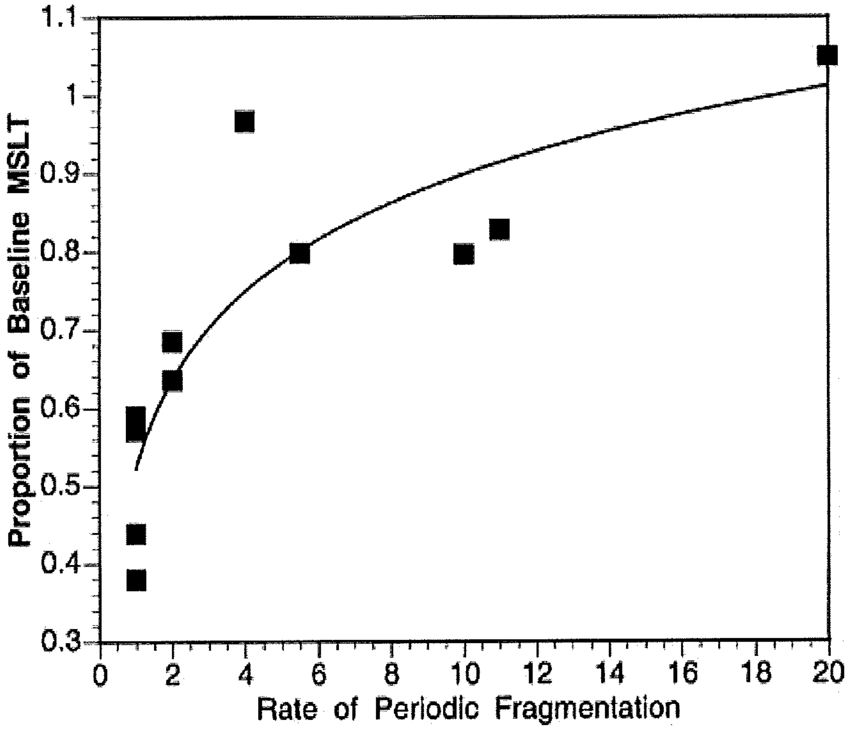


Figure 2 – Proportion of baseline multiple sleep latency test (MSLT) representing the minute-by-minute recuperative value of sleep (the higher the proportion the more recuperative value per minute of sleep) plotted as a function of rate of sleep fragmentation (the interval of time between awakenings or partial awakenings during the night). The shorter the interval between sleep fragmenting events, the less the recuperative value. When sleep is fragmented at one minute intervals the proportion and hence recuperative value is near zero. When sleep is fragmented every 20 minutes the proportion is near 1 to 1 indicating full minute-by-minute recuperative value with sleep broken every 20 minutes when compared to normal, continuous, unbroken sleep. Adapted from Bonnet and Arand (2003).

4. Consecutive Nighttime Operations 117.27 - 17)

Comment: Assuming the goal of the NPRM is to assure 7-8 hours of sleep per 24 hours, the issue of consecutive night duties is critically tied to the ability of the split duty rest periods to provide sufficient sleep. In a recent study comparing the sleep of physicians working night shifts and day shifts (McDonald et al., 2010), it was found that they got equivalent amounts of sleep (i.e., approximately 7 hrs) when working either type of shift. When working days their sleep was consolidated into a single 7 hr sleep period at night. When working nights they split their sleep averaging 4 hrs of sleep off duty during the day and 3 hours of sleep on duty at night. Performance tested when going on and off shift was equivalent for day and night shifts.

It is therefore important to realize that the NASA study of night cargo operations showed that crews obtained 5 hrs sleep during each day after duty. This is similar to other studies on shift workers (Akerstedt, 2003) that found that they also slept five hours during the daylight hours. Obtaining another 2 hrs of sleep during split night duty should sustain performance across more than 3 consecutive nights. This is supported by Mollicone et al's laboratory studies (2007, 2008) that showed that following restricted sleep for the same total sleep time performance was the same whether the sleep was consolidated into a single sleep period or split into two sleep periods.

5. Fitness for duty 117.5(e) –

Comment: The state-of-the-art of fatigue science today cannot provide an objective standard to identify fitness for duty for compliance with this section. Even if a tool such as the PVT could be used as a basis for such assessments there would be several major obstacles to overcome: (1) each pilot would need to be tested to establish his or her own well rested norm, (2) even with a norm, the airline and the FAA would have to determine the % deviation from the baseline defining unfitness to perform, and (3) in making that decision circadian phase effects would have to be considered because despite being well rested a pilot could "fail" at one phase and "pass" at another.

More important are the general difficulties from a scientific viewpoint posed by paragraphs (d) and (e) of this section. It is not at all clear whether the NPRM literally means "any person" "must immediately report". Such persons could range from passengers, ground workers, and security to cabin crew and other pilots. While the latter two groups may be assumed to have some working experience with tired crews, there is little reason to believe that the general public or non-flying aviation personnel could make an informed judgment. Regarding para (e), despite the claims of draft AC 120-FIT para 8 (b), a person trained in accordance with 117.11 would be unable to make such an assessment in a reliable manner. There is no evidence that even a certified aeromedical specialist could make a reliable assessment in this situation unless the level of fatigue was obviously debilitating. At a minimum an accurate sleep-wake history is required to begin the task. This of course would raise significant privacy issues. All this begs the question of how the FAA is going determine how such assessments should be carried out.

6. Flight Duty Period: Augmented Crew 117.19 (c) (1)(2)(3) -

Comment: In order to assure that the landing pilot has adequate rest he or she should time the in-flight rest opportunity to coincide with time that he or she is most likely to sleep. In the case of a single long-haul flight, this requirement should be readily satisfied. The requirement becomes an issue when a short flight (<4 hrs) occurs within the augmented flight duty. The time when the pilot is most likely to sleep may not necessary be the last available rest period or occur during the last segment of a multi-segment flight. Similarly such a last segment may too short to encompass a 2-hr sleep period in which case the rest period may need to occur in the previous segment.

The science would also support an additional rest shorter than 2 hrs before top of descent since the data suggest that any sleep longer than 20 min provides full minute-by-minute recuperative value (Bonnet and Arand, 2003). This value was dramatically demonstrated in NASA's study of the effectiveness of controlled rest on the flight deck where the pilot's rest was not obtained in a bunk but rather in his assigned duty seat (Rosekind et al., 1994) NASA Technical Memorandum 108839, 1994). Short naps (including controlled napping on the flight deck) are an effective fatigue mitigation to sustain pilot performance during critical phases of flight (Graeber, et al., 1990). Since naps longer than 30 min have the same minute-by-minute recuperative value as longer naps and main sleep periods and the recuperative effect of sleep is cumulative across sleep periods, it is also possible that the 2 hr sleep opportunity could be broken up and distributed over more than one segment.

Furthermore, if the short segment was the final segment, and the required rest were allowed to occur during the last 6 hrs of duty, then it may be appropriate to reduce the manipulating pilot's workload by limiting the pilot to only one landing after his or her rest. Conversely, we also point out that a short flight segment could be at the start of a multi-segment duty period where the NPRM would limit the length of such flights to greater than 4 hours and prohibit an operator from capitalizing on a well rested crew at the beginning of the flight duty period.

7. Tables B & C -

Comment: It is interesting to note that the longest duty times are allowed for the 0700-1259 start times in both Tables B and C. This is presumably because crews are assumed to have gotten a full night's sleep and, in accordance with the scientific evidence, are therefore fully rested at the start. That said, there is no scientific basis for the different hours assigned as limits for different departure times.

In reality modern onboard crew rest facilities are designed to enable the crew to manage their alertness throughout the flight and especially that of the landing crew. Unpublished 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. In other words, a sufficient on-board rest prior to top of descent may mitigate landing crew fatigue sufficiently to obviate the need different duty limits for fully augmented crews based on departure time. Studies of sleep and performance in ultra-long range and long range flights are underway to test this.

8. Limiting flight time in addition to duty time –

Comment: There are no scientific papers supporting the idea that flight time should be treated differently from duty time except perhaps in so far as they involve differences in workload. Workload in the commercial aviation context is thought of primarily in terms of number of segments, specifically number of take offs and landings. Since both number of segments and circadian timing are taken care of in the duty time limits there is no rationale for putting further limits on flight time.

<u>References</u>:

Akerstedt, T. (2003) Shift work and disturbed sleep/wakefulness. Occup. Med., 55, pp. 89-94.

Bonnet, M.H. and Arand, D.L. (2002) Clinical effects of sleep fragmentation versus sleep deprivation. Sleep Medicine Reviews, 7, no. 4 pp. 297-310.

Gander, P.H., Gregory, K.B., Connell, L.J., Miller, D.L., Graeber, R.C., and Rosekind, M.R. (1996) Crew Factors in Flight Operations VII: Psychophysiological responses to overnight cargo operations. NASA Technical Memorandum 110380.

Graeber, R.C., Rosekind, M.R., Connell, L.J., and Dinges, D.F. (1990) Cockpit napping. The ICAO Journal, 45, pp. 6-10.

Rosekind, M.R., Graeber, R.C., Connell, L.J., Dinges, D.F., Rountree, M.S., Spinweber, C.L., and Gillen, K.A. (1994) Crew Factors in Flight Operations IX: Effects of preplanned cockpit rest on crew performances and alertness in long-haul operations. NASA Technical Memorandum 108839.

McDonald, J.L., Tompkins, L.A., Lillis, T.A., Bowen, A.K., Grant D.A., Van Dongen, H.P.A., and Belenky, G. (2009) Work hours, sleep, and performance in medical residents working night float vs. day shift. Sleep, 32, pp. A394.

Mollicone, D.J., Van Dongen, H.P.A., and Dinges, D.F. (2007) Optimizing sleep/wake schedules in space: Sleep during chronic nocturnal sleep restriction with and without diurnal naps. Acta Astronautica, 60, no. 4-7, pp. 354-361.

Mollicone, D.J., Van Dongen, H.P.A., Rogers, N.L., and Dinges, D.F. (2008) Response surface mapping of neurobehavioral performance: Testing the feasibility of split sleep schedules for space operations. Acta Astronautica, 63, no. 7-10, pp. 833-840.

Wesensten, N.J., Belenky, G., Thorne, D.R., Kautz, M.A., and Balkin, T.J. (2004) Modafinil versus caffeine: Effects on fatigue during sleep deprivation. Aviat. Space Environ. Med., 75, pp. 520-525.

Attachment 2.

QinetiQ

A fatigue study of consecutive nights and split-night duties during air cargo operations

MB Spencer, KA Robertson, SP Foster
QINETIQ/KI/CHS/CROO/Version 1.0
March 2004

Administration page

Customer Information	
Customer reference number	N/A
Project title	Sleep and wakefulness of the airline pilot
Customer Organisation	Civil Aviation Authority
Customer contact	Mr SE Griffin
Contract number	7D/S/952/5, Amendment 2
Milestone number	N/A
Date due	31 March 2004

Principal author	
MB Spencer	01252 394468
QinetiQ, Cody Technology Park, Building A50, Ively Road, Farnborough, Hampshire GU14 OLX	mbspencer@qinetiq.com
KA Robertson	01252 393339
QinetiQ, Cody Technology Park, Building A50, Ively Road, Farnborough, Hampshire GU14 OLX	karobertson@qinetiq.com
SP Foster	01252 394477
QinetiQ, Cody Technology Park, Building A50, Ively Road, Farnborough, Hampshire GU14 OLX	spfoster@qinetiq.com

Release Authority	
Name	Dr PA Ward
Post	Business Group Leader
Date of issue	March 2004

Record of changes

Issue	Date	Detail of Changes
1.0	March 2004	Draft issue for comment

Executive Summary

Introduction

This study of aircrew fatigue during night cargo operations was carried out on behalf of the UK Civil Aviation Authority. It forms part of an on-going programme of research into the sleep and wakefulness of the airline pilot.

The computer program SAFE (System for Aircrew Fatigue Evaluation) is based on a model that predicts the alertness of aircrew on different schedules of duty. The program incorporates a factor associated with the accumulation of fatigue over several consecutive duty periods, derived from previous aircrew fatigue studies. This factor does not differentiate between daytime and overnight duties, although there are grounds for suspecting that consecutive nights may be especially fatiguing.

An earlier study investigated levels of alertness overnight on short-haul passenger operations, but the data obtained were insufficient to establish the changes associated with consecutive nights. It was therefore proposed to carry out a study of air cargo operations, which would provide the opportunity to collect considerably more data on night duties and hence to establish with greater certainty whether the SAFE program required further amendment in this area.

Accordingly, DHL were approached, and agreed to participate in a study. At the time DHL were operating up to 4, and occasionally 5, consecutive nights, as well as schedules that incorporated 'split nights'. Split nights were operated instead of the longer overnight duty periods, and incorporated a 24-hour layover, away from base, which split the duty in two shorter duty periods, one in the evening and one in the early morning. This study provided the opportunity to investigate the effects on alertness of these split nights, in addition to the effects of consecutive nights.

Methods

All DHL crews based at East Midlands Airport were asked to volunteer. The two different types of schedules (consecutive nights and split night) were identified from the rosters, and crews were asked to participate during the period covered by those schedules.

Data were collected using a sleep and duty diary and Actiwatches. The diary covered one schedule (typically a period of 4 to 5 days), together with the 48 hours prior to the first duty period, and the 72 hours after the final duty period. Subjective assessments of fatigue were made at the start of each duty period and at the end of each sector. Similar ratings were also obtained before and after each sleep period and, in addition, participants were asked to estimate the timing and duration of their sleep. Actiwatches were worn throughout the schedule and were used to investigate periods of inactivity, and hence sleep, during the duty periods themselves.

Results

Forty-four pilots participated in the study, with 20 individuals completing both types of schedule on at least one occasion. Information was obtained from 46 consecutive night duties, which included 13 schedules of 3 consecutive nights, 25 schedules of 4 consecutive nights, and 8 of 5 consecutive nights. In addition, data were collected from 40 split night schedules.

On average, duty periods were 6 hours 39 minutes in duration and the number of sectors ranged between 1 and 4 flights. The average flight length was 1 hour 14 minutes.

The sequence number of the flight within the duty period, the time of day and the duration of the duty period all had a significant effect on fatigue levels at the end of a flight, and these effects were similar to those observed in previous studies. After correcting for these factors, the pattern over consecutive nights did not reveal a long-term trend: the only night which was associated with increased levels of fatigue was the first of a sequence. There were no differences between the 2nd, 3rd or 4th nights. For split night duties, and after correcting for other factors, fatigue was lower than expected on the second part of the split night, and there was no evidence of a residual effect on the following duty period.

In spite of the high percentage of overnight work, average levels of fatigue in this study were well within the range of earlier studies of short-haul passenger operations.

Sleep after the first night of a sequence was approximately 30 minutes shorter, and subjective sleep quality was poorer, than after subsequent nights. There was no significant difference in duration or quality between the sleep periods taken after the 2nd, 3rd and 4th night duties.

Conclusions

There is no evidence in these operations of an increase in fatigue over four consecutive nights. This may be partly explained by the different nature of cargo, compared with passenger operations, and by an element of self-selection by the crews undertaking this type of work. Based on these results, no further changes will be made to the implementation of consecutive nights in the SAFE program.

Split night duties are effective in limiting the development of fatigue overnight, and have no adverse effect on subsequent duty periods.

These results suggest that some relaxation of the current guidelines might be considered for cargo operations, including for example an increase in the number of consecutive nights, or a small extension in the duty period limits. However, any changes would need to be carefully monitored and implemented in a step-wise manner, so that any unacceptable increase in fatigue could be quickly identified.

List of contents

1 Introduction

1.1 Terms of reference

1.1.1 This study of night operations was carried out as part of an on-going programme of work for the UK Civil Aviation Authority under contract 7D/S/952/5, Amendment 2.

1.2 Background

1.2.1 The SAFE (System for Aircrew Fatigue Evaluation) computer program is being developed by QinetiQ on behalf of the UK Civil Aviation Authority [1]. The program provides predictions of the levels of fatigue likely to be experienced by aircrew during different duty schedules. Validation of the program and of the model underlying the program has been carried out via field studies of aircrew and this information has been used to update the model. These studies have focussed on several different aspects of civil air operations including, for example, early starts and multiple sectors.

1.2.2 The current version of SAFE includes a factor associated with duties over successive days. The strongest evidence for this effect comes from previous studies carried out by QinetiQ as part of this research programme [2][3]. It has also been reported in another study of short-haul crews where fatigue increased across the first two days of consecutive duty [4], although there was no difference between trips of three and four days.

1.2.3 The implementation in SAFE does not differentiate between consecutive duties during the day and overnight. However, information from shift work and other studies suggests that the cumulative effect of consecutive night duties may be more fatiguing than the equivalent daytime duties [5]. Whilst a previous study of aircrew failed to demonstrate a reliable effect of consecutive night duties (mainly due to the limited information that was available from 2 and 3 consecutive nights), there was still a tendency for fatigue to increase over successive nights [2]. Such an increase might be expected, due to the cumulative effect of the poorer quality of sleep during the day between two night duties.

1.2.4 The possibility therefore exists that SAFE, as currently implemented, underestimates the effect of working on consecutive nights. Further data are required from civil air operations to demonstrate whether night duties are more fatiguing than comparable daytime duties and whether SAFE should be modified to account for such differences.

1.3 Previous studies

1.3.1 The majority of information regarding the impact of consecutive night duties comes from studies of shift workers. They have shown that sleepiness and fatigue are more pronounced during the night shift [5][6], particularly during the period 04:00 – 07:00 [7][8], and that fatigue increases over consecutive duties [9]. It has been estimated that between 10-20% of workers regularly fall asleep on the night shift [10].

1.3.2 In a study of railway workers the night shift was associated with increased risk of sleepiness, which was up to 14 times higher on the night shift than on the day shift [11]. Indeed, the night shift has been associated with a greater risk of accidents [12]. However, some studies have shown that there is no difference in alertness over successive nights [13].

1.3.3 For many night workers the problem is getting enough sleep between shifts. Some authors have suggested that chronic sleep deprivation among shift workers leads to performance decrements and health problems [14]. The general consensus seems to be to limit the number of consecutive night duties [15], mainly because of the impact that night work has on subsequent sleep. Daytime sleep tends to be of shorter duration and of poorer quality than that obtained overnight [16][17]. Indeed, in a previous study of cargo operations, daytime sleep was of poorer quality and 41% shorter than overnight episodes [18].

1.3.4 In a study of helicopter operations [19], where crews were working five consecutive nights between 19:00 and 07:00, there was little evidence of a cumulative effect of fatigue over successive night duties. One reason for this may have been the ability to nap during the night shift, together with the relatively low workload. Though most crews were able to cope with working 5 consecutive nights, there was evidence that one pilot experienced difficulties with the shift pattern.

1.3.5 Consecutive night duties in short-haul operations have been associated with shorter sleep during the subsequent rest period [2]. Sleep is reduced as the duty end time is delayed beyond midnight, to the extent that, for duties ending between 06:00 and 08:00, the average sleep time was only 4.4 hours. In laboratory studies, restricting sleep to 4-5 hours a night has been associated with cumulative increases in cognitive impairment and greater fatigue [21].

1.3.6 Fatigue was also shown to increase during both the outward and return flights of two consecutive night duties [22]. On the return flight, fatigue was more pronounced than on the outward flight, and the return was also associated with an increase in sleepiness during the second half of the flight. This contrasted with the prediction of the SAFE model that fatigue would be greater on the first night duty, because of the longer time since sleep.

1.4 Current study and routes monitored

1.4.1 The current UK flight time regulations (CAP371 [23]) place restrictions on the number of consecutive duties that occur during the period 01:00 to 06:59. For those crews who are employed on regular night duty (any part between 01:00 and 06:59), the maximum number of consecutive duties is 5 and, the duty hours may not exceed 9 hours, irrespective of the number of sectors flown [23]. However, for cargo flights, which are mainly carried out at night, this can be somewhat restrictive, certainly when compared with the schedules that are permitted in other parts of Western Europe. For this reason, DHL requested a variation, with respect to consecutive night duties, which would allow them to complete 4 and 5 consecutive duty sequences (Figure 1). Essentially, within a 28-day period it enabled a maximum of 8 duties of up to 10.25 hours to be carried out. Only one sequence of 4 or 5 duties exceeding 9.5 hours could be completed in any 28-day period.

1.4.2 For operations that are required to be carried out over an even longer overnight period, DHL has introduced schedules based on 'split-nights'. In these, the overnight duty is 'split' into two separate duties, between which the aircrew have a 24-hour layover, usually away from their home base (see Figure 2).

1.4.3 As part of the approval for the variation, it was agreed that the new operation should be monitored. This provided an opportunity to supplement existing data on consecutive duties and to extend it up to 5 duties. In addition, the opportunity was taken to investigate the fatigue implications of split nights.

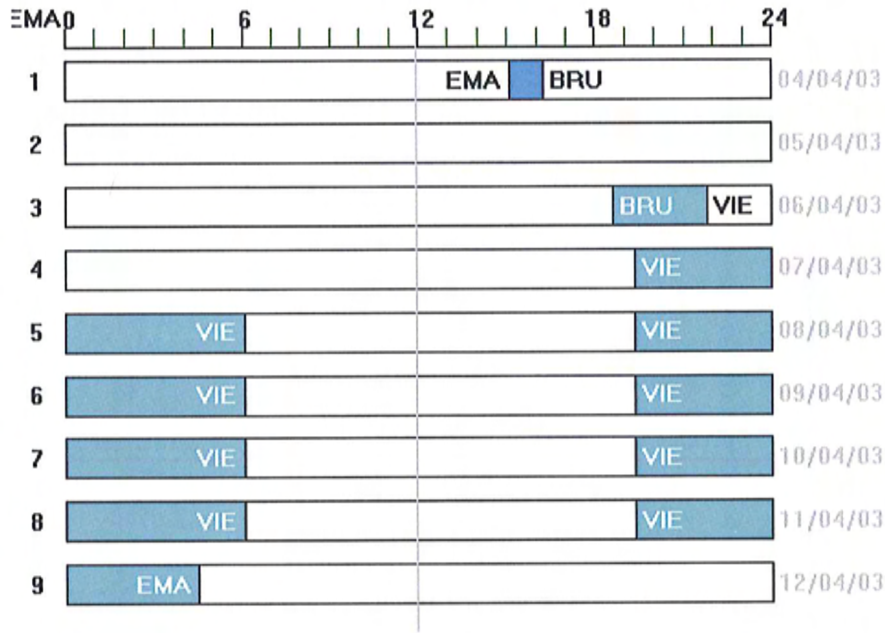


Figure 1 Example consecutive night roster

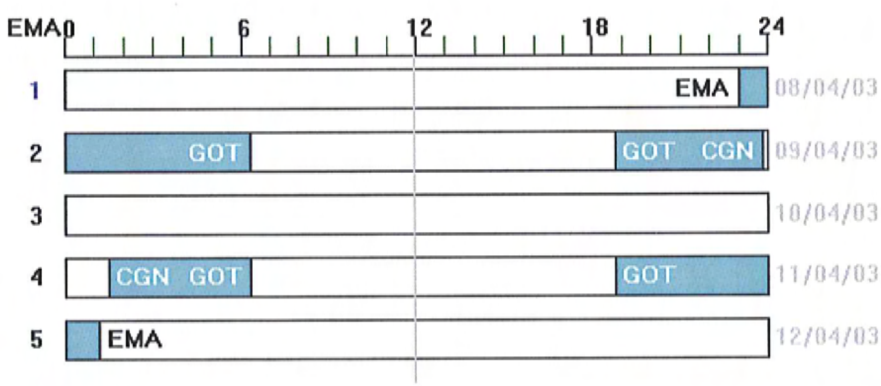


Figure 2 Example split night roster

2 Methods

2.1 Background

2.1.1 DHL crews based at East Midlands Airport (EMA) were asked to participate in a field study investigating the fatigue implications of two different schedules. The two schedules involved overnight duty periods, one of which included split night duties and the other a sequence of up to 5 consecutive nights. Crews were asked to provide information relating to their sleep and duty pattern and to wear an Actiwatch.

2.1.2 The study followed a similar methodology to that used in previous studies, namely the completion of a diary of sleep and duty and the use of an Actiwatch. However, in this case the period covered by each diary was limited to the duration of the schedule of interest (e.g. consecutive nights, split nights) which was approximately one week.

2.2 The diary

2.2.1 The initial page of each diary requested information about the participant's age, position (captain, first officer), and the number of years experience both on the aircraft type and of night operations. Other details requested related to the timing of the previous duty period, and to their normal sleep on days off. To enable the Actiwatch to be linked to the appropriate diary, crews were also asked to enter the watch serial number.

2.2.2 The diary contained two main sections, one relating to sleep (Appendix A) and the other to duty (Appendix A). For each schedule, crews were asked to provide information about their sleep during the 48 hours prior to the first duty period, during the duty schedule and for 72 hours after the final duty period.

2.2.3 For each sleep period information was requested before and after sleep. Before sleep they were asked enter their level of fatigue using the 7-point Samn-Perelli scale [24], the location of the sleep period (at home, in a hotel, at an airport) and the type of facility used (bed/bunk or seat). After getting up they were requested to provide estimates of the timing and duration of sleep, to rate their quality of sleep (on a 7-point scale) and the level of fatigue (on the 7-point Samn-Perelli scale).

2.2.4 During each duty period crews were asked to record information at the time they reported for duty, at the end of each sector and at the end of the duty period. On report, information was requested on the rostered report and off-duty times, the duration of the journey to the airport and their subjective level of fatigue. To identify differences from the rostered times, aircrew were also asked to record their actual report time. At the end of each sector, information was requested on the timing of the flight (blocks off and blocks on), the type of duty (duty or positioning), the destination airport and their level of fatigue at the end of the flight. At the end of the duty period, crews were asked if they had experienced 'heavy eyelids' at any point during the duty, and if so, to estimate the total period over which this had occurred. Finally, details of the actual off-duty time were recorded. Each duty page contained a small area where crews could enter comments and further space for comments was provided at the end of the duty section.

2.3 Actiwatches

2.3.1 As in previous studies, Actiwatches were used to monitor levels of activity [2][19]. The watches used during the study were the Cambridge Neurotechnology AW4 devices, which include an event button. Crews operating out of EMA were asked to wear an Actiwatch throughout each trip and to indicate, by using the event button, when the watch was being worn. Integrated activity data were recorded at two-minute intervals.

2.4 Liaison and distribution of diaries and Actiwatches

2.4.1 An initial letter detailing the study and inviting pilots to take part was sent to all DHL pilots based at EMA. Those individuals who wished to participate in the study were asked to inform the crewing manager of their interest. Contact details for these pilots were then forwarded to the study co-ordinator at QinetiQ. Subsequently, volunteers were sent a pack containing further details of the study, two diaries and stamped return envelopes. If possible, crews were asked to complete both diaries, one for each type of duty.

2.4.2 The roster for each volunteer was sent by DHL to QinetiQ and the route/s of interest identified. QinetiQ then notified DHL of the dates on which the selected trips began. Approximately three days before the chosen trip, individuals were contacted by e-mail. They were asked to start recording information in the diary and to collect an Actiwatch. The crews collected the watches from the crew room at EMA immediately prior to departure and returned them before going off duty at the end of the trip.

2.5 Data analysis

2.5.1 Subjective fatigue.

2.5.1.1 Because of the extreme variability of the data with respect to the timing of individual duty periods and the different sequences of duty periods, it was not possible to combine schedules directly in any meaningful way. For this reason, the analysis of subjective fatigue was carried out in two separate stages, as follows.

2.5.1.2 The first stage included the data from all duty periods and all schedules, not just those involving continuous nights or split nights. The subjective fatigue at the end of each flight was analyzed using a similar methodology, based on unbalanced repeated measures analysis of variance models, to that used in previous studies of aircrew fatigue [3]. The purpose of this analysis was to determine those factors relating to a particular duty period, but not to a sequence of duties, that influenced levels of fatigue. The factors included in this analysis were:

i. time of day,
ii. time on duty,
iii. total flying time,
iv. number of sectors,
v. type of sector (flying or positioning).

2.5.1.3 The second stage of the analysis involved only periods of consecutive nights and schedules including split nights. These were corrected for the significant factors identified during the first stage. These corrected values represented the 'residual' fatigue, over and above the fatigue levels that would be expected based on factors related to the individual duties. These values of residual fatigue were then analyzed to identify where there was any consistent effect associated with the position of the duty period within the schedule. For consecutive nights, this involved an additional factor relating to the order of the nights within a sequence (one to five); for the split nights, the additional factor had three values, corresponding to the pre-midnight duty preceding the split, the post-midnight duty and the duty that immediately followed the split. This third duty was included in the analysis to identify any residual effect of the split duty.

2.6 Activity

2.6.1.1 The data collected were analysed to identify periods of inactivity. Initially, data were scanned and counts were made of the number and duration of periods of inactivity. In particular, periods of inactivity of 6 minutes or more were identified. This was because data from a previous study of the alertness of aircrew on the flight deck indicated that approximately 90% of periods of inactivity of at least 6 minutes were associated with sleep or the early stages of sleep, including microsleeps [25].

2.6.2 Sleep

2.6.2.1 Since the main purpose of this study was to investigate the ability of crews to cope with a period of several consecutive nights, the analysis of sleep described in this report is limited to the duration and subjective quality of sleep during the rest periods between two consecutive nights. These were analyzed to determine whether there was any trend in the pattern of sleep on successive days.

2.6.2.2 The two sleep variables used in the analysis were total sleep time and sleep quality. Where there was more sleep between two consecutive nights, sleep time was taken as the sum total of the individual sleep durations; sleep quality was taken from the assessment associated with the last sleep period.

3 Results

3.1 The sample

3.1.1 Data were collected over a 7-month period between April and September 2003. A total of 48 pilots volunteered for the study, of whom 44 finally participated, with 20 individuals completing both schedules (consecutive night and split night duties) at least once. A total of 97 diaries were returned, with individuals contributing between one and six diaries each. The diaries provided information from 46 consecutive night duties, which included 13 schedules of 3 consecutive nights, 25 schedules of 4 consecutive nights, and 8 schedules of 5 consecutive nights. Information from 40 split night schedules were collected. In addition, there were a further 11 diaries which could not be assigned to either type of schedule.

3.1.2 Twenty-four captains and 20 first officers took part in the study, and their mean age was 44.7 years (range 25-62). On average their experience with the B757 aircraft was 2.5 years (range 0 – 15.8 years) and their experience of cargo operations was 4.4 years (range 1 month – 18.1 years).

3.1.3 The distribution of duty periods across the 24-hour day (in GMT) is shown in Figure 3. Approximately 83% of all duty periods lay entirely within the period between 17:30 and 06:30 GMT (18:30 - 07:30 local time).

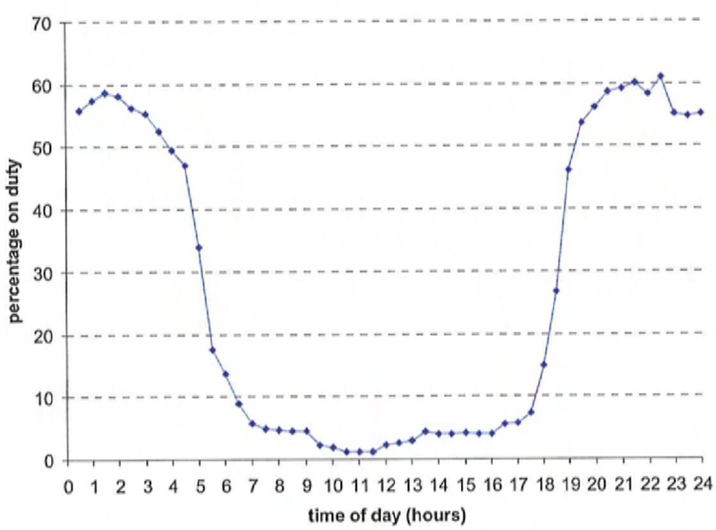


Figure 3 Distribution of duty by time of day

3.1.4 The distribution of the duration of individual duty periods is shown in Figure 4[1]. The overall mean duration was 6 hours 39 minutes. The total number of sectors varied between one (25% of duties), two (39%), three (22%) and four (14%). The distribution of the individual flight times is shown in Figure 5. The average flight length was one hour 14 minutes. Fifteen per cent of all flights were positioning flights.

---

[1] In this figure, as in the other bar charts in this report, the label relates to the highest value included within the corresponding bar. For example, in Figure 4, the bar above the label 5 includes all duties between 4 and 5 hours, including those that were exactly 5 hours, but excluding those that were exactly 4 hours.

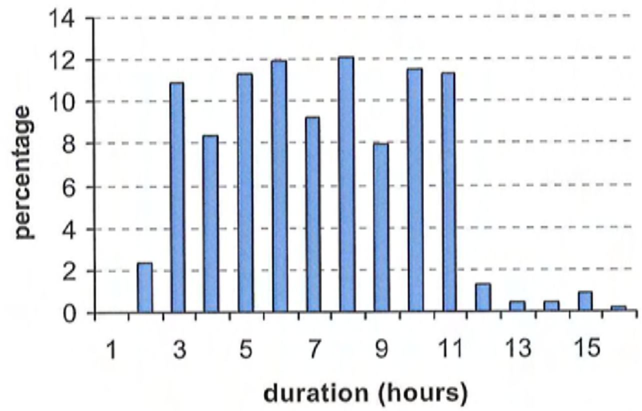


Figure 4 Duration of duty periods

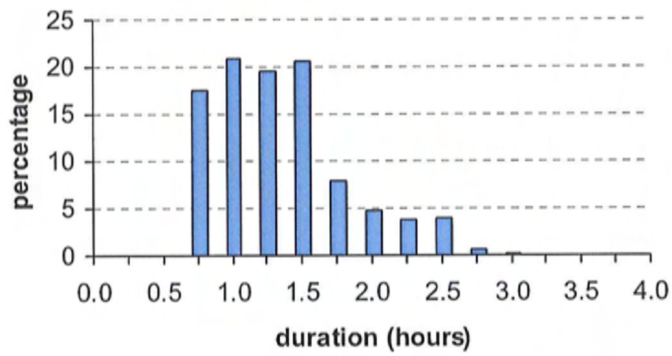


Figure 5 Distribution of flight time

3.2 Subjective fatigue

3.2.1 The following factors, related to a single duty period, had a significant effect on fatigue at the end of a flight:

- the sequence number of the flight within the duty period ($p<0.05$),
- the time of day ($p<0.001$),
- the duration of the duty period ($p<0.001$).

These effects are illustrated in Figures 6, 7 and 8.

3.2.2 The effect of the length of duty was well explained by a linear trend in duty length, whereas the effect of time of day was only partially explained by a sinusoidal trend, with lowest levels of fatigue at 6 hours 21 minutes GMT.

3.2.3 In the figures, the values of fatigue corresponding to a particular factor are shown relative to average levels of the other significant factors. For example, in Figure 7, and working to one decimal place, the level of fatigue at 04:00 is approximately 4.0 and, in Figure 8, the level of fatigue after 10 hours duty is 4.1. These are higher, by 0.6 and 0.7 respectively, than the overall average, which is approximately 3.4. Therefore when both these factors combine for a flight ending at 04:00 after more than 10 hours duty, the expected level of fatigue would be increased by 0.6 + 0.7 =1.3, to give a value of 3.4 + 1.3 = 4.7.

3.2.4 The other factors that were considered, namely total flying hours (in addition to duration of duty) and type of sector (flying / positioning), did not have a significant effect on fatigue.

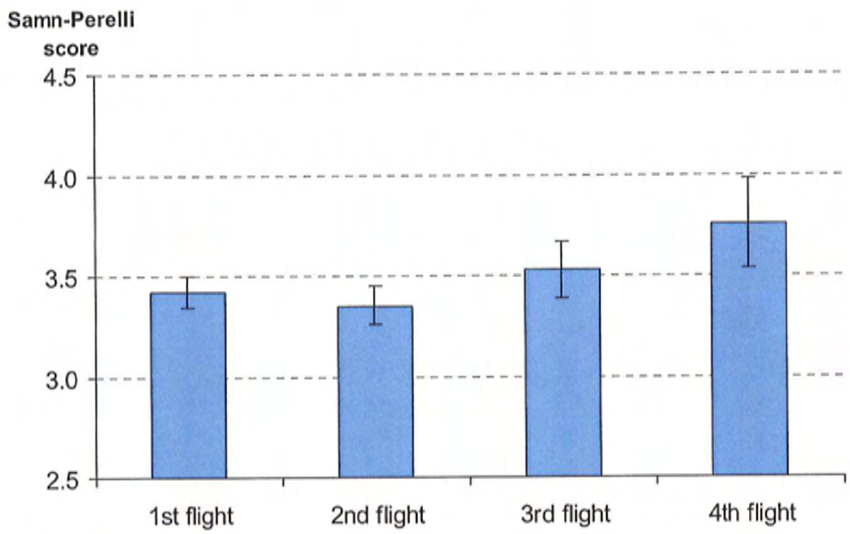


Figure 6 The effect of multiple sectors on fatigue

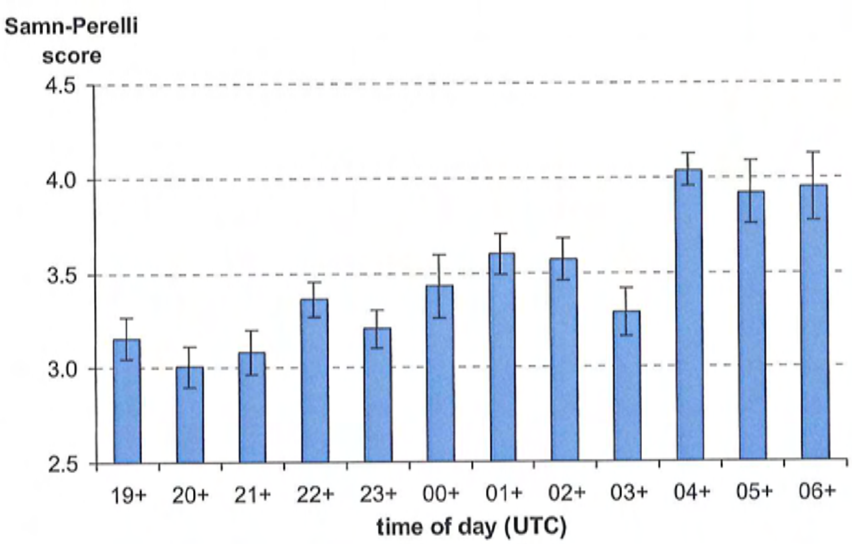


Figure 7 The effect of time of day on fatigue

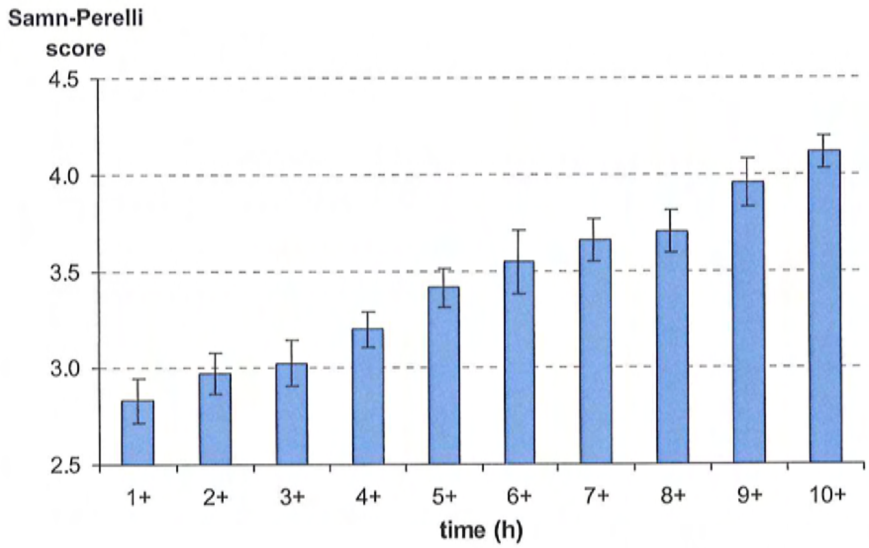


Figure 8 The effect of time on duty on fatigue

3.2.5 The average levels of fatigue associated with consecutive night duties on fatigue is shown in Figure 9. There was a tendency for fatigue to be higher on the first night of a sequence than on the following nights ($p<0.1$), and this trend was maintained after the fatigue levels have been corrected for time of day, time on duty and the number of sectors (Figure 10). Residual fatigue was higher than expected on the first night ($p<0.05$), but did not differ from the expected values on the 2nd, 3rd and 4th nights.

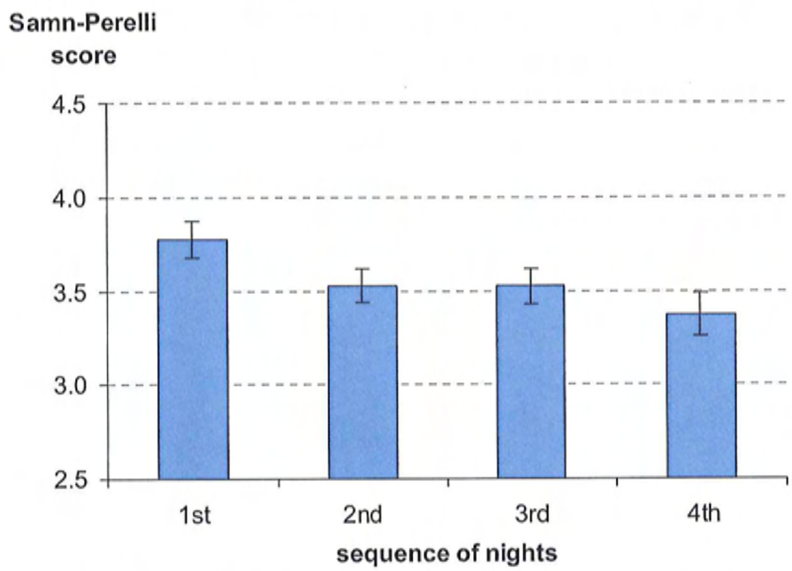


Figure 9 The effect of consecutive duties on fatigue – uncorrected data

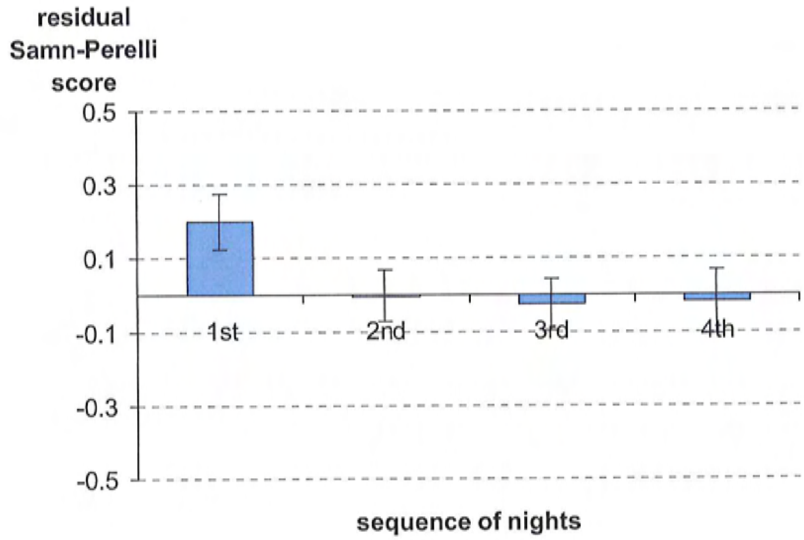


Figure 10 Residual fatigue on consecutive nights

3.2.6 The uncorrected trend during a schedule involving a split night is shown in Figure 11. There were significant differences between the three duty periods, with the highest levels of fatigue on the second part of the split night ($p<0.01$). The pattern was different after the data were corrected. Residual fatigue was lower than expected on the second part of the split night ($p<0.01$), and no different from expected during the other two duty periods.

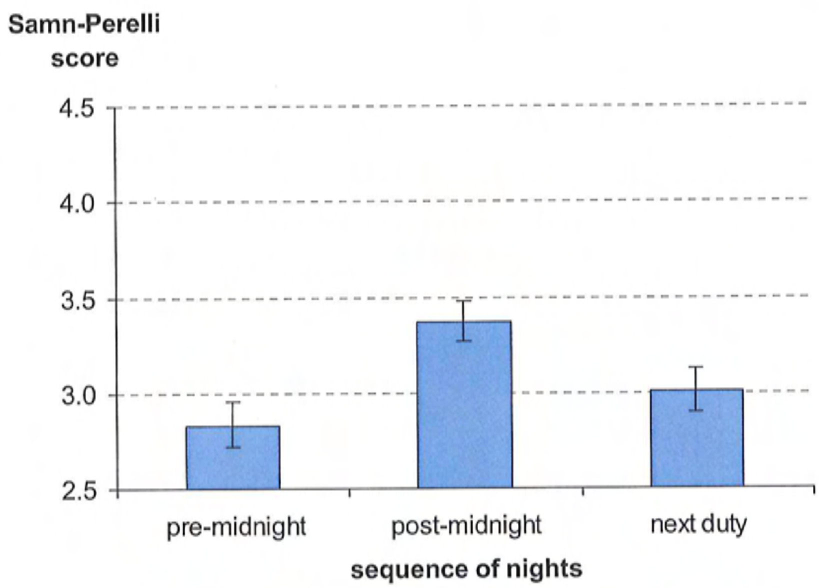


Figure 11 The effect of split nights on fatigue - uncorrected data

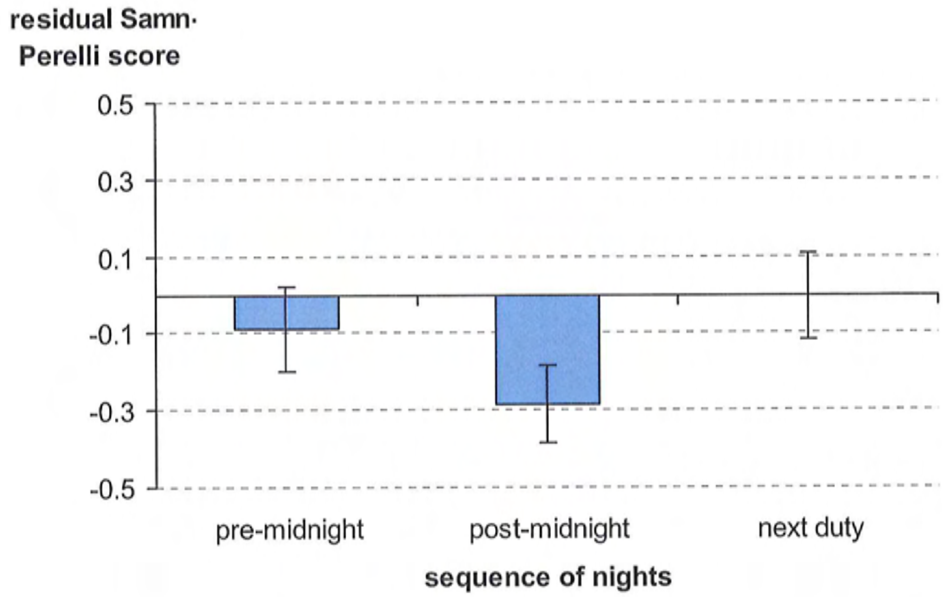


Figure 12 Residual fatigue on split nights

3.2.7 Comparisons between mean ratings of fatigue from the current study and those of previous studies indicate that levels of fatigue were not exceptionally high. For example, the overall average in this study (3.4) compares with 3.3 and 3.6 from two earlier studies of short-haul operations, both with very few overnight duties [26].

3.3 Sleep

3.3.1 The analysis of sleep taken during the individual schedule was carried out on 127 inter-duty periods, 44 between the 1st and 2nd and also between the 2nd and 3rd nights, 31 between the 3rd and 4th, and 8 between the 4th and 5th. Ninety-three (73%) of these periods contained a single sleep period, 32 (25%) contained two, and two contained three sleep periods.

3.3.2 Sleep after the first night was approximately 30 minutes shorter than after subsequent nights ($p<0.05$; see Figure 13). Sleep quality was also poorer after the first night than subsequent nights ($p<0.05$). There was no significant difference in duration or quality, between sleep after the 2nd, 3rd and 4th nights.

3.3.3 On days off crews reported that, on average, they slept for 7 hours and 49 minutes (range of 5 to 10 hours). This compares with an average of 6 hours 14 minutes, during the day following the 2nd, 3rd and 4th nights.

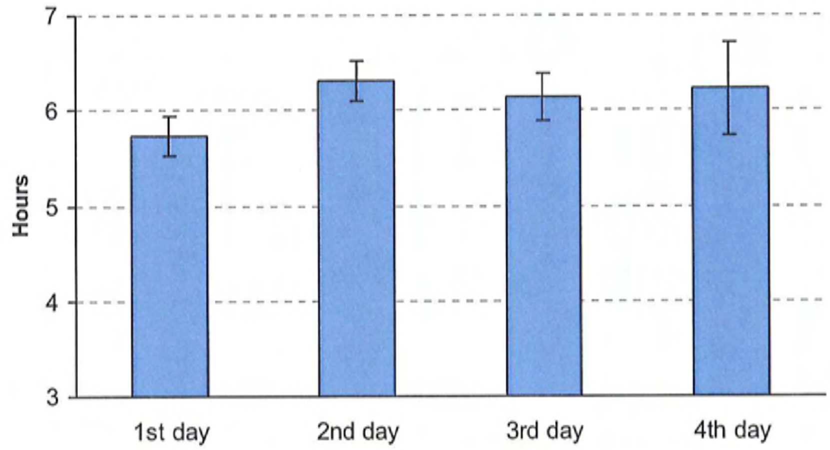


Figure 13 Sleep between consecutive duties

3.4 Activity

3.4.1 Activity data were available from 54 individuals, 24 completing split night duties and 30 operating consecutive nights. This represented 32 split duty schedules (116 flights) and 35 sequences of consecutive nights (337 flights).

3.4.2 There was one inactivity period of 6 minutes during the split nights, which occurred just over 1 hour into the second night duty. For the consecutive night data, there were a total of 8 episodes (from 4 individuals), which ranged from 6 to 14 minutes in duration. The periods of inactivity occurred during 4 separate flights, with 5 episodes observed during the first flight of the first night duty.

4 Discussion

4.1 Modelling consecutive nights

4.1.1 This study did not provide any evidence of an increase in fatigue associated with consecutive nights, and this conclusion applies to sequences of up to 4 consecutive nights, beyond which there were insufficient data. The only increase in fatigue was associated with the first night of the sequence when levels were higher than on subsequent nights.

4.1.2 The lack of an effect of consecutive nights is not consistent with some previous studies of aircrew [2][22]. Data collected by the DLR on return flights between Frankfurt and the Seychelles [22] originally led to the suspicion that the SAFE program may be underestimating the fatiguing effect of consecutive night duties. In that study, levels of fatigue on the second night were considerably higher than on the first. This is in contrast to the current study, where there is a tendency for the second night to be less fatiguing than the first. This result is closer to the model prediction, which is based on the much longer time since sleep prior to the first night compared with the second.

4.1.3 After the second night there was no evidence of any further increase in alertness, but neither was there any decrease. Such a decrease might be expected based on the accumulated sleep loss associated with the periods of daytime sleep. However, the results of the current study are consistent with the findings of a study of police helicopter operations [19] where there was a similar lack of change over 5 consecutive night duties.

4.1.4 One reason for a lack of an effect may be that individuals are adapting, at least to some extent, to the night-time schedule. Sleep quality and duration were reduced after the first night but over subsequent sleep periods there was no difference, with crews obtaining slightly more than 6 hours sleep between night duties. This is consistent with the amount of sleep obtained in a study of rotating night workers where the average sleep duration was 6.12 hours [27]. However, it is less than that normally achieved by day workers, and an hour and a half less than they would normally sleep on days off.

4.1.5 The implications for the SAFE model are somewhat uncertain. For the present, it may be preferable to leave the model unchanged, i.e. the relatively small deterioration associated with all consecutive duty periods will be retained, and no difference will be made between daytime and overnight duty period. However further data, particularly on passenger rather than cargo operations, would be extremely valuable.

4.2 Implications for scheduling

4.2.1 It is useful to consider the implications of these results more generally for the scheduling of overnight cargo operations. As there is no evidence of an increase in fatigue over consecutive nights, and as the overall levels of fatigue are not high in absolute terms, some of the earlier concerns about these types of schedule have been reduced or removed. It is natural to ask to what extent it might be possible to relax the current limits, with respect to both the number of consecutive nights and the duration of the duty period. Indeed, many of the crew would like to work the less restricted patterns of their colleagues who are based on the mainland of Europe.

4.2.2 However, it would not be wise to extrapolate these results too far. Adverse effects could easily appear after another one or two nights, especially if there is no increase in the amount of daytime sleep. In a comparable group of helicopter pilots [19] alertness and performance remained steady for 5 consecutive nights, but the average amount of daytime sleep (6.79 hours) was considerably more than in this study.

4.2.3 There are other factors that may restrict the extent to which these results can be applied more generally. For example, individuals may be self-selecting based on their ability to tolerate night work. It appears that the crews are coping reasonably well with the overnight schedules, in spite of their age, which, at 45 years, is on average 5 years more than in many previous aircrew studies. Indeed, at around 45 years of age, there are reports that more individuals have problems coping with nights [28]. It is reasonable to suppose that those who suspect that they might not be able to cope with night work will not choose to apply in the first place. If these schedules were imposed on a broader sample of aircrew, who had not been subject to self-selection, it is likely that more problems would be encountered.

4.2.4 A further factor is that there are significant differences between cargo operations and the other night operations previously studied. For example, the Britannia crews who showed a tendency towards increased fatigue over consecutive nights [2] were carrying passengers to and from holiday destinations in Europe, North Africa and the Middle East. Many of these flights were subject to delays and, together with the increased hassle usually associated with passenger flights, this may have contributed towards a greater accumulation of fatigue. The delays and the hassle tend to be much reduced in cargo operations.

4.2.5 The split nights, incorporating a 24-hour layover away from base, were effective in limiting the development fatigue. On the second part of the split night, fatigue was lower than anticipated and there was no accumulation of fatigue that affected the next duty period. However, given the relatively low levels of fatigue in these operations as a whole, the possibility of a small extension of the duty period overnight, to avoid the requirement for some of the split duties, might also be considered.

5 Conclusions

5.1.1 There is no evidence in these operations of an increase in fatigue over four consecutive nights. This may be partly explained by the different nature of cargo, compared with passenger operations, and by an element of self-selection by the crews undertaking this type of work. Based on these results, no further changes will be made to the implementation of consecutive nights in the SAFE program.

5.1.2 Split night duties are effective in limiting the development of fatigue overnight, and have no adverse effect on subsequent duty periods.

5.1.3 These results suggest that some relaxation of the current guidelines might be considered for cargo operations, including for example an increase in the number of consecutive nights, or a small extension in the duty period limits. However, any changes would need to be carefully monitored and implemented in a step-wise manner, so that any unacceptable increase in fatigue could be quickly identified.

6 References

[1] Spencer MB. Development of an aircrew fatigue model. In: Fatigue and Working hours in Aviation, Proceedings of the Royal Aeronautical Society, London, October, 2002.

[2] Robertson KA, Spencer MB. Aircrew alertness on night operations: an interim report. QinetiQ Report No. QINETIQ/KI/CHS/CR021911/1.0, 2003.

[3] Spencer MB, Robertson KA. Aircrew alertness during short-haul operations, including the impact of early starts. QinetiQ Report No. QINETIQ/CHS/PPD/CR010406/1.0, 2002.

[4] Graeber RC. Aircrew fatigue and circadian rhythmicity. In: Human Factors in Aviation. Weiner EL, Nagel DC (eds). Academic Press Inc, California. 305-344, 1988.

[5] Akerstedt T. Sleepiness as a consequence of shift work. Sleep 11(1): 17-34, 1988.

[6] Knauth P. Speed and direction of rotation. J Sleep Res 4(suppl 2): 41-46, 1995.

[7] Kecklund G, Akerstedt T. Sleepiness in long distance truck driving: an ambulatory EEG study of night driving. Ergonomics 36: 1007-1017, 1993.

[8] Torsvall L, Akerstedt T. Sleepiness on the job: continuously measured EEG changes in train drivers. Electroencephalogr Clin Neurophysiol 66: 502-511, 1987.

[9] Tilley AJ, Wilkinson RT, Warren PSG, Watson B, Drud M. The sleep and performance of shift workers. Hum Factors 24: 629-641, 1982.

[10] Akerstedt T. Work hours, sleepiness and the underlying mechanisms. J Sleep Res 4 (suppl 2): 15-22, 1995.

[11] Harma M, Sallinen M, Ranta R, Mutanen P, Muller K. The effect of an irregular system on sleepiness at work in train drivers and railway traffic controllers. J Sleep Res 11: 141-151, 2002.

[12] Folkard S, Tucker P. Shift work, safety and productivity. Occupat Med 53: 95-101, 2003.

[13] Minors DS, Waterhouse JM. Circadian rhythms in deep body temperature, urinary excretion and alertness in nurses on night work. Ergonomics 28: 1523-1530, 1985.

[14] Tepas DI. Shiftworker sleep strategies. J Human Ergol 11 (suppl): 325-336, 1982.

[15] Knauth P. The design of shift systems. Ergonomics 36(1): 15-28, 1993.

[16] Tepas DI, Carvalhais AB. Sleep patterns of shiftworkers. Occup Med 5(2): 199-208, 1990.

[17] Akerstedt T. Shift work and sleep disturbances. In: Sleep and Health Risk. Peter JH, Penzel T, Podszus T, vonWichert P (eds). Springer-Verlag, 265-278, 1991.

[18] Gander PH, Gregory KB, Connell LJ, Graeber RC, Miller DL, Rosekind MR. Flight crew fatigue IV: Overnight cargo operations. Aviat Space Environ Med 69(9, suppl): B26-B36, 1998.

[19] Robertson KA, Spencer MB. Comparison between two 12-hour shift patterns in police helicopter operations. DERA Report No. DERA/CHS/PPD/CR000329, 2000.

[20] Dinges DF, Pack F, Williams K, Gillen KA, Powell JW, Ott GE, Aptowicz C, Pack AI. Cumulative sleepiness, mood disturbance, and psychomotor vigilance performance decrements during a week of sleep restricted to 4-5 hours per night. Sleep 20(4): 267-277, 1997.

[21] Van Dongen HPA, Maislin G, Mullington JM, Dinges DF. The cumulative cost of additional wakefulness: Dose response effects on neurobehavioral functions and sleep physiology from chronic sleep restriction and total sleep deprivation. Sleep 26(2): 117-126, 2003.

[22] Samel A, Wegmann HM, Vejvoda M, Drescher J, Gundel A, Manzey D, Wenzel J. Two-crew operations: Stress and fatigue during long-haul night flights. Aviat Space Environ Med 68(8): 679-687, 1997.
[23] CAP371: Avoidance of fatigue in Air Crews. Civil Aviation Authority. 4th Edition. January 2004.
[24] Samn SW, Perelli LP. Estimating aircrew fatigue: A technique with implications to airlift operations. Brooks AFB, TX: USAF School of Aerospace Medicine. Technical Report No. SAM-TR-82-21, 1982.
[25] McGown AS, Wright NA, Montgomery JM. Wakefulness on the civil flight deck: an investigation of wrist activity. CAA Paper 97001, 1997.
[26] Spencer MB, Robertson KA. A diary of aircrew fatigue in short-haul multi-sector operations. DERA Report No. DERA/CHS/PPD/CR000394, 2000.
[27] Wilkinson RT. How fast should the night shift rotate? Ergonomics 35(12): 1425-1451, 1992.
[28] Akerstedt T, Torsvall L. Shiftwork. Shift-dependent well-being and individual differences. Ergonomics 24: 265-273, 1981.

A. Appendix A

Duty page of the diary

DUTY PERIOD
(ALL times in ZULU)

ON REPORT

DATE *(Zulu)* — day / mon / yr: / /03

ROSTERED REPORT TIME *(Zulu)* — hrs : mins

ROSTERED/PLANNED OFF-DUTY TIME *(Zulu)* — hrs : mins

DURATION OF JOURNEY TO AIRPORT — hrs : mins

REPORT TIME AT AIRPORT *(Zulu)* — hrs : mins

DEPARTURE AIRPORT CODE

PRE-FLIGHT FATIGUE RATING * — 1 2 3 4 5 6 7

DURING DUTY PERIOD

SECTOR	BLOCKS OFF *(Zulu)* hrs mins	TYPE OF DUTY (✓) FLYING	POSITIONING	BLOCKS ON *(Zulu)* hrs mins	THREE-LETTER DESTINATION AIRPORT CODE	POST-FLIGHT FATIGUE RATING *
1	:	○	○	:		1 2 3 4 5 6 7
2	:	○	○	:		1 2 3 4 5 6 7
3	:	○	○	:		1 2 3 4 5 6 7
4	:	○	○	:		1 2 3 4 5 6 7
5	:	○	○	:		1 2 3 4 5 6 7
6	:	○	○	:		1 2 3 4 5 6 7

AT END OF DUTY PERIOD

DID YOU EXPERIENCE 'HEAVY EYELIDS' AT ANY POINT DURING THE DUTY PERIOD? NO ○ YES ○

IF 'YES', FOR HOW MANY MINUTES? mins

DATE *(Zulu)* OFF-DUTY — day / mon / yr: / /03

ACTUAL OFF-DUTY TIME *(Zulu)* — hrs : mins

IF YOU FELL ASLEEP PLEASE PROVIDE DETAILS IN THE SLEEP SECTION

COMMENTS

*** FATIGUE RATING** PLEASE SELECT ONE STATEMENT THAT RELATES TO YOUR CURRENT LEVEL OF FATIGUE

1= fully alert, wide awake;
2= very lively, responsive, but not at peak;
3= okay, somewhat fresh;
4= a little tired, less than fresh;
5= moderately tired, let down;
6= extremely tired, very difficult to concentrate;
7= completely exhausted, unable to function effectively.

Sleep page of the Diary

SLEEP PERIODS (ALL times in ZULU)

BEFORE SLEEP

DATE ON WAKING (Zulu) day mon yr	CURRENT TIME (Zulu) hrs mins	FATIGUE RATING *
/ /03	:	1 2 3 4 5 6 7

LOCATION (✓): HOME ◯ HOTEL ◯ AIRPORT ◯

TYPE OF FACILITY (✓): BED/BUNK ◯ SEAT ◯

AFTER SLEEP

IN BED AT (Zulu) hrs mins	ASLEEP AT (Zulu) hrs mins	DATE ON WAKING (Zulu) day mon yr	AWOKE AT (Zulu) hrs mins	GOT UP AT (Zulu) hrs mins	TOTAL DURATION OF SLEEP (EXCLUDING AWAKENINGS) hrs mins
:	:	/ /03	:	:	:

SLEEP QUALITY: extremely good 1 2 3 4 5 6 7 extremely poor

FATIGUE RATING *: 1 2 3 4 5 6 7

ADDITIONAL COMMENTS :

BEFORE SLEEP

DATE ON WAKING (Zulu) day mon yr	CURRENT TIME (Zulu) hrs mins	FATIGUE RATING *
/ /03	:	1 2 3 4 5 6 7

LOCATION (✓): HOME ◯ HOTEL ◯ AIRPORT ◯

TYPE OF FACILITY (✓): BED/BUNK ◯ SEAT ◯

AFTER SLEEP

IN BED AT (Zulu) hrs mins	ASLEEP AT (Zulu) hrs mins	DATE ON WAKING (Zulu) day mon yr	AWOKE AT (Zulu) hrs mins	GOT UP AT (Zulu) hrs mins	TOTAL DURATION OF SLEEP (EXCLUDING AWAKENINGS) hrs mins
:	:	/ /03	:	:	:

SLEEP QUALITY: extremely good 1 2 3 4 5 6 7 extremely poor

FATIGUE RATING *: 1 2 3 4 5 6 7

ADDITIONAL COMMENTS :

*** FATIGUE RATING**

PLEASE SELECT ONE STATEMENT THAT RELATES TO YOUR CURRENT LEVEL OF FATIGUE

1= fully alert, wide awake;
2= very lively, responsive, but not at peak;
3= okay, somewhat fresh;
4= a little tired, less than fresh;
5= moderately tired, let down;
6= extremely tired, very difficult to concentrate;
7= completely exhausted, unable to function effectively.

Initial distribution list

External

CAA

DHL

Capt. William Moore – Flight Operations Director

Mr Andy O'Shea – Crewing Manager

QinetiQ

Information Resources

Project Manager

Mr Mick Spencer

Miss Karen Robertson

Mr Steve Foster

File

Blank page

Attachment
3.

Consecutive Night Duty Periods with Mid-duty Sleep Opportunities

SAFTE/FAST Fatigue Analysis
Steven R. Hursh, Ph.D.
Institutes for Behavior Resources, Inc., and
Johns Hopkins University School of Medicine
October 25, 2009

Introduction

The Institutes for Behavior Resources, Inc. was asked to evaluate the fatigue risk associated with multiple consecutive night duty periods with the allowance for a mid-duty sleep opportunity as a planned fatigue mitigation. The analysis was performed using a biomathematical fatigue model – the Sleep, Activity, Fatigue, and Task Effectiveness (SAFTE) model implemented in the Fatigue Avoidance Scheduling Tool (FAST) (Hursh, Balkin, Miller, and Eddy, 2004). SAFTE/FAST is a validated model shown to predict accident risk and severity (Hursh, Raslear, Kaye, and Fanzone, 2006). The predictions of the model are based on work schedule and sleep opportunities combined with the effects of time-of-day (circadian rhythms) on cognitive speed (Hursh, Redmond, Johnson, Thorne, Belenky, Balkin, Miller, Eddy, and Storm, 2004). The predictions of the model are expressed in units of effectiveness ranging from 100 (best normal performance) to zero (worst performance).

For this analysis, the following nominal scenarios were considered. Flight crew report for duty at 2000 hrs and are on duty a total of 9 hrs. As a planned fatigue mitigation, a mid-duty sleep opportunity (nap) was placed in the schedule at about 2330 and lasted for a period of time that was evaluated in the analysis. The analysis considered mid-duty night naps of the following durations: 2, 3, 3.4, and 4 hrs long. Nap sleep quality was adjusted for the environment (terminal sleeping room) to fair, i.e. 67% restorative value relative to sleep at home or in a hotel. In addition, after the completion of duty in the morning, the analysis considered the recuperative effect of varying amounts of daytime sleep ranging from 6 to 8 hrs in duration commencing 1 hr after duty with sleep quality adjusted to excellent for sleep at home or a hotel. The sleep and duty scenario was repeated every day for five consecutive days. For simplicity, modeling scenarios did not include varying waypoints, a factor that was not considered dominant in this scenario. The model calculated effectiveness predictions for every minute while on duty (outside the nap period) and the total amount of time on duty below an effectiveness of 80.

Each of the combinations of mid-duty night sleep and daytime sleep were evaluated with the SAFTE/FAST model. For purposes of evaluation of risk, the modeling software calculated the percent of scheduled duty time below a scale value of 80 or 77. For planning purposes, to minimize fatigue risk, duty time below 80 should be minimized and critical flight duty time (take-off plus 30 min and 30 min prior to landing) below 77 should be avoided, a score roughly equivalent to the effects of a blood alcohol concentration of 0.05 (Dawson and Reid, 1967; Arnedt, Wilde, Munt, and MacLean, 2001). The model calculated the percent of duty time below these criteria for consecutive duty periods from one to five.

Daytime Sleep Total of 6.5 hours

First, the results of scenarios that assume that flight crew can achieve about 6.5 hrs of daytime sleep in addition to their mid-duty nap is summarized as follows.

- With 6.5 hrs of daytime sleep, the 4 hrs mid-duty sleep opportunity results in performance on duty that is never below 80 across five days of night duty.
- For the case with a 3.5 hrs mid-duty nap, duty time below 80 was negligible across 5 days. All duty time was above 77.
- The 3 hrs mid-duty nap case resulted in over 20% of time below 80 across five days. The fifth duty day was 42% below 80. Duty time was above 77 throughout.
- The 2 hrs scenario resulted in over 53% of duty time below 80 and 34% of time below 77.

These results are summarized in the following graphs. Figure 1 shows the effectiveness curves for the four cases modeled. The dashed line is the criterion line set at 80.

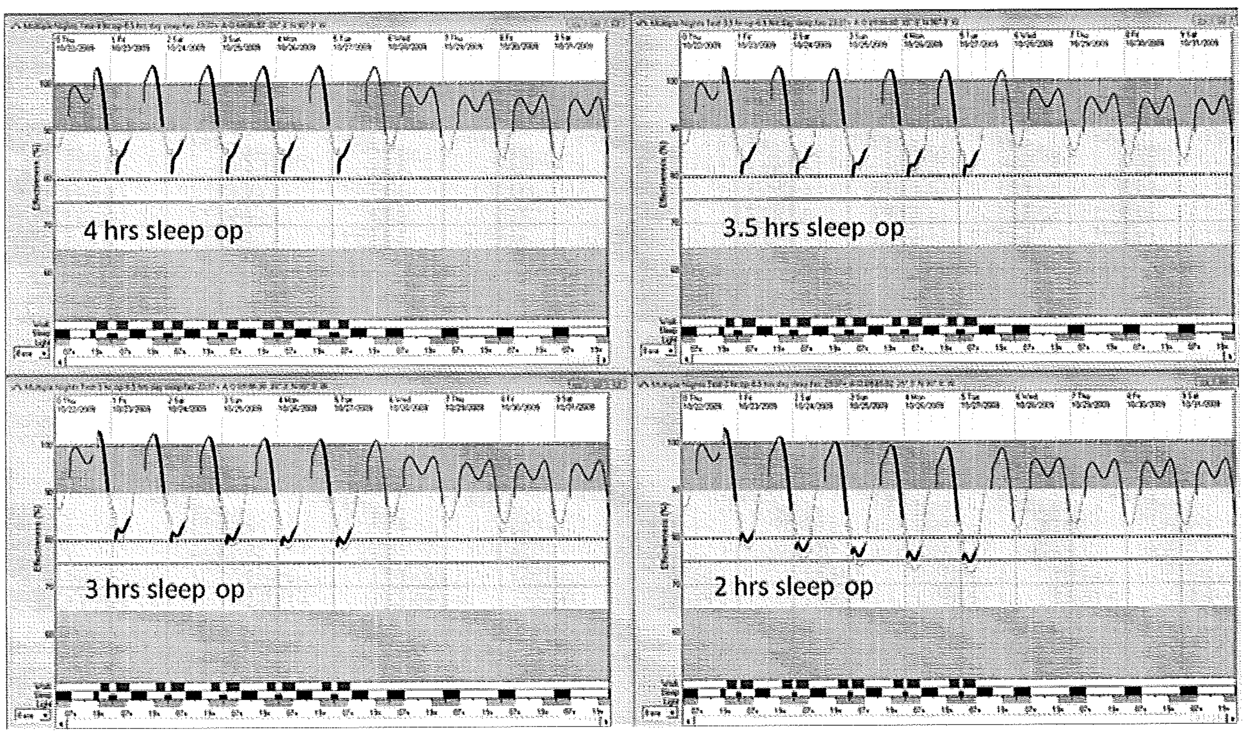


Figure 1: Effectiveness curves with 6.5 hrs daytime sleep.

The following chart (Figure 2) summarizes the amount of duty time below a criterion of 80 for the four scenarios that assumed 6.5 hrs of daytime sleep.

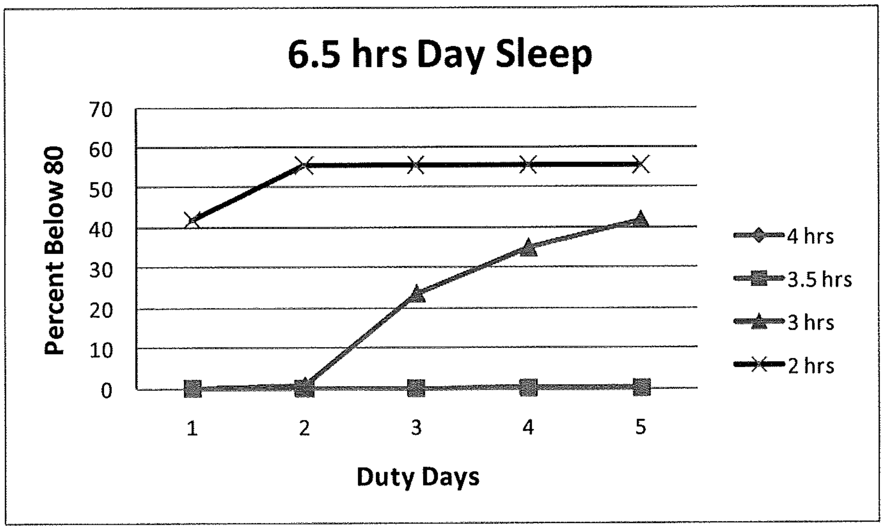


Figure 2: Percent of duty time below 80 for four nap scenarios combined with 6.5 hrs of daytime sleep. Note that the results for 4 and 3.5 hrs overlap at zero across five days.

Daytime Sleep Total of 6 hours

Next, the results of scenarios that assume that flight crew can achieve about 6 hrs of daytime sleep in addition to their mid-duty nap is summarized as follows.

- With 6 hrs daytime sleep, the 4 hrs mid-duty sleep opportunity remains above 80 throughout.
- The 3.5 hrs mid-duty nap scenario results in only 3 % of total duty time below 80 across 5 days; the fifth day has about 10% of time below 80. Duty time is above 77 throughout.
- The 3 hrs scenario results in over 40% of time below 80 across five days; the fifth day is 61% below 80. Duty time is above 77 throughout.
- The 2 hrs scenario results in over 53% of duty time below 80 and 41% of time below 77.

The results with 6 hrs of daytime sleep are summarized in the following graphs. Figure 2 shows the effectiveness curves for the four cases modeled. The dashed line is the criterion line set at 80.

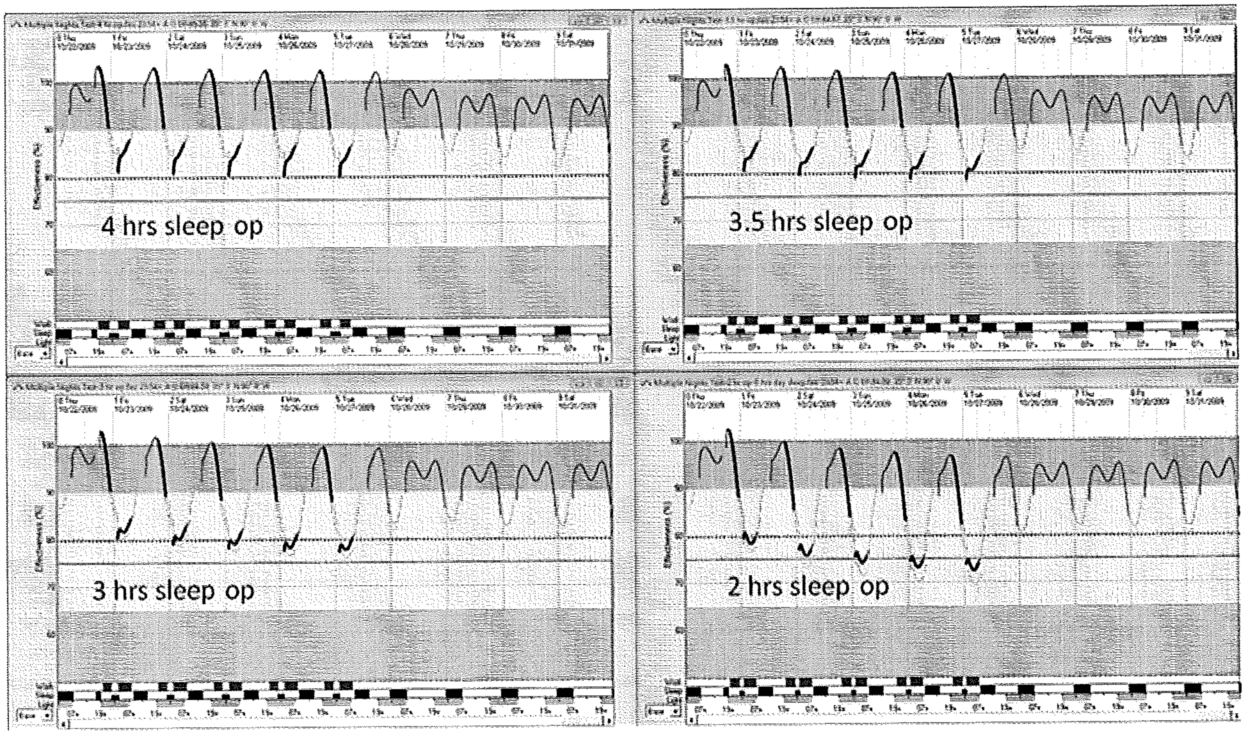


Figure 3: Effectiveness curves with 6 hrs daytime sleep.

The following chart (Figure 4) summarizes the amount of duty time below a criterion of 80 for the four scenarios that assumed 6 hrs of daytime sleep.

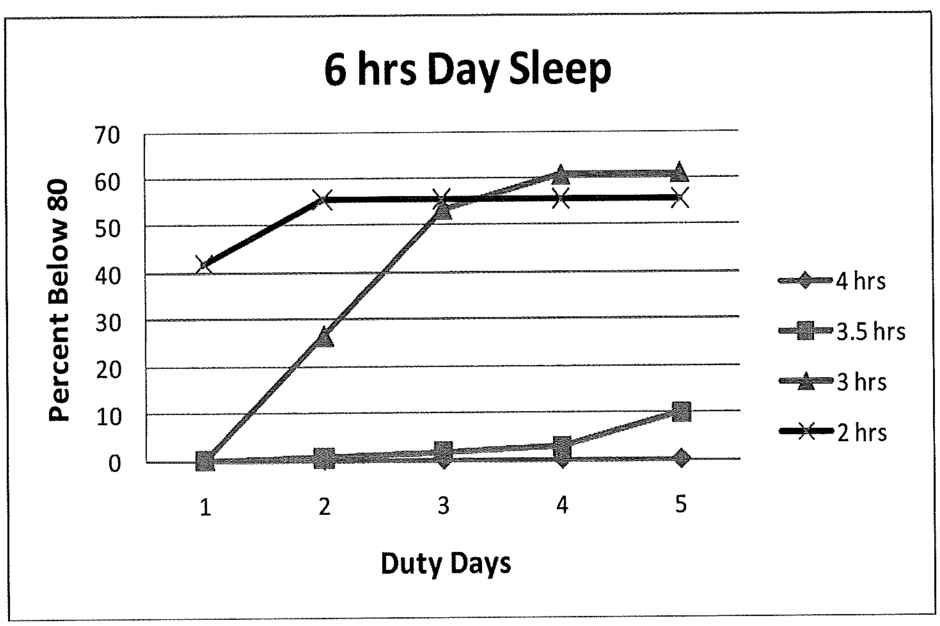


Figure 4: Percent of duty time below 80 for four nap scenarios combined with 6 hrs of daytime sleep.

Other Combinations of Night and Daytime Sleep

The analysis also considered the following combinations of night, mid-duty, and daytime sleep that sum to 10 hrs total sleep per day.

- 4 hrs mid-duty, 6 hrs day
- 3.5 hrs mid-duty, 6.5 hrs day
- 3 hrs mid-duty, 7 hrs day
- 2 hrs mid-duty, 8 hrs day

The effectiveness results can be summarized as follows:

- All but the last case with only 2 hrs mid-duty sleep led to stable performance above 80.
- The 2 hrs scenario results in over 37% of duty time below 80 but no duty time below 77. In this scenario, with a 30 min break between sleep and duty, 32% of duty time was below 80.

The results of these scenarios are summarized in the effectiveness graphs below, Figure 5. The red graph is the circadian phase line showing that phase is stable across five days in all scenarios.

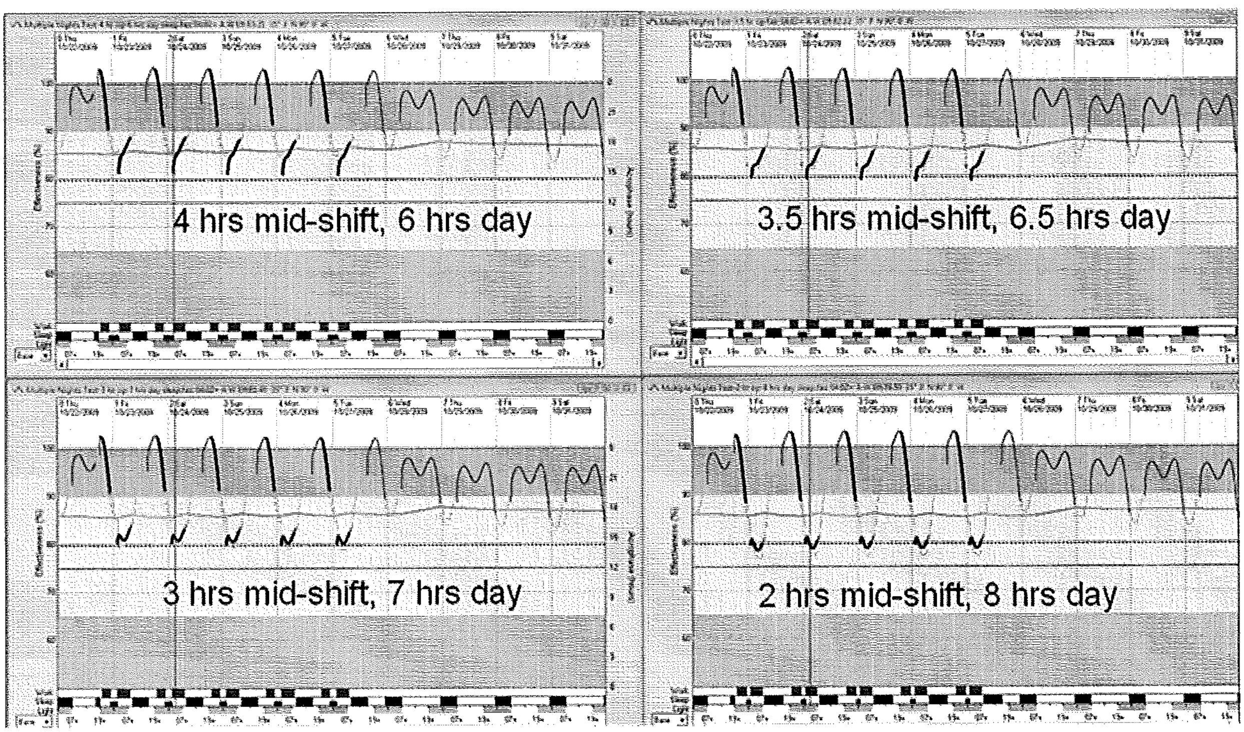


Figure 5: Effectiveness curves with combinations of night and daytime sleep that total to 10 hrs.

The effectiveness on duty below 80 results for these scenarios is summarized in the graph below, Figure 6. Only the case with a short 2 hrs mid-duty nap results in any significant time below the criterion value of 80.

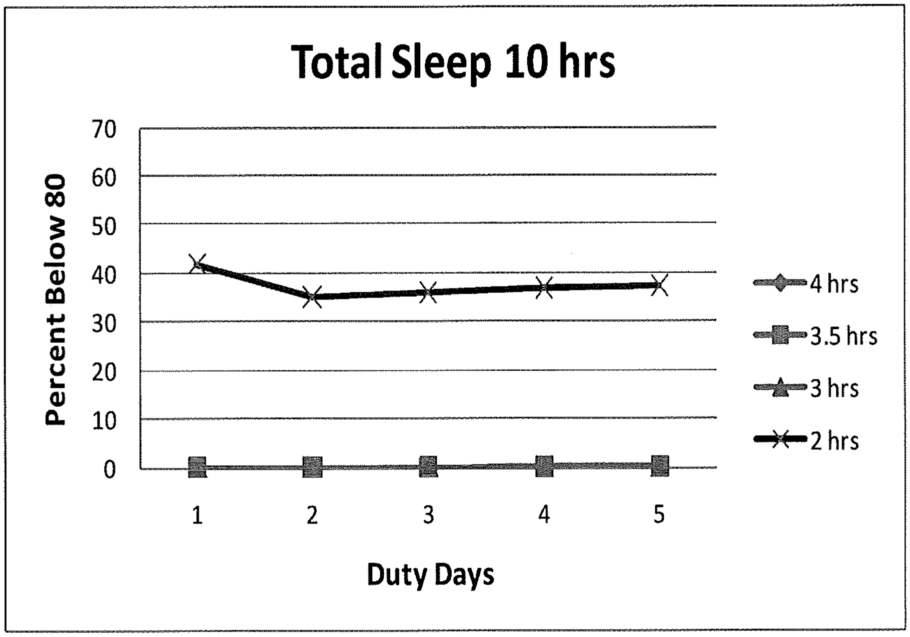


Figure 6: Percent of duty time below 80 for four scenarios in which night and daytime sleep combine for a total of 10 hrs of sleep per day.

Conclusions

As a rule of thumb, if the amount of mid-duty sleep at night is at least 3 hrs and the sum of night and day sleep equals 10 hrs, then performance remains above 80 for five consecutive nights. If the amount of mid-duty sleep at night is at least 3.5 hrs, then a sum of 9.5 hrs sleep results in a minor amount of time below 80 (3%) and no time below 77 across five consecutive nights. In this case, an allowance of 30 min after sleep before duty eliminates any time below 80 due to sleep inertia. With as little as 3 hrs of mid-duty night sleep and 6 hrs of daytime sleep there is no duty time below 77 across five consecutive nights. A short 2-hr mid-duty night sleep appears to be insufficient to avoid significant time below 80 even when combined with 8 hrs of daytime sleep. This is because daytime sleep is less restorative than night time sleep based on modeling the circadian rhythm of sleep propensity.

All mid-duty nap scenarios that combine with daytime sleep to sustain performance assume that crewmembers are trained in the importance of achieving maximal daytime sleep to complement the relatively short nighttime sleep. Often night shift workers without such training resort to relatively short daytime sleep (often only 5.5 hrs per day) and make up sleep on days off (Knauth, Landau, Dröge Schwitteck, Widynski, and Rutenfranz, 1980). That pattern will not work successfully in flight operations with multiple consecutive nights and crewmembers must be trained and encouraged to use their days for productive sleep.

References

Arnedt, J.T., Wilde, G.J., Munt, P.W., and MacLean, A.W. (2001). How do prolonged wakefulness and alcohol compare in the decrements they produce on a simulated driving task? *Accident Analysis and Prevention*, 33, 3, 337-44.

Dawson, D., and Reid, K. (1997). "Fatigue, alcohol and performance impairment." *Nature 388*, 23.

Hursh SR, Raslear TG, Kaye AS, Fanzone Jr JF: Validation and Calibration of a Fatigue Assessment Tool for Railroad Work Schedules, Summary Report. (Report No. DOT/FRA/ORD-06/21) Washington D.C., Federal Railroad Administration, 2006.

Hursh SR, Balkin TJ, Miller JC, Eddy DR: The fatigue avoidance scheduling tool: Modeling to minimize the effects of fatigue on cognitive performance. *SAE Trans* 2004;113:111-119.

Hursh SR, Redmond DP, Johnson ML, Thorne DR, Belenky G, Balkin TJ, Miller JC, Eddy DR, Storm WF: Fatigue models for applied research in warfighting. *Aviat Space Environ Med* 2004;75:A44-A53.

Knauth P., Landau, K., Dröge C. Schwitteck, M., Widynski, M., and Rutenfranz, J. Duration of sleep depending on the type of shift work. *International Archives of Occupational and Environmental Health, 46* (2), 1980, 167-177.

TAB 12

INDEPENDENT PILOTS ASSOCIATION

Submission of Comments on Flightcrew Member Duty and Rest Requirements: Proposed Rule

Docket No. FAA-2009-1093

November 15, 2010

INDEPENDENT PILOTS ASSOCIATION

Docket Operations, M-30 15 November 2010
U.S. Department of Transportation
1200 New Jersey Ave., SE
West Building Ground Floor, Room W12-140
Washington, DC 20590

RE: Submission of Comments on Flightcrew Member Duty and Rest Requirements: Proposed Rule, Docket No. FAA-2009-1093

Administrator Babbit:

The Independent Pilots Association (IPA), the bargaining unit for the 2900 pilots of United Parcel Service, has reviewed the proposed rules on Flightcrew Member Duty and Rest Requirements published in the Federal Register on September 14, 2010. We applaud the FAA for taking this first step in addressing the longstanding issue of pilot fatigue within the aviation industry. The IPA has been honored to participate in the FAA's long history of proposed rule making efforts on this issue for more than a decade. We have participated in the FAA's Reserve Rest ARAC in 1998, the URL industry/labor working group, panel member at the FAA Fatigue Management Symposium in 2008 and most recently an IPA flightcrew member was a representative on the 2009 ARC on Flightcrew Member Duty and Rest Requirements. We have also attended numerous fatigue conferences and symposiums and have adopted and currently utilize a bio-mathematical model for schedule evaluation.

As cargo pilots, we have witnessed first hand how difficult creating rules which are acceptable to the aviation industry has been. We are, therefore, heartened to see that many of the ARC's recommendations have been included in the proposed rules - most importantly, the FAA's commitment to one level of safety for all Part 121 operators - both passenger and cargo carriers alike. The uniform treatment of all pilots who fly under Part 121 is a significant step forward in securing the safety of American skies and promotion of the health and welfare of all Part 121 pilots and the public.

After a thorough review of the NPRM, the IPA has developed a list of continued concerns as well as answers to the questions posed by the FAA. Our comments to the rules, answers to the FAA's questions and supporting documents are attached herein. We look forward to the publication of the final rules and applaud the FAA for its dedication in creating rules, which will address the issue of pilot fatigue.

Sincerely,

Michael Moody, Jr
IPA At-Large Representative

Lauri Esposito
IPA Fatigue Committee Chairperson

3607 FernValley Road • Louisville, KY 40219-1916
502-968-0341 Fax: 502-968-0470
800-285-4472

Table of Contents

BEFORE THE
U.S. DEPARTMENT OF TRANSPORTATION
FEDERAL AVIATION ADMINISTRATION
WASHINGTON, D.C.

Notice of Proposed Rulemaking for	)	Docket No. FAA-2009-1093
Flightcrew Member Duty and Rest	)	Notice No. 10-11
Requirements	)	

INDEPENDENT PILOTS ASSOCIATION'S COMMENTS

On behalf of the pilots who fly for United Parcel Service, the Independent Pilots Association (IPA) submits the following comments and responses to questions to the Notice of Proposed Rulemaking ("NPRM") for Flightcrew Member Duty and Rest Requirements.

Introduction

The Independent Pilots Association (IPA) is the collective bargaining representative for the 2,900 pilots employed by United Parcel Service (UPS). UPS Co. (the airline division of UPS) began operations as a certified Part 121 carrier in 1988. Currently, it operates the world's ninth largest fleet of 238 jet aircraft including the Boeing 747-400, 757, 767, McDonnell-Douglas 11 and the Airbus 300. UPS operates on a hub and spoke (called "gateway") model with the main hub located in Louisville, Kentucky based primarily on set routes and flight schedules. It operates over 1,600 domestic and international flight segments daily, flying from hubs located throughout the United States and the world including Philadelphia, Pennsylvania; Dallas, Texas; Ontario, California; Rockford, Illinois; Columbia, South Carolina; Shenzhen, Hong Kong and Shanghai, China; and Cologne, Germany. While the UPS system is based on a hub and spoke model, the collective bargaining agreement dictates that pilots fly trips that begin and end at fixed crew bases (called domiciles) to gateways or other hubs throughout the UPS system. The fixed crew bases are: Louisville, Kentucky; Miami, Florida; Ontario, California; and Anchorage, Alaska. Domestically, UPS pilots fly packages into the main hub in Louisville, Kentucky and then out again once the packages have been sorted. Internationally, UPS flies long-haul trunk routes, intra-Europe and intra-Asia flights and around-the-world flights. Unlike other cargo airlines which focus primarily on freight, UPS is the world's largest package delivery company.[1]

UPS' use of an extensive and intricate hub and gateway system to route packages throughout the world requires it to set airline schedules months in advance.[2] Like passenger airlines, set schedules means that UPS pilots fly several hundred block hours per year- well in excess of smaller cargo carriers who, because they move freight on demand, do not have set schedules.[3] Even though UPS' hub and spoke operations very closely resemble the type of operations witnessed in the passenger airline industry, one critical distinction remains: nighttime flying. UPS brown tails fly through the night to deliver the packages to the hubs where they are sorted and loaded onto UPS' brown trucks, which then delivers them during the business day. The back-side-of-the-clock air operations ensure timely, daylight arrival of thousands of packages at destination points around the globe.

Over the twenty-two years that UPS has operated its airline, our pilots have become well acquainted with the effects of nighttime flying. Many of our pilots have flown for passenger airlines and can speak to the distinction between daytime and nighttime flying. Our real world experience has shown us that nighttime flying is more onerous than daytime flying. We have experienced the debilitating effects of fatigue as a result of regularly operating during the window of circadian low[4] (WOCL) on a consistent basis in both the domestic and international arenas. The FAA cites three types of fatigue:[5] transient, cumulative and circadian. We support the FAA's acknowledgement that the pronounced impact of fatigue includes lapses of judgment, decrease in speed and accuracy of performance, loss of situational awareness and, most

---

[1] UPS Pressroom, *UPS Fact Sheet*, http://www.pressroom.usp.com/Fact+Sheets/ci.UPS+Fact+Sheet (last visited Nov. 12, 2010)

[2] The UPS/IPA Collective Bargaining Agreement, Article 13.B.1.(a) requires that UPS publish all known flying on lines. A pilot's schedule is separated into 7 bid periods in a year. Six bid periods are 56 days long. The seventh is 28 days long. (*See* Article 2, Definitions, Bid Period). UPS builds its schedules at least a bid period in advance. Pilots bid and are awarded a schedule for each bid period in accordance with their seniority. (*See* Article 8.D).

[3] UPS pilots average approximately 550 block hours/year domestically and 650 block hours per year internationally.

[4] During the WOCL, body temperatures are the lowest and fatigue (if present) is most severe. Flight Duty Regulation Scientific Study Group, *A Scientific Review of Proposed Regulations Regarding Flight Crewmember Duty Period Limitations (1996)*.

[5] Flightcrew Member Duty and Rest Requirements, 75 FR 55852, 55855 (proposed Sept. 14, 2010) (to be codified at 14 C.F.R. pt. 117 and 121).

significantly, impaired decision making and risk assessment.[6] Based on the knowledge that operations during the WOCL present a higher level of exposure to fatigue than operations during daylight hours, it is readily apparent that a shorter flight duty period would be warranted during back-side-of-the-clock operations.

We fully expect that certain stakeholders will dispute the applicability of the proposed rules to cargo pilots by arguing the lack of sufficient scientific data and the economic impact on the cargo aviation industry in general. These arguments are negated by the primary aim of the proposed rules: to wit, "that pilots have an opportunity to obtain sufficient rest to perform their duties, with an objective of improving aviation safety."[7] Additionally, claims of economic devastation made by stakeholders are rebutted by the fact that the rule will apply equally to all Part 121 Stakeholders. Thus, the entire industry will bear the economic burden of the changes, not just one or two stakeholders.[8] Finally, the promulgation of these long overdue rules (with changes recommended by the IPA) will bring the regulations more in line with ICAO standards.

The IPA also applauds the FAA's acknowledgement that pilot fatigue is not different depending on whether the pilot operates domestically, internationally or as a supplemental operation. We wholeheartedly support the FAA's decision to apply one level of safety equally to all Part 121 certificate holders, passenger and cargo pilots, as well as to all Part 121 certificate holders when conducting flights under Part 91 of this chapter. We also encourage the FAA to continue to treat the Fatigue Risk Management System (FRMS) as a supplement to prescriptive regulations rather than a replacement for such regulations. Allowing FRMS to remain a supplement to rather than a replacement of prescriptive regulations will provide pilots with an equal or greater level of safety. Finally, using FRMS as a supplement will allow for further scientific studies to be completed within an existing framework.

The IPA also supports the concept that a flight crewmember must be fit for duty prior to operating an aircraft. The fitness for duty is and must be a joint responsibility of the certificate holder and the flight crewmember. While it is important that both the flight crewmember and the certificate holder be involved in fitness for duty determinations, we cannot create an environment that requires tracking and reporting the activities of an individual flight crewmember prior to

[6] Id.
[7] Id. at 55852.
[8] The IPA notes the similarity of economic claims made when the Whitlow decision was issued. Airlines claimed that Whitlow would put them out of business yet several years later, they are still operating under Whitlow.

their reporting for flight duty. Such tracking would be difficult and costly for the certificate holder and constitute an unwarranted invasion of the personal privacy of the flight crewmember. The proposed provision, Section 117.5, provides a framework for educating and encouraging responsible jointly managed commuting policies. The proposed 117.5 should be adopted as written. However, the accompanying Advisory Circular (AC 120-FIT) should be removed from the docket since the topic itself did not receive the same peer review and recommendations that other aspects of the proposed rule received during the ARC process. The IPA notes the FAA has chosen to take a path that is significantly different from ARC recommendations, as this was one area where all ARC members were in agreement. If it is the desire to continue down this path, all of the applicable stakeholders should have a similar opportunity to provide input in the process and a corresponding comment period following. We would recommend a process be set up where this occurs and would recommend an ARAC approach so that the problem is properly identified and jointly addressed.

The IPA also agrees with the FAA's decision to require that air carriers include administrative duties when calculating maximum cumulative duty limits. We suggest that for subordinate officials who engage in administrative duties as well as flying, the FAA place a duty period limitation of 65 hours a week, which cannot be increased. The rationale for this suggestion is that allowing stakeholders to increase the limit past 65 hours within a 5 ¾ day[9] period would have an adverse safety impact. Subordinate officials who have worked in an office all day and report to fly a nighttime duty period will be more likely to be fatigued. They should be held to the same limits of duty and rest as other flightcrew members. Failure to provide the same limitations for these individuals will burden other flightcrew members with the additional task of monitoring the fatigue level of these individuals. Finally, the IPA maintains that carriers must be responsible for tracking the time subordinate officials spend on administrative duties-duties which include answering e-mails at home and remaining on call at home for check airman assignments from the certificate holder.

The IPA supports the proposed rules. We do however note some areas of concern. We have included in our comments modifications to the rules, which we believe, if accepted, will provide a framework to ensure the safety of our airways.

---

[9] Proposed Rule 117.25 (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…"

117.7 Fatigue Risk Management System (FRMS)

IPA Proposes:

> **The FRMS section 117.7 of the proposed rule should clearly state that an FRMS is meant to address individual exceptions by pairing and city pairs, not to replace this entire proposed rule set for a specific carrier.**

The IPA proposes the following changes:

We strongly support the introduction of FRMS in the U.S. Aviation System. We do, however, believe that Section 117.7(b) needs to be amended to include the following items:

- **The FRMS must be an equal partnership that includes the FAA, the certificate holder and non-management pilot representative.**
- **FRMS does not replace the regulatory scheme, its purpose is to supplement adequate prescriptive rules.**
- **Any FRMS must provide an equivalent or better level of safety and be centrally approved by the FAA. (One office at FAA headquarters should be responsible for approving FRMS. This is the only way to provide a uniform FRMS approval scheme.)**
- **FRMS should be limited to specific certificate holders' data and scheduled city pairs, which must be scientifically and then operationally validated by all stakeholders.**
- **FRMS, like SMS, requires a commitment from the certificate holder's senior management team and a specified line of accountability in the organization.**

A FRMS comprises a comprehensive range of procedures that are both scientifically based and data - driven, allowing a cooperative and flexible means of managing fatigue. There remains a requirement for the regulator to provide prescriptive flight and duty time rules for operators not embracing FRMS principles. Such a set of rules will also provide a base line against which the fatigue levels of any FRMS can be compared, and in the case where an FRMS does not provide at least an equivalent level of safety to the prescriptive scheme, provide a reversion. Operators may, subject to regulator approval, embrace FRMS for all or part of their operations.

The *purpose* of any FRMS is to ensure that flightcrew members are sufficiently alert so that they can operate to a satisfactory level of performance and safety under all circumstances.

A FRMS supplements prescribed flight and duty time regulations and other validated independent scientific research based software tools by applying safety management principles and processes to proactively and continuously manage fatigue risk through a partnership approach requiring shared responsibility among management and crew members. These changes to the prescriptive rules must be operationally validated prior to acceptance. It can therefore only operate in circumstances where all stakeholders, particularly the pilot body, support the operation of a FRMS. Accordingly, an open reporting system and non-punitive working environment, sometimes referred to as a “just culture” is a prerequisite within the organization for a FRMS to exist because crew feedback is an essential component of the program. All successful safety programs such as ASAP and FOQA are based on a three-way partnership and FRMS should be the same. A FRMS must specify the prescriptive regulatory scheme upon which it is based. In the event of suspension, termination or revocation of FRMS, the carrier’s affected operations shall revert to the baseline prescriptive scheme.

FRMS is intended to be used to supplement prescriptive fatigue management regulations as a means of ensuring that flight crew remain sufficiently alert during duty to achieve a satisfactory level of operational performance and hence safety under all circumstances. A well developed and managed FRMS integrates operational and scientific data such as physiological and behavioral measures in the scheduling of crew members by providing a balance between duty types, crew rest and recovery. In the case of extended flight duty periods with augmented crew, such as ultra long range (ULR) operations, the planning of in-flight rest can be optimized.

FRMS must be based on a partnership approach for which there is agreement between the operator, regulator and pilot body. As FRMS is a new emerging concept, a Memorandum of Understanding between principle stakeholders should form the basis of initial agreement and be the subject to on-going periodic review based on assessment of the effectiveness of the program in achieving its stated goals. The Memorandum of Understanding must include a mechanism for the representatives of the stakeholding pilots to suspend or terminate participation in the operator’s FRMS in the event that the representatives of the stakeholding pilots determine in their discretion that the FRMS program’s safety *purpose* is not being met.

Pilot representatives, either from, where such a body exists, an established organization independent of the company, or where such a body does not exist, independently elected directly by the pilots, must be included as members of the operator’s Fatigue Management Steering Group. This committee will be fully involved in the initial development of the FRMS program, and shall be fully and directly the on-going oversight of the operator’s FRMS program including the development of modifications of the FRMS to meet the program’s safety *purpose*.

117.9 Schedule Reliability

The IPA proposes the following changes:

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**.

This change in definition to include measurement of "flight segments" is necessary for consistency with our proposed changes to 117.9.

§ 117.9(a) Change 60 days to **30 days**

(a)(1)(*modified*) Its system-wide flight duty periods if the total actual flight duty periods exceed the scheduled flight duty periods **by more than 15 minutes** more than 5 percent of the time**,** and

(a)(2)(*modified*) Any scheduled flight **segment** that is shown to actually exceed the schedule 20 percent of the time.

(b)(*modified)* Each certificate holder must submit a report detailing the scheduling reliability adjustments required in paragraph (a) of this section to the FAA every **30 days** detailing both overall schedule reliability and **flight segment reliability.** Submissions must consist of:

(1)*(modified)* The carrier's entire FDP schedule for the previous 30 day period and separately those FDP's exceeding the scheduled FDP by 15 minutes.

(2)*(modified)* The carrier's flight segments on a per segment basis and the list of those segments exceeding the 20 percent requirement in (a)(2).

These proposed amendments accomplish two changes to the proposed rule. First, the reporting period is 30 days rather than 60 days and second, a flight segment reliability requirement is added.

If a schedule exceeds the limits in this section the certificate holder should take prompt action to correct the schedule. A certificate holder should not be allowed to operate a schedule that violates the scheduling limitations for 60 days. With the sophisticated computerized scheduling programs available and used by most, if not all certificate holders, a 30 day reporting period is neither unreasonable nor burdensome. The certificate holder should correct any schedule exceedance at the point the certificate holder becomes aware that the schedule does not meet the scheduling limitations.

To achieve schedule reliability the individual flight segments must be considered. If a given segment within a FDP causes the FDP to exceed the limits, the certificate holder can merely leave the offending segment and change the pairing mix to hide the problem and/or bring it within limits. The problem 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 and we have incorporated the familiar 15 minute buffer metric for the FDP reporting criteria.

Finally, the reporting information should be available in a timely manner to all stakeholders and the public.

117.13 Flight Time Limitation

IPA Proposes:

I. New Definition of Flight Time

II. Table A which specifies flight time limits be amended.

The IPA proposes the following changes:

I. The definition of flight time in FAR 1.1 is currently defined as the moment the aircraft fist moves under its own power. However, the PIC and required flight deck crewmembers are always responsible and must perform their duties when the aircraft is moved by a tug or sits at a hardstand with the engines running, and that time should count as flight time if the movement is with the intention for flight. This definition is consistent with EU-OPS subpart Q, which provides:

> "*The **time** between an aeroplane 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*."

We propose the following definition for flight time:

> **Flight Time – means when the aircraft first moves with the intention of flight until it comes to rest on the designated parking position.**

II. We propose that Table A which specifies flight time limits be amended as follows:

Table A—Maximum Flight Time (Block) Limits

Time of Report (Home Base or Acclimated Local Time)	Maximum Flight Time (hours)
0000-0459	7
0500-0659	8
0700-1259	9
1300-1959	8
2000-2359	7

The IPA does not support an increase in flight time to the limits proposed by the FAA in the proposed rule Table A to Part 117-Maximum Flight Time Limits for Un-augmented Operations.

We do recommend that Table A be modified to reflect the unanimous view of the ARC that the limit be 7 hours for the early morning hours and the majority view that it be 7 hours for the late evening hours. Likewise, the majority view was that the maximum limit should be 9 hours for the period, which is a 12.5 percent increase when compared to the current rule. Even if certificate holders have to “buffer” schedules, they will be in no worse position than they are today because of the increased limits.

There are not any existing scientific studies that have scientifically evaluated or verified flight time and its impact on fatigue. However, there is applied fatigue science that indicates factors such as workload, time on task, noise, vibration, increased cabin altitude, pressure changes, low humidity and cosmic radiation are all factors related to fatigue but have not been evaluated in the context of flight time. Common sense would dictate that increased exposure to these factors could increase fatigue and negatively impact safety. Fatigue and loss of alertness associated with inactivity due to being confined to a seat in the cockpit and performing monitoring functions for longer time periods without rest have also not been evaluated. Additionally, the combination of immobility and relative dehydration are well known causes of deep vein thrombosis (also known as deep-vein thrombosis or deep venous thrombosis and usually abbreviated as DVT), which is sometimes cited as “air travel” or “economy class syndrome”.[10] Until there are scientific studies on the physiological effects of pilots spending more time aloft and its impact on fatigue the IPA recommends not increasing

[10] Scurr JH, Machin SJ, Bailey-King S, Mackie IJ, McDonald S, Smith PD, *Frequency and Prevention of Symptomless Deep-Vein Thrombosis in Long-Haul Flights: A Randomised Trial*, 357 Lancet No. 9267, 1485–9. (May 2001).

the amount of flight time a flightcrew member can fly to the limits proposed by the NPRM.

The IPA also strongly believes the flight time limits must be “hard” and not “scheduled” for several reasons. Foremost, the most frequently abused provision of the current rules is the “scheduled flight limitation provision.” Certificate holders consistently schedule to the limit (i.e. 7:59) even when they know in advance that the flight on a given day will not meet the scheduled time because of winds or ATC delays at busy airports. In practice, many of these schedules exceed 8 hours by 45 minutes or more. In addition, we have observed some schedules that exceed the current block hour limits in excess of 80% of the time over several consecutive months.[11]

The hard limits would be applied similar to how “Whitlow” is currently applied with regards to the 16 hours duty limit. As the Agency and others will recall, in 2001 the certificate holders resisted Whitlow on the grounds that the cost would put certificate holders out of business. We anticipate the same approach to this NPRM. In their request to stay enforcement of Whitlow, the RAA stated that the Whitlow interpretation would “bring about the demise of smaller carriers.” They would be required to hire numerous flight crewmembers and the cost would mean elimination of service to smaller cities. Likewise, the ATA complained that enforcement of Whitlow would inconvenience the traveling public, as their members would have to delay and cancel flights. Additionally, the ATA carriers would be subjected to having to hire many additional flight crewmembers incurring tremendous costs for salaries, benefits and training.

For this reason they engaged in litigation to overturn Whitlow. When that effort failed, the certificate holders implemented the interpretation with little or no impact on their operation. They adjusted their scheduling practices with minimal or no cost. It can be anticipated that the certificate holders will take the same position on hard limits as they did with Whitlow. *The sky is falling* approach should be rejected. With the sophisticated scheduling programs and historical data available to certificate holders, the implementation of this provision should be accomplished at minimal cost.

Finally, under the current FAR 121.471 the regulation permits flight time to be exceeded provided compensatory rest would be provided. The proposed rule prescribes only a minimum rest period and does not take into account additional rest for exceeding flight time limits. If Table A were scheduled there would be no protection for fatigue caused by the exceedures, therefore, flight time limits should remain hard limits and not scheduled limits.

[11] Letter from Robert Thrush, IPA President, IPA, to Larry Ortkeise, FAA POI for UPS, FAA (June 1, 2010) (on file with the IPA)

Flight Duty Period: Extensions
117.15(c)(1) and (c)(2) and 117.19(f)(1) and (f)(2)

IPA Proposes:

I. **IPA supports 117.15(c)(1) and (c)(2) and 117.19(f)(1)*(modified)* and (f)(2) as proposed by the FAA**

II. **Change NPRM proposed extension to a scheduled flight duty period for augmented operations from a maximum of 3 hours to 2 hours.**

The IPA supports part 117.15 as proposed by the FAA. We strongly support part (c)(1) and (c)(2) regarding FDP extensions. We applaud the FAA for proposing regulatory language that predicates FDP extensions on the scheduled FDP and not the maximum FDP permitted based upon the time the flight crewmember reported for duty. We believe the proposed unrestricted 30 minutes extension of a scheduled FDP is an acceptable amount of time to provide a carrier with operational flexibility.

We can also support an extension of a scheduled FDP up to 2 hours beyond the scheduled flight duty period not to exceed the charted maximum value (based upon the time the flight crewmember reported for duty) with joint agreement of the pilot in command and certificate holder.

Pilot in command agreement is essential as he is in the best position to determine whether or not the flightcrew could safely extend a FDP based on previous rest, previous duty and anticipated future duty. To eliminate the pilot in command from the decision making process strays from the concept of “fitness for duty” as he can best assess his fitness to extend a scheduled FDP. We believe 2 hours is a reasonable amount of time to provide a certificate holder with schedule flexibility due to unforeseen operational circumstances. The single occurrence beyond 30 minutes in 168 hours ensures there is not abuse of the extension provision and reinforces schedule reliability which is also predicated on scheduled flight duty periods. Finally, we further agree with the FAA that a decision to extend a FDP, “cannot be an arbitrary decision by either party, and safety of flight must be the primary consideration.”[12]

FDP extensions are predicated on “unforeseen operational circumstances” beyond the carrier’s control and are discussed in detail in the Preamble.[13] The ARC discussed the issue of unforeseen circumstances beyond the carrier’s control in the context of extreme

---

[12] Response to Clarifying Questions 14 CFR parts 117 and 121 Flightcrew Member Duty and Rest Requirements; Proposed Rule Docket No. FAA-2009-1093 p.12
[13] Flightcrew Member Duty and Rest Requirements, 75 FR 55852, 55860 (proposed Sept. 14, 2010) (to be codified at 14 C.F.R. pt. 117 and 121).

weather events such as a blizzard in Newark that cripples the entire northeast or an unforecast March ice storm in Memphis. As further discussed in the Preamble, "Thus, while the FAA contemplates that adverse weather could fit within the criteria because it is beyond the control of the certificate holder, it would not always be considered unforeseeable. Carriers should anticipate thunderstorms in many parts of the United States during the summer months. Likewise, heavy snow in the northern parts of the country should be anticipated during the winter, and the jet stream follows basic seasonal patterns."[14] We do not believe circumstances based strictly on economic business consideration, inadequate staffing or poor schedule planning qualify as being beyond the control of the certificate holder.

We are concerned that some submitters may propose allowing an extension of a FDP beyond the maximum limits in Table B. Any extension to a scheduled FDP must take into account the amount of sleep a flightcrew member has had during the last rest period, as well as any accumulated sleep debt. For example, a flightcrew member could show at 1200 for a scheduled 8:00 hour FDP ending at 2000 expecting the following FDP to start the next day at 0700. Extending the FDP to the charted maximum of 13:00 (ending at 0100) is over a 60% increase from scheduled duty. Extending the FDP to the maximum plus two hours (15:00 hours ending at 0300) is almost a 90% increase from scheduled duty. If the flightcrew member awoke at 0600 prior to the start of the FDP (expecting to get off duty at 2000 the same evening), when getting off duty at 0300 he would have been awake for 21 hours. Science has drawn the correlation between time awake and blood alcohol content (BAC). Twenty-one hours awake closely mimics the mental acuity of a BAC of .08.[15] While some operations could be scheduled with a longer FDP, prospective rest opportunities must be taken into account, not future make-up rest opportunities.[16] Additionally consideration must be given to other factors such as number of legs, time of day, previous flight duty periods and environmental factors as the interactions between multiple fatigue-related factors contribute to fatigue buildup.

We also apply the same rationale to FDP extensions to 117.19 Flight Duty Period: Augmented flightcrew. As currently proposed the rule does not provide greater rest opportunities for augmented operations, as well as the consensus opinion that rest during flight cannot be guaranteed. Therefore, the 2-hour extension should remain the same for augmented operations.

We propose the following amendment to 117.19:

117.19(f)(1)(*modified)* The pilot in command and certificate holder may extend a flight duty period **beyond the scheduled flight duty period** up to ~~3~~ **<u>2</u>** hours.

---

[14] Id.
[15] Drew Dawson and Kathryn Reid. *Fatigue, Alcohol and Performance Impairment*, 388 Nature 235 (1997).
[16] *An Overview of the Scientific Literature Concerning Fatigue, Sleep, and the Circadian Cycle* (Battelle Memorial Institute, Frederick Md.) January 1998 at 13

Acclimation

IPA Proposes:

- I. **Definition of Acclimated**
- II. **Definition of Acclimated Local Time**
- III. **Definition of Unacclimated**
- IV. **Definition of Theater**

The IPA proposes the following changes:

I. **Acclimated: means a condition in which a crewmember has been in a new theater for the first 72 hours since arriving <u>and</u> has been given at least 36 consecutive hours free from duty during the 72 hour period.**

The established science, as we demonstrate below, is that at least three consecutive local nights rest is required to become acclimated. CAP 371 recognizes this science and requires three consecutive local nights rest to be acclimated.

As the proposed rule is currently written, it would allow carriers to provide 36 hours of uninterrupted rest at the layover location and then be considered "acclimated" to the local time zone. Such an assumption is incorrect for the following reasons:

1. For typical flights from the US to Europe or Pacific destinations, the number of time zones crews would transit would be in excess of 5 or more. The general agreed upon acclimation rate is about 1 time zone or one-hour difference per day.[17] Some expert researchers have published data showing even longer periods to become acclimated to the local time zone.[18] Conclusion: The crew would not be acclimated after 36 hours of layover rest.

---

[17] *A Review of Issues Concerning Duty Period Limitations, Flight Time Limitations, and Rest Requirements* (Battelle Memorial Institute). (1998). Federal Aviation Administration (AAR-100). Washington, D.C.

[18] Gander et al. (1989) showed that it took several days for the acrophase of the temperature rhythm to come within one standard error of complete resynchronization after a 9 hour westward transition, and that the adaptation in an eastward direction took even longer. This differing rate of adaptation related to direction of travel is shown in table 1 (after Klein and Wegmann, 1979). PH Gander, G. Myhre, RC Graeber, HT Andersen and JK

2. While three consecutive physiological nights may start approaching a reasonable compromise for the purpose of entering the FDP tables, a 36-hour rest clearly would not. In order for the rules to approach parity, the implication is that a night of normal sleep would be approximately 8-9 hours of sleep. Three nights of consecutive sleep would be 24-27 hours of sleep. The 36-hour rule suggests that crews would remain asleep for nearly the entire layover period. This is not physiologically plausible for healthy aircrews.

3. Further, it is critical for any fatigue safety regulation to assess where a flightcrew member is in their own circadian cycle – as that will determine when in the following rest periods they will be able and likely to sleep from a physiological perspective. To be sure, being put into a rest cycle does not mean that the crew will be able to sleep according to a desired clock position. The Crews' circadian phase will be the key-determining factor as to when and how long crews will subsequently sleep. In a 36 hour rest situation, crews could have only one full sleep cycle in their physiological nadir and if that falls early in the layover rest period, they would initially sleep, then be awake for an extended period before reporting for duty. At that point, the pilot, through no fault of their own, would be significantly fatigued after being awake for 12 or 15 hours prior to start their duty period.

While everyone expects crews to be professional and report fit and rested for their flying duties, it would unfair if they rested when they were physiologically and predictably tired and then awake when they physiologically were unable to easily sleep and subsequently had to report to duty more fatigued then when they started.

The IPA believes that the regulation should require 3 local nights rest. However, 72 hours in theater in conjunction with a 36 hour rest within the 72 hours may allow a flight crewmember to become acclimated. Merely being in theater for a 72-hour period without at least a 36 consecutive hours rest during that time would not allow a person to become acclimated. It is necessary to have both time in theater and adequate rest to become acclimated.

The preamble to the proposed regulation states that the tables selected from the ARC were in part based on being the most conservative approach. Given the wide range of available research on the topic of acclimation combined with the operational consequences of not taking a correct approach clearly points to selecting a more conservative approach. We believe 72 hours in theater comprising 36 hours free of duty as the compromise position in determining if a crew is acclimated for the purposed of determining the length of the subsequent FDP.

Lauber, *Sleep/Wakefulness Management in Continuous/ Sustained Operations,* 61 Aviation Space Envtl. Med. (1989) 733-743.

II. Acclimated Local Time - means the local time at the location where the flightcrew member last had greater than 36 hours free from duty in the first 72 hours in theater.

This definition provides an unambiguous time for applying the definition of Nighttime Duty Period and for entering the FDP and Flight Time limit tables. The original NPRM wording of “acclimated or home base” time left many questions of interpretation. Similarly, the exact location of acclimation must be known to determine future loss of acclimation. For example, a pilot flies to Paris and has 37 hours off, but at the end of his 72 hours in theater happens to be 3 more hours east at Tel Aviv. He is now acclimated, but where? Would a further flight two more hours east to Dubai cause him to be unacclimated? It depends whether you define the point of acclimation as being tied to the 36-hour rest or to the 72 hours in theater condition. The above-proposed definition removes such doubts about the location of acclimation and the use of regulation tables, allowing reliable computer programming of scheduling. Both the tables and the definition of Nighttime Duty Period should then use the new term, “Acclimated Local Time”.

III. Unacclimated – A flightcrew member becomes unacclimated if he has traveled to a location more than 4 times zones or more than 60 degrees of longitude from the location at which he was last acclimated.

The NPRM references “unacclimated” in several sections of the proposed regulation but does not define the term. We believe it should be defined. Defining acclimation in terms of “time zones” is subject to whim of governmental policy, (e.g., all of China is in a single time zone even though it spans 5 normal time zones in width) 60 degrees of longitude is equivalent to 4 normal time zones and should be included as an alternative to the time zone metric.

IV. Theater *(amended)*: means a geographical area where local time at the crewmember’s flight duty period departure point and arrival point differ by no more than 4 **time zones, or 60 degrees of longitude.**

117.19 Flight Duty Period: Augmented Flightcrew

The IPA proposes the following changes:

Revised Table C—Flight Duty Period: Acclimated Augmented Flightcrew

Time of Start (Home Base or Acclimated 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	N/A
0600-0659	15:10	17:40	14:10	15:40	12:55	N/A
0700-1259	16:00	18:00	15:25	17:05	14	N/A
1300-1659	15:10	17:40	14:10	15:40	12:50	N/A
1700-2359	13:50	16:05	12:55	14:20	11:45	N/A

Revised Table D—Flight Duty Period: Nonacclimated Augmented Flightcrew

Time of Start (Home Base or Acclimated 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 Pilot	4 Pilot	3 Pilot	4 Pilot	3 Pilot	4 Pilot
0000-0559	13:15	15:20	12:20	13:35	11:15	N/A
0600-0659	14:30	17	13:35	15	12:15	N/A
0700-1259	15:50	18:00	14:50	16:25	13:30	N/A
1300-1659	14:30	17	13:35	15	12:20	N/A
1700-2359	13:15	15:20	12:20	13:35	11:15	N/A

Amend 117.19 (c)(1) to read:

117.19(c)(1)*(amended)* The final segment provides a minimum of 2 consecutive hours available for in-flight rest for both flightcrew members occupying a control seat during landing. (This would require a minimum segment length of 6 hours for a 3 pilot crew and 3:45 for a 4 pilot crew to achieve the required rest.)

117.19(c)(3) deleted

117.19(d)(*modified*) No certificate holder may assign and no flightcrew member may accept an assignment involving more than ~~three~~ **two** flight segments under this section unless the certificate holder has an approved fatigue risk management system under §117.7

117.19(f)(1)(*modified)* The pilot in command and certificate holder may extend a flight duty period **beyond the scheduled flight duty period** up to ~~3~~ **2** hours.

117.19(f)(2)(*modified*) An extension in the **scheduled** flight duty period exceeding 30 minutes may occur only once in any 168 consecutive hour period.

***As an administrative matter, we have pointed out in our clarifying questions on the docket that Table C as published in the NPRM has an incorrect heading. The table heading needs to match Table B and the "Time of Start" should include home base or acclimated local time.**

The NPRM proposed chart in Table C is based on the TNO Report. Upon a further review of the TNO Report, we believe the proposed Table C was oversimplified in two regards. The first was that many of the values were oversimplified following a rounding process that does not adequately represent the actual calculations used in the ARC process. The second oversimplification is the use of a standard 30-minute reduction for a nonacclimated crewmember. The end result is an improper application of a nonacclimated penalty for the operation planned. Additionally, just as is the case with the acclimated discussion, a table that reflects the true values is better suited to accurately reflect the appropriate reduction for the crewmember not being acclimated. In today's world with the prevalence of electronic interaction with schedules, there is little need to round values to a whole or half hour.

Additionally, the TNO Report was intended for single segment operation only and the addition of more than one additional segment would stray too far from the science on which the charts were developed. Multi-leg augmentation should only be allowed when no crew change is possible. Multi-leg augmentation should never be used solely for the purpose of extending a flight duty period. Augmented flights must not be mixed with non-augmented flights in the same flight duty period.

The proposed regulation 117.19 (c)(3) provides for a 2-hour consecutive sleep opportunity for the flight crewmember manipulating the controls on landing. That sleep opportunity should be mandated for both required crewmembers during approach and landing. Both crewmembers manipulate the controls, i.e., the pilot monitoring normally operates flaps, landing gear, and radios and performs monitoring so he must be equally alert. Much emphasis has been placed on the concept of crew resource management (CRM) and pilot monitoring duties.[19] Also, there are circumstances such as Category III approaches where the pilot monitoring might actually be the pilot landing. To deprive any of the operating flightcrew members an in-flight rest opportunity would not help

[19] Robert Sumwalt, Ronald Thomas and Key Dismukes, *Enhancing Flightcrew Monitoring Skills Can Increase Flight Safety,* 55th Air Safety Seminar, (Nov. 2002).

mitigate fatigue. This is especially important as augmentation has the potential to significantly increase time on task. The final segment of any augmented flight must provide the required rest. During the most challenging approaches, such as Category III approaches, both crewmembers are manipulating the controls. On short final, the manipulation of the flight controls transfers from one pilot to the other at approximately 300 feet, which illustrates why it is essential for both pilots to receive adequate rest to be prepared for landing. 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.

As currently proposed the rule does not provide greater rest opportunities for augmented operations, therefore, the 2-hour extension should remain the same for augmented operations, not be increased to 3-hours as proposed under 117.19. We also provide the same rationale to section (f) as the same stated previously in the IPA comments on 117.15(c) and is equally applicable here.

The IPA recommends that four-pilot augmentation should not be permitted with an inferior rest facility. Placing more pilots on board under these circumstances when obtaining rest is marginal just increases the likelihood that you will have more fatigued pilots. FDPs of a length that mandate four pilots should be limited to Class 2 facilities or better.

Finally, the IPA recommends the following provision be incorporated into section 117.19:

> **Any FDP that includes total flight time in excess of 12 hours shall require a minimum of a Class 1 rest facility aboard the aircraft.**

From AC 120-100 Basics of Aviation Fatigue, "The ULR Crew Alertness workshops of the FAA's 2008 Fatigue Symposium showed that ensuring adequate bunk sleep is one of the most important in-flight countermeasures to use to address sleep loss and circadian disruption during extended aviation operations[20]."

[20] Flight Safety Foundation, *Lessons from the Dawn of Ultra-Long-Range Flight*, Flight Safety Dig., Aug-Sept, 2005, 1-60.

117.21 Reserve Status

The IPA proposes the following changes:

Due to overly complex language, we propose to rewrite section **117.21(c)** as follows:

(c) For short call reserve,

(1) **The maximum reserve duty period for un-augmented operations is defined as:**

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

(2) **All time within the reserve availability period is duty**.

(3) **The maximum reserve duty period (to include phone availability and/or flight duty period assignments) is determined by the earlier end point of**
(a) the start of the RAP time plus value in Table E or
(b) the Flight Duty Period limitation in Table B as measured from the FDP time of start (home base or acclimated local time).

Note: For example: If the RAP started at 0100, crewmember called at 0115, show at 0300, then it would be the EARLIER FDP end time of:

(i) RAP start 0100 + 13 hours = 1400 FDP end

(ii) RAP start 0100 + 1307 hours (+ 7 minute WOCL adjustment) = 1407 FDP end

(iii) FDP start at 0300 + 9 hours FDP limit = 1200 FDP end

This ensures that the reserve will NOT have an allowable FDP limit greater than the lineholder the reserve is paired with and does not impact the operator in any manner since the reserve and lineholder end point is the same.

(4) **If all or a portion of a reserve flightcrew member's reserve availability period falls between 0000 and 0600, the air carrier may increase the maximum reserve duty period in Table E by one-half of the length of the time during the reserve availability period of 0000-0600 in which the air carrier did not contact the flightcrew member, not to exceed 3 hours; however, the maximum reserve duty period may not exceed 16 hours. If the flightcrew member is contacted for an assignment prior to 0000 hours the reserve duty period would not be extended.**

Note: For example, RAP starts at 2200 hours, pilot called at 0300 for flight assignment, the RAP may be extended by 1.5 hours. If the pilot was called prior to 0000 hours there would be no extension.

The short call reserve section is complex and we are concerned that there will be misunderstanding by flight crewmembers, schedulers and management officials with the section as written. Consistent with other limitations in the proposal, we believe a chart is a better way to set forth the short call reserve limits expressed in the proposal. We urge that the chart that sets forth the short call reserve limits be adopted. In both the ARC and the NPRM preamble, the intent was expressed that RAP extension credit is to be made available for not contacting reserves between 0000 and 0600 whose RAPs touch that time period. However, the proposed language in 117.21(c)(4) (iv) and 117.21(c)(5)(iii) neglects this distinction, providing credit for *any* period of non-contact. This error in the language has been corrected in our revised language above. Note also our concern that a certificate holder should not be able to contact a flightcrew member at 2300 and require them to show for duty at 0400 and still attempt to take credit for allowing the flightcrew member to sleep during 0000-0600. This example would require the flightcrew member to awaken hours before 0400, thus negating any benefit of extending the maximum reserve duty period.

(5) No certificate holder may schedule and no reserve flightcrew member on short call reserve may accept an assignment of a flight duty period that begins before the flightcrew member's next reserve availability period unless the flightcrew member is given at least 14 hours rest. This provision may be used only once in a rolling 168 hour period.

The need for this provision is best illustrated by real world examples. A pilot is scheduled and adjusts his rest schedule for a series of RAPs beginning at 0400. If the operator contacts the pilot at 0600 (after the morning bank of departures) and releases the pilot for a 14-hour rest period, the pilot could then begin a RAP at 2000 to cover the late evening bank of departures. The pilot could then be contacted at 2200 and released for another 14-hour rest period. This cycle could continue for an indefinite period. Our proposal aligns this section with the provision for shifting of a RAP in section (e). Without this provision there is essentially no difference between a short-call and long-call reserve removing all circadian protection afforded by having a RAP system in the first place.

117.25 Rest Period

IPA Proposes:

I. No Reduction in Minimum Rest Period

II. Minimum Rest Period of 10 hours or 12 Hours Unacclimated in a New Theater

III. Recovery Rest Return to Home Base

The IPA proposes the following changes:

(c) ***(deleted)*** ~~No certificate holder may reduce a rest period more than once in any 168 consecutive hour period.~~

(d) No certificate holder may schedule and no flightcrew member may accept an assignment for reserve or a flight duty period unless the flightcrew member is given a rest period of at least ~~9~~ **10** consecutive hours before beginning the reserve or flight duty period measured from the time the flightcrew member reaches the hotel or other suitable accommodation.

According the FAA's own Fitness for Duty Advisory Circular, AC120-FIT: "Managing rest is the means for managing the risk of being unfit for duty because of fatigue. This is the joint responsibility of the air carrier and the crewmember. It's unrealistic to assume that a 9-hour rest period will yield nine or even eight hours of sleep by the crewmember. The reality is that a 9-hour rest period may yield seven hours of sleep when you take into consideration the time lost in checking in at a hotel, eating, and preparing to resume duty at the conclusion of the sleep opportunity." We believe that a 10-hour rest period starting at the rest facility is the minimum period of time that will allow the scientifically mandated eight hours of sleep.[21]

[21] Battelle, *supra* note 16 at 18.

(d)(1) (*added*) An unacclimated flightcrew member shall be given at least 12 consecutive hours of rest beginning upon arrival at the rest facility before beginning a RAP or flight duty period.

(e) ***(deleted)*** ~~In the event of unforeseen circumstances, the pilot in command and certificate holder may reduce the 9 consecutive hour rest period in paragraph (d) of this section to 8 consecutive hours.~~

Reduced rest should never be permitted. The science supporting reduced rest assumes a full sleep bank.[22] It strikes us that assuming a full sleep bank at any point in any FDP is a risky proposition. As a reduced rest period would in all likelihood follow an extended FDP, it makes even less sense to consider reducing rest. We feel that the best policy is to consistently take the conservative route, especially when one considers the variations in report time, daytime sleep, and the whole host of other factors that flightcrew members must deal with. Should the FAA persist in allowing reduced rest it is critical that this is not permitted in conjunction with an extension of a flight duty period beyond the maximums in Table B.

(f) (*added*) No certificate holder may schedule and no flightcrew member may accept an assignment for reserve or a flight duty period after completion of any duty period(s) (flight or reserve) in a new theater unless the flightcrew member is given a rest period upon return to the flightcrew member's home base location in accordance Table F.

(f)(1) *(added)* The recovery rest in Table F satisfies the requirements for acclimation and the flightcrew member would then enter Table B without a penalty.

[22] Id. at 18.

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 local night's recovery rest should be provided on return to base, except when the returning flight duty period encroaches the WOCL, then an additional local nights rest will be added

A flight from the U.S. to Europe or Asia disrupts the circadian cycle and a rest of 10 hours is not sufficient to achieve an appropriate level of alertness. Thus, when flight crewmembers fly to a new theater they should be given at least 12 hours at a suitable accommodation until acclimated.

We also believe that there should be recovery rest for time away from home operating flights in a different theater that is less than 168 hours. The current regulations provide for recovery rest in international operations for operations less than a 168 consecutive hours period. (See: 121.483, 485; 121.523, 525)

We believe that this recovery rest is necessary to address cumulative fatigue, to provide circadian restabilization and to repay accumulated sleep debt. We therefore propose the above recovery rest chart be incorporated into the final rule.

117.27 Consecutive Nighttime Operations

IPA Proposes:

I. New Definition of Nighttime Flight Duty and Consecutive Night Duty Period

II. 4th Night of Consecutive Nighttime Operations

The IPA proposes the following changes:

I. We agree with science and from professional experience that a flight duty period encompassing the hours of 0200 and 0600 is challenging, as fatigue is more likely. A majority of our flight operations begin in the early evening and end the following morning. The FAA's Response to Clarifying Questions document defined "nighttime operations" as those that commence between 2200 and 0500. Under this definition a FDP could begin at 2100 and conclude at 0600 and that would not satisfy the FAA's definition of nighttime operations even though the flight duty period required the pilot to be awake all night. The definition of nighttime flight duty is important because the current proposal limits consecutive nighttime flight duty periods to three.

Fatigue during nighttime operations is a result of the pilot being prevented from sleeping during his normal sleep period and a function of circadian rhythms. Simply put, the pilot is forcing himself to stay awake when his body is telling him to sleep. After a period of approximately three consecutive nights of nighttime work performance decreases as a result of sleep debt. The only way to replenish the "sleep bank" is with an adequate sleep opportunity.

We believe it is necessary to re-define ***Nighttime Flight Duty*** to encompass operations operating through the WOCL. Also, to avoid confusion in applying 117.27 ***Consecutive Night Duty Period*** must be defined.

We propose the following definitions that are based on the CAP 371 definitions, which we believe is most appropriate:

> **Nighttime Flight Duty – means 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.**

Consecutive Night Duty Period - means two or more nighttime 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 (0100 to 0700) at home base or acclimated local time.

II. We agree with the FAA that there should be a limit placed on consecutive nighttime flight duty periods. Nighttime operations should be limited to three nights unless some type of strategy to mitigate fatigue is prospectively available to the flightcrew member. Science supports the fact that flight operations that impinge on the WOCL contribute to circadian fatigue and transient fatigue. Also, because daytime sleep is less restorative than nighttime sleep an individual accrues cumulative sleep deprivation, which has a profound impact on fatigue. We strongly disagree with any claim that a flightcrew member can simply "train" themselves to sleep during the day, thus negating all known science regarding the human body's need to sleep during the WOCL.

In the Preamble of the NPRM the FAA acknowledges there may be adverse safety impacts by limiting nighttime operations to three consecutive nights. Unintended consequences of limiting nighttime operations to three consecutive nights increases the number of first night operations, which many pilots agree is the most difficult because they aren't accustomed to being awake all night on the first night. The IPA agrees with this assessment.

The solution proposed by the FAA to allow more than three consecutive nighttime flight duty periods does not accommodate current flight operations at UPS. The opportunity to rest during the flight duty period in accordance with 117.7 is a minimum of 4 hours, measured from the time the flightcrew member reaches the rest facility. While the IPA can support mitigating fatigue by providing a rest opportunity, in reality there are very few of our flight operations that would meet these requirements.

Science acknowledges that adequate sleep is required to sustain performance. Additionally, if a sleep debt is accrued the only way to eliminate the sleep debt is with recovery sleep. By providing pilots an opportunity to maximize the amount of sleep obtained through an extended sleep opportunity the accumulation of significant chronic sleep debt may be avoided. We believe this strategy can be employed to permit a fourth consecutive nighttime flight duty period so long as the flightcrew member receives a minimum of 12 hours of rest following each flight duty period.

We propose the following amendment:

117.27 Consecutive nighttime operations ***(amended)***:

No certificate holder may schedule and no flight crew member may accept more than three consecutive nighttime flight duty periods unless the certificate holder provides an opportunity to rest during the flight duty period in accordance with § 117.17.

A fourth consecutive nighttime flight duty period may be assigned if the flight crewmember receives a minimum of 12 hours rest following each nighttime flight duty period.

24-Hour Layovers

While the IPA is supportive of the vast improvements in the current proposal we remain concerned that 24-hour layovers and their disruption on sleep and circadian rhythms was not addressed at all in the NPRM. This issue was discussed at length during the ARC process and several different concepts to limit or restrict 24-hour layovers were presented.

Professional pilots overwhelmingly agree that a 24-hour layover presents many challenges for a flightcrew member. The difficulty with 24-hour layovers is that the crewmember has to get two sleep opportunities in one off duty period. Many pilots will confirm that it is almost impossible to get one full sleep cycle, let alone two in a 24-hour period. The result is a circadian shift of the pilot's "body clock" resulting in a sleep deficit. This is especially true when flying internationally and an individual may not be predisposed to sleep based on his circadian rhythms. The result of a lost sleep opportunity is that through no fault of his own the pilot would be significantly fatigued prior to starting his duty period.

Further compounding this sleep debt are multiple 24-hour layovers on consecutive days. This results in a cumulative sleep debt and increased fatigue. The length of the duty period is irrelevant because the issue with 24-hour layovers is specific to the amount of rest an individual can obtain in the 24-hour off duty period. It is physically impossible to obtain two full sleep cycles in a 24-hour period. The IPA suggests limiting flightcrew members to no more than two scheduled layovers between 18-30 hours in a rolling 168 hours to prevent accumulated sleep debt. The IPA urges the FAA to revisit the issue of 24-hour layovers when drafting the final rule.

Summary of proposed regulatory changes and amendments

117.3 Definitions

Acclimated – means 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.

Acclimated Local Time - means the local time at the location where the flightcrew member last had greater than 36 hours free from duty in the first 72 hours in theater.

Consecutive Night Duty Period - means two or more nighttime 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 (0100 to 0700) at home base or acclimated local time.

Flight Time – means when the aircraft first moves with the intention of flight until it comes to rest on the designated parking position.

Nighttime Flight Duty – means 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.

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**.

Theater - means a geographical area where local time at the crewmember's flight duty period departure point and arrival point differ by no more than 4 time zones or 60 degrees of longitude.

Unacclimated – A flightcrew member becomes unacclimated if he has traveled to a location more than 4 times zones or more than 60 degrees of longitude from the location at which he was last acclimated.

117.7 Fatigue Risk Management System (FRMS)

Section 117.7(b) needs to be amended to include the following items:

- **The FRMS must be an equal partnership that includes the FAA, the certificate holder and non-management pilot representative.**
- **FRMS does not replace the regulatory scheme, its purpose is to supplement adequate prescriptive rules.**
- **Any FRMS must provide an equivalent or better level of safety and be centrally approved by the FAA. (One office at FAA headquarters should be responsible for approving FRMS. This is the only way to provide a uniform FRMS approval scheme.)**
- **FRMS should be limited to specific certificate holders' data and scheduled city pairs, which must be scientifically and then operationally validated by all stakeholders.**
- **FRMS, like SMS, requires a commitment from the certificate holder's senior management team and a specified line of accountability in the organization.**

117.9 Schedule Reliability

§ 117.9(a) Change 60 days to **30 days**

(a)(1)(*modified*) Its system-wide flight duty periods if the total actual flight duty periods exceed the scheduled flight duty periods **by more than 15 minutes** more than 5 percent of the time**,** and

(a)(2)(*modified*) Any scheduled flight **segment** that is shown to actually exceed the schedule 20 percent of the time.

(b)(*modified)* Each certificate holder must submit a report detailing the scheduling reliability adjustments required in paragraph (a) of this section to the FAA every **30 days** detailing both overall schedule reliability and **flight segment reliability.** Submissions must consist of:

(1)*(modified)* The carrier's entire FDP schedule for the previous 30 day period and separately those FDP's exceeding the scheduled FDP by 15 minutes.

(2)*(modified)* The carrier's flight segments on a per segment basis and the list of those segments exceeding the 20 percent requirement in (a)(2).

117.13 Flight Time Limitation

Table A—Maximum Flight Time (Block) Limits

Time of Report (Home Base or Acclimated Local Time)	Maximum Flight Time (hours)
0000-0459	7
0500-0659	8
0700-1259	9
1300-1959	8
2000-2359	7

117.19 Flight duty period: Augmented flightcrew

Revised Table C—Flight Duty Period: Acclimated Augmented Flightcrew

Time of Start (Home Base or Acclimated 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	N/A
0600-0659	15:10	17:40	14:10	15:40	12:55	N/A
0700-1259	16:00	18:00	15:25	17:05	14	N/A
1300-1659	15:10	17:40	14:10	15:40	12:50	N/A
1700-2359	13:50	16:05	12:55	14:20	11:45	N/A

Revised Table D—Flight Duty Period: Nonacclimated Augmented Flightcrew

Time of Start (Home Base or Acclimated 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 Pilot	4 Pilot	3 Pilot	4 Pilot	3 Pilot	4 Pilot
0000-0559	13:15	15:20	12:20	13:35	11:15	N/A
0600-0659	14:30	17	13:35	15	12:15	N/A
0700-1259	15:50	18:00	14:50	16:25	13:30	N/A
1300-1659	14:30	17	13:35	15	12:20	N/A
1700-2359	13:15	15:20	12:20	13:35	11:15	N/A

Amend (c)(1) to read:

§ 117.19(c)(1)*(amended)* The final segment provides a minimum of 2 consecutive hours available for in-flight rest for both flightcrew members occupying a control seat during landing. (This would require a minimum segment length of 6 hours for a 3 pilot crew and 3:45 for a 4 pilot crew to achieve the required rest.)

§ 117.19(c)(3) deleted

§ 117.19(d)(*modified*) No certificate holder may assign and no flightcrew member may accept an assignment involving more than ~~three~~ **two** flight segments under this section unless the certificate holder has an approved fatigue risk management system under §117.7

§ 117.19(f)(1)(*modified)* The pilot in command and certificate holder may extend a flight duty period **beyond the scheduled flight duty period** up to ~~3~~ **2** hours.

§ 117.19(f)(2)(*modified*) An extension in the **scheduled** flight duty period exceeding 30 minutes may occur only once in any 168 consecutive hour period.

****Any FDP that includes total flight time in excess of 12 hours shall require a minimum of a Class 1 rest facility aboard the aircraft.**

***As an administrative matter, we have pointed out in our clarifying questions on the docket that Table C as published in the NPRM has an incorrect heading. The table heading needs to match Table B and the "Time of Start" should include home base or acclimated local time.**

117.21 Reserve Status

Due to overly complex language, we propose to rewrite section **117.21(c)** as follows:

(c) For short call reserve,

(1) **The maximum reserve duty period for un-augmented operations is defined as:**

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

(2) **All time within the reserve availability period is duty**.

(3) **The maximum reserve duty period (to include phone availability and/or flight duty period assignments) is determined by the earlier end point of**
(a) the start of the RAP time plus value in Table E or
(b) the Flight Duty Period limitation in Table B as measured from the FDP time of start (home base or acclimated local time).

Note: For example: If the RAP started at 0100, crewmember called at 0115, show at 0300, then it would be the EARLIER FDP end time of:

(i) RAP start 0100 + 13 hours = 1400 FDP end

(ii) RAP start 0100 + 1307 hours (+ 7 minute WOCL adjustment) = 1407 FDP end

(iii) FDP start at 0300 + 9 hours FDP limit = 1200 FDP end

(4) **If all or a portion of a reserve flightcrew member's reserve availability period falls between 0000 and 0600, the air carrier may increase the maximum reserve duty period in Table E by one-half of the length of the time during the reserve availability period of 0000-0600 in which the air carrier did not contact the flightcrew member, not to exceed 3 hours; however, the maximum reserve duty period may not exceed 16 hours. If the flightcrew member is contacted for an assignment prior to 0000 hours the reserve duty period would not be extended.**

Note: For example, RAP starts at 2200 hours, pilot called at 0300 for flight assignment, the RAP may be extended by 1.5 hours. If the pilot was called prior to 0000 hours there would be no extension.

(5) No certificate holder may schedule and no reserve flightcrew member on short call reserve may accept an assignment of a flight duty period that begins before the flightcrew member's next reserve availability period unless the flightcrew member is given at least 14 hours rest. This provision may be used only once in a rolling 168 hour period.

117.25 Rest Period

(c) ***(deleted)*** ~~No certificate holder may reduce a rest period more than once in any 168 consecutive hour period.~~

(d) No certificate holder may schedule and no flightcrew member may accept an assignment for reserve or a flight duty period unless the flightcrew member is given a rest period of at least ~~9~~ **10** consecutive hours before beginning the reserve or flight duty period measured from the time the flightcrew member reaches the hotel or other suitable accommodation.

(d)(1) (*added*) An unacclimated flightcrew member shall be given at least 12 consecutive hours of rest beginning upon arrival at the rest facility before beginning a RAP or flight duty period.

(e) ***(deleted)*** ~~In the event of unforeseen circumstances, the pilot in command and certificate holder may reduce the 9 consecutive hour rest period in paragraph (d) of this section to 8 consecutive hours.~~

(f) (*added*) No certificate holder may schedule and no flightcrew member may accept an assignment for reserve or a flight duty period after completion of any duty period(s) (flight or reserve) in a new theater unless the flightcrew member is given a rest period upon return to the flightcrew member's home base location in accordance Table F.

(f)(1) *(added)* The recovery rest in Table F satisfies the requirements for acclimation and the flightcrew member would then enter Table B without a penalty.

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 local night's recovery rest should be provided on return to base, except when the returning flight duty period encroaches the WOCL, then an additional local nights rest will be added

117.27 Consecutive nighttime operations ***(amended)***:

No certificate holder may schedule and no flight crew member may accept more than three consecutive nighttime flight duty periods unless the certificate holder provides an opportunity to rest during the flight duty period in accordance with § 117.17.

A fourth consecutive nighttime flight duty period may be assigned if the flight crewmember receives a minimum of 12 hours rest following each nighttime flight duty period.

Flightcrew Member Duty and Rest Requirements: Proposed Rule; Docket No. FAA-2009-1093
Preamble Questions

1) Please comment on adopting maximum FDPs. Should the maximum FDP vary based on time of day?

Yes, the maximum FDP should vary based on the time of day. The method of varying the maximum FDP based on the time of day recognizes a flightcrew member's circadian rhythms and adjusts the FDPs accordingly.

Should it vary based on the number of scheduled flight segments?

Yes. There are numerous studies indicating the longer a person spends on a given task the more fatigued they become.[23] As a pilot completes more takeoffs and landings they may become more fatigued and more error prone.

Should the proposed limits be modified up or down, and to what degree?

No, the proposed FDP limits do not require modification.[24]

2) Please comment on permitting flightcrew members and carriers to operate beyond a scheduled FDP. Is the proposed 2-hour extension appropriate?
(See IPA Comments regarding FDP Extensions)

Yes, two hours is a reasonable amount of time to provide a certificate holder with schedule flexibility due to unforeseen operational circumstances. Also, the IPA supports the proposed rule, which requires both the pilot in command and the certificate holder to jointly extend a FDP. Circumstances based strictly on an economic business consideration (such as holding an aircraft to wait for payload from a customer who is late) should not be considered a circumstance beyond the control of the operator.

---

[23] Studies which have investigated the effects of extended shift durations on worker performance may be relevant as they assess fatigue and performance as a function of the set of tasks that are performed during a shift rather than performance decrements that accrue on a single task." Battelle, *Supra* Note 16 at 10.
[24] 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." Jeffrey H. Goode, *Are Pilots at Risk of Accidents Due to Fatigue*, 34 J. Safety Res. 309, 311 (2003).

As currently proposed the regulation does not provide greater rest opportunities for augmented operations, therefore, the two-hour extension should remain the same for augmented operations, not be increased to three-hours as proposed under 117.19.

Is the restriction on a single occurrence beyond 30 minutes in a 168-hour period appropriate?

Yes, 30 minutes is an acceptable amount of time to provide an operator with flexibility. If the certificate holder requires more than 30 minutes on a regular basis a schedule adjustment would be necessary.

Should a flightcrew member be restricted to a single occurrence regardless of the length of the extension?

Yes, the single occurrence beyond 30 minutes in 168 hours ensures there is not abuse of the extension provision and reinforces schedule reliability. In the FAA's response to clarifying questions, the FAA agrees that a single duty extension in a 168-hour rolling period is appropriate. If delays were occurring on a regular basis a schedule adjustment would appear to be necessary.

3) Please comment on the proposed schedule reliability reporting requirements. Should carriers be required to report on crew pairings that exceed the scheduled FDP, but not the maximum FDP listed in the FDP table? ***(See IPA comments regarding 117.9 Schedule Reliability)***

Yes, operators should be required to report on any crew pairings that exceed the scheduled FDP regardless of the maximum FDP listed in the FDP table. Scheduled FDPs should be accurately constructed so that the scheduled FDP equates the actual FDP. If an operator were only to report exceeding the maximum allowable FDP that would not be a measure of scheduling reliability, instead it would only be a measure of exceeding the values set forth in the FDP tables. 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. Also, by using flight segments that would address the operator's concerns regarding schedule reliability and minimal volume pairings that only fly twice a year and fail once. Finally, the schedule reliability report should be made available to all stakeholders and the public.

4) Should carriers be required to report on more parameters, such as cumulative duty hours or daily flight time? If so, why?

Yes, the reporting parameters required by the proposed rule should include total flight time (block time) per flight duty period, in addition to flight segment (city pair). The rationale behind measuring schedule reliability is because it directly impacts a flightcrew member's ability to plan rest. A flight duty period or scheduled block time that consistently exceeds planned schedule prevents a flightcrew member from being prospectively rested for duty.

5) What should be the interval between reporting requirements?

The reporting interval should be changed from 60 days to 30 days.

6) How long after discovering a problematic crew pairing should the carrier be afforded to correct the scheduling problem?

The IPA agrees with the FAA as stated in the FAA's Clarifying Questions (Docket No. FAA-2009-1093) document that the obligation to correct schedules that exceeded the percentages proposed in the regulatory text would be required once the certificate holder discovered the corrections were needed. A certificate holder should not be allowed to operate a schedule that violates the scheduling limitations longer than 30 days and should also not repeat the same problematic schedule from one season to the next.

7) Is a 3-day adjustment to a new theater of operations sufficient for an individual to acclimate to the new theater? ***(See IPA comments regarding Acclimation)***

During the ARC the sleep specialists noted that an individual would take approximately one hour per day for each hour of time zone difference to adjust his internal clock and acclimate to a new time zone (i.e. four days minimum to acclimate to a new theater). Although a much more compressed timeframe than explained by the sleep scientists, a 72-hour adjustment to a new theater of operations would be sufficient only if it included three local nights rest (physiological nights rest). Remaining in theater for 72-hours does not necessarily allow for three physiological nights rest. If a flightcrew member were to remain in theater for 72-hours <u>and</u> given at least 36 consecutive hours free from duty in that theater the flight crewmember would be adequately synchronized to the new theater because it is necessary to have both time in theater and adequate rest to become acclimated. This issue is further discussed in our comments.

8) Is a 36-hour break from duty sufficient for an individual to acclimate to a new theater?

As discussed in question #7, a minimum 36-hour break from duty is sufficient for an individual to acclimate to a new theater <u>only</u> if that individual has been in that theater for 72-hours. The IPA agrees with the FAA that the 36-hour break should be predicated on actual time and not scheduled time.

9) Should flightcrew members be given a longer rest period when returning to home base than would otherwise be provided based on moving to a new theater? ***(See IPA comments regarding 117.25 Rest Period)***

Yes. We have proposed a modification to Section 117.25 to provide a table for recovery rest on return to home base. This concept is contained in numerous international regulations and current FAA regulations.

10) Should the FAA have different requirements for flightcrew members who have been away from their home base for more than 168 hours? If so, why?

Yes, these flightcrew members may have crossed multiple times zones and operated with irregular duty hours over the course of the week resulting in circadian disruptions. Additionally, many of these types of pairings have consecutive or multiple 24-hour layovers resulting in cumulative sleep debt. Extended recovery sleep is necessary to fully restore the individuals sleep reservoir and recover from the effects of cumulative and transient fatigue.

We also believe that there should be recovery rest for time away from home operating flights in a different theater that is less than 168 hours. The current regulations provide for recovery rest in international operations for operations less than a 168 consecutive hours period. <u>See</u> FAR 121.483, 121.485, 121.523, 121.525

11) Should the FAA require additional rest opportunities for multiple pairings between two time zones that have approximately 24-hour layovers at each destination? What if the scheduled FDPs are well within the maxima in the applicable FDP table or augmentation table? ***(See IPA comments regarding 24-hour Layovers)***

Yes, rest needs to be adjusted and multiple 24-hour layovers should be limited on consecutive days and on a weekly basis. The difficulty with 24-hour layovers is the crewmember has to get two sleep opportunities in one off duty period, which results in a circadian shift of the pilot's "body clock" resulting in a sleep debt. Further compounding this sleep debt are multiple 24-hour layovers on

consecutive days. The result is a cumulative sleep debt and increased fatigue. The length of the FDP is irrelevant because the issue with 24-hour layovers is specific to the amount of rest an individual can obtain in the 24-hour off duty period. It is impossible to obtain two full sleep cycles in a 24-hour period. The IPA suggests limiting flightcrew members to no more than two scheduled layovers between 18-30 hours in a rolling 168 hours to prevent accumulated sleep debt.

12) If the FAA adopts variable FDP limits, is there a continued need for daily flight time limits? ***(See IPA comments regarding 117.13 Flight Time Limitation)***

Yes, it is necessary to maintain daily flight time limits even with the variable FDP limits. The maximum FDP permitted in the NPRM is 13 hours, if we assume a 1-hour report time that would permit an operator to schedule an un-augmented flight crew up to 12 hours of flight time, which represents a fifty-percent increase from the current FAR flight time limit of 8 hours. There have been no studies on the affects of altitude, noise, vibration and limited movement on flight crews. Until such studies are completed it is prudent to err on the side of safety, just as has been stated in the preamble to the proposed regulation. These limits have been in place since the beginning of the flight limitation regulations and there is no basis not to continue these limits.

13) If the FAA retains daily flight time limits, should they be higher or lower than proposed? Please provide data supporting the answer.

The proposed daily flight time limits should more accurately reflect the majority position of the ARC, including industry and labor. As discussed in the answer to question #12, there is an absence of scientific data supporting a dramatic increase in flight time limits.

Equally as important the maximum flight time limits must state, as proposed in 117.13, "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: (a) will exceed the limits specified in Table A of this part if the operation is conducted with the minimum required flight crew." The language in the NPRM differs from current regulation and determines block time to be a hard limit, not a scheduled limit as it is today. Foremost, the most frequently abused provision of the current rules is the "scheduled flight limitation provision." Certificate holders consistently schedule to the limit, i.e. 7:59, even when they know in advance that the flight on a given day will not meet the scheduled time because of winds or ATC delays at busy airports. Under the current FARs eight hours scheduled flight time could realistically be in excess of nine hours, under the proposed NPRM eight hours would mean exactly that, eight hours. The new language will require the operators to schedule more realistically and supplements 117.9. With the sophisticated scheduling programs and historical

data available to certificate holders, the implementation of this provision should be accomplished at minimal cost.

Additionally, under the current FAR 121.471 the regulation permits flight time to be exceeded provided compensatory rest will be scheduled. The proposed rule prescribes only a minimum rest period and does not take into account additional rest for exceeding flight time limits. If Table A were scheduled there would be no protection for fatigue caused by the exceedures, therefore, flight time limits should remain hard limits and not scheduled limits.

The IPA does recommend that Table A be modified to reflect the unanimous view of the ARC that the limit be 7 hours for the early morning hours and the majority view that it be 7 hours for the late evening hours. Likewise, the majority view was that the maximum limit should be 9 hours, which is a 12.5 percent increase when compared to the current rule. Even if certificate holders have to "buffer" schedules, they will be in no worse position than they are today because of the increased limits.

Finally, the definition of flight time in FAR 1.1 currently defines flight time as the moment the aircraft fist moves under its own power. However, often the PIC is responsible and performing his duties when the aircraft is moved by a tug or remains at the gate with the engines running, and that time should count as flight time if the movement is with the intention for flight. This definition is consistent with EU-OPS subpart Q which provides:

"The time between an aeroplane 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."

14) Should modifications be made to the proposed flight time limits to recognize the relationship between realistic flight time limits and the number of flight segments in an FDP?

The proposed limits correctly address the need for lower FDP limits when multiple segments are being flown.

15) Should augmentation be allowed for FDPs that consist of more than three flight segments? ***(See IPA comments regarding 117.19 FDP: Augmented Flightcrew)***

No, multi-leg augmentation should only be allowed if no crew change is possible. Page 55866 of the Preamble states, "however, the initial theory behind augmentation was that it was simply impossible to place a fresh crew aboard the

aircraft." In no case should augmented operations contain more than two segments. The proposed chart in Table C to Part 117-Flight Duty Period: Augmented Operations is based on the TNO Report which only evaluated single flight segment duty periods.

Multi-leg augmentation should never be used solely for the purpose of extending a flight duty period. A freshly rested flightcrew is always preferable to a flightcrew who has had a long duty period. Onboard rest is fragile and merely a countermeasure to mitigate fatigue and may not always be obtained due to factors such as turbulence, time of day and readiness to sleep.

Does it matter if each segment provides an opportunity for some rest?

From the NPRM Preamble, "The proposed requirement for the 2-hour rest opportunity on the last flight segment is designed to address a common recognition among the ARC members that, even on a flight with only two segments, the last segment is often of such duration that there is no realistic rest opportunity, even though this is when the crew is likely to be the most fatigued." We agree and have recommended that the last flight provide an adequate sleep opportunity, two hours each for both pilots at the controls during approach and landing, for a minimum segment length of six hours. In reality this may operationally allow a FDP containing a short flight, followed by a long flight. In some cases this may preclude a rest opportunity on the first short flight. At no time should an operation consist of a long flight followed by a short flight.

We recommend a 2-hour consecutive sleep opportunity for both required crewmembers at landing. Both crewmembers manipulate the controls, i.e., the non-flying pilot normally operates flaps, landing gear and radios and performs monitoring duties so he must be equally alert. Much emphasis has been placed on the concept of crew resource management (CRM) and pilot monitoring duties. Also, there are circumstances such as Category III approaches where the pilot monitoring might actually be the pilot landing. To deprive any of the operating flightcrew members an in-flight rest opportunity would not help mitigate fatigue and violates the spirit and intent of augmented flight.

16) Should flight time be limited to 16 hours maximum within an FDP, regardless of the number of flightcrew members aboard the aircraft, unless a carrier has an approved FRMS?

Yes, flight time should be limited to 16 hours maximum within an FDP. Anything beyond 16 hours should require FRMS

17) Should some level of credit be given for in-flight rest in a coach seat? If so, what level of credit should be allowed? Please provide supporting data.

No credit should be given for rest in a coach seat. Sleep scientists document obtaining rest without leg and foot support and the ability to recline at least 40 degrees as difficult. Page 55864 of the Preamble states, "in-flight sleep has restorative value and the flatter one is able to lie, the more beneficial the sleep." Additionally, the note at the bottom of the page states, "sitting up increases blood flow to the brain and causes emission of norephrenephrine, which is stimulative instead of relaxing."

18) Is there any reason to prohibit augmentation on domestic flights assuming the flight meets the required in-flight rest periods proposed today?

Yes, domestic augmentation should be prohibited. Domestic augmentation has the potential to be a deliberate lowering of pilot alertness for economic gain and goes against the original intent and spirit of augmentation. A freshly rested flightcrew is always preferable to a flightcrew who has had a long duty period. Science does indicate that the sleep quality in an aircraft rest facility is not equivalent to the sleep in a bed. Noise, vibration and low humidity are elements that contribute to fatigue and will always be present on an aircraft.[25] Additionally, bunk size, turbulence and readiness to sleep are factors that may be present and can impact the quality of sleep. Onboard rest facilities simply do not provide the same level of rest that a ground based rest facility does. Onboard rest is merely a countermeasure to mitigate fatigue and should not be a substitute for a normal rest period. Domestically, there is always an ability to change crews. Permitting domestic augmentation is a step backwards from current FARs and does not enhance aviation safety for the flying public by mitigating pilot fatigue.

19) Are the proposed required rest periods appropriate? ***(See IPA comments regarding 117.25 Rest Period)***

The IPA applauds the FAA for recognizing rest should begin when the flightcrew members reach the hotel. The IPA recommends 10 hours of rest at the rest facility. According the FAA's own Fitness for Duty Advisory Circular, AC120-FIT, "Managing rest is the means for managing the risk of being unfit for duty because of fatigue. This is the joint responsibility of the air carrier and the crewmember. It's unrealistic to assume that a 9-hour rest period will yield 9 or even 8 hours of sleep by the crewmember. The reality is that a 9-hour rest period

---

[25] M.R Rosekind, D.L. Miller, K.B. Gregory, and D.F. Dinges, *Crew Factors in Flight Operations XII: A Survey of Sleep Quantity and Quality in On-Bard Crew Rest Facilities*, (NASA Technical Memorandum 2000-209611, Moffett Field, California) (2000) at 1.

may yield 7 hours of sleep when you take into consideration the time lost in checking in at a hotel, eating, and preparing to resume duty at the conclusion of the sleep opportunity."

Also it should be recognized that a flight from the U.S. to Europe or Asia disrupts the circadian cycle and a rest of 9 hours is not sufficient to achieve an appropriate level of alertness. When a flightcrew member is unacclimated they should be given at least 12 hours rest at a suitable accommodation until acclimated. We also believe that there should be recovery rest for time away from home operating flights in a different theater that is less than 168 hours. The current regulations provide for recovery rest in international operations for operations less than a 168 consecutive hours period (FAR 121.483, 121.485, 121.523, 121.525)

We also do not believe that scheduled rest periods should ever be reduced below the 10-hour and 12-hour proposed. The only time this could be a factor would be after an extended FDP, which is exactly the time when a good quality sleep opportunity is required.

20) Should credit be allowed if a flightcrew member is not type-rated and qualified as a PIC or SIC?

No, relief on the flight deck during augmented operations must ensure that it is by flightcrew members with the same or greater level of qualification on that segment. All flightcrew members are required to be current and qualified type-rated as a second-in-command (SIC) or pilot-in-command (PIC). These qualifications provide a consistent level of safety in the event of an emergency.

21) Please comment on whether a single occupancy rest facility provides a better opportunity for sleep or a better quality of rest than a multiple occupancy facility**.**

A single occupancy rest facility is superior to obtain an adequate level of rest. A single occupancy facility provides a crewmember a rest opportunity free from environmental and interpersonal disturbances that may be present in a multiple occupancy facility.

22) Should there be any restriction on consecutive nighttime operations? If not, why?
(See IPA comments on 117.27 Consecutive Nighttime Operations)

Yes, there should be a limit on consecutive nighttime operations. Flight operations that impinge on the WOCL contribute to circadian fatigue and transient fatigue, which may also result in cumulative fatigue. Also, daytime sleep

is more difficult than nighttime sleep resulting in greater fatigue. Nighttime operations should be limited to 3 nights unless there is some sort of fatigue mitigation strategy.

23) If the nighttime sleep opportunity is less than that contemplated under the split duty provisions of this notice, should a carrier be allowed to assign crew pairing sets in excess of three consecutive nights? Why or why not?

We agree with the FAA and science that consecutive nighttime duty periods contribute to sleep debt and increased fatigue. We also agree with science that fatigue can be mitigated to some extent when a flightcrew member is given a sleep opportunity in a suitable accommodation. However, we do not believe this sleep opportunity mitigates the fatigue associated with an extended flight duty period and should not be used to extend a flight duty period.

24) If the nighttime sleep opportunity meets the split duty provisions of this notice, should the carrier be allowed to extend the flight duty period as well as the number of consecutive nighttime flight duty periods? Why or why not?

No, the carrier should not be allowed to extend the flight duty period. The FDP table was constructed based on acknowledging that duty during the WOCL contributed to fatigue. The sleep opportunity afforded during split duty should be to mitigate fatigue not to extend a flight duty period.

25) Should a fourth night of consecutive nighttime duty be permitted if the flightcrew member is provided a 14-hour rest period between nights three and four?

The FAA's concept in the proposed rule to allow a fourth consecutive nighttime duty is better handled by requiring 12-hours of rest before each nighttime duty period as recommended in the language proposed in this submission.

26) Please comment on whether a 16 maximum hour FDP for long call reserve is appropriate when the maximum FDP for a lineholding flightcrew member is 13 hours**.** ***(See IPA comments regarding 117.21 Reserve Status)***

The FDP for a long call reserve should be 13-hours which is equivalent to the maximum duty period as a lineholding flightcrew member. Since a long call reserve receives the same pre-duty rest as a line holder there is no rationale to assume he can work longer. The same physiological considerations should be given to each flightcrew member regardless of his schedule status.

27) Please comment on whether the proposed maximum extended FDP of 22 hours for an augmented flightcrew member is appropriate. If not, please provide an alternative maximum FDP.

The proposed maximum extended FDP of 22 hours is not appropriate. The maximum proposed FDP should be the maximum FDP 18 hours.

28) Please comment on whether a certificate holder should receive credit for not calling a flightcrew member during the WOCL while on reserve.

Yes. If all or a portion of a reserve flightcrew member's reserve availability period falls between 0000 and 0600, the air carrier may increase the maximum reserve duty period by one-half of the length of the time during the reserve availability period in which the air carrier has not contacted the flightcrew member, not to exceed 3 hours. However, the maximum reserve duty period may not exceed 16 hours. This credit will only be calculated for the time during 0000-0600 before the flightcrew member was contacted. In both the ARC and the NPRM preamble, the intent was expressed that RAP extension credit is to be made available for not contacting reserves between 0000 and 0600 whose RAP's touch that time period. However, the proposed language in 117.21(c)(4) (iv) and 117.21(c)(5)(iii) neglects this distinction, providing credit for *any* period of non-contact.

29) Should minimum required rest while on reserve status be greater than the amount of rest required for a lineholding flightcrew member? If so, please provide supporting data, if not, please provide rationale.

No, minimum rest for reserve and a line holder should be the same to provide an equivalent level of safety.

30) Please comment on the level of complexity on the proposed reserve system.

The short call reserve section is complex and we are concerned that there may be misunderstanding by flightcrew members, scheduler and management officials as currently written. Consistent with other limitations in the proposal, we believe a chart is a better way to set forth the short call reserve limits expressed in the proposal. We urge that the chart contained in our comments that sets forth the short call reserve limits be adopted. *(See IPA Comments regarding 117.21 Reserve Status*)

31) The FAA seeks input on the appropriate cumulative limits to place on duty, flight duty periods and flight time. Is there a need for all the proposed limits?

Yes, the proposed cumulative duty and flight time limits need to be retained as proposed. Just as the certificate holder tracks flight time and flight duty periods, administrative duties should also be tracked. Administrative duties include any duty required by the certificate holder and counts towards daily and cumulative duty limits just as short call reserve does.

32) The FAA also asks for comments on measuring limits on an hourly rather than daily or monthly basis. Does this approach make sense for some time periods but not for others?

Hourly limits make sense for daily and weekly limits, but monthly limits should be based on 28 calendar days. Annual limits should also be based on calendar days.

33) If transportation is not considered part of the mandatory rest period, is there a need for a longer rest period for international flights?

Yes, we recommend 12-hours as a minimum. Crossing multiple times, an individual's readiness to sleep, circadian de-synchronization and wrong time of the day for sleep are all factors impacting fatigue when flying internationally. *(See IPA Comments regarding 117.25 Rest Period*)

34) Whether some elements of an FRMS, such as an incident reporting system, would be better addressed through a voluntary disclosure program than through a regulatory mandate? ***(See IPA Comments regarding 117.7 FRMS*)**

We strongly support the introduction of FRMS in the U.S. Aviation System. We do, however, believe that Section 117.7(b) needs to be amended to include the following items:

- **The FRMS must be an equal partnership that includes the FAA, the certificate holder and non-management pilot representative.**
- **FRMS does not replace the regulatory scheme; its purpose is to supplement adequate prescriptive rules.**
- **Any FRMS must provide an equivalent or better level of safety and be centrally approved by the FAA. (One office at FAA headquarters should be responsible for approving FRMS. This is the only way to provide a uniform FRMS approval scheme.)**

- **FRMS should be limited to specific certificate holders' data and scheduled city pairs, which must be scientifically and then operationally validated by all stakeholders.**

- **FRMS, like SMS, requires a commitment from the certificate holder's senior management team and a specified line of accountability in the organization.**

35) Are there other types of operations that should be excepted from the general requirements of the proposal? If so, what are they, and why do they need to be accommodated absent an FRMS?

No. We believe that the single set of rules approach to fatigue is the correct and reasonable approach. The human physiology of fatigue is the same regardless of the type of operation. Any exceptions to the rules should be rare and addressed only through an instituted FRMS. To that end, the FRMS section 117.7 of the proposed rule should clearly state that an FRMS is meant to address individual exceptions by pairing and city pairs, not to replace this entire proposed rule set for a specific carrier.

IPA's Response to Questions Posed in the Response to Clarifying Questions

1) The FAA is open to suggestions on how to improve the clarity of the proposed regulatory text regarding schedule reliability.

The IPA has proposed modifications to Section 117.9 to clarify the language and add a flight segment metric.

2) The agency is interested in suggestions on how to measure the reliability of infrequently flown pairings in unscheduled operations.

These pairings in the aggregate would be captured in the system-wide flight duty metric and a single FDP would fall under the 20 percent metric. While the FDP is not "scheduled" in advance, it is nevertheless a FDP with a start and end time when the flight crew receives the assignment. This could be captured in a record and used to demonstrate compliance.

3) The FAA seeks comment on allowing a certificate holder to reschedule a flight crewmember if the rescheduled time is within the limits of Tables B and C.

We support the FAA's proposed language and believe the 2 hour extension of a scheduled flight duty period is appropriate for rescheduling events during, "unforeseen circumstances beyond the carrier's control." We anticipate these types of situations to be a rare occurrence.

4) The FAA seeks comments when a certificate holder's customer demands less than a 2 hour final segment and situations where both crewmembers are manipulating the controls.

The final segment must allow 2 hours of rest for each pilot occupying a control seat during the landing. For a single crew this would require a minimum 6 block hour segment. For a dual crew this would require a minimum 3 + 45 block segment. These block times are based on 45 minutes from block out to top of climb, 2 hours of sleep opportunity and 1 hour in the seat prior to block in for the crew performing the landing. For single augmented crews 15 minutes is required for pilot swap out in the rest facility. As you can see, there are options available to the certificate holder to safely satisfy the wants of a customer. These limits should be mandated by the FAA to ensure operators truly allow a realistic sleep opportunity.

5) The FAA seeks input on whether the flight crewmember must be current on the aircraft and actually at the controls rather than simply on the flight deck.

It is our position that both flight crewmembers occupying a control seat throughout the flight must be current (including landings) and qualified (to include Operational Experience). This is essential so that qualified flightcrew are immediately available in the cockpit to handle any in-flight emergencies from cruise altitude thru landing, especially during a security lockdown. Additionally, given that sleep science indicates up to 30 minutes

may be required to overcome the affects of sleep inertia, the option of waking up a sleeping qualified flightcrew member during a time critical emergency is ineffective. Integrity of augmented crew for the entire FDP is essential.

6) Should short call reserve count as duty?
Yes. The agency has consistently interpreted reserve duty to be a present responsibility for duty. In our view, that is tantamount to duty. The flight crewmember is restricted in his/her activities and must be prepared to perform flight duty when called on short notice. We agree that flight crewmembers in reserve status can acclimate just as any other flight crewmember.

7) Can a certificate holder assign additional duty time if there is no additional FDP contemplated for the relevant time period?
No. An extreme example would be the completion of a 18-hour augmented flight duty period followed by an immediate scheduling of an 8-hour training period. The level of cumulative fatigue without an intervening rest period is unacceptable. Any duty (FDP, reserve, training) performed on behalf of the carrier should require the appropriate minimum rest period before beginning the duty period. We believe that the cumulative duty periods should apply as written. The consecutive duty limits apply to crewmembers that do fly and these limits are necessary to assure alertness over a longer period of time. Also, the "implied 16 hour duty day" as stated in the Preamble should be part of the regulatory scheme. If a management or other pilot wants to work excessive hours performing administrative duties, he or she should relinquish flight duties.

8) Does Union work count as administrative time?
Yes, however the difficulty is that the work is not performed for the certificate holder, not required to be reported to the certificate holder, is difficult to track and even more difficult for the FAA to oversee. An individual performing administrative time for the carrier has a defined work schedule easily monitored by the carrier. As previously stated within the findings it is incumbent upon all flight deck crewmembers to ensure they are adequately rested prior to reporting for any flight deck duty period. Not only would this apply to those who would be engaged in labor representative activities but any other activity outside of that associated with the flight deck duty period. This concept is covered within the requirement to report fit for duty.

9) The FAA seeks input on a circumstance where a flight crewmember is at the end of the cumulative duty period but cannot be released due to circumstances beyond the control of the certificate holder.

We believe this would be an isolated occurrence limited to operations in an unsafe area or during extreme weather conditions and perhaps the best way to handle this issue is under the emergency powers of the PIC. Any further continuation of duty should be validated within an FRMS. It would be, in our view, so rare that it need not be addressed in a regulation but should be discussed in the accompanying guidance material.

10) Is prospective scheduling of short call reserve in excess of cumulative duty limits permissible so long as actual duty limits are met?

Since short call reserve is duty, this presents a circumstance where the schedule would have to be modified prior to the actual duty limits being reached. To over-schedule certainly would not be realistic scheduling and it would be disruptive to the crewmember. Cumulative duty limits should not be exceeded. We agree that this issue is best addressed in the labor-management context.

The IPA is attaching the following document, which represents a consensus opinion and comments of all ARC Labor Representatives. The IPA was a participant to the summer 2009 ARC.

BEFORE THE
U.S. DEPARTMENT OF TRANSPORTATION
FEDERAL AVIATION ADMINISTRATION
WASHINGTON, D.C.

Notice of Proposed Rulemaking for Flightcrew Member Duty and Rest Requirements	)	**Docket No. FAA-2009-1093** **Notice No. 10-11**

Comments

117.1 Applicability

We are 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. We support the FAA's determination that one level of safety with regard to fatigue should apply equally to all Part 121 certificate holders.

117.3 Definitions

We propose the following additions and clarifications to the Definition section.

> **Acclimated –** means a condition in which a crewmember 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.

Rationale: The established science, as we demonstrate below, is that 3 consecutive local nights rest is required to become acclimated. CAP 371 recognizes this science and requires 3 consecutive local nights rest to be acclimated.

As the rule currently is written, it would allow carriers to provide 36 hours of uninterrupted rest at the layover location and then be considered "acclimated" to the local time zone. Such an assumption is incorrect for the following reasons:

1) For typical flights from the U.S. to Europe or Pacific destinations, the number of time zones crews would transit would be in excess of 5 or more. The general agreed upon acclimation rate is about 1 time zone or one hour difference per day.[26] Some expert researchers have published data showing even longer periods to become acclimated to the local time zone.[27] Conclusion: The crew would not be acclimated after 36 hours of layover rest.

2) While 3 consecutive physiological nights may start approaching a reasonable compromise for the purpose of entering the FDP tables, a 36 hour rest by itself clearly would not. In order for the rules to approach parity, the implication is that a night of normal sleep would be approximately 8-9 hours of sleep. Three nights of consecutive sleep would be 24-27 hours of sleep. The 36 hour rule suggests that crews would remain asleep for nearly the entire layover period. This is not physiologically plausible for healthy aircrews.

3) Further, when crews are put into a rest period, it is critical for any fatigue safety regulation to assess where they are in their own circadian cycle – as that will determine when in the following rest periods, crews would be able and likely to sleep from a physiological perspective. To be sure, being put into a rest cycle does not mean that the crew will be able to

---

[26] It takes about one day for every time zone crossed to recover from jet lag. When circadian disruption and sleep loss occur together, the adverse effects of each are compounded.

Battelle Memorial Institute. March 1998. *A Review of Issues Concerning Duty Period Limitations, Flight Time Limitations, and Rest Requirements as stated in the FAA's Notice of Proposed Rulemaking 95-18*, 60 Fed. Reg. 244 (Proposed Dec. 20, 1995).

[27] For example: Gander, et al. (1989) showed that it took several days for the acrophase of the temperature rhythm to come within one standard error of complete resynchronization after a 9h westward transition, and that the adaptation in an eastward direction took even longer. *Paper presented at the RTO HFM Lecture Series on "Sleep/Wakefulness Management in Continuous/ Sustained Operations," held in Fort Rucker, Alabama, United States, 17-18 June 2002; Warsaw, Poland, 24-25 June 2002; Paris, France, 27-28 June 2002, and published in RTO-EN-016,* Gander PH, Myhre G, Graeber RC, Andersen HT, Lauber JK (1989) *Aviat Space Environ Med* 61: 733-743.

sleep according to a desired clock position. The crews' circadian phase will be the key-determining factor as to when and how long crews will subsequently sleep. In a 36 hour rest situation, crews could have only one full sleep cycle in their physiological nadir and if that falls early in the layover rest period, they would initially sleep, then be awake for an extended period before reporting for duty. At that point, the pilots, through no fault of their own, would be significantly fatigued after being awake for 12 to 15 hours prior to starting their duty period.

We believe that the regulation should require 3 local nights rest. However, during the first 72 hours in theater, measured from the time of first arrival, a 36 hour rest within the 72 hours may allow a flight crewmember to become acclimated. Merely being in theater for a 72 hour period without at least 36 consecutive hours rest during that time would not allow a person to become acclimated. It is necessary to have both time in theater and adequate rest to become acclimated. The preamble to the proposed regulation states that the tables selected from the ARC were in part based on being the most conservative approach. The wide range of available research on the topic of acclimation, combined with operational experience, clearly supports a more conservative approach of 72 hours in theatre with 36 hours free of duty to consider the crew acclimated.

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.

Rationale: This definition provides an unambiguous time for applying the definition of Nighttime Duty Period and for entering the FDP and Flight Time limit tables. The original NPRM wording of "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 wording, enter the tables at Home Base time instead of Europe time. Similarly, the exact location of acclimation must be known to determine future loss of acclimation. For example, a pilot flies to Paris and has 37 hours off, but at the end of his 72 hours in theater happens to be 3 more hours east at Tel Aviv. He is now acclimated, but where? Would a further flight two more hours east to Dubai cause him to be unacclimated? It depends whether you define the point of acclimation as being tied to the 36 hour rest or to the 72 hours in theater condition. The above proposed definition removes such doubts about the location of acclimation and the use of regulatory tables, allowing practical and reliable computer programming of scheduling. Under this proposal, both the tables and the definition of Nighttime Flight Duty Period would then use the new term, "Acclimated Local Time".

Consecutive night duty period - means 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).

Rationale: Part 117.27 limits consecutive nighttime flight duty periods to three periods. The term *consecutive night duty period* is not defined, and to avoid confusion in applying 117.27 we believe it should be defined.

Flight Time – means when the aircraft first moves with the intention of flight.

Rationale: The FAA in FAR 1.1 currently defines flight time as the moment the aircraft first moves under its own power. However, the PIC and required flight deck crewmembers 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 as flight time if the movement is with the intention for flight. This definition is consistent with EU-OPS subpart Q which provides:

> "The **time** between an aeroplane 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."

Nighttime Flight Duty – means 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.

Rationale: The term "nighttime flight duty" is not defined and to avoid confusion in applying 117.27 we believe it should be defined. The Nighttime Flight Duty definition we have used is the CAP 371 definition which we believe is scientifically correct.

Rest Facility definition should include the following clarification:

"A rest facility on an aircraft shall only be used for in-flight rest opportunities."

Rationale: 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. A bunk or seat on an aircraft is simply not a suitable rest facility on the ground.

Schedule Reliability – means the accuracy of the length of both a scheduled flight duty period and a <u>scheduled flight segment</u> as compared to the actual flight duty period <u>and segment</u>.

Rationale: This change in definition to include measurement of "flight segments" is necessary for consistency with our proposed changes to 117.9 below.

Suitable accommodation - means a <u>single occupancy</u>, facility with sound mitigation that provides a crewmember with the ability to sleep in a bed and to control light.

Rationale: Operational experience has demonstrated that a <u>single occupancy</u> room is required. Otherwise, disruptions such as the other person reading, watching TV, snoring, etc., will disrupt the roommate's rest.

Theater - means a geographical area where local time at the crewmember's flight duty period departure point and arrival point differ by no more than 4 time zones or 60 degrees of longitude.

Rationale: Theater is a term used in the proposed regulation and should be defined. 60 degrees of longitude is necessary for those countries such as China which for political reasons is a single time zone.

Unacclimated – 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.

Rationale: The NPRM references “unacclimated” in several sections of the proposed regulation but does not define the term. We believe it should be defined. Defining acclimation in terms of “time zones” is subject to whim of governmental policy, (e.g., all of China is in a single time zone even though it spans 5 normal time zones in width). 60 degrees of longitude is equivalent to 4 normal time zones and should be included as a supplement to the time zone metric.

117.5 Fitness for Duty

We support the concept that a flight crewmember must be fit for duty prior to operating an aircraft. The fitness for duty is and must be a joint responsibility of the certificate holder and the flight crewmember. While it is important that both the flight crewmember and the certificate holder be involved in fit for duty determinations, we cannot create an environment that requires tracking and reporting the activities of an individual flight crewmember prior to their reporting for flight duty. Such tracking would be difficult, costly and impractical for the certificate holder to administer and would constitute an unwarranted invasion of the personal privacy of the flight crewmember. The proposed provision provides a framework for educating and encouraging responsible jointly-managed commuting policies. The proposed 117.5 should be adopted as written and the accompanying Advisory Circular (AC 120-FIT) should be removed from the docket, as the topic itself was not exposed to the same peer review and recommendations that other aspects of the proposed rule were during the ARC process. The FAA took a path in AC 120-FIT significantly different from ARC recommendations. If it is the desire to continue down this path, all of the applicable stakeholders should have a similar opportunity to provide input in the process and a corresponding comment period should follow separate from this rulemaking.

We would recommend a process set up where this occurs and would recommend an ARAC approach so that the issue is properly identified and jointly addressed.

117.7 Fatigue Risk Management System (FRMS)

We strongly support the introduction of FRMS in the U.S. Aviation System. We do, however, believe that Section 117.7(b) needs to be amended to include the following items:

- **The FRMS must be an equal partnership that includes the FAA, the certificate holder and a non-management pilot representative.**
- **FRMS does not replace the regulatory scheme, its purpose is to supplement adequate prescriptive rules.**
- **Any FRMS must provide an equivalent or better level of safety and be centrally approved by the FAA. (One office at FAA headquarters should be responsible for approving FRMS. This is the only way to provide a uniform FRMS approval scheme.)**
- **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 then operationally validated by all stakeholders.**
- **FRMS, like SMS, requires a commitment from the certificate holder's senior management team and a specified line of accountability in the organization.**

Rationale: A FRMS comprises a comprehensive range of procedures that are both scientifically based and data-driven, allowing a cooperative and flexible means of managing fatigue. There remains a requirement for the regulator to provide prescriptive flight and duty time rules for operators not embracing FRMS principles. Such a set of rules will also provide a base line against which the fatigue levels of any FRMS can be compared, and in the case where an FRMS does not provide at least an equivalent level of safety to the prescriptive scheme, provide a reversion. Operators may, subject to regulator approval, embrace FRMS for all or part of their operations.

The *purpose* of any FRMS is to ensure that flight crew members are sufficiently alert so that they can operate to a satisfactory level of performance and safety under all circumstances.

A FRMS supplements prescribed flight and duty time regulations and other validated independent scientific research based software tools by applying safety management principles and processes to proactively and continuously manage fatigue risk through a partnership approach requiring shared responsibility among management and crew members. These changes to the prescriptive rules must be operationally validated prior to acceptance. It can therefore only operate in circumstances where all stakeholders, particularly the pilot body, support the operation of a FRMS. Accordingly, an open reporting system and non-punitive working environment, sometimes referred to as a "just culture" is a prerequisite within the organization for a FRMS to exist because crew feedback is an essential component of the program. All successful safety programs such as ASAP and FOQA are based on a three-way partnership and FRMS should be the same. A FRMS must specify the prescriptive regulatory scheme upon which it is based. In the event of suspension, termination or revocation of FRMS, the carrier's affected operations shall revert to the baseline prescriptive scheme.

FRMS is intended to be used to supplement prescriptive fatigue management regulations as a means of ensuring that flight crew remain sufficiently alert during duty to achieve a satisfactory level of operational performance and hence safety under all circumstances. A well developed and managed FRMS integrates operational and scientific data such as physiological and behavioral measures in the scheduling of crew members by providing a balance between duty types, crew rest and recovery. In the case of extended flight duty periods with augmented crew, such as ultra long range (ULR) operations, the planning of in-flight rest can be optimized.

FRMS must be based on a partnership approach for which there is agreement between the operator, regulator and pilot body. As FRMS is a new emerging concept, a Memorandum of Understanding between principle stakeholders should form the basis of initial agreement and be the subject to on-going periodic review based on assessment of the effectiveness of the program in achieving its stated goals. The Memorandum of Understanding must include a mechanism for the representatives of the stakeholding pilots to unilaterally suspend or terminate participation in the operator's FRMS in the event that the representatives of the stakeholding pilots determine in their discretion that the FRMS program's safety *purpose* is not being met.

Pilot representatives, either from, where such a body exists, an established organization independent of the company, or where such a body does not exist, independently elected directly by the pilots, must be included as members of the operator's Fatigue Management Steering Group. This committee will be fully involved in the initial development of the FRMS program, and shall be fully and directly involved in the on-going oversight of the operator's FRMS program including the development of modifications of the FRMS to meet the program's safety *purpose*.

117.9 Schedule Reliability

We propose the following additions and changes to the Schedule Reliability section:

117.9(a) Change 60 days to **30 days**

(a)(2)(*modified*) Any scheduled flight segment that is shown to actually exceed schedule 20 percent of the time.

(b)(*modified*) Each certificate holder must submit a report detailing the scheduling reliability adjustments required in paragraphs (a) of this section to the FAA every

30 days detailing the overall scheduling reliability, and flight segment reliability. Submissions must consist of:

(2) The carrier's flight segments on a per segment basis and the list of those segments exceeding the 20 percent requirement in (a)(2).

Rationale: These proposed amendments accomplish two changes to the proposed rule. First, the reporting period is 30 days rather than 60 days and second, a flight segment reliability requirement is added.

If a schedule exceeds the limits in this section the certificate holder should take prompt action to correct the schedule. A certificate holder should not be allowed to operate a schedule that violates the scheduling limitations for 60 days. With the sophisticated computerized scheduling programs available and used by most if not all certificate holders, a 30 day reporting period is neither unreasonable nor burdensome. The certificate holder should correct any schedule exceedance at the point the certificate holder becomes aware that the schedule does not meet the scheduling limitations. This is particularly true considering the amount of change in an air carrier's flight crew schedule month to month.

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 hide the problem and/or bring it within limits. The problem 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.

117.13 Flight Time Limitation

We propose that Table A which specifies flight time limits be amended as follows:

Table A—Maximum Flight Time (Block) Limits

Time of Report (Home Base or Acclimated Local Time)	Maximum Flight Time (hours)
0000-0459	7
0500-0659	8
0700-1259	9
1300-1959	8
2000-2359	7

Rationale: The flight time limits must be "hard" and not scheduled for several reasons. Foremost, the most frequently abused provision of the current rules is the "scheduled flight limitation provision." Certificate holders consistently schedule to the limit, i.e., 7:59 or 7:55, even when they know in advance that the flight on a given day will not meet the scheduled time because of winds or ATC delays at busy airports. In practice, many of these schedules exceed 8 hours by 45 minutes or more.

The hard limits would be applied like "Whitlow" is with the 16 hours duty limit. As the FAA and others will recall, in 2001 the certificate holders resisted Whitlow on the grounds that the cost would put certificate holders out of business. We anticipate the same approach to this NPRM. In their request to stay enforcement of Whitlow, the RAA stated that the Whitlow interpretation would "bring about the demise of smaller carriers." They would be required to hire numerous flight crewmembers and the cost would mean elimination of service to smaller cities. Likewise, the ATA complained that enforcement of Whitlow would inconvenience the traveling public as their members would have to delay and cancel flights. Additionally, the ATA carriers would be subjected to having to hire many additional flight crewmembers incurring tremendous costs for salaries, benefits and training.

For this reason they engaged in litigation to overturn Whitlow. When that effort failed, the certificate holders implemented the interpretation with little or no impact on their operation. They adjusted their scheduling practices with minimal or no cost. It can be anticipated that the certificate holders will take the same position on hard limits as they did with Whitlow. *The sky is falling* approach should be rejected. With the sophisticated scheduling programs and historical data available to certificate holders, the implementation of this provision should be accomplished at minimal cost. Another reason these limits must remain hard is that the current protection for exceeding schedule, which is *compensatory rest,* is not included in this proposal. If Table A were to be scheduled rather than actual flight time there would be no protection for fatigue caused by the exceedances. We do recommend that Table A be modified to reflect the unanimous view of the ARC that the limit be 7 hours for the early morning hours and the majority view that it be 7 hours for the late evening hours.

Likewise, the majority view was that the maximum limit should be 9 hours for the 0700-1259 time period, which is a 12.5 percent increase when compared to the current rule. Even if certificate holders have to "buffer" schedules, they will be in no worse position than they are today because of the changed limits. In most instances, they will receive a distinct advantage with the increased flight limits.

117.19 Flight Duty Period: Augmented Flightcrew

We propose the following amendments and additions to 117.19.

Amend (c)(1) to read:

117.19(c)(1) The final segment provides a minimum of 2 consecutive hours available for in-flight rest for both flightcrew members occupying a control seat during landing. (This would require a minimum segment length of 6 hours for a 3 pilot crew and 3:45 for a 4 pilot crew to achieve the required rest).

117.19(c)(3) deleted.

117.19(d)(*modified*) No certificate holder may assign and no flightcrew member may accept an assignment involving more than **2** flight segments under this section unless the certificate holder has an approved fatigue risk management system under §117.7

Rationale: As an administrative matter, we have pointed out in our clarifying questions on the docket that Table C as published in the NPRM has an incorrect heading. The Table heading needs to match Table B and the "Time of Start" should include home base or acclimated local time.

The NPRM proposed chart in Table C is based on the TNO Report. Upon a further review of the TNO Report, we believe the proposed Table C was oversimplified in two regards. The first was that many of the values were oversimplified following a rounding process that doesn't adequately represent the actual calculations used in the ARC process. The second oversimplification is the use of a standard 30-minute reduction for a nonacclimated crewmember. The end result is an improper application of a nonacclimated penalty for the operation planned. Additionally, just as is the case with the acclimated discussion, a table that reflects the true values is better suited to accurately reflect the appropriate reduction for the crewmember not being acclimated.

Additionally, the TNO Report is intended for single segment operation only and the addition of more than one additional segment would stray too far from the science on which the charts were developed. Multi-leg augmentation should only be allowed when no crew change is possible. Multi-leg augmentation should never be used solely for the purpose of extending a flight duty period. Augmented flights must not be mixed with non-augmented flights in the same flight duty period.

The proposed regulation (117.19 (c)(3)) provides for a two hour consecutive sleep opportunity for the flight crewmember manipulating the controls on landing. That sleep opportunity should be mandated for both required crewmembers at landing. Both crewmembers 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. This is especially important as augmentation has the potential to significantly increase time on task. The final segment of any augmented flight must provide the required rest. During the most challenging approaches on short final, both crewmembers are manipulating the controls and the manipulation of the flight controls transfers from one pilot to the other at about 300 feet. 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.

117.21 Reserve Status

Due to overly complex language, we propose to rewrite section **117.21(c)** as follows:

(c) For short call reserve,

(1) **The maximum reserve duty period for un-augmented operations is defined as:**

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

(3) **The maximum reserve duty period (to include phone availability and/or flight duty period assignments) is determined by the earlier end point of (a) the start of the RAP time plus value in Table E or (b) the Flight Duty Period limitation in Table B as measured from the FDP time of start (home base or acclimated local time).**

Note: For example: If the RAP started at 0100, crewmember called at 0115, show at 0300, then it would be the EARLIER FDP end time of:

(i) RAP start 0100 + 13 hours = 1400 FDP end

(ii) RAP start 0100 + 1307 hours (+ 7 minute WOCL adjustment) = 1407 FDP end

(iii) FDP start at 0300 + 9 hours FDP limit = 1200 FDP end

Rationale: This ensures that the reserve will NOT have an allowable FDP limit greater than the lineholder the reserve is paired with and does not impact the operator in any manner since the reserve and lineholder end point is the same.

(4) **If all or a portion of a reserve flightcrew member's reserve availability period falls between 0000 and 0600, the air carrier may increase the maximum reserve duty period in table E by one-half of the length of the time during the reserve availability period of 0000-0600 in which the air carrier did not contact the flightcrew member, not to exceed 3 hours; however, the maximum reserve duty period may not exceed 16 hours. If the flight crewmember is contacted for an assignment prior to 0000 hours the reserve duty period would not be extended.**

Note: For example, RAP starts at 2200 hours, pilot called at 0300 for flight assignment, the RAP may be extended by 1.5 hours. If the pilot was called prior to 0000 hours there would be no extension.

Rationale: The short call reserve section is complex and we are concerned that there will be misunderstanding by flight crewmembers, schedulers and management officials with the section as written. Consistent with other limitations in the proposal, we believe a chart is a better way to set forth the short call reserve limits expressed in the proposal. We urge that the chart that sets forth the short call reserve limits be adopted. In both the ARC and the NPRM preamble, the intent was expressed that RAP extension credit is to be made available for not contacting reserves between 0000 and 0600 whose RAP's touch that time period. However, the proposed language in 117.21(c)(4) (iv) and 117.21(c)(5)(iii) neglects this distinction, providing credit for *any* period of non-contact. This error in the language has been corrected in our revised language in (4) above.

(5) **No certificate holder may schedule and no reserve flightcrew member on short call reserve may accept an assignment of a flight duty period that begins before the flightcrew member's next reserve availability period unless the flightcrew member is given at least 14 hours rest. <u>This provision may be used only once in a rolling 168 hour period.</u>**

Rationale: The need for this provision is best illustrated by real world examples. A pilot is scheduled and adjusts his rest schedule for a series of RAPs beginning at 0400. If the operator contacts the pilot at 0600 (after the morning bank of departures) and releases the pilot for a 14 hour rest period, the pilot could then begin a RAP at 2000 to cover the late evening bank of departures. The pilot could then be contacted at 2200 and released for another 14 hour rest period. This cycle could continue for an indefinite period. Our proposal aligns this section with the provision for shifting of a RAP in section (e). Without this provision there is essentially no difference between a short-call and long-call reserve removing all circadian protection afforded by having a RAP system in the first place.

117.25 Rest

The following changes are proposed:

(d)(1) (*added*) An unacclimated flight crewmember shall be given at least 12 consecutive hours of rest beginning upon arrival at the rest facility before beginning a RAP or flight duty period.

(f) (*added*) No certificate holder may schedule and no flightcrew member may accept an assignment for reserve or a flight duty period after completion of any duty period(s) (flight or reserve) in a new theater unless the flightcrew member is given a rest period upon return to the flightcrew members home base location in accordance with Table F.

(f)(1)(*added*) The recovery rest in Table F satisfies the requirements for acclimation and the flight crewmember would then enter Table (B) without a penalty.

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 local night's recovery rest should be provided on return to base, except when the returning flight duty period encroaches the WOCL, then an additional local nights rest will be added.

Rationale: A flight from the U.S. to Europe or Asia disrupts the circadian cycle and a rest of 9 hours is not sufficient to achieve an appropriate level of alertness. However, when flight crewmembers fly to a new theater they should be given at least 12 hours at a suitable accommodation between all duty periods until they become acclimated to the new theater in accordance with 117.25 or return to home base.

Where crew members are not acclimated, upon return to home base, a recovery period should be provided that ensures a crew member's body clock has recovered to home base local time before the start of the next duty. The time necessary to ensure complete recovery of the circadian rhythm varies as a function of the elapsed time away from home base and the maximum time difference from home base. Table F can be used to determine the number of local nights required to readapt within an hour of home base.

We also believe that there should be recovery rest for time away from home when operating flights in a different theater that is less than 168 hours away from home base. The current regulations provide for recovery rest in international operations for operations less than a 168 consecutive hours period. See 121.483, 485; 121.523, 525

We believe that this recovery rest is necessary to address cumulative fatigue, to provide circadian restabilization and to repay accumulated sleep debt. We therefore propose the recovery rest chart (Table F) be incorporated into the final rule.

117.27 Consecutive Nighttime Operations

We propose the following amendment:

> No certificate holder may schedule and no flight crew member may accept more than three consecutive nighttime flight duty periods unless the certificate holder provides an opportunity to rest during the flight duty period in accordance with § 117.17.
>
> **A fourth consecutive nighttime flight duty period may be assigned if the flight crewmember receives a minimum of 12 hours rest following each nighttime flight duty period.**

Rationale: Operational experience has shown over a period of years that overnight cargo airlines can assign up to four consecutive nighttime duty periods providing that flight crewmembers are given adequate rest between each consecutive duty period. If a crewmember is given a 12 consecutive hour rest break after each duty period, that will provide for an 8 hour rest opportunity and the cumulative sleep debt incurred will not be so excessive as to prevent a 4th consecutive nighttime FDP.

TAB 13

BEFORE THE
DEPARTMENT OF TRANSPORTATION
FEDERAL AVIATION ADMINISTRATION
WASHINGTON, D.C.

In the matter of	)	
	)	
14 CFR Parts 117 and 121	**)**	
Flightcrew Member Duty and	**)**	Docket FAA-2009-1093
Rest Requirements:	**)**	
Proposed Rule	**)**	
	)	
Notice of Proposed Rulemaking	)	
	)	

COMMENTS OF KALITTA AIR, L.L.C.
ON NOTICE OF PROPOSED RULEMAKING
COMMENTS TO THE DOCKET

Communications with respect to this document should be addressed to:

Captain Norm Gage
Kalitta Air, L.L.C.
818 Willow Run Airport
Ypsilanti, MI 48198

November 14, 2010

BEFORE THE
DEPARTMENT OF TRANSPORTATION
FEDERAL AVIATION ADMINISTRATION
WASHINGTON, D.C.

In the matter of **14 CFR Parts 117 and 121 Flightcrew Member Duty and Rest Requirements: Proposed Rule** Notice of Proposed Rulemaking	)	Docket FAA-2009-1093

COMMENTS OF KALITTA AIR, L.L.C.
ON NOTICE OF PROPOSED RULEMAKING
FLIGHTCREW MEMBER DUTY and REST REQUIREMENTS

Kalitta Air welcomes the opportunity to provide the following information in response to the FAA's Notice of Proposed Rulemaking (NPRM) concerning flightcrew member duty and rest requirements.

Kalitta Air, LLC ("Kalitta") is a certificated 14 CFR Part 121 Air Carrier based in Ypsilanti, Michigan and engaged in on demand cargo operations worldwide. Kalitta currently operates 20 Boeing 747 aircraft and has approximately 1,200 employees including approximately 300 Flightdeck Crewmembers. As defined by the Small Business Administration, Kalitta Air is considered a small operator with less than 1,500 employees.

This NPRM proposes to eliminate approximately 100 regulations currently contained in 14 CFR Part 121 Subparts Q, R, and S, most of which have been in place for decades, and replace them with the rules contained in the proposed 14 CFR Part 117. (FR Vol. 75, No. 177 55889)

This constitutes one of the largest, if not the largest, proposed regulatory change in the history of the FAA. Regulatory requirements mandate the FAA provide a period of time for public comment on any Notice of Proposed Rulemaking. Typically the comment period is 90 to 120 days. For example:

On October 12, 2010, the FAA published an NPRM titled; "Air Ambulance and Commercial Helicopter Operations, Part 91 Helicopter Operations, and Part 135 Aircraft Operations; Safety Initiatives and Miscellaneous Amendments; Proposed Rule". The executive summary states, in pertinent part; "*The proposal aims to address safety concerns arising from an increase in air ambulance related fatalities from 2002 to 2008.*" (FR Vol. 75, No. 177 No. 196 62640) The comment period closes on January 10, 2011, a 90 day window.

On December 14, 2004, the FAA published an NPRM titled; "Disqualification for Airman and Medical Certificate Holders Based on Alcohol Violations and Refusals to Submit to Drug or Alcohol Testing". (FR Vol. 69 No. 239 56993) This can easily be identified as a safety issue. The comment period closed on March 14, 2005, a 90 day window.

On September 20, 2000, the FAA published an NPRM titled; "Improved Flammability Standards for Thermal/Acoustic Insulation Materials Used in Transport Category Airplanes". This NPRM states, in pertinent part; "*The FAA is aware of at least six events in which the flammability characteristics of thermal/acoustic insulation material may have been a contributing factor*." (FR Vol. 65 No. 183 56993) The most memorable of the six cited events was Swiss Air flight 111."*On September 2, 1998, an MD–11 airplane experienced a catastrophic accident as the result of an inflight fire. Although the cause of the accident has not been determined, the FAA considers that it is likely that the fire spread on the thermal/acoustic insulation,…*" (FR Vol. 65 No. 183 56994) Subsequent investigation would confirm the fire was caused by faulty wiring. 222 lives were lost that night. The comment period closed January 18, 2005, a 120 day window.

On August 27, 1998, the FAA published an NPRM titled; "Prohibition on the Transportation of Devices Designed as Chemical Oxygen Generators as Cargo in Aircraft". This NPRM states, in pertinent part; "*The National Transportation Safety Board found that one of the probable causes of the May 11, 1996 crash of ValuJet Airlines flight No. 596 was a fire in the airplane's cargo compartment that was initiated and enhanced by the actuation of one or more chemical oxygen generators that were being improperly carried as cargo*." 110 lives were lost in that tragedy. This was certainly a safety issue, yet the comment period closed on October 26, 1998, a 90 day window.

We now come to this NPRM. Erase the decades long held understanding that there is a fundamental difference between scheduled and non-scheduled, passenger and cargo carriers (FR Vol. 75, No. 177 55852), erase approximately 100 tailored regulations (FR Vol. 75, No. 177 55889), concede in the preamble significant financial impact (FR Vol.75 55881), concede an impact to competitiveness in the worldwide market (FR Vol.75 55882), and concede the significant impact on small carriers (less than 1,500 employees as defined by the SBA) (FR Vol. 75, No. 177 55881). Admit in the preamble that the FAA cannot quantify the scope of some of these impacts and dictate a **60 day comment window**.

Over a dozen non-scheduled air carriers requested an extension to this comment period. Most of the requests came from small non-scheduled air carriers, those most affected and with the fewest available resources to digest, evaluate, and quantify the impact this NPRM will have on their ability to survive and compete in the worldwide marketplace. Look at the language in this NPRM regarding "small entity operators".

"The ***FAA believes that this proposed rule would have a significant economic impact on a substantial number of small entities*** *and therefore has performed an initial regulatory flexibility analysis as required by the RFA. The Small Business Administration* ***small entity criterion for small air carrier operators is 1,500 or fewer employees****. The FAA invites comment from affected small entities and others to* ***aid us to make an assessment of these impacts****."* (FR Vol. 75, No. 177 55881 Emphasis added)

"Based on ***small operators*** *who would need to hire more pilots and the resulting pressure on overall wages,* ***there could be a significant economic impact****."* (FR Vol. 75, No. 177 55881 Emphasis added)

*"****Overall the disproportionate impact is likely to weaken small entity operators' competitive situation, but the FAA is unable to provide a measure of how much.****"* (FR Vol. 75, No. 177 55882 Emphasis added)

*"While the preceding discussion points out potential impacts of the proposed rule on the **competitiveness of small entities, the FAA is uncertain about this impact on the level of competition within the U.S. airline industry**."* (FR Vol. 75, No. 177 55882 Emphasis added)

"*Thus, the proposed rule is **likely to have a disproportionate economic impact on small entities***." "***The FAA has very little firm-specific flight crew schedule data** and route structure market data to refine this analysis and **asks commenters to provide information on the impact this proposed rule would have on the continued capacity of small airlines to compete in their current markets***." "***While small entity operators are likely to experience a significant economic impact, changes to crew schedules are difficult to assess***". (FR Vol. 75, No. 177 55882 Emphasis added)

*"Even if there is a **disproportionate impact and a loss in competitive positioning** does not mean a firm would have to close because of this proposed rule. **While small entity operators are likely to experience a significant economic impact, changes to crew schedules are difficult to assess.**"* (FR Vol. 75, No. 177 55882 Emphasis added)

With all that said, the FAA denies the request to extend the **60 day** comment period in this NPRM to allow air carries the opportunity to fully evaluate the impact of this NPRM. This constitutes the most blatant headlong rush to implement a severely flawed, both in concept and content, series of regulations the FAA has ever proposed. I was surprised by the FAA's denial of the requests to extend the comment period considering FAA Administrator Babbitt's comments in a speech to ALPA in August 2009 when he said; "*Well, rulemaking is a deliberative process, and it's slow by design. **The last thing we want is a knee-jerk rule that doesn't answer the mail***. (Emphasis added)

Well, Mr. Administrator, it appears we got the last thing we wanted.

Kalitta is a major supplier of air transportation to the United States Government in connection with its activities worldwide, including Afghanistan and Iraq.

Some members of Congress became concerned about the impact this sweeping revamp of the current regulations would have on non-scheduled supplemental carriers which supply a significant portion of the military's airlift capabilities.

A letter dated January 22, 2010 to Secretary LaHood by Representatives Westmoreland, Coble, Kline, Manzullo, and Sullivan communicated their concerns. That letter says, in part; "*In addition, nonscheduled operators provide vital air mobility for national security, providing critical air transportation of military personnel and cargo.*" The letter goes on to say, "*The vast majority of these CRAF missions are performed by nonscheduled passenger and cargo airlines. In so doing, they must at all times meet their DOT and FAA regulations and operating specifications.*" Lastly the congressmen pointed out, "*If the Department were to propose rules that required all commercial air carriers to meet the same flight and duty limitations, **these very critical missions could not be carried out in a timely and responsive manner**. It is important that the Department consider these types of operations and provide real and meaningful rules that provide a similar level of safety within the Part 121 community. Such rules should also provide realistic scheduling opportunities for these nonscheduled carriers performing the critical missions described above.*" (2009-1093-0016 Emphasis added)

In another letter to Secretary LaHood dated February 16, 2010 from Senators Coburn and Inhoef, the Senators stated, in part; "*we are concerned that **in its haste** to implement regulations that appear to address safety concerns, **the FAA may inadvertently and unnecessarily put certain carriers out of business** and, consequently, weaken future humanitarian efforts across the world.*" (Emphasis added) The Senator's letter goes on to say; "***Non-scheduled carriers play a pivotal role in providing humanitarian relief and military logistical support** because they have the flexibility to respond to crises and other emergencies immediately. Under current regulations, 14 CFR 121, Subpart S, **the FAA already differentiates between different types of carriers. This arrangement has provided non-scheduled air carriers with the ability to provide commercial service without any safety compromises."*** (2009-1093-0014 Emphasis added)

In his letter of May 12, 2010, FAA Administrator Babbit to the Honorable Lynn A. Westmoreland and the cosigners of the congressional letter; Administrator Babbit states; "*You were concerned about how these proposed changes will affect humanitarian and military transportation. **Current regulations address these issues and are not the subject of this rulemaking."*** (2009-1093-0015 Emphasis added) In point of fact, 14 CFR Part 121, Subpart S, will be removed from the code of federal regulations and the one size fits all language of 14 CFR Part 117 will severely limit all air carriers ability to provide critical logistical support to the military. Perhaps Administrator Babbit is referring to the language contained in proposed **14 CFR §117.31 Operations into unsafe areas**. The problem is the ambiguity present throughout the NPRM. “Unsafe Area” is an undefined term, no guidance exists as to what criteria will be considered in the determination of unsafe areas and no guidance exists as to who can designate an area unsafe. Will it be the FAA, the carrier, the military, the Congress or some other entity?

The matter of military support was further confused with the posting to the docket of 2009-1093-365, Response to Clarifying Questions. In response to a request to clarify the term “unsafe area” used in § 117.31, the FAA responded on page 24; “*As to operations into safe areas in support of the U.S. military, the FAA does not anticipate a certificate holder being able to invoke the proposed exception.*”

In support of U.S. worldwide humanitarian efforts, Kalitta recently airlifted 90 tons of relief and medical supplies to North Korea. Kalitta also operated flights in support of earthquake relief in Haiti and airlifted outsize cargo to the Gulf in response to the recent oil spill.

These flights epitomize the nature of non-scheduled supplemental operations. It is not uncommon for flights of this nature to be airborne within 24 to 36 hours of notification, and sometimes with even less notice. It is exactly this kind of response to previously unknown flying that is not considered in the NPRM.

With this NPRM, the FAA attempts to justify its intention to combine scheduled and non-scheduled, cargo and passenger air carriers into a single regulated entity by stating the differences have become blurred. Reference FR Vol. 75, No. 177 55857; “*The FAA recognizes there are different business models and needs that are partly responsible for the differences in the current regulations. It is sympathetic to concerns raised within the ARC by cargo carriers and* ***carriers engaged in supplemental operations that new regulations will disproportionately impact their business*** *models. However,* ***the FAA also notes that the historical distinction between the types of operators has become blurred. Cargo carriers conduct the vast majority of their operations at night, but passenger carriers also offer ‘‘red eyes’’ on a daily basis****. Some carriers operate under domestic, flag or supplemental authority, depending on the nature of the specific operation. Additionally, in some instances, the FAA has authorized a carrier to* *conduct supplemental operations under the flag rules.*" (FR Vol. 75, No. 177 55857 Emphasis added)

While we concede both passenger and cargo flights operate during daytime and nighttime, we fail to see this as significant in the matter of blurring the distinction between passenger and cargo operations. Perhaps if the FAA would look in the back of the airplane and see that one is full of boxes and the other is full of people, the distinction would become less "blurred".

It is Kalitta's hope the FAA will recognize 14 CFR Part 117, as proposed, will cause significant economic harm to non-scheduled supplemental operators and their customers. 14 CFR §119.3 defines supplemental operations and states, in pertinent part; "*Operations for which the departure time, departure location, and arrival location are specifically negotiated with the customer or the customer's representative;*"

The term "schedule" as used in the preamble of the NPRM, proposed 14 CFR 117, and the Regulatory Impact Analysis does not have the same meaning when comparing non-scheduled supplemental operations and (scheduled) domestic or (scheduled) flag operations. Currently no definition exists in Part 1, Part 121, or the proposed Part 117 for "schedule" and the meaning differs widely within Part 121. To illustrate, for a scheduled domestic air carrier the schedule, departure, and arrival time, is published in the Official Airline Guide (OAG) and a schedule exceedance can be measured against that "schedule". Since the city pair is serviced may times within a given period, a single exceedance does not skew the data to a great degree and would not trigger the exceedance reports contained in §117.9 In the case of the non-scheduled supplemental operation no such published schedule need exist and the "schedule" becomes the flight plan time for today, generated using today's winds aloft forecasts and routing, which may change from day to day depending on weather, and adjusted for anticipated taxi times. The results of this real time flight planning then become the basis for the construction of the "scheduled" flight duty period (FDP). As for frequency, the customer may need only a single trip or a series of a few trips to satisfy their transportation requirements and therefore, a variance to the flight plan time, which can be caused by weather, ATC delay, etc., will cause the reporting provisions of §117.9 to come into play. Also, as contained in the definition for supplemental cited above, the customer established the "schedule". In the event the customer changes the departure time due to circumstances beyond the carrier's control, late arrival of freight as an example, the “scheduled” FDP, report time, will be affected. The reporting burden will thus become an administrative and financial hardship on the carrier supplying non-scheduled, ad hoc air transportation.

It is abundantly clear no consideration whatsoever was given to the non-scheduled supplemental operator. In the FAA document titled “Response to Clarifying Questions”, (2009-1093-365 10), the FAA offers the following example when clarifying §117.13 Flight Time Limitations; “*For example, if the certificate holder is required to designate an alternate airport, it should assume that there is a chance the flight will have to be diverted to that airport.*” Perhaps the drafter of this clarification isn’t aware of the requirement in 14 CFR § 121.623 Alternate airport for destination: IFR or over-the-top: Supplemental operations, which states in pertinent part; “(*a) Except as provided in paragraph (b) of this section, each person releasing an aircraft for operation under IFR or over-the-top* ***shall list at least one alternate airport for each destination airport in the flight release****.* (Emphasis added) This clarification indicates the FAA intends for the air carrier to include not only the flight time to destination in the FDP calculation, but the time to the alternate as well. As the forecast for the destination airport is required to be at or above the required minimums at the estimated time of arrival, continuing to the alternate has always been considered “unforecast weather”, a condition included in the examples for “Unforeseen operational circumstance”. 14 CFR § 117.3 states; *“Unforeseen operational circumstance means an unplanned event beyond the control of a certificate holder of insufficient duration to allow for adjustments to schedules,* ***including unforecast weather****, equipment malfunction, or air traffic delay.”* (FR Vol. 75, No. 177 55885 Emphasis added)

During calendar year 2009, Kalitta operated 4206 segments (ref DOT landing reports for 2009). The incidence of proceeding to the alternate airport due to unforecast weather was less than 1 %. Assuming an average flight plan time to alternate plus approach, landing and taxi in of 42 minutes, this would amount to 2944 lost hours. These lost hours pose a potential $17,488,000.00 revenue loss to Kalitta. The time associated with these unflown segments will manifest itself in the cumulative flight duty period limits included in § 117.23.

Kalitta is opposed to any flight time limits being inserted into flight duty periods, but this “clarification” hinting at including time to the alternate pushes the FAA’s proposal into the realm of the absurd.

This is another example of why "one size fits all" isn't a viable option as is proposed in this NPRM. The FAA now proposes to remove nearly 100 regulations specifically designed to fit the operational requirements of scheduled domestic, scheduled flag, and non-scheduled supplemental carriers and replace them with the "one size fits all" regulations contained in this NPRM. This represents a major change in position for FAA Administrator Babbitt who, in a speech to ALPA in August 2009, stated; "***In rulemaking, not only does one size not fit all, but it's unsafe to think that it can.***" (Emphasis added).

The FAA has long recognized that tailored regulations are required to provide a sound basis for safety while acknowledging the unique nature of the non-scheduled air carrier. To now impose the same rules on scheduled and non-scheduled carriers is not only unfair but, to quote Administrator Babbitt; "***it's unsafe to think that it can.***" (Emphasis added).

The FAA crossed the line into areas that rightfully belong in the collective bargaining arena. "*Deadheading to and from ground training would not be considered part of an FDP, although deadheading to simulator or flight training device training would be part of an FDP if it immediately preceded the training.*" (2009-1093-365 3) How does the FAA justify its attempted regulation of travel before simulator or flight training device training? Does the FAA hold the position that public safety is jeopardized in a flight simulator? There is no doubt any training, including simulator training, flight training device training, and groundschool, that immediately precedes duty performed for the carrier involving flight in an aircraft should be included in an FDP and certainly falls within the purview of the FAA to regulate, but to carve out simulator and flight training devices for inclusion into this NPRM is fundamentally wrong. Training not immediately preceding a flight assignment is a matter for the carrier and the pilots to negotiate.

This NPRM has all the earmarks of a bureaucratic mugging of the non-scheduled supplemental carrier. Is it ignorance, indifference, or inattention to the non-scheduled supplemental operator's role within the air transportation system or is the FAA intentionally trying to force the non-scheduled small carrier out of business?

Kalitta's Answers to NPRM Questions

Flight Duty Period

1. **Please comment on adopting maximum FDPs. Should the maximum FDP vary based on the time of day? Should it vary based on the number of scheduled flight segments? Should the proposed limits be modified up or down, and to what degree? Please provide supporting data.**

   a. **Should the Maximum FDP vary based on the time of day?**

Yes. However, the FAA proposal is clearly designed around domestic scheduled service operations; gives no consideration to non-scheduled cargo and passenger (henceforth non-scheduled) operations; is much more complex than necessary; presents no science to support the specific numbers; appears to include industrial concerns undesirable in prescriptive regulations; and the Table A and Table B time-of-day windows are not synchronized. This strongly suggests random FAA selection of flight time limits and/or FDPs based upon CAP371, EU proposals, and non-consensus positions offered in the ARC. Kalitta offers a much simpler FDP and rest format to mitigate fatigue in the responses to specific Part 117 sections below. To the extent the FAA continues to insist upon a one-size-fits-all approach, Kalitta recommends that the FAA consider the needs of non-scheduled operations by adopting the Kalitta Proposal set forth in Kalitta's Comments to the NPRM. To pattern the U.S. Federal aviation Regulations after the CAP371 and EU OPS subpart Q prescriptions to European leadership is to cede worldwide commercial competition to European airlines with no assurance of fatigue mitigation or increased safety.

   b. **Should it vary based on the number of scheduled flight segments?**

Yes. However, Kalitta does not agree with the FAA' proposed flight duty periods ("FDPs"). Kalitta's proposed FDPs, as set forth in its comments pertaining to Part 117.15, recognize all of the common fatigue issues. Kalitta's Proposal offers fatigue mitigation based upon number of segments, with similar FDPs of 14 hrs for segments 1 thru 4 complete with mitigation for WOCL with a 2-hour reduction where the FDP encounters the WOCL at any point. Kalitta further recommends that FDPs for each segment from 5 – 7 (maximum segments) should be reduced 1 hour each resulting in a maximum FDP of 14 hours for segments 1 thru 4; 13 hours for 5 segments; 12 hours for 6 segments; and 11 hours for a maximum of 7-segments that do not encounter the WOCL.

   c. **Should the proposed limits be modified up or down, and to what degree?**

Yes. As stated above and in Kalitta's responses to section 117.15, the maximum FDP should be increased to 14 hours for up to 4 segments. FDPs for additional segments (5+) are reduced one hour for each added segment operated, as noted in 1.b. above and the Kalitta Table B. Unaugmented FDPs are further de-rated where the FDP encounters the

WOCL. That provides a minimum of 10 - 12 hours off duty, depending on FDP operating hours, to assure a minimum 9-hours rest period in suitable accommodations.
.

d. Please provide supporting data.

Dr. Hursh states that "there is no magic number to describe what is safe and what is not." Kalitta's Proposal recognizes and mitigates all of the common fatigue issues, including a simple formula that requires a 2-hour decrease of the applicable FDP if the scheduled FDP encounters the WOCL for even one minute, and continues to decrease the applicable FDP by one hour for each segment greater than four mission segments. Kalitta also specifies a scheduled 10-hour period free of duty between FDPs and schedules an opportunity for 9 hours of rest at a facility with suitable accommodations.

2. Please comment on permitting flightcrew members and carriers to operate beyond scheduled FDP. Is the proposed 2-hour extension appropriate? Is the restriction on a single occurrence beyond 30 minutes in a 168-hour period appropriate? Should a flightcrew member be restricted to a single occurrence regardless of the length of the extension? Please provide supporting data.

a. Please comment on permitting flightcrew members and carriers to operate beyond a scheduled FDP.

Kalitta agrees with this concept. However, Kalitta cannot agree with "scheduled FDP" without further discussion and agreement. The extension in discussion is an extension occurring after a FDP actually begins and is an operation beyond the maximum FDP limit for the time of actual start, the number of segments actually flown, and the crew combination, as shown in sections 117.15 and 117.19 and at Tables B and C in the NPRM. Kalitta does not agree with the Proposed Rule's limit on the total extensions greater than 30 minutes to one in a 168-hour look-back period.

b. Is the proposed 2-hour extension appropriate?

Yes. However, Kalitta proposes a 2-hour extension for both augmented and unaugmented FDPs.

c. Is the restriction on a single occurrence beyond 30 minutes in a 168-hour period appropriate?

No. This concept appears to address industrial concerns and only works in domestic scheduled operations, at best, where the certificate holder has crews on reserve for use in lieu of extensions. There must be provisions for more extensions per 168-hour period for each particular crew pairing in non-scheduled operation. As clarified in the definition at 14 CFR § 119.3, "supplemental operations" ("non-scheduled" herein) are "[o]perations for which the departure time, departure location and arrival location are specifically negotiated with the customer . . . ." While the certificate holder and the customer will agree on the departure time in advanced scheduling, customers are often not reliable in making passengers and/or cargo available for loading at the negotiated time, and the amount of time between contract and operations can be as little as hours, not days. Thus, a single crew operating more than one FDP together or in different crew pairings often experience more than one extension per 168-hour period. This can be mitigated with added rest before the second and/or subsequent extensions, and the provision of maximum FDP limits and a 30-hour period free of all duty in that same 168-hour period provided for fatigue mitigation. Furthermore, the provision for more than one extension cannot be left to individual FRMS programs, or there will be nearly 100 FDP and rest programs. This issue must be resolved in changes to the FAA language of this proposal, as specified in Kalitta's Comments and its comments on specific part 117.

d. Should a flightcrew member be restricted to a single occurrence regardless of the length of the extension?

No. See Kalitta's responses above and its comments on specific Part 117.

e. Please provide supporting data.

Drs. Belenky and Hursh stated that consecutive extensions should not be allowed; however, there should be the ability to perform more than one extension in a 168-hour period if restorative rest is provided. CAP371 permits extensions without limits in the 168-hour look-back period. Kalitta's Proposal provides restorative rest after each FDP extended beyond scheduling limits in its proposed tables at section 117.15 and 117.19.

3. Please comment on the proposed schedule reliability reporting requirements. Should carriers be required to report on crew pairings that exceed the scheduled FDP, but not the maximum FDP listed in the FDP table?

a. Please comment on the proposed schedule reliability reporting requirements.

The Proposed Rule, as written, does not consider non-scheduled operations and, more specifically, appears to assume scheduled operations with established stations and regular routes, as described in 14 C.F.R. Subpart E. In non-scheduled operations, the customer determines the departure airport and time, as well as the destination airport. Non-scheduled operations consist of low-frequency, *ad hoc* or one-off commercial opportunities. There are no established stations and routes. They operate under the provisions of 14 C.F.R. Subpart S. Non-scheduled operations only infrequently operate on the initial schedule agreed-upon by the certificate holder and the customer. The proposed section 117.9 must be rewritten as shown in Kalitta's specific comments on that section. A quarterly report consisting of actual changes to schedules that require re-setting crew rest within 24 hours of departure and FDP extensions required to accommodate actual mission accomplishment will best describe interruptions to "schedule reliability" for both scheduled and non-scheduled operations.

b. Should carriers be required to report on crew pairings that exceed the scheduled FDP, but not the maximum FDP listed in the FDP table?

No. Every scheduled or non-scheduled operation must be permitted to operate up to the maximum FDP established for time-of-day and number of segments. Quarterly reports of actual maximum FDPs exceeded are all that should be required.

4. **Should carriers be required to report on more parameters, such as cumulative duty hours or daily flight time? If so, why?**

No. Kalitta recommends that any FDP that is exceeded be reported in the quarterly report suggested above. The stated purpose of the reliability reports is to insure carriers do not overuse the extension process. As noted, what is scheduled a month in advance has nothing to do with fatigue. Reporting crew pairings that exceed the scheduled FDP, but not the maximum FDP, prevents overuse of the extension process, which would possibly increase fatigue. Reports on operations within limits are unnecessary.

5. **What should be the interval between reporting requirements?**

Quarterly.

6. **How long after discovering a problematic crew pairing should the carrier be afforded to correct the scheduling problem?**

Quarterly reports are all that is necessary in non-scheduled operations.

<u>Acclimating to a New Time Zone</u>

7. **Is a 3-day adjustment to a new theater of operations sufficient for an individual to acclimate to the new theater?**

Kalitta does not agree with a 3-day adjustment. Kalitta believes a 30-hour break is sufficient.

8. **Is a 36-hour break from duty sufficient for an individual to acclimate to a new theater?**

Yes. It is more than sufficient. It should be 30 hours.

9. **Should flightcrew members be given a longer rest period when return to home base than would otherwise be provided based on moving to a new theater?**

No. This appears to be an industrial issue, not a safety issue. According to Dr. Demitry, hotel rest is not as restful as home rest. If this is the case, why would additional rest be needed when returning home? The definition of “acclimated” in proposed section 117.3 states that “36 hours free from duty” provides acclimatization regardless of the number of time zones changed. Kalitta recommends 30 hours. The same must apply to coming back to home base. Additional breaks in duty may be negotiated by individuals in the bid process or through management labor agreements.

10. Should the FAA have different requirements for flightcrew members who have been away from their home base for more than 168 hours? If so, why?

No. Only the science of fatigue should guide the FAA in the Proposed Rule. Again, that is not a regulatory requirement based upon science. It is an industrial consideration for management and labor to determine.

11. Should the FAA require additional rest opportunities for multiple pairings between two time zones that have approximately 24-hour layovers at each destination? What if the scheduled FDPs are well within the maxima in the applicable FDP table or augmentation table?

a. Should the FAA require additional rest opportunities for multiple pairings between two time zones that have approximately 24-hour layovers at each destination?

No. The only question should be "is the crewmember acclimated." If not, the applicable FDP limit should be decreased by 2 hours, as recommended in Kalitta's Proposal.

b. What if the scheduled FDPs are well within the maxima in the applicable FDP table or augmentation table?

No. This issue is already covered by decreasing the applicable FDP limit for flightcrew members who are not acclimated.

Daily Flight Time Restrictions

12. If the FAA adopts variable FDP limits, is there a continued need for daily flight time limits?

No. Kalitta is adamantly opposed to the inclusion of flight time limits in the Proposed Rule. Kalitta fully agrees with fatigue mitigated scheduling based upon reasonable FDPs and the provision of prescriptive fatigue mitigating rest. Restrictions on FDPs, which include ground time for pre- and post-flight duties and the turn times involved with multiple mission segments, provide reasonable limits to actual flight time. Dr. Hursh stated that "duty time, and not flight time, is what limits pilots' opportunity to sleep," and Dr. Belenky noted that "duty time limitations are a stronger predictor of sleep and rest opportunities than flight time limitations." Additionally, neither CAP 371 nor EASA Subpart Q contains daily flight limits. Adding another layer of limitations will not provide additional safety. It will merely have the unintended consequence of preventing pilots from flying as much and thereby reducing productivity, international competitive posture, their pay and their proficiency.

13. If the FAA retains daily flight limits, should they be higher or lower than proposed?

Kalitta is adamantly opposed to the inclusion of flight time limits in the Proposed Rule. As stated above, FDP limits combined with fatigue mitigating rest is the scientific prescription. Should the FAA insist on flight time restrictions, the only reasonable limitation would be established FDP minus one hour.

14. Should modifications be made to the proposed flight time limits to recognize the relationship between realistic flight time limits and the number of flight segments in an FDP?

No. There is no justification for flight time restrictions in light of scientifically established FDP limits.

<u>**Mitigation Strategies**</u>

(1) Augmentation

15. Should augmentation be allowed for FDPs that consist of more than three flight segments? Does it matter if each segment provides an opportunity for some rest?

a. Should augmentation be allowed for FDPs that consist of more than three flight segments?

Yes. While Kalitta supports the three flight segment limit based upon its recommended FDP limits, that limit does not appear to be a science-based proposal. Furthermore, while not part of this specific question, Kalitta does not agree that no on-board rest credit should be given for less than five hours of flight. Many scientists have proven that a 45-minute nap is extremely useful in fatigue mitigation. Thereafter, 90-minute cycles have a scientific basis.

This particular question appears to be based upon scheduled operations, in which missions cross airports with crew change opportunities not less than every three mission segments. That is not the case for non-scheduled operations.

b. Does it matter if each segment provides an opportunity for some rest?

No. What matters is that the rest opportunity in flight, on the ground during split duty, and in required rest periods provide fatigue mitigation. In non-scheduled operations, it is extremely important that short last segments be permitted to complete a multiple segment operation and/or to reposition the crew and aircraft.

16. Should flight time be limited to 16 hours maximum within an FDP, regardless of the number of flightcrew members aboard the aircraft, unless a carrier has an approved FRMS?

No, as noted above, flight time should not be limited. The pre- and post-flight duties and the flow of operations over more than one segment will limit flight time within any reasonable FDP.

17. Should some level of credit be given for in-flight rest in a coach seat? If so, what level of credit should be allowed? Please provide supporting data.

a. Should some level of credit be given for in-flight rest in a coach seat?

Yes. A coach seat should be included in the definition of a Class 3 rest facility. The combination of time off task, ability to exercise, and the opportunity to nap mitigates fatigue, and use of a coach seat is entirely appropriate in prescriptive regulations. The TNO study admitted that it gave no credit to a coach seat only because no scientific studies existed to support any position, and it assumed that any sleep obtained would be minimal. That assumption has been refuted by other scientists. Furthermore, the FAA places too much emphasis on that study. On the other hand, Dr. Hursh states that his models value "sleep in a coach seat at approximately 50 percent of the value of normal sleep." As is well known, the benefits of napping in the cockpit have also been deemed dramatic in fatigue mitigation by the NASA study presented in the ARC. NASA stated that a 40 minute cockpit nap, including in a jump seat, with a 20 minute recovery resulted in increased alertness for a minimum of 90 minutes. The Proposed Rule should not ignore the existing science and give zero value for a coach seat. Kalitta strongly recommends that FAA accept Dr. Hursh's position and grant 50% credit for rest in a coach seat for a 4-pilot crew. For a 3-pilot crew, FAA must grant at least a 30% credit for rest in a coach seat or napping in the cockpit for non-scheduled operations. This should not be left to an individual carrier's FRMS. However, additional mitigations should be encouraged in individual carrier's FRMS. In addition to the in-flight rest opportunity, Kalitta recommends that, where this coach seat rest is required, the post-mission rest period be extended to a minimum of 12 hours.

b. If so, what level of credit should be allowed?

As explained above, 50% credit should be given to rest in a coach seat. As a minimum, grant 50% for a 4-pilot crew and up to 30% credit for one pilot augmentation (3-pilot crew) over the appropriate FDP limits.

c. Please provide supporting data.

See the scientific references in response to question 16.a. above. Furthermore, more than 50 years of current, safe operations prove this concept is safe. After all, all scientific theories must be put to extensive testing. Millions of flights are the proof.

18. Is there any reason to prohibit augmentation on domestic flights assuming the flight meets the required in-flight rest periods proposed today?

No. The FAA offers no scientific basis for limiting augmentation to international operations. Any such claim would seem to be based upon the argument "why augment when you can put a fresh crew on board at the next scheduled station?" The Proposed Rule must also accommodate non-scheduled operations worldwide. Proper augmentation, limits on FDP and appropriate rest periods will mitigate fatigue.

19. Are the proposed required rest periods appropriate?

In the context of the other questions in this area, Kalitta assumes this question pertains to the proposed in-flight rest periods allowed for various in-flight rest facilities or seats. Kalitta is opposed to the FAA's proposed structure. As noted in response to question 15 above, credit must be given for less than 5-hour mission segments and more credit must be provided for the various rest seat configurations.

If this question pertains to the 9 hours in a suitable accommodation for "rest period" between FDPs, Kalitta agrees that is a minimum. In fact, Kalitta proposes added rest in some circumstances.

20. Should credit be allowed if a flightcrew member is not type-rated and qualified as a PIC or SIC?

Yes. In particular, Kalitta supports providing credit for the Flight Engineer as a third safety team member on three-position aircraft. Decades of operations with two pilots and one flight engineer have proven that the crewmember not qualified to land the aircraft adds significant added safety, in general, and also provides an added safety monitor to permit one pilot to have time off task, time out of the seat at cruise for exercise, and other fatigue mitigation. Furthermore, these crew pairings are now almost exclusively used in international operations on missions of three segments maximum. Thus, where a tech stop is made, there is added fatigue mitigation opportunity on the ground, as noted in split duty circumstances below.

(2) Split Duty Rest

21. Please comment on whether a single occupancy rest facility provides a better opportunity for sleep or a better quality of rest than a multiple occupancy facility such as a multi-bed crew sleeping facility or multi-bed living quarters. Please provide supporting data.

Kalitta assumes this question addresses an actual sleep opportunity in a ground-based facility at a technical stop and as a "split duty" rest. Kalitta does not agree that a single occupancy rest facility is required to mitigate fatigue in split duty rest on the ground during a single FDP, and we do not agree with the 4-hour minimum requirement set forth in proposed section117.17. The requirements for this facility should be the best available, and the credit should not be less than the concepts of a Class 1, Class 2, and Class 3 rest facility. This fatigue-mitigating, restorative rest opportunity must be maximized for single and/or augmented crews and in the best available rest facility. In fact, this 4-hour limitation defies the FAA's statement in the preamble of the NPRM that, over time, 4 hours of split sleep may result in cumulative fatigue. Furthermore, the science shows that the split sleep can be restorative at much smaller periods and not interfere with the next major sleep opportunity during the post-FDP required rest period. As stated above, science has repeatedly shown that restorative rest is gained in as little as 45 minutes off task when it includes an ideal nap of approximately 20 – 30 minutes. The FAA must use available science in arriving at the Proposed Rule. Because science shows that a 45 minute rest provides that restorative rest, the only question is how much credit to award. The answer is the same credit as a Class 1 rest facility. Kalitta believes that 90 minutes of ground time provides sufficient time to safely provide 45 minutes for crew members at a rest facility, including a 20 – 30-minute nap, and to safely have the crew arrive back in the aircraft 30 minutes prior to departure.

Where the discussion pertains to a "rest period" as defined in proposed section 117.3 and as prescribed in proposed section117.21, Kalitta agrees a single occupancy rest facility provides a better opportunity for sleep than does a multiple occupancy facility. Kalitta also agrees that adequate rest sleep is the principle means of fatigue mitigation. For that reason, for rest periods prior to and subsequent to flight duty periods away from home station, Kalitta's members provide single occupancy rest facilities for flight crewmembers.

Consecutive Nighttime Flight Duty Periods

22. Should there be any restriction on consecutive nighttime operations? If not, why?

There should be no restriction on consecutive nighttime operations. This appears to be an industrial issue, not a science-based prescription for fatigue mitigation. Alaska and other northern hemisphere home bases and destinations are immersed in darkness for most of the late fall and winter months. So, which nighttime is in discussion? Kalitta's Proposal appropriately accounts for nighttime operations by limiting FDPs for flying that encounters the WOCL, further decreasing applicable FDP limits for number of segments, further decreasing applicable FDP limits for non-acclimated crewmembers, and applying the 168-hour look-back provision limiting total FDP. In the ARC, scientists noted that the repeated infringement of duty time on the opportunity to sleep results in accumulated sleep debt and that the operative factor in recovery from cumulative fatigue is sleep. In the short term, it does not matter if the sleep is during the daytime. As long as the crew member is given sufficient opportunity to sleep, there should not be any limit on consecutive night operations.

23. If the nighttime sleep opportunity is less than that contemplated under the split duty provisions of this notice, should a carrier be allowed to assign crew pairing sets in excess of three consecutive nights? Why or why not?

Yes, the carrier must be allowed to assign crew pairing sets in excess of three consecutive nights. This may be an industrial issue. Experienced pilots have stated that the most difficult crew pairing in a 5-consecutive night pairing is the first night.

24. If the nighttime sleep opportunity meets the split duty provisions of this notice, should the carrier be allowed to extend the flight duty period as well as the number of consecutive nighttime flight duty periods? Why or why not?

Yes. See the responses to questions 22 and 23 above.

25. Should a fourth night of consecutive nighttime duty be permitted if the flightcrew member is provided a 14-hour rest period between nights three and four?

Yes, it should be permitted. Kalitta agrees with the suggested 14-hour rest period as one mitigation, but that is not the only fatigue mitigation option. See the responses to questions 22, 23, and 24 above. A fourth consecutive night of operations should be allowed as long as normal minimum rest requirements are met (9 hours in a suitable accommodation once each 24 hours plus any available nap opportunity). No additional rest should be required.

<u>Reserve Duty</u>

26. Please comment on whether a 16 maximum hour FDP for long call reserve is appropriate when the maximum FDP for a line holding flightcrew member is 13 hours.

Kalitta sees no connection between long call reserve and the FDP for a line-holding flightcrew member. The preamble and the definitions of "duty" and "long call reserve" in the NPRM make clear that long call reserve is not duty. Thus, it cannot be compared to FDPs, which are included in duty. While long call reserve can be assigned at home, home base or at en route stations, the phrase "16 hour FDP for long call reserve" in this question appears to be misplaced, at best.

27. Please comment on whether the proposed maximum extended FDP of 22 hours for an augmented flightcrew member is appropriate. If not, please provide an alternative maximum FDP.

Yes, Kalitta agrees that the FDP should be extended to 22 hours for the combination of short-call reserve and FDP with an augmented crew. As noted in the NPRM, there will be on-board rest, and in this case of 22 hours, there must be a Class 1 rest facility.

28. Please comment on whether a certificate holder should receive credit for not calling a flightcrew member during the WOCL while on reserve.

Yes. It can be reasonably assumed that the flight crewmember on reserve is sleeping during the WOCL or that his/her sleep reservoir is full. Thus, credit for sleep during the WOCL is supported by science. Kalitta does not agree that there should only be half credit for not calling during the WOCL – full credit should be given.

29. Should minimum required rest while on reserve status be greater than the amount of rest required for a line-holding flightcrew member? If so, please provide supporting data, if not please provide rationale.

No. This very concept is illogical in light of established limits on total FDP. Furthermore, because the crewmember in short call reserve should be conserving energy and mitigating fatigue, Kalitta believes that, where the crewmember is not called out for an FDP, the short call reserve availability cycle should be 16 hours on 8 hours off (i.e., 8 hours rest added to what has already been a fatigue mitigating day). After all, where a second day of short-call reserve is scheduled, the crew member remains in the same theater, in the same rest facility, and 8 hours of sleep is all that science says is required.

30. Please comment on the level of complexity on the proposed reserve system.

The proposed reserve system is highly complex, both in the prescribed limits and in the novelty of any regulated regime for reserve. Furthermore, the proposed reserve system appears to be built specifically for scheduled operations. While U.S. certificate holders and their crewmembers have decades of experience with long and short call reserve and airport standby, it has never been a part of the regulations. Availability of reserve crewmembers is one of the two most significant issues in this proposal for non-scheduled operations. Without significant change, it is a "show-stopper" for world-wide non-scheduled air transportation which must, in most cases, must be operated with augmented crews, or must be operated with only one reserve crew available. See Kalitta's specific comments on proposed section 117.21.

Cumulative Duty Periods

31. The FAA seeks input on the appropriate cumulative limits to place on duty, flight duty periods and flight time. Is there a need for all the proposed limits? Should there be more limits (e.g., biweekly, or quarterly limits)?

Kalitta supports the concept of cumulative limits for 168 hours and 28 days. Combined with a scientifically-constructed FDP based upon number of crewmembers, time of day and number of mission segments, 168-hour and 28-day cumulative limits should suffice to permit a crewmember to either avoid fatigue or to mitigate fatigue. Furthermore, the required FRMP will audit this situation. Thus, Kalitta sees no scientific basis for added cumulative limits. There should be no daily, monthly, annual or any other limits on flight time in light of a regulation limiting duty, FDPs and rest requirements.

32. The FAA also asks for comments on measuring limits on an hourly rather than daily or monthly basis. Does this approach make sense for some time periods but not for others?

See answer to question 31 above.

Rest Requirements

(1) Pre-Flight Duty Period Rest

33. If transportation is not considered part of the mandatory rest period, is there a need for a longer rest period for international flights?

Kalitta recommends a minimum of 10 hours from crew release-to-show time for the next FDP for an acclimated crew and 12 hours crew release-to-show for non-acclimated crews. Any rationale and consideration for longer rest periods internationally must be justified scientifically.

(2) Cumulative Rest Requirements

Kalitta recommends that 30 hours uninterrupted rest be provided to all crewmembers in each 168-hour look back period. That look back is applied at the report time for each FDP.

Fatigue Risk Management Systems

34. Would some elements of an FRMS, such as an incident report system, be better addressed through a voluntary disclosure program than through a regulatory mandate?

Kalitta has strongly supported a FRMS in its ARC comments. The FRMP requires reporting and monitoring of fatigue. Kalitta also does not object to any crewmember or certificate holder entering into a voluntary reporting program with the FAA, NTSB or other authority. A voluntary reporting program, on the other hand, faces the same challenges of other voluntary programs (e.g., ASRS). That challenge is primarily one of retaining non-attribution standards and agreed-upon amnesty for revealing any detail that may have been a regulatory infraction. On the other hand, amnesty cannot always be granted. Thus, Kalitta recommends that the incident reporting system be internal to the certificate holding company, not part of an FAA regulated system. The purpose of the incident reporting system is to add data to the decision making process of fatigue management, modifications of the FRMP, if necessary, but provides the certificate holder with prerogatives where violations of policy or safety occur.

Commuting

The FAA offers no questions on commuting. However, Kalitta believes commuting is a significant issue in fatigue and its mitigation. As carriers develop training programs for FRMP and for this regulation, commuting must be addressed. This will place significant pressure on labor – management relations. However, Kalitta sees no regulatory solution at this time.

Exception for Emergency and Government Sponsored Operations

35. Are there other types of operations that should be excepted from the general requirements of the proposal? If so, what are they, and why do they need to be accommodated absent an FRMS?

Yes. All short notice "emergency operations" (hurricane evacuation, fire fighting, earthquake response, WMD response, prisoner movement, etc.) should be excepted either under proposed section 117.31 or through traditional FAA SFARs granting relief.

Kalitta Air strongly recommends the FAA adopt NACA's Proposal for Non-Scheduled Carriers posted to docket 2009-1093.

The following comments are based on 14 CFR 117 as presented in the NPRM.

Kalitta's comments on the FAA's proposed new 14 C.F.R. Part 117.

PART 117--FLIGHT AND DUTY LIMITATIONS AND REST REQUIREMENTS: FLIGHTCREW MEMBERS

Sec.

117.1 Applicability.

117.3 Definitions.

117.5 Fitness for duty.

117.7 Fatigue risk management system.

117.9 Schedule reliability.

117.11 Fatigue education and training program.

117.13 Flight time limitation.

117.15 Flight duty period: Unaugmented operations.

117.17 Flight duty period: Split duty.

117.19 Flight duty period: Augmented flightcrew.

117.21 Reserve status.

117.23 Cumulative duty limitations.

117.25 Rest period.

117.27 Consecutive nighttime operations.

117.29 Deadhead transportation.

117.31 Operations into unsafe areas.

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.

Sec. 117.1 Applicability.

This part prescribes flight and duty limitations and rest requirements for all flightcrew members and certificate holders conducting operations under part 121 of this chapter. This part also applies to all flightcrew members and part 121 certificate holders when conducting flights ***directed by the certificate holder*** under part 91 of this chapter.

Comment: The FAA's preamble, Federal Register (FR), vol. 75, No. 177, p.55857, makes it clear that this part applies to "all flights conducted by part 121 certificate holders," and the FAA's answers to clarifying questions filed in the docket as Document FAA-2009-1093-0365 highlights this point. However, the docket is rarely available to pilots and certificate holder personnel, and the language in this section does not make clear that the reference to Part 91 flights is to only those flown under the direction of the Part 121 certificate holder (i.e., ferry flights with no commerce on board, maintenance proving flights).

Recommendation: Change the second sentence as shown above or in a similar manner.

Sec. 117.3 Definitions.

In addition to the definitions in Sec. 1.1 and 119.3 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 crewmember has been in a theater for 72 hours or has been given at least 30 consecutive hours free from duty.

Comment: Kalitta believes it is important in regulations controlling both schedules and operations that the extended rest periods be consistent across domestic and international operations. Our proposal includes other mitigations for non-acclimation, including significantly reduced flight duty periods ("FDPs"). Kalitta recommends that the acclimation time be changed to reflect the FAA's proposed 168-hour look-back rest period of 30 hours (see § 117-25.b). Also, as the FAA noted in the preamble of the NPRM (75 Fed. Reg. 55861), while scientists consulted by the Aviation Rulemaking Committee ("ARC") predicted acclimation at approximately one hour per day per time zone, experienced pilots in the session stated it occurred much more rapidly. The ARC's discussion therefore focused on a range of 30-36 hours to acclimate. Kalitta believes that 30 hours is appropriate. Kalitta also notes that any further time to acclimate may preclude crewmembers from returning to their home base as crewmembers, which is especially important in all commercial operations where flight hours are guaranteed.

Recommendation: Make the change to hours as shown and add the recommended clarification as presented above.

Airport/**standby reserve** means a defined duty period during which a crewmember 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.***

Comment: This definition does not adequately distinguish between airport/standby reserve and short-call reserve. While Kalitta does not object to defining airport/standby reserve in this rule, it is unnecessary to do so because it is an assignment within a "flight duty period." In non-scheduled operations, long-call and short-call reserve are often served "in close proximity to an airport of possible assignment." As the FAA has defined them herein, long-call reserve is not "duty"; short-call reserve is duty (*see* Kalitta objection below) but is not part of a flight duty period ("FDP") until the call out; and airport/standby reserve is part of a FDP. In long-call reserve, a full "rest period" must be given at the time of an assignment involving flight. In short-call reserve, the crewmember must be at a "suitable accommodation." In airport/standby reserve, the crewmember is in a FDP with known limits and may or may not be at a suitable accommodation. The rationale for assigning one or the other of these reserves depends upon how soon after notification the certificate holder expects the crewmember to show up at the terminal or aircraft. If the FAA intends to keep this term in the regulation, Kalitta recommends the FAA expand this definition in terms of the response time, as shown above, to distinguish it from short-call reserve. Kalitta does not concur that with FAA's answer to clarifying questions in Document FAA-2009-1093-0365 at page 16 that infers that short-call reserve could not be served in a suitable accommodation within "close proximity" to the airport. *See* Kalitta comments on "Short-call reserve," below.

<u>Recommendation</u>: Rewrite this definition as shown above.

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.

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.

Crew pairing means a flight duty period or series of flight duty periods assigned to a flightcrew member which originate or terminate at the flight crewmember's home base.

Deadhead transportation means transportation of a crewmember as a passenger, by air or surface transportation, as required by a certificate holder, excluding transportation to or from a suitable accommodation.

Duty means any task, other than long-call reserve, that ***<u>is directed by</u>*** the certificate holder, including but not limited to airport/standby reserve, short-call reserve, flight duty, pre- and post-flight duties, training, deadhead transportation, aircraft positioning on the ground, aircraft loading, and aircraft servicing.

<u>Comment</u>: To remove any argument about whether activities of a crewmember are "on behalf of" the certificate holder, Kalitta recommends the sentence construction shown in the changes above. If directed by the certificate holder, clearly it is duty. The changes above also make the inclusion of the vague term "administrative work" unnecessary. "Administrative work" is too vague and inclusive of issues that have nothing to do with direction by the certificate holder or

FDP fatigue mitigation. With the changes above to indicate that “duty” is a task that is directed by the certificate holder, the other examples given are illustrative enough.

Recommendation: Kalitta recommends that the definition be rewritten as shown above.

Duty period means a period that begins when a certificate holder requires a crewmember to report for duty and ends when that crew member is free from all duties.

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 crewmember's alertness and ability to safely operate an aircraft or perform safety-related duties.

Fatigue risk management system (FRMS) means a management system for an operator 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 in flight with 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, ***but is not limited to,*** 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 ***whenever these duties are performed in conjunction with duties involving flight without an intervening rest period.***

Comment: Kalitta does not agree with the FAA’s response to clarifying questions that states that “All training conducted on a flight simulator or flight training device would be considered part of an FDP regardless of when it occurs." See Document FAA-2009-1093-0365, at 3. A "flight duty period" must involve a flight or, as a minimum, movement of an aircraft where the public is at risk where an aircraft accident potential immediately exists. Training in a simulator or flight training device has no inherent safety risk. Kalitta agrees that an assignment of flight simulator training and training in a flight training device should count as duty time. The requirement at § 117.25 that a minimum of nine hours of rest be scheduled prior to reporting for a FDP and the added requirement that a crewmember have 30 hours free of duty in the 168 hour period prior to reporting for a flight duty period mitigate any fatigue accumulated in any ground duty. Furthermore, the cumulative limits for duty provide added fatigue mitigation.

As to cumulative limits, where a FDP and/or airport/standby reserve are scheduled and no actual flight occurs, neither can be included in the FDP cumulative limits of § 117.23. Kalitta agrees that those hours count towards cumulative "duty" limits.

Recommendation: Make the changes noted above.

Home base means the location designated by a certificate holder where a crew member normally begins and ends his or her duty periods.

Lineholder means a flightcrew member who has a flight schedule and is not acting as a reserve flightcrew member.

Long-call reserve means a reserve period in which a crewmember receives a required rest period following notification by the certificate holder to report for duty.

ADD a definition of "Night" as follows:
Night means the period between 0100 and 0700 at the crewmember's designated home base or acclimated location.

Comment: The term "night" is used several times in the Proposed Rule. Kalitta believes the FAA's intent for its use should be defined. If not, then the FAA should always use the term “physiological night” in all text in the preamble and in the final rule. This would make the term compatible with “physiological night’s rest” as defined below.

Recommendation: Add a definition of night as shown above.

Physiological night's rest means the rest that encompasses the hours of 0100 and 0700 at the crewmember's home base, unless the individual has acclimated to a different theater. If the crewmember has acclimated, 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 crewmember to report for a duty period.

Reserve availability period means a ~~duty~~ **period of time** during which a certificate holder requires a reserve crewmember on short call reserve to be available to receive an assignment for a flight duty period.

Comment: Kalitta does not concur that short call reserve is duty. 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 should not constitute duty for cumulative duty purposes. Kalitta does limit the period of time the crewmember has to respond to the call and further limits any flight duty period assignment that results from the call. See comments on part 117.21 below.

Recommendation: Make the changes noted above.

Reserve duty period means the time from the beginning of the reserve availability period to the end of an assigned flight duty period, and is applicable only to short call reserve.

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, seat, room, or other accommodation that provides a crewmember with a sleep opportunity.

(1) Class 1 rest facility means a bunk or other surface that allows for a flat sleeping position, is located separate from both the flight deck and passenger cabin, ***for passenger aircraft,*** in an area that is temperature-controlled, allows the crewmember to control light, and ***provides reasonable separation from potential*** noise and disturbance.

(2) Class 2 rest facility means a seat in ***a passenger*** aircraft cabin ***or cargo aircraft flight deck*** 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.

(3) Class 3 rest facility means ***any seat in the passenger cabin or any seat in an all-cargo aircraft that is not a required crew seat and that does not meet the standards for Class I and Class II rest facilities above.***

Comment: The FAA appears to apply these definitions to passenger aircraft only. Cargo aircraft often have rest facilities that include horizontal sleep opportunities or other seats with significant recline capability that are suitable for Class 1, Class 2 or Class 3 rest facilities. They are often on the flight deck, but relatively free of disturbance from other crewmembers. While that concept is applicable to all three class definitions, the emphasis on "passenger aircraft" in our proposed changes to the definition of Class 1 and Class 2 rest facilities above does not need to be applied in Kalitta's proposed change to the definition of a Class 3 rest facility above. Also, the definition of a Class 1 rest facility needs to be further revised as it is impossible to "isolate" a rest area entirely, even with the specifications set forth in Advisory Circular AC-120-31A. Kalitta does not agree with the FAA's proposed definition of a Class 3 rest facility. The Class 3 definition must include a common coach class seat or non-crew seat on the flight deck of an all-cargo aircraft because rest in a coach seat provides valuable fatigue mitigation, as noted in the record of ARC discussions on science that are included in the docket. "Dr. Hursh stated that his models value sleep on a bunk at approximately 66 to 80 percent of normal sleep, and values sleep in a coach seat at approximately 50 percent of the value of normal sleep

Recommendation: Change the introductory sentence and the definitions of Class 1 and Class 2 rest facilities as shown above to accommodate all-cargo aircraft flight deck rest capabilities, and redefine the definition of a Class 3 rest facility as shown above. Kalitta acknowledges the FAA answer to clarifying questions that a "rest facility" includes both in-flight and ground rest facilities.

Rest period means a continuous period determined prospectively during which the crewmember is free from all restraint by the certificate holder, including freedom from present responsibility for work should the occasion arise.

Scheduled means times assigned by a certificate holder when a crewmember is required to report for duty.

Schedule reliability means the accuracy of the length of a scheduled flight duty period as compared to the actual flight duty period.

Short-call reserve means a period of time in which a crewmember does not receive a required rest period following notification by the certificate holder to report for a flight duty period, Short call reserve is not duty.

Comment: Kalitta notes that the FAA has not defined short-call reserve as duty. Kalitta concurs it is a period of time, but it is not duty. The only task assigned in that time is to answer the phone, and the crewmember is free to conduct his/her life just as a crewmember is in a rest period. Kalitta proposes the minor change above to specify that short-call reserve is not duty and to distinguish it from airport/standby reserve which falls within a FDP.

Recommendation: Make the changes noted above.

Split duty means a flight duty period that has an actual break in duty that is less than a required rest period.

Comment: Kalitta proposes the minor change above to make clear that the term "scheduled" is used only where it is clearly applicable to the situation intended. This may not mean the initial bid package in non-scheduled operations, as the FAA states in its answer to clarifying questions in Document FAA-2009-1093-0365. When does a "schedule" begin in non-scheduled operations? Kalitta's position is that it begins when the crewmember shows up for a FDP. However, a break may occur in a FDP for non-scheduled operations that was not foreseen before the event occurs. Additionally, a split duty may be intended in a non-scheduled FDP at the time the crewmember shows up for the FDP, but not used for real-time operational reasons. The fatigue mitigating rest must be provided in the FDP where the time actually occurs. The FDP extension can only be used if the split duty rest opportunity is actually provided.

Recommendation: Make the changes noted above.

Suitable accommodation means a temperature-controlled facility with sound mitigation that provides a crewmember with the ability to sleep in a bed and to control light.

Comment: Kalitta notes that "suitable accommodation" should not be applied to a "rest facility" used for in-flight augmentation or on the ground for fatigue mitigation within a FDP. Kalitta acknowledges the FAA's clarification of this issue in its answer to clarifying questions in Document FAA-2009-1093-0365.

Theater means a geographical area where local time at the crewmember's flight duty period departure point and arrival point differ by no more than 4 hours.

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, unforecast 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.***

Comment: The FAA's proposed definition works well for scheduled service, but it does not include the major unforeseen operational circumstances in non-scheduled service: the customer, who determines departure and arrival airport and the departure time, and the ground service providers, who give no priority to *ad hoc* or non-scheduled operations with low frequency, even though service contracts are assured before aircraft arrival. This definition also does not include other operational irregularities such as Minimum Equipment List issues.

Recommendation: Revise the definition to add important non-scheduled unforeseen operational circumstances that are beyond the control of the certificate holder, as shown above.

Window of circadian low means a period of maximum sleepiness that occurs between 0200 and 0559 during a physiological night.

Sec. 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 ***up to the prescribed flight duty period limits in Table B or C for that operation.***

~~(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.~~

(b) ~~***(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.

~~(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.~~

~~(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 Sec. 117.11 and must be completed before the flightcrew member begins or continues an FDP.~~

(c) ~~***(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.

(d) ~~***(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.

Comment: In general, this section, as written, cannot be realistically implemented in any aviation operating environment. While Kalitta does not request that the entire section be removed, Kalitta believes it must be significantly simplified. Specifically, subsection (b) hinges upon what a certificate holder "believes" regardless of physical evidence. Upon what will the certificate holder base its decision? Subsection (d) will invite widespread erroneous input by persons with questionable motives. Subsections (b), (d), and (e) cannot be implemented without extensive development of medical standards, fielding of medical equipment and assumption of significant legal liability. Kalitta agrees there must be a joint responsibility for safety and fatigue mitigation. The crewmember must have the responsibility that he/she must report fatigue when the situation would preclude safe flight. The training envisioned in each carrier's fatigue risk management plan ("FRMP") must be developed and implemented to build confidence in our understanding of fatigue and its mitigations before any requirement in this section can be confidently met. As that training and confidence building is accomplished, crewmembers will know how to better prepare for FDPs and when to report themselves to be too fatigued to enter or continue a FDP.

Recommendation: Add the language above to clarify subsection (a), and eliminate subsections (b), (d), and (e).

Sec. 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 protection 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.

(c) Whenever the Administrator finds that revisions are necessary for the continued adequacy of an FRMS that has been granted final approval, the certificate holder must, after notification, make any changes in the program deemed necessary by the Administrator.

Comment: Kalitta supports the FRMP and the concepts of using a Fatigue Risk Management System ("FRMS") for fatigue management and risk mitigation. The FRMS, however, must first be based on a flight and duty time regulation that adequately addresses the rest and flight requirements of each segment of the affected community including non-scheduled carriers' operations. Kalitta is concerned that this section as drafted does not provide any foundation for uniform application of this section to non-scheduled carriers and scheduled carriers. Kalitta believes that, should proposed Part 117 not be changed to accommodate non-scheduled cargo and passenger operations as recommended, the final regulations must not be implemented until the FAA and industry have a clear understanding of the parameters and implementation of FRMS so that competitive advantages are not realized through differing interpretations and implementations of FRMS.

Sec. 117.9 Schedule reliability.

~~(a) Each certificate holder must adjust within 60 days --~~

~~(1) Its system-wide flight duty periods if the total actual flight duty periods exceed the scheduled flight duty periods more than 5 percent of the time, and~~

~~(2) Any scheduled flight duty period that is shown to actually exceed the schedule 20 percent of the time.~~

~~(b) Each certificate holder must submit a report detailing the scheduling reliability adjustments required in paragraph (a) of this section to the FAA every two months detailing both overall schedule reliability and pairing-specific reliability. Submissions must consist of:~~

~~(1) The carrier's entire crew pairing schedule for the previous 2-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 pairings, and~~

~~(3) The percentage of discrepancy between the two data sets on both a cumulative, and a pairing-specific basis.~~

Rewrite section 117.9 as follows:

Each certificate holder must record each extension to the maximum FDP limitations shown at Table B and C and report them to the FAA quarterly. Reports must include the scheduled FDP hours at time of report for duty involving flight; the actual FDP hours; and a brief explanation for the extension.

Comment: This reliability standard does not consider or accommodate the non-scheduled community. This provision appears to assume that all operations are scheduled operations with established stations and regular routes and ignores the operational needs of non-scheduled carriers which do not have established stations and regular routes. In non-scheduled operations, the customer determines the departure airport and time, as well as the destination airport. Non-scheduled operations only infrequently operate on the initial schedule agreed-upon by the certificate holder and the customer because of the nature of the customer's requirements.

In answering a question about how the schedule is to be measured in non-scheduled operations, the FAA stated in Document FAA-2009-1093-0365, at 8, that "[t]he requirements for schedule reliability are not a function of scheduled service versus unscheduled service. Rather, 'scheduled' in this instance means "times assigned by a certificate holder when a crewmember is required to report for duty." Non-scheduled carriers offer service that moves when the customer is ready to move, not on a schedule of the carrier's making. Every scheduled or non-scheduled operation must be permitted to operate up to the maximum FDP established for time-of-day and number of segments as shown in Tables B or C of the NPRM. In general, a quarterly report consisting of actual FDP extensions will best describe interruptions to "schedule reliability" for both scheduled and non-scheduled operations.

Recommendation: Rewrite this section as shown above.

Sec. 117.11 Fatigue education and training program.

(a) Each certificate holder must develop and implement an education and training program, approved by the Administrator, applicable to all employees ***determined by the certificate holder to require the training, but the training must include pilots, dispatchers, flight followers, schedulers and the Director of Operations.***

~~of the certificate holder responsible for administering the provisions of this rule including flightcrew members, dispatchers, individuals involved in the scheduling of flightcrew members, individuals involved in operational control, and any employee providing management oversight of those areas.~~

(b~~)(1) Initial training for all individuals listed in paragraph (a) of this section must consist of at least 5 programmed hours of instruction in the subjects listed in paragraph (b)(3) of this section.~~

~~(2) Recurrent training for all individuals listed in paragraph (a) of this section must be given on an annual basis and must consist of 2 programmed hours of instruction in the subjects listed in paragraph~~
~~(b)(3) of this section.~~

(b) ~~(3)~~ The fatigue education and training program must include information on--

(i) FAA regulatory requirements for flight, duty and rest and NTSB recommendations on fatigue management.

(ii) Basics of fatigue, including sleep fundamentals and circadian rhythms.

(iii) Causes of fatigue, including possible medical conditions.

(iv) Effect of fatigue on performance.

(v) Fatigue countermeasures.

(vi) Fatigue prevention and mitigation.

(vii) Influence of lifestyle, including nutrition, exercise, and family life, on fatigue.

(viii) Familiarity with sleep disorders and their possible treatments.

(ix) Responsible commuting.

(x) Flightcrew member responsibility for ensuring adequate rest and fitness for duty.

(xi) Operating through and within multiple time zones.

(c) Whenever the Administrator finds that revisions are necessary for the continued adequacy of a fatigue education and training program that has been granted final approval, the certificate holder must, after notification, make any changes in the program that are deemed necessary by the Administrator.

Comment: Kalitta fully supports fatigue education and training. Indeed, true fatigue management is as much about an individual's training, discipline and the management of his or her life style as it is a prescriptive regulatory process. The FRMP, as being implemented by airlines and the FAA, will provide the basis for that.

In general, subsection (a) appears too broad and all-inclusive. There are subtle differences between scheduled and non-scheduled operations that place the regulatory responsibility for dispatch of a flight on different individuals. Furthermore, within each sector's operating environment – cargo, passenger, scheduled and non-scheduled – there are subtle differences in the manner in which airlines manage these regulatory requirements. Beyond pilots, dispatchers, flight followers, schedulers, and the Director of Operations, each airline must be permitted to determine which employees require training.

The requirement of certain hours of training in subsection (b) appear to have no basis in science. Thus, Kalitta recommends that they be deleted. Additionally, the preamble appears to require initial training for new hires only, but subsection (b) is not consistent with that concept. The fact that this program has to be approved by the Administrator and will be part of a FRMP should permit each carrier to formulate its training program, including the number of hours required, for that approval. Perhaps by the time the program has to be implemented, the FAA and industry can produce some model training programs to achieve the intent of fatigue training.

Recommendation**:** Implement the changes to section 117.11(a) shown above. Delete section 117.11(b) (1) and (2) above and renumber subsequent paragraphs accordingly.

Sec. 117.13 Flight time limitation.

~~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:~~

~~(a) Will exceed the limits specified in Table A of this part if the operation is conducted with the minimum required flightcrew.~~

~~(b) Will exceed 16 hours if the operation is conducted with an augmented flightcrew.~~

Comment: Kalitta is opposed to the inclusion of flight time limits in this regulation. In fact, the FAA's answers to clarifying questions on this subject in Document FAA-2009-1093-0365 increase Kalitta's concerns about the complexity of scheduling around too many limitations. The discussion of flight and duty regulatory change for the past two decades has focused on the transition from a regulation based upon flight time limits to a science-based regulation of flight duty periods. Beyond that philosophical consideration, the FAA's proposed flight time scheme of hourly limits for an unaugmented crew is not consistent with the hours of operational limits for FDPs. Furthermore, this limitation is particularly oppressive as it applies to unaugmented crews in a three-person cockpit (2 pilots & one flight engineer ("FE")). Those three-person cockpit aircraft were engineered and manufactured, as certificated by FAA, based upon the international scheduled and non-scheduled commercial air transportation needs. Current regulations at 14 C.F.R. Subparts R and S recognize the added safety of the FE, even though in some cases the FE is not qualified to land the aircraft. While aircraft with three-person cockpits are no longer manufactured and current fleets will eventually phase out of the inventory, the phase-out will not occur in the first several years of implementation of this proposal. The costs of operations encountered by not permitting the three-person cockpit to continue to be an augmented crew will destroy the commercial viability of those aircraft prematurely. There is no evidence that these significant costs are considered in the FAA's cost-benefit analysis.

Kalitta agrees with the concept of science-based, fatigue mitigated FDPs and fatigue-mitigating rest. Restrictions on FDPs, which include ground time for pre- and post-flight duties and the turn times involved with multiple mission segments, will concurrently provide reasonable limits to actual flight time. In the ARC discussions set forth in Document FAA-2009-1093-005, Dr. Hursh stated that "duty time, and not flight time, is what limits pilots' opportunity to sleep." Similarly, Dr. Belenky noted that "duty time limitations are a stronger predictor of sleep and rest opportunities than flight time limitations." Additionally, neither CAP 371 nor EASA Subpart Q contains daily flight limits. Adding another layer of limitations for flight time will not provide additional safety. It will merely have the unintended consequence of preventing pilots from flying as much and thereby reducing their proficiency, thus their safety; and reducing productivity, international competitive posture, and pilots' pay.

Recommendation: Delete this section.

Sec. 117.15 Flight duty period: Unaugmented operations.

(a) Except as provided for ***in section 117.15(b)*** and in Sec. 117.17, 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.

Insert new 117.15(b) as follows:

(b) In the case of an aircraft with a three-person cockpit with an unaugmented crew, a certificate holder may assign and a crewmember may accept a flight duty period that is extended up to 2 hours beyond the applicable flight duty period for an unaugmented flightcrew in Table B. In no case may the flight duty period exceed 16 hours.

(c) If the flightcrew member is not acclimated:

(1) The maximum flight duty period in Table B of this part is reduced by ***one hour***.

(2) The applicable flight duty period is based on the local time at the flightcrew member's home base ***or acclimated location.***

(d) In the event unforeseen circumstances arise:

(1) The certificate holder may extend a flight duty period up to 2 hours, ***unless the pilot in command reports at the time of the decision that the crew is too fatigued to continue.***

(2) An extension in the flight duty period exceeding 30 minutes may occur ***no more than two times*** in any 168 consecutive hour period, and never on consecutive days.

NEW! (3) Should flight duty periods be extended on two consecutive days, an intervening rest period of 16 hours must be provided prior to the next flight duty period.

Comment: Kalitta does not agree with the FDPs set forth in Table B in the NPRM or that there can only be one extension to safe FDPs. As with other provisions in the proposed part 117, the FAA's proposal on this issue is clearly designed around domestic scheduled service and does not recognize non-scheduled cargo and passenger operations flown under Subpart S. It is too complex, completely ignores the three-person cockpit, is not based upon science, and appears to address labor issues not appropriate for regulatory actions. Lastly, the time-of-day windows set forth in Tables A and B are not synchronized. As noted above, Kalitta recommends that Table A and any limitations on flight time be removed from these regulations. Federal Aviation Regulations have always recognized that the three-person cockpit provides an added safety monitor and the three-person cockpit must continue to be recognized as a safer environment for fatigue mitigation than just the two-pilot cockpit. The 3-person cockpit not only adds safety, but those aircraft have been the cornerstone of aviation operations around which aircraft were designed, markets were developed and some non-scheduled business is still conducted. To ignore their safety and value in this regulation will prematurely cause these aircraft to become non-competitive and will cause owners and operators significant loss of capital that is not computed in the Regulatory Impact Analysis.

Recommendation: Mitigate fatigue through a simple, science-based flight duty period and rest requirement (see part 117.21 below for rest recommendations). For a two-pilot, unaugmented operations, Kalitta recommends a 14-hour flight duty period, as shown in Table B below, where no part of the FDP occurs during the WOCL hours of 0200 – 0600 at the pilot's home base (as assigned by the certificate holder) or acclimated location. Where the FDP encounters the WOCL, decrease the FDP by two hours. Where the pilot is unacclimated, further decrease the FDP by one hour. Where the FDP operated over more than four segments, further decrease the FDP by one hour for each added mission segment beyond four. Kalitta agrees with the FAA's proposed two-hour extension for unforeseen operational circumstances. However, Kalitta proposes that up to two extensions be permitted in a single 168-hour look-back period as long as they are not on consecutive FDPs. If the second extension is required within 168 hours, 16 hours of rest must be provided prior to the next FDP. The scientific experts in the ARC supported occasional but not consecutive extensions of duty. Those experts further stated that "[r]ecovery 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. However, sleep on recovery days should be extended beyond the usual sleep amount." The proposal to extend the sleep amount to 16 hours provides for several opportunities to obtain the required recovery sleep.

The table shown here as Table B for the purpose of replacing Table B in the NPRM. This proposal mitigates all of the types of fatigue discussed by the FAA in the preamble of the NPRM. See 75 Fed. Reg. 55855. Combined with the basic rest period of 10 hours block-to-block and 9 hours at a suitable accommodation, as set forth in Table B, below, ensures a sleep opportunity of more than 8 hours, provides significant mitigation for WOCL disruption, is less than the time awake limit of 17 hours, and further mitigates for a non-acclimated crewmember and for more than four segments. Further restrictions on cumulative FDP and duty ensure that its proposal is science-based and safe, yet remains flexible enough for non-scheduled and scheduled operations.

Kalitta Proposed

TABLE B TO PART 117—FLIGHT DUTY PERIOD: UNAUGMENTED OPERATIONS

	Acclimated Segments					
Time of start	**1 - 4**	**5**	**6**	**7+**	**Extension[1]**	**Not Acclimated**
0000-0559	**12**	**11**	**10**	**9**	**2**	**-1**
0600-1159	**14**	**13**	**12**	**11**	**2**	**-1**
1200-1259	**13**	**12**	**11**	**10**	**2**	**-1**
1300-2359	**12**	**11**	**10**	**9**	**2**	**-1**

The minimum rest period for an unaugmented operation is not less than 9 hours at the suitable accommodation for acclimated locations and not less than 11 hours at the suitable location for un-acclimated locations.
Note 1: Should a second extension be required within a 168-hour period, a 16-hour rest period must be provided prior to the next flight duty period.

Sec. 117.17 Flight duty period: Split duty.

~~For a split duty period, a certificate holder may extend and a flightcrew member may accept a flight duty period up to 50 percent of time that the flightcrew member spent in a suitable~~

~~accommodation up to a maximum flight duty period of 12 hours provided the flightcrew member is given a minimum opportunity to rest in a suitable accommodation of 4 hours, measured from the time the flightcrew member reaches the rest facility.~~

Re-write section as follows: ***<u>For a split duty period, a certificate holder may extend an unaugmented flight duty period up to 90 minutes where the ground time permits a rest opportunity of at least 45 minutes with a subsequent 20-minute recovery period. Should the ground time permit a longer rest opportunity, the flight duty period may be extended by 75 per cent of the available rest opportunity for a rest facility equivalent to a Class 1 on-board rest facility; up to 50 per cent of the rest opportunity for a Class 2 rest facility; or up to 30 percent for a Class 3 rest facility, whichever is greater.</u>***

<u>Comment</u>: Kalitta does not agree with the FAA proposal as written. The credit for split duty should be more science-based. NASA 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. If this is applicable for the cockpit nap, this is even more applicable to a ground rest facility. The credit for in-flight rest in Class 1, 2, or 3 rest facilities is outlined in section 117.19 below. Finally, because section 117.5 already gives a flight crewmember the prerogative to cease operating by simply informing the operator of fatigue, there is no need to further restate the flightcrew prerogative to accept or decline split duty accommodations or FDP extensions here.

<u>Recommendation</u>: Rewrite this section as shown above.

Sec. 117.19 Flight duty period: Augmented flightcrew.

The flight duty period limits in Sec. 117.15 may be extended by augmenting the 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 ***one hour*.**

(2) The applicable flight duty period is based on the local time at the flightcrew member's ***acclimated location or*** home base.

~~(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 are available for in-flight rest for the flightcrew member manipulating the controls during landing;~~

~~(2) A ninety minute consecutive period is available for in-flight rest for each flightcrew member;~~

~~(3) The last flight segment provides an opportunity for in-flight rest in accordance with paragraph (c)(1) of this section.~~

~~(d) No certificate holder may assign and no flightcrew member may accept an assignment involving more than three flight segments (should we add ferry?) under this section unless the certificate holder has an approved fatigue risk management system under Sec. 117.7.~~

(c) At all times during flight, at least one flightcrew member with
a PIC type-rating must be alert and on the flight deck.

(d) In the event unforeseen circumstances arise:

(1) The certificate holder may extend a flight duty period up to 3 hours.

(2) An extension in the flight duty period exceeding 30 minutes may occur ***no more than twice and not on consecutive days***, in any 168 consecutive hour period.

NEW! (3) Should flight duty periods be extended twice in 168 hours, an intervening rest of 16 hours must be provided prior to the next flight duty period or short-call reserve.

Comment: Kalitta notes that in a detailed analysis of NTSB accidents, it found no accidents from augmented operations in which human fatigue was cited as a cause or contributing factor. Recommendations in this section reduce the duty times currently in 14 C.F.R. Part 121 for 4-pilot crews by 33 percent and for 3-pilot crews by 20 percent. For that reason and based upon scientific studies referenced below, Kalitta does not agree with the specific maximum hours of FDP recommended by FAA's Table C for the various classes of in-flight rest facility. The FAA has used a format and calculation based upon the TNO report that is more than 10 years old and was proposed by a limited number of scientists and based upon limited studies. Since then, there have been a large number of studies on the value of in-flight rest. Dr. Belenky stated, "[a]ll other factors being equal, if the total amount of actual sleep is the same, split sleep is as valuable as continuous sleep." Several recent studies demonstrated that the length of performance benefits is longer than previously revealed. One study showed that 20-30 minute naps improved cognitive performance for as long as 155 minutes and a 10 minute nap improved performance for 95 minutes. This was also confirmed in an analysis of 12 other studies which showed that a 15 minute nap led to a 2-hour benefit and that a 4-hour nap led to as much as a 10-hour benefit. In the ARC discussions, Dr. Hursh stated that his models value sleep on a bunk at approximately 66 to 80 percent of normal sleep, and values sleep in a coach seat at approximately 50 percent of the value of normal sleep. Table C below grants approximately those percentages of credit. They are also approximately within range of the TNO credit of 75, 55 and 25 per cent based upon class of seat. Finally, in comparing Kalitta's 3- and 4-pilot per cent extension credit for augmented versus unaugmented crew hours against FAA's credit, Kalitta's percent credit is significantly smaller in most areas except for a 4-pilot crew in a class 3 rest facility during non-WOCL hours. Considering all of the science referenced above, this presents well-conceived, fatigue-mitigated augmented flight duty periods.

Kalitta is opposed to FAA's proposed sections 117(c) and (d). Additionally, the FAA's answers to clarifying questions in Document 2009-1093-0365, at 15, is confusing and appears to misrepresent the language as proposed at 117.19(c). It states, "[a]ugmentation does not require that each flight segment provide a 2-hour rest period." However, section 117.19(c) (1) states that two consecutive hours in-flight rest must be available for the pilot making the landing. If there is more than one segment, there will be more than one landing. Thus, it implies at least two hours rest opportunity in each segment.

Other statements within the FAA's answer to clarifying questions do clarify that the FAA does not expect that each augmented flight segment require sufficient flight time at cruise to provide all pilots an in-flight rest on each trip segment. Kalitta agrees with that clarification. However, Kalitta cannot agree that the last flight segment must have an in-flight rest segment, as the last segment of augmented flight operations is often less than two hours.

In light of the confusion caused by the proposed language and the FAA's answers to questions noted above, Kalitta recommends that the FAA withdraw sections 117.19(c) and 117.19(d) above. The rationale is that crew rostering and on-the-scene cockpit resource management by the crewmembers will best permit timely rest for the pilot with the greatest need. Finally, as noted above, a thorough search of NTSB data did not reveal any human factors-related accidents involving augmented crews, we feel there is no need for the FAA to insert revised language for sections 117.19(c) and 117.19(d).

Kalitta does not agree that the number of mission segments needs to be limited to three. Kalitta believes the construction of subsection (f) (1) is incorrect as noted above. Kalitta proposes two non consecutive FDP extensions in 168 hours, with a 16-hour rest period required if the second extension actually occurs. As noted in our comments on section 117.15 above, science supports this position. Table C below reduces the length of FDPs by one hour for an un-acclimated flightcrew versus the 30 minutes proposed by FAA. Finally, as shown in section 117.25 below, Kalitta proposes 11 hours of rest at the suitable accommodation for non-acclimated locations.

<u>Recommendation</u>: See changes in proposed text above and Table C below.

Proposed

TABLE C TO PART 117—FLIGHT DUTY PERIOD:

AUGMENTED OPERATIONS

FDPs not De-rated for WOCL, as in-flight rest is provided

Acclimated	**Class1**	**Class 1**	**Class 2**	**Class 2**	**Class 3**	**Class 3**
Time of Start	**3 Pilots**	**4 pilots**	**3 Pilots**	**4 pilots**	**3 Pilots**	**4 pilots**
0000-2359	**18**	**20**	**17**	**19**	**16**	**18**
Extension	**+2**	**+2**	**+2**	**+2**	**+2**	**+2**
Non-Acclimated	**-1**	**-1**	**-1**	**-1**	**-1**	**-1**

Rest Period: Not less than 9 hours in a suitable accommodation at an acclimated location, and not less than 11 hours in a suitable rest facility at an un-acclimated location.

Sec. 117.21 Reserve status.

(a) Unless specifically designated otherwise by the certificate holder, all reserve is considered long-call reserve.

(b) 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 period of time that the flightcrew member is in a reserve status does not count as duty.

(2) The reserve availability period may not exceed ***16*** hours.

(3) No certificate holder may schedule and no reserve flightcrew member on short call reserve may accept an assignment of a flight duty period that begins before the flightcrew member's next reserve availability period unless the flightcrew member is given at least ***9*** hours rest.

(4) The maximum reserve duty period for unaugmented operations is the lesser of--

(i) 16 hours, as measured from the beginning of the reserve availability period;

(ii) The flight duty period in Table B of this part plus ***6*** hours, as measured from the beginning of the reserve availability period.

(iii) 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 in paragraph (c)(4)(iii) of this section by *the full*-length of the time during the reserve availability period in which the certificate holder did not contact the flightcrew member.

(5) The maximum reserve duty period for augmented operations is the lesser of--

(i) The flight duty period in Table C of this part plus *6* hours, as measured from the beginning of the reserve availability period.

(ii) 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 in paragraph (c)(5)(ii) of this section by *the full*-length of the time during the reserve availability period in which the certificate holder did not contact the flightcrew member,.

(d) For long call reserve,

(1) The period of time that the flightcrew member is in a reserve status does not count as duty.

(2) If a certificate holder contacts a flightcrew member to assign him or her to a flight duty period or a short call reserve, the flightcrew member must receive the required rest period specified in Sec. 117.25 prior to reporting for the flight duty period or commencing the short call reserve duty.

(3) 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 air carrier.

~~(e) An air carrier may shift a reserve flightcrew member's reserve availability period under the following conditions:~~

~~(1) A shift to a later reserve availability period may not exceed~~
~~12 hours.~~

~~(2) A shift to an earlier reserve availability period may not exceed 5 hours, unless the shift is into the flightcrew member's window of circadian low, in which case the shift may not exceed 3 hours.~~

~~(3) A shift to an earlier reserve period may not occur on any consecutive calendar days.~~

~~(4) The total shifts in a reserve availability period in paragraphs~~
~~(e)(1) through (e)(3) of this section may not exceed a total of 12 hours in any 168 consecutive hours.~~

Comment: While U.S. certificate holders and their crewmembers have decades of experience with long- and short-call reserve and airport standby, it has never been incorporated into regulations. The prescriptive requirements of this section of the proposal are confusing in itself and is illogical in consideration of other sections and definitions within the proposal. FAA has gone too far in calling "short-call reserve duty. Availability of reserve crewmembers is one of the two most significant issues in this proposal for non-scheduled operations. Without significant change, the proposed regulation will cripple world-wide non-scheduled air transportation which must, in most cases, be operated with augmented crews or must be operated with only one reserve crew available because non-scheduled operations do not have crew bases structured along the route of flight. In most cases, a reserve crew will have deadheaded to a rest location where a technical stop is planned for crew change. If the flight is delayed, the reserve crewmembers must be kept at a suitable accommodation until called out. Kalitta recommends a basic short-call reserve duty of 16 hours on 8 hours off so that, if the crewmember is called out in the first six hours, he or she can utilize the entire maximum FDP as prescribed at Table B or Table C. When a crewmember is called out after that, all time in short call reserve should be subtracted from the maximum FDP, unless the un-interrupted short call reserve included the crewmember's WOCL. In that case, the full period of the WOCL should be considered rest. This scheme is necessary to permit long-haul non-scheduled operations to continue and can be accommodated within our proposal as presented.

Furthermore, the proposed scheme for shifting short-call reserve periods is illogical in light of the fact that a crewmember in long-call reserve can respond to an assignment to reserve or flight duty with only 9 hours rest (see section 117.25(d). Thus, sections (d)(3) and (e) of the proposal must be deleted.

Recommendation: Make changes shown above.

Sec. 117.23 Cumulative duty limitations.

(a) The limitations of this section on flightcrew members apply to all commercial flying by the flightcrew member 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 28 consecutive calendar day period and~~

~~(2) 1,000 hours in any 365 consecutive calendar day period.~~

(b) ~~(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) **75** ~~60~~ flight duty period hours in any 168 consecutive hours and

(2) **215** ~~190~~ flight duty period hours in any 672 consecutive hours.

(d) Except as provided for in paragraph (d)(3) of this section, no certificate holder may schedule and no flightcrew member may accept an assignment if the flightcrew member's total duty period will exceed:

(1) **80** 65 duty hours in any 168 consecutive hours and

(2) **215** 200 duty hours in any 672 consecutive hours.

~~(3) If a flightcrew member is assigned to short-call reserve or a certificate holder transports a flightcrew member in deadhead transportation in, at a minimum, a seat in aircraft cabin that allows for a flat or near flat sleeping position, the total duty period may not exceed:~~

~~(i) 75 duty hours in any 168 consecutive hours and~~

~~(ii) 215 duty hours in any 672 consecutive hours.~~

~~(4) Extension of the duty period under paragraph (d)(3) of this section is limited to the amount of time spent on short-call reserve or in deadhead transportation.~~

Comment: As to cumulative flight time limitations in 117.23(b), Kalitta has already commented on section 117.13 above that there is no need for flight time limits when FDP and other science-based fatigue mitigations provide the basis for this regulation. The scientists who advised the ARC agreed on that concept. In addition, to add flight time limits at 365 days would imply that we have failed to mitigate fatigue on a continuing basis. That will be totally unsatisfactory. We must mitigate fatigue in a timely manner, but flight time limits need not be prescribed.

The FAA's proposed cumulative duty limits are entirely too restrictive for non-scheduled operations and can and should be changed as reflected in this proposal. Furthermore, sections 117.23(d)(3) and (4) are already included in the sections above them. If the FAA's rationale for section 117.27(d)(3) is science-based then there is absolutely no reason why the same limits for maximum FDP cannot be established using the 168-hour period.

In the FAA's answers to clarifying questions pertaining to 117.23, it stated "[t]he question of whether a certificate holder should be allowed to assign additional duty time if there is no additional FDP contemplated for the relevant time period strikes the FAA as a fair one, and the agency seeks input on this matter." There is no further risk of an aviation accident unless flight is involved. As the FDP is over, the certificate holder should be able to assign duty not involving flight.

Kalitta does not agree with many of the statements in the FAA's answers to clarifying questions pertaining to 117.23 in Document FAA-2009-1093-0365. For example, Kalitta agrees that long-call reserve is not duty. However, the certificate holder must be able to contact the crewmember to assign the required rest and to schedule the new flight duty period after the rest. The FAA's statement that the certificate holder must track the time a crewmember is commuting defies the FAA's position that commuting will not be addressed in the regulations. It also defies the concept that the crewmember is free to choose his home location. With all the other fatigue mitigations, tracking time that a crewmember is not technically on duty is unnecessary. The FAA's statement that "the certificate holder cannot allow the individual to be free from duty because of circumstances beyond its control" also is baffling. Kalitta is opposed to the concept that union time is science-based flight and duty regulations. The comments introduce quality of life issues that need not be in prescriptive regulations.

The FAA's answers to questions on airport/reserve and FDP also stimulate another position as noted in the definition of "flight duty period" above. Specifically, where airport/reserve and/or flight duty period is scheduled but not performed, the hours should not be included in the cumulative limits for FDP. They should be included in the cumulative limits for "duty."

Kalitta has made every effort in its proposal to mitigate fatigue with rest, specifically, with sleep opportunity. Sleep is the fatigue mitigation of science. This proposal increases the FAA's proposed rest after each FDP; provides compensatory rest when two or more normal FDPs are exceeded; decreases applicable FDP limits more than the FAA does for non-acclimated situations; provides an increase from the current standard of 24-in-7 to 30 hours off in the 168 hour look-back; and takes better advantage of split duty rest. Combine all of these improvements with both the need and the desire to have a science-based FRMP based upon our proposal as presented, we achieve our common goal of safe, fatigue mitigated FDP limitations and rest requirements. The limits to cumulative duty in our changes prevent a certificate holder from assigning a crewmember to more than two full 168-hour maximum operating periods in a 28-day period. “Drs. Belenky and Hursh stated that occasional extensions of duty would likely be okay, but consecutive extensions would not be.” This is science-based fatigue mitigation.

<u>Recommendation</u>: Change section 117.23 as shown above.

Sec. 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 short call 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, except that:

(1) The flightcrew member must be given a minimum of <u>**30 hours**</u> ~~three physiological nights~~ rest upon return to home base..

(2) A flightcrew member operating in a new theater must receive <u>**30**</u> ~~36~~ hours of consecutive rest in any 168 consecutive-hour period.

(c) No certificate holder may reduce a rest period more than once in any 168 consecutive hour period.

(d) No certificate holder may schedule and no flightcrew member may accept an assignment for reserve or a flight duty period unless the flightcrew member is given a rest period of at least 9 consecutive hours before beginning the reserve or flight duty period measured from the time the flightcrew member reaches the hotel or other suitable accommodation.

<u>***Add new (e). At international non-acclimated locations the minimum rest is not less than 12 hours from crew release to show time for the next FDP***</u>~~.~~

(f) In the event of unforeseen circumstances <u>***at acclimated locations***</u>, the pilot in command and certificate holder may reduce the 10 consecutive hour rest period in paragraph (d) of this section to 9 consecutive hours. At non-acclimated locations, the rest period may be reduced to 11 hours.

Comment: Kalitta does not agree that three physiological nights rest is required upon return to home base because fatigue has been mitigated throughout the crewmember's trip experience. Kalitta sees no need to provide a different standard for rest at home. On the contrary, rest at home is generally more fatigue mitigating than rest at operating locations. Furthermore, any added rest requirement will hamper certificate holders' flexibility to give crew member negotiated time off, as is already the case in labor – management relations.

Kalitta is adamantly opposed to any rest calculation that is predicated on "check in to check out". Kalitta does not believe any tracking mechanism can be constructed to accurately predict the travel time from release to arrival at the suitable accommodation. That prediction is simply not possible considering variances due to traffic, road conditions, hotel van scheduling, etc., all of which are beyond the direct control of the certificate holder. Further, this NPRM contains no language to preclude "discretionary detours" initiated by the flightcrew, such as a stop at a convenience store or fast food restaurant. A detour of this nature, well outside the control of the certificate holder, would skew the check in time that the FAA cites as a tool to determine adequate time was available for rest (2009-1093-365[1] at 21). Thus, Kalitta's proposal increases the rest period to 10 or 12 hours depending upon whether the crewmember is acclimated or not and calculated from release to report. This will provide ample time for an 8-hour sleep opportunity at the suitable accommodation.

Recommendation: See recommended changes above.

Sec. 117.27 Consecutive nighttime operations.

~~No certificate holder may schedule and no flightcrew member may accept more than three consecutive nighttime flight duty periods unless the certificate holder provides an opportunity to rest during the flight duty period in accordance with Sec. 117.17.~~

Comment: Kalitta's Proposal is structured to mitigate cumulative fatigue using limited FDPs, significant reductions for FDPs that encounter night operations (specifically encounters with the WOCL), and the provision of significant rest periods. With all the fatigue mitigation built into the regulations above this section, Kalitta sees no need for this section.

Recommendation: Remove this section.

Sec. 117.29 Deadhead transportation.

(a) All time spent in deadhead transportation is considered part of a duty period.

(b) Time spent in deadhead transportation is considered part of a flight duty period if it occurs before a flight segment without an intervening required rest period.

~~(c) Time spent entirely in deadhead transportation during a duty period may not exceed the flight duty period in Table B of this part for the applicable time of start 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 Sec. 117.25 upon completion of such transportation.~~

Comment: Subsection (c) is unnecessary. Deadhead assigned by the certificate holder is duty, and section 117.25 prescribes required rest before a short-call reserve or FDP. If the language at (c) is not deleted, this would imply that the certificate holder should prevent a crewmember from deadheading home at the end of a FDP, even if the crewmember requests to do so. Additionally, the rest period proposed is punitive and not supported by science. Otherwise, the FAA could not propose a 9-hour rest period between FDPs.

Recommendation: Delete section subsection (c).

Sec. 117.31 Operations into ***unique*** ~~***unsafe***~~ areas.

(a) This section applies to operations that cannot otherwise be conducted under this part because of unique circumstances that could prevent flightcrew members from being relieved by another crew or safely provided with the rest required under Sec. 117.25 at the end of the applicable flight duty period.

(b) A certificate holder may exceed the maximum applicable flight duty periods to the extent necessary to allow the flightcrew to fly to a 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) 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.

(d) No extension of the cumulative fatigue limitations in Sec. 117.3 is permitted.

(e) If the operation was conducted under contract with an agency or department of the United States Government, each affected air carrier must submit a report every 60 days detailing the--

(1) Number of times in the reporting period it relied on this section to conduct its operations.

(2) For each occurrence,

(i) The reasons for exceeding the applicable flight duty period;

(ii) The extent to which the applicable flight duty period was exceeded; and

(iii) The reason the operation could not be completed consistent with the requirements of this part.

(f) If the operation was not conducted under contract with an agency or Department of the United States Government, each affected air carrier must submit a report within 14 days of each occurrence detailing--

(1) The reasons for exceeding the applicable flight duty period;

(2) The extent to which the applicable flight duty period was exceeded; and

(3) The reason the operation could not be completed consistent with the requirements of this part.

(g) Should the Administrator determine that a certificate holder is relying on the provisions on this section the Administrator may require the certificate holder to develop and implement a fatigue risk management system.

Comment: Kalitta believes it preferable to not refer to areas of operations as "unsafe areas." Kalitta agrees that some unique circumstances will justify deviation from the prescriptive limitations of this part. However, the FAA answer to clarifying questions in Document FAA-2009-1093-0365 actually causes further concern on the FAA's intent with this section. The FAA appears unable or reluctant to define "unsafe areas" but will permit them on a planned and unplanned basis. Also, the FAA states that it does not anticipate use of this paragraph "into safe areas in support of the U.S. military." Document FAA-2009-1093-0365, at 24. That leaves the individual certificate holder with the dilemma of presuming a "safe area" is not an "unsafe area," which is not defined. Also, if this section cannot be used for military flight to "safe areas," does that also mean it could not be used for charters to other government agencies under circumstances such as humanitarian relief or deportation of illegal immigrants?

Recommendation: Remove "unsafe" and use "Operations into ***unique*** ~~***unsafe***~~ areas.." Be more specific in guidance in the final rule.

Recommendation: Revise 14 CFR **§ 119.55 Obtaining deviation authority to perform operations under a U.S. military contract.**: *(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****, 121, or part 135 of this chapter in order to perform operations under a U.S. military contract.*

~~Table A to Part 117--Maximum Flight Time Limits for Un-augmented Operations~~

~~Time of start (Home base)~~	~~Maximum flight time (hours)~~
~~0000-0459~~	~~8~~
~~0500-0659~~	~~9~~
~~0700-1259~~	~~10~~
~~1300-1959~~	~~9~~
~~2000-2359~~	~~8~~

~~Table B to Part 117--Flight Duty Period: Unaugmented Operations~~

~~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+~~
~~0000-0359~~	~~9~~	~~9~~	~~9~~	~~9.~~	~~9~~	~~9~~	~~9~~
~~0400-0459~~	~~10~~	~~10~~	~~9~~	~~9~~	~~9~~	~~9~~	~~9~~
~~0500-0559~~	~~11~~	~~11~~	~~11~~	~~11~~	~~10~~	~~9.5~~	~~9~~
~~0600-0659~~	~~12~~	~~12~~	~~12~~	~~12~~	~~11.5~~	~~11~~	~~10.5~~

~~0700-1259.........~~	~~13~~	~~13~~	~~13~~	~~13~~	~~12.5~~	~~12~~	~~11~~
~~1300-1659..........~~	~~12~~	~~12~~	~~12~~	~~12~~	~~11.5~~	~~11~~	~~10.5~~
~~1700-2159.........~~	~~11~~	~~11~~	~~10~~	~~10~~	~~9.5~~	~~9~~	~~9~~
~~2200-2259.......~~	~~10.5~~	~~10.5~~	~~9.5~~	~~9.5~~	~~9~~	~~9~~	~~9~~
~~2300-2359........~~	~~9.5~~	~~9.5~~	~~9~~	~~9~~	~~9~~	~~9~~	~~9~~

~~Table C to Part 117--Flight Duty Period: Augmented Operations~~

~~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~~........	~~14~~	~~16~~	~~13~~	~~14.5~~	~~12~~	~~12.5~~
~~0600-0659~~........	~~15~~	~~17.5~~	~~14~~	~~15.5~~	~~13~~	~~13.5~~
~~0700-1259~~........	~~16~~	~~18~~	~~15.5~~	~~17~~	~~14~~	~~14.5~~
~~1300-1659~~........	~~15~~	~~17.5~~	~~14~~	~~15.5~~	~~13~~	~~13.5~~
~~1700-2359~~........	~~14~~	~~16~~	~~13~~	~~14.5~~	~~12~~	~~12.5~~

Recommendation: See Tables B and C above. Once flight time limits have been removed from this proposal, tables of FDP limits should be re-named as Table A and Table B.