Examining Fatigue in an Accident Investigation: An NTSB Perspective

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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
Major product: safety recommendations

Moral compass and industry conscience
• 130,000+ accident investigations

• 13,000+ safety recommendations

• 82% acceptance rate
NTSB: The Board

• Five Members:
  - President nominates
  - Senate confirms

Mark Rosekind
Member

Chris Hart
Vice Chairman

Debbie Hersman
Chairman

Robert Sumwalt
Member

Earl Weener
Member
Go! Flight 1002

- early starts, multiple segment days, sleep apnea
Honorable John K. Lauber:

No Accident ≠ Safe Operation
Fatigue Risks

Fatigue can degrade every aspect of human capability.
Fatigue Risks

• degraded 20 – 50%+: 
  - reaction time
  - memory
  - communication
  - situational awareness

• increased: 
  - irritability
  - apathy
  - attentional lapses
  - microsleeps
Fatigue Risks

- awake/alert
- reduced performance
- variability
- asleep
Fatigue and Reaction Times

Fatigue Factors

• sleep

• circadian clock

• hours awake

• sleep disorders
Fatigue Factors

• sleep
  - acute sleep loss
  - cumulative sleep debt

• circadian clock

• hours awake

• sleep disorders
Fatigue Factors

• sleep

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

• hours awake

• sleep disorders
After Traveling Eastward

Sleep periods

Individuals

Home Destination
After Traveling Westward

Home Destination
NASA Long-Haul Study
Circadian Results

• 80% of crewmembers showed circadian variation in temperature (ave period = 25.7 hr)

• 20% had no detectable circadian rhythm
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
  - sleep apnea
Sleep Apnea is a Safety Risk

- > 6 times increased risk for crash
- > 7 times increased risk for multiple crashes
- SA performance = 0.06 - 0.08 BAC
Guantanamo Bay Cuba

First NTSB aviation accident to cite fatigue as probable cause

- acute sleep loss, sleep debt, circadian disruption
Fatigue Factors: Accident Investigation

- Acute sleep loss/cumulative sleep debt
- Continuous hours of wakefulness
- Time of day/circadian effects
- Sleep disorders
Crew Sleep History

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<td>6 h</td>
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- **Sleep**
- **Wake**
- **Duty**

**Accident MGUM**
Observed Performance Effects

- Degraded decision-making
- Visual/cognitive fixation
- Poor communication/coordination
- Slowed reaction time
“The National Transportation Safety Board determines that the probable causes of this accident were the impaired judgment, decision making, and flying abilities of the captain and flight crew due to the effects of fatigue…”
Owatonna, MN/July 31, 2008

8 fatalities
Owatonna Crew Fatigue Factors

- acute sleep loss (Capt/FO)
- cumulative sleep debt (FO)
- early start time (Capt/FO)
- excessive sleep need (Capt)
- insomnia (FO)
- self-medicate/prescription sleep med (FO)
“The National Transportation Safety Board determines that the probable cause of this accident was the captain’s decision to attempt a go-around late in the landing roll with insufficient runway remaining. Contributing to the accident were (1) the pilots’ poor crew coordination and lack of cockpit discipline; (2) fatigue, which likely impaired both pilots’ performance; and (3) the failure of the Federal Aviation Administration to require crew resource management training and standard operating procedures for Part 135 operators.”
Shuttle America Flight 6448

- 4 crew + 71 PAX: only 3 minor injuries
- Capt awake 31 hrs, FO 3-day 6-leg sequence
Kirksville, Missouri, October 19, 2004

- 2 crew + 11 PAX fatally injured, 2 serious injuries
- circadian disruption, 6th flight segment
Continental Connection (Colgan Air) Buffalo NY (February 12, 2009)

• 50 fatalities; commuting, acute sleep loss
Fatal Airline Accidents (Examples) (fatigue cited)

- 8/97 Guam: 228 fatalities
- 6/99 Little Rock AK: 11 fatal
- 10/04 Kirksville MO: 11 fatalities
- 8/06 Lexington KY: 49 fatalities
- 7/08 Owatonna MN: 8 fatalities
- 2/09 Buffalo NY: 49 fatalities
NTSB Recommendations

• MOST WANTED since 1990

• 190+ 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
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
Hours of Service / Scheduling

- Science-based hours of service
- Allow for at least 8 hours of uninterrupted sleep
- Reduce schedule irregularity and unpredictability
Health Related Recommendations

• Develop standard medical exam to screen for sleep disorders; require its use

• Educate companies and individuals about sleep disorder detection and treatment, and the sedating effects of certain drugs

• Establish a system to track prescription and OTC drug use of operators
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