Enhancing Transportation Safety:
NTSB Investigations and Recommendations

Honorable Mark R. Rosekind, Ph.D.
Board Member

ISASI
San Francisco Chapter
February 24, 2012
Presentation Topics

• **NTSB overview**

• Physiological fatigue factors

• Examining role of fatigue in accidents

• Strategies to manage fatigue
Mission

The NTSB is charged with:

1) determining the probable cause of transportation accidents

2) making recommendations to prevent their recurrence
In 1996, the Aviation Disaster Family Assistance Act: NTSB to coordinate victim and family assistance following a major aviation accident.

This responsibility was extended to other modes by Executive Order.
The NTSB is Responsible for Investigating:

Aviation, highway, rail, marine, pipeline, and hazardous material accidents
PG&E/San Bruno Gas Pipeline Explosion
Key On-scene Events

Organizational Meeting
- Designate parties and party coordinators
- Establish and organize groups

Progress Meetings
- Summarize findings
- Info for briefings

Family Briefings

Press Briefings
NTSB Investigative Process

On-scene Investigation
Organizational Meeting
Groups and Parties
Progress meetings
Media Briefings
Press Releases

Preliminary Report
Factual information

Public Hearing
Fact finding
Depositions
Witnesses
Docket

Board Meeting
Docket
Findings
Conclusions
Probable Cause
Safety Recommendations

Government in the Sunshine Act
• 130,000+ accident investigations

• ~13,500 safety recommendations

• 82% acceptance rate
13,454 Safety Recommendations issued since 1967

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

Rev: July 1, 2011
“Swiss Cheese” Model (Reason)

Successive layers of defenses, barriers, and safeguards

Accident

Hazards
The Challenge (Haueter)

Successive layers of defenses, barriers, and safeguards
Presentation Topics

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• *Physiological fatigue factors*

• Examining role of fatigue in accidents

• Strategies to manage fatigue
Fatigue Risks

Fatigue can degrade every aspect of human capability.
Performance Reduced 20-50+% 

Memory 
Communication 
Mood 
Situational awareness 

Reaction time 
Judgment 
Attention 
Impaired mood 
Concentration
Fatigue Factors

- sleep
- circadian clock
- hours awake
- sleep disorders
Cumulative Sleep Debt

Sleep need

Hours of Sleep

Sleep debt

Actual sleep

Time (days)

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
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Honorable John K. Lauber:

No Accident ≠ Safe Operation
Go! Flight 1002

- early starts, multiple segment days, sleep apnea
Four Fatigue Factors +

- Sleep loss
- Continuous hours of wakefulness
- Circadian/time of day
- Sleep disorders
- Other considerations
Guantanamo Bay Cuba

First NTSB aviation accident to cite fatigue as probable cause

- acute sleep loss, sleep debt, circadian disruption
### Crew Sleep History

<table>
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<td>8 h</td>
<td>9 h</td>
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<td>17.5 h</td>
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<td>8 h</td>
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<tr>
<td></td>
<td>9 h</td>
<td>6 h</td>
<td>21 h</td>
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</tbody>
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**0000 0800 1600 2400 0800 1600 2400 0800 1600 2400**

- **Sleep**: Capt. 8 h, 9 h, 2 h, 17.5 h, 5 h, 23.5 h, F/O 8 h, 9 h, 2 h, 19 h, 8 h, 19 h, F/E 9.5 h, 15 h, 6 h, 9 h, 6 h, 21 h
- **Wake**: Accident MGUM
• 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)
“Contributing to the accident were . . . (2) fatigue, which likely impaired both pilots’ performance; . . .”
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
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• Examining role of fatigue in accidents
• \textit{Strategies to manage fatigue}
MOST WANTED LIST

A program to increase the public's awareness of, and support for, actions to adopt safety steps that can help prevent accidents and save lives.

The following are ten of the current issues:

1. **Addressing Human Fatigue**
2. **General Aviation Safety**
3. **Safety Management Systems**
4. **Runway Safety**
5. **Bus Occupant Safety**
6. **Pilot & Air Traffic Controller Professionalism**
7. **Recorders**
8. **Teen Driver Safety**
9. **Addressing Alcohol-Impaired Driving**
10. **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
Example

Fatigue Risk Management Systems

Implementation Guide for Operators
1st Edition
July 2011

Fatigue Risk Management Systems
Manual for Regulators
2011 Edition
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
Changing Safety Culture

Safety goal . . .