Managing Fatigue in Helicopter Operations: Risks and Recommendations

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Board Member

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Mission

The NTSB is charged with:

1) determining the probable cause of transportation accidents

2) making recommendations to prevent their recurrence
The NTSB is Responsible for Investigating:

Aviation, highway, rail, marine, pipeline, and hazardous material accidents
PG&E/San Bruno Gas Pipeline Explosion
• 130,000+ accident investigations
• \(\sim 13,500\) safety recommendations
• 82\% acceptance rate
13,454 Safety Recommendations issued since 1967

- Railroad (2156)
  - 16.0%
- Aviation (5252)
  - 39.0%
- Marine (2352)
  - 17.5%
- Highway (2207)
  - 16.4%
- Pipeline (1253)
  - 9.3%
- Intermodal (234)
  - 1.7%

Rev: July 1, 2011
Major product: safety recommendations

Moral compass and industry conscience
“Swiss Cheese” Model (Reason)

Successive layers of defenses, barriers, and safeguards

Hazards

Accident
The Challenge (Haueter)

Successive layers of defenses, barriers, and safeguards
Fatigue in Helicopter Operations

- Risks
- Fatigue factors
- NTSB recommendations
Honorable John K. Lauber:

No Accident ≠ Safe Operation
Kalaheo, Hawaii (September 24, 2004)

5 fatalities

Honolulu Advertiser

5 fatalities
Contributing Factors (Fatigue)

“operator’s pilot-scheduling practices that likely had an adverse impact on pilot decision-making and performance”
District Heights, Maryland (September 27, 2008)

4 fatalities, 1 serious injury
Finding #17 (Fatigue)

“Based on the late hour, the length of time awake, the risk factors for sleep apnea exhibited by the pilot, and the decision to deviate from the published procedures, the pilot was likely less than fully alert, and fatigue may have contributed to his deficient decision-making.”
Contributing Factors (Fatigue)

. . . “the pilot’s fatigue” . . .
Fatigue can degrade every aspect of human capability.
Fatigue Risks

- awake/alert
- reduced performance
- variability
- asleep
Performance Reduced 20-50+%

- Memory
- Communication
- Mood
- Situational awareness
- Reaction time
- Judgment
- Attention
- Impaired mood
- Concentration
Fatigue and Reaction Times

Fatigue Factors

• sleep
  - acute sleep loss
  - cumulative sleep debt

• circadian clock

• hours awake

• sleep disorders
Sleep Requirement

![Graph showing the distribution of sleep hours with a peak at 8 hours.]
Cumulative Sleep Debt

Cumulative Sleep Debt is the difference between the amount of sleep needed and the amount of sleep actually obtained over a period of time. As time passes, the sleep debt grows cumulatively over time. The diagram illustrates the relationship between time (days), hours of sleep, sleep need, actual sleep, and sleep debt.

Sleep Need – Actual Sleep = Sleep Debt

Sleep debt grows cumulatively over time.
Fatigue Factors

• sleep

• circadian clock
  - ‘sleepy’ windows
  - ‘alert’ windows
  - irregular schedule
  - time zones

• hours awake

• sleep disorders
Fatigue Factors

- sleep
- circadian clock
- hours awake
  - > 12 hrs
  - > 16 hrs
  - 24 hrs
- sleep disorders
Fatigue Factors

• sleep
• circadian clock
• hours awake
• sleep disorders
  - ~ 90 sleep disorders
Fatigue Factors: Environmental

- Helicopters:
  - noise
  - vibration
Alertness Reports Often Inaccurate

Subjective alertness

Physiological alertness

Time

Adapted from Sasaki et al., 1986
NTSB Most Wanted List
Critical changes needed to reduce transportation accidents and save lives.

MOST WANTED LIST
A program to increase the public’s awareness of, and support for, action to adopt safety steps that can help prevent accidents and save lives. The following are ten of the current issues.

- Addressing Human Fatigue
- General Aviation Safety
- Safety Management Systems
- Runway Safety
- Bus Occupant Safety
- Pilot & Air Traffic Controller Professionalism
- Recorders
- Teen Driver Safety
- Addressing Alcohol-Impaired Driving
- Motorcycle Safety
NTSB Recommendations

• MOST WANTED since 1990
• ~200 fatigue recommendations
Complex Issue: Requires Multiple Solutions

- Scheduling Policies and Practices
- Education
- Organizational Strategies
- Raising Awareness
- Healthy Sleep
- Vehicle and Environmental Strategies
- Research and Evaluation
NTSB Recommendations: Hours of Service / Scheduling

• Science-based hours of service
• Allow for at least 8 hours of uninterrupted sleep
• Reduce schedule irregularity and unpredictability
NTSB Recommendations:
Fatigue Management Systems

- Develop guidance based on empirical and scientific evidence for operators to establish fatigue management systems
- Develop and use a methodology that will continually assess the effectiveness of fatigue management systems
NTSB Recommendations: Education/Strategies

- Develop a fatigue education and countermeasures training program
- Educate operators and schedulers
- Include information on use of strategies: naps, caffeine, etc.
- Review and update materials
NTSB Recommendations: Education/Strategies

• Include information on use of strategies: naps, caffeine, etc.

• No recommendations on specific personal strategies
Example: NASA Planned Rest Study
Changing Safety Culture

Safety goal . . .

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