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# TESTIMONY OF R. CURTIS GRAEBER ON BEHALF OF

# THE FLIGHT SAFETY FOUNDATION

## TRANSPORTATION AND INFRASTRUCTURE COMMITTEE AVIATION SUBCOMMITTEE HEARING ON REGIONAL AIR CARRIERS AND PILOT WORKFORCE ISSUES

**JUNE 11, 2009**

Chairman Costello, Ranking Member Petri, and distinguished members of the Subcommittee: My name is Dr. Curtis Graeber and I am a Fellow of the Flight Safety Foundation.

The Foundation is an independent, nonprofit, international organization engaged in research, auditing, education, advocacy and publishing. Its mission is to pursue the continuous improvement of global aviation safety and the prevention of accidents. On behalf of the Foundation, I appreciate your providing me this opportunity to testify about recent scientific and technological progress related to flight crew fatigue. As a former National Aeronautics and Space Administration (NASA) scientist, I led the Foundation's Task Force on Crew Alertness in Ultra-Long Range Operations and also chaired the International Civil Aviation Organization's (ICAO's) Subpanels on Flight and Duty Time Limits and on Fatigue Risk Management.

We have all experienced fatigue to one degree or another. It can be a welcome prelude to a well-deserved rest or an insidious threat to our personal safety and well-being. Like Charles Lindbergh, we can ignore it at our own peril, but not when it threatens the safety of others or their property.

Unfortunately, fatigue is ubiquitous and unavoidable in aviation. It can negatively affect both physical and cognitive functioning as well as mood and thereby negatively impact a crew's response time, decision making, and crew coordination. While today's hearing focuses on flight crews and commuter flight operations, the challenge of fatigue is much broader and extends to all aviation professionals in all types of operations.

Fortunately, despite fatigue's presence, our aviation system typically operates safely day in and day out. Commercial pilots understand that they have an individual responsibility to report for duty fully rested and alert. When accidents do occur, the transient nature of fatigue and its poor signature make its contribution difficult to confirm and its etiology a challenge to unravel.

In order to minimize fatigue-related errors and accidents, regulators have traditionally imposed hours-of-service limits governing how long and how often pilots can operate an airplane. Different countries impose different limits, but they are usually based upon very little, if any, scientific knowledge. The Federal Aviation Administration (FAA) regulations governing flight time limitations are no different. They also lack a sound scientific basis and have remained essentially unchanged for the last fifty years. While these regulations have undoubtedly saved many lives, they are a fairly "blunt instrument" for managing the safety risk posed by fatigue. As a result, accidents continue to occur in which fatigue is cited as a significant contributor. While several unsuccessful attempts have been made to update the regulations, such efforts can best be described as "tweaking" what already exists and would likely result in little improvement.

Other, more effective, tools are needed. Fortunately, science and technology can offer a better way forward. The past three decades have witnessed an extensive scientific effort to better understand the complex origins of fatigue, its impact on performance, and how it can be mitigated. In 1979, NASA sought to undertake the first study to examine the effects of fatigue on decision making, in an aircraft simulator. Soon afterwards Congress directed NASA to undertake a multi-year effort to improve our understanding of crew fatigue and jet lag. This led to a series of in-flight and laboratory studies with volunteer pilots, coupled with a very productive collaboration with laboratories in the United Kingdom, the Federal Republic of Germany, and Japan. The cooperation of the airline and pilot communities was a key factor in producing truly outstanding results.

While the focus was on domestic and international flight operations, and not regional commuter operations, many of the findings have general applicability. Subsequent work, including a study of controlled rest on the flight deck, was also carried out with FAA support. The scientific approach has enabled us to examine how various factors interact to produce fatigue as well as how individuals and crews cope with it.

This work, as well as other, non-aviation, studies on fatigue and sleep loss have resulted in three decades of research which can provide the scientific basis for a paradigm shift in how regulators, operators, and pilots manage fatigue risk. In addition, the Flight Safety Foundation and the industry have worked together over the past several years to develop the processes needed to connect the science with the operators' needs and regulatory oversight.

This shift has become known as Fatigue Risk Management or FRM. It is a proactive approach to addressing fatigue in a systematic, comprehensive manner that does not rely solely on adherence to a set of prescribed hourly limits of duty and required time off. Instead, the FRM concept decreases the role of the regulator and increases the responsibility of the operator and its employees to jointly manage the risk. In its broadest interpretation, FRM takes a systematic three-pronged, incremental approach to managing fatigue risk:

1. **Prevention** — This fundamental first step can be characterized as proactive strategic risk prevention. It includes such measures as scientifically defensible scheduling, suitable hotels for sleep, crew augmentation, and education and training about sleep hygiene and fatigue. We believe that this step should also include medical identification and treatment of sleep disorders which are known to increase with aging; however, the FAA's annual medical examination for Air Transport Pilots (FAA Form 8500-8; Application Process and Examination Techniques) has no requirement to identify possible sleep disorders.

2. **Mitigation** — This second step encompasses risk mitigation at the operational level. It includes such measures as responsible trip planning, including pre-trip rest and commuting if necessary, crew rest facilities (both at the airport and in flight for augmented crews), meal planning, anticipation of irregular operational events, and Crew Resource Management (CRM) training that addresses fatigue effects on crew performance.

3. **Intervention** — This final step recognizes the inevitable fact that crews sometimes experience significant fatigue despite their and the operator's best efforts to prevent it. It includes those actions that can be invoked to manage the risk until the flight is safely concluded. Such interventions can include tailored procedural guidelines, enhanced CRM, timely intake of caffeine, and controlled rest on the flight deck.

The effectiveness of the latter was demonstrated by NASA in 1989 and subsequently incorporated into a draft Advisory Circular entitled "Controlled Rest on the Flight Deck" by an Aviation Rulemaking Advisory Committee Working Group in 1993 (ref 1, 2). While it has never been implemented in the United States, it has been approved for use by numerous other authorities around the world and has been successfully implemented by foreign carriers since 1994.

A key part of the first step involves the alternative use of an FRM System (FRMS) in place of prescribed flight duty limits to determine what is acceptable "scientifically defensible scheduling." It takes into account known variables that affect sleep and alertness which prescriptive flight/duty limits cannot address, such as multiple time zone crossings, sleep at inappropriate circadian times, night work, effects of sunlight, and cumulative sleep deficit. Using the latest technology, an FRMS employs a multi-layered defense to manage operational fatigue risk proactively. Data related to crew alertness, as well as operational flight performance data, are routinely collected and analyzed.

An FRMS's comprehensive range of safeguards is designed to control the risk associated with both transient and cumulative fatigue. In contrast to prescriptive limits, this approach does not rely on *a priori* decisions about the factors most likely to be causing fatigue. Instead FRMS is data-driven, monitoring where fatigue risk occurs and where safety may be jeopardized. It then allows for generating new scheduling solutions or other strategies to mitigate measured fatigue risk. At the same time, FRMS provides operators with flexibility to seek the most efficient safe crewing solutions to meet operational needs.

In early 2006, the International Civil Aviation Organization (ICAO) established a Fatigue Risk Management Sub-Group (FRMSG) of the Operations Panel to develop an international regulatory framework for fatigue risk management in commercial aviation. Their starting point was the FRMS model developed by the Flight Safety Foundation for ultra-long range operations (i.e., flights longer than 16 hours), through a series of international workshops involving airlines, representatives of flight and cabin crew, regulators, and scientists (ref 4). The draft regulatory framework developed by the FRMSG defines FRMS as a data-driven, flexible alternative to prescriptive flight and duty time limitations which is based on scientifically valid principles and measurements. It requires a continuous process of monitoring and managing fatigue risk. FRMS incorporates the management of operational fatigue risk into a proactive and accountable Safety Management System (SMS) framework (ref 3) which is data-driven to reflect unique and changing airline factors.

FRMS enables an enhanced level of safety because it is a data-driven, ongoing adaptive process which can identify fatigue risks and develop and evaluate mitigation strategies to manage any emerging operational risks relevant to specific circumstances.

In its current form the draft ICAO FRMS framework is based on three key structural elements:

**Fatigue Risk Management Policy**, which establishes the commitment of senior management to the general philosophy and goals of the operator's FRMS. It also defines management and employee responsibilities at all levels for the elements of the FRMS;

**Fatigue Management Steering Group**, which coordinates all fatigue management activities (e.g., standard operating procedure [SOP] recommendations, rostering, and data collection and analysis). It includes all stakeholders, including those with scientific, data analysis, operational and medical expertise; and

**Sleep/Fatigue Awareness and Countermeasure Training**, which is designed to educate relevant staff about sleep and performance.

The draft FRMS framework is currently under consideration by ICAO. ICAO envisions the FRMS framework to be a high-level policy document which needs to be accompanied by more specific guidance to regulators and operators on how to actually implement an FRMS program. Efforts are under way to develop the latter.

An FRMS enhances the capability of prescriptive flight-time limitation concepts to provide an equivalent or enhanced level of safety based on the identification and management of fatigue risk relevant to the specific circumstances. Use of an FRMS can allow greater operational flexibility and efficiency while maintaining safety by relying on in-flight measurements of sleep and alertness, including subjective reports by crew members, to monitor how scheduling affects flight and cabin crew alertness during flight duty.

Commercially available computer models aim to predict average performance capability from sleep/wake history and circadian rhythm (24-hour physiological cycle) phase. They can be embedded within FRMS as a component to help understand the likely effects on performance of sleep obtained before and during trip patterns. Such models, though not required, encapsulate the latest scientific research on human circadian systems, sleep, and performance capability and can be useful for rapidly estimating the likely fatigue levels associated with proposed new routes or schedule changes. However, certain assumptions and limitations need to be taken into account.

An FRMS, where implemented, should be an integral part of an operator's established SMS and its capability should be commensurate with the risk oversight needs. An FRMS applies SMS principles and processes to proactively and continuously manage fatigue risk through a process requiring shared responsibility amongst management and flight and cabin crewmembers. Since feedback and non-punitive reporting from flight and cabin crewmembers are essential elements of an FRMS, a "just culture" is integral to any FRMS program. By including Flight Operational Quality Assurance (FOQA) and Aviation Safety Action Program (ASAP) reporting as data tools within the FRMS framework, the operator can strengthen its multi-layered systematic defense against fatigue risk.

The FAA implicitly recognized this new safety opportunity by sponsoring a major international symposium in June 2008 titled "Aviation Fatigue Management Symposium: Partnerships for Solutions." For the first time, they brought together leading scientists and industry leaders from around the world to share the latest scientific and industry developments (ref 5). At that symposium several airlines outside the United States reported in detail on their already successful implementation of FRMS, both in short-haul and long-haul operations. The result has been improved safety, improved crew satisfaction, greater operational flexibility, and lower costs, including insurance costs. While the U.S. is lagging in FRMS implementation, the FAA has recently begun utilizing an FRMS approach to oversee three carriers' 16-hour-plus flights to destinations such as Mumbai, India and Hong Kong, China. The Foundation applauds this data-driven effort based on the Foundation's ULR Task Force recommendations.

The Department of Transportation has also sought to gather scientific expertise, and in March of this year hosted the second "International Conference on Fatigue Management in Transportation Operations" in Boston (ref 6).

The Flight Safety Foundation strongly encourages the industry to adopt the systematic three-pronged approach of Prevention, Mitigation, and Intervention to address fatigue risk management. The United States aviation community can no longer treat fatigue risk as just another rule that has to be met. A proactive focused commitment to fatigue management is the only way we can successfully address this serious safety concern. In this context the Foundation agrees strongly with the participants at the June 2008 FAA symposium that controlled rest on the flight deck should be made legal and used when necessary for safety of flight. The excuse that "it doesn't pass the Jay Leno test" is no longer valid. The traveling public understands that all measures should be taken to ensure an alert flight crew during approach and landing, the most risky phase of flight.

The Foundation also urges the FAA to capitalize on its June 2008 symposium and its ULR experience to further develop and implement FRMS within the context of current prescriptive flight-time limitations on a trial basis. As in other countries, close cooperation and support among airline management, pilot organizations, and regulators will be critical to achieving success. In addition, since ICAO is the appropriate body to establish mutually acceptable worldwide standards for FRMS, the Foundation strongly encourages the FAA's continued participation in and support of ICAO's efforts.

These two actions will enable U.S. commercial aviation to enhance its level of safety with regard to fatigue risk and to do so efficiently and proactively. The United States commercial aviation community should be leading the world in fatigue management instead of lagging behind other nations because of parochial interests that stifle consensus.

Thank you for your consideration.

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