



**NTSB** National Transportation Safety Board

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# **The NTSB: Overview, Addressing Fatigue, and Safety Tools**

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# Presentation Topics

- ***NTSB overview***
- Physiological fatigue factors
- Examining role of fatigue in accidents
- Strategies to manage fatigue
- NTSB tools to enhance safety



UNITED STATES CODE, TITLE 49

## CHAPTER 11—NATIONAL TRANSPORTATION SAFETY BOARD

### SUBCHAPTER 1—GENERAL

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1101. Definitions.

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### SUBCHAPTER 5—GENERAL

§1181. Definitions

Section 40102(a) of this title applies to this chapter.

### SUBCHAPTER 6—ORGANIZATION AND ADMINISTRATIVE

§1113. General organization

(a) ORGANIZATION.—The National Transportation Safety Board is an independent establishment of the Executive Branch of the Government.

(b) APPOINTMENT OF MEMBERS.—The Board is composed of 5 members appointed by the President, with the advice and consent of the Senate. Not more than 3 members may be appointed from the same political party. The members shall be appointed on the basis of technical qualification, professional standing, and demonstrated knowledge of accident reconstruction, safety engineering, human factors, transportation safety, or transportation regulation.

(c) TERMS OF OFFICE AND REMOVAL.—The term of office of each member is 7 years. An individual may be reappointed to fill a vacancy occurring before the expiration of the term for which the predecessor of that individual was appointed for the remainder of that term. When the term of office of a member ends, the President may reappoint a successor if a successor is appointed and qualified. The President may remove a member for inefficiency, neglect of duty, or other cause.

(d) CHAIRMAN AND VICE CHAIRMAN.—The President shall designate, by and with the advice and consent of the Senate, a Chairman of the Board. The President also shall designate a Vice Chairman of the Board. The terms of both the Chairman and Vice Chairman are 2 years. When the Chairman is absent or unable to perform the duties of the office, the Vice Chairman shall perform the duties of the office.

# 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



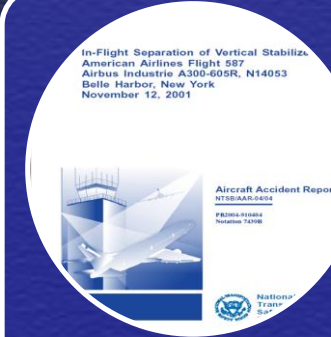
Preliminary Report  
Factual information



Public Hearing  
Fact finding  
Depositions  
Witnesses  
Docket



Board Meeting  
Docket  
Findings  
Conclusions  
Probable Cause  
Safety Recommendations



Final Report

**Government in the Sunshine Act**

NTSB

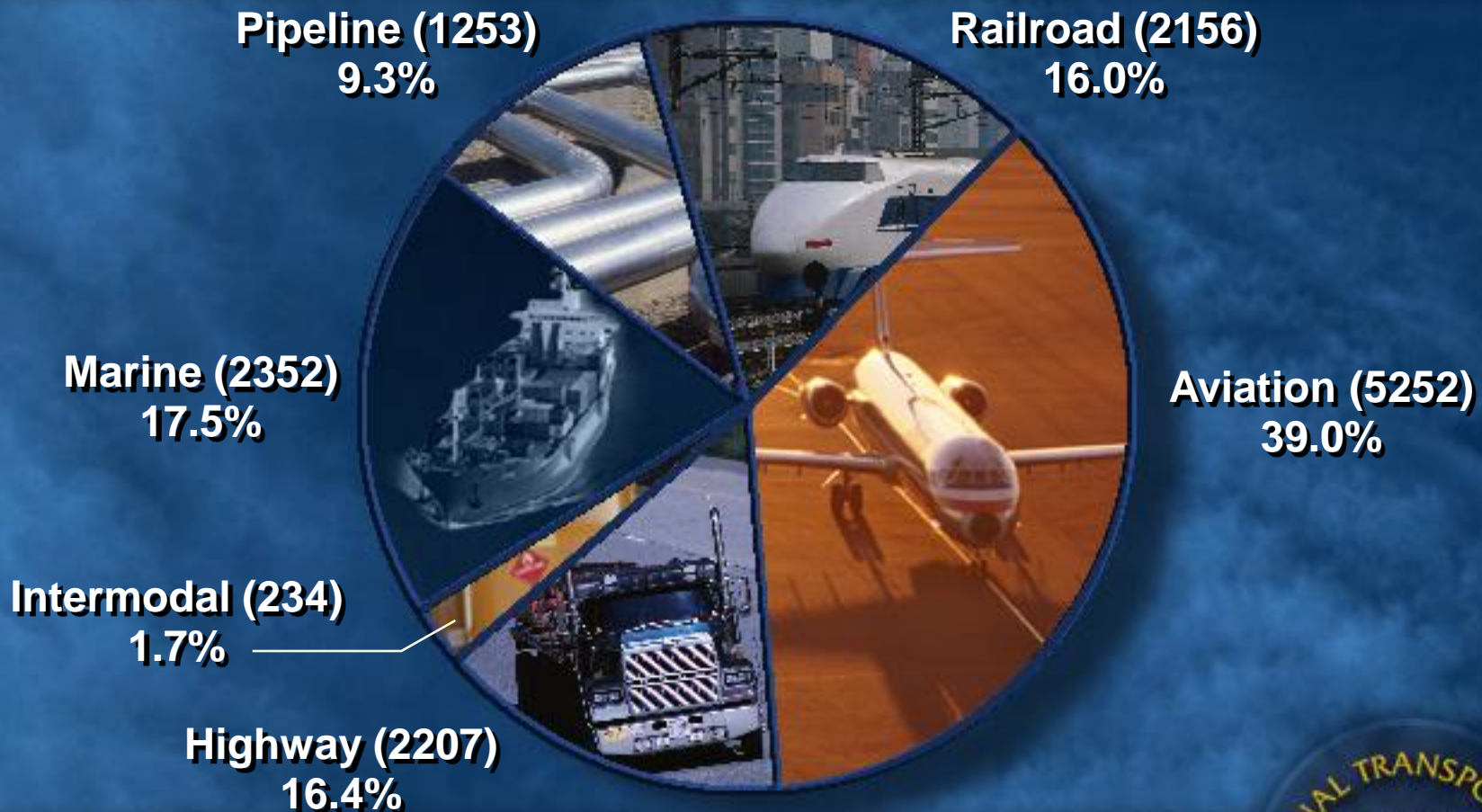




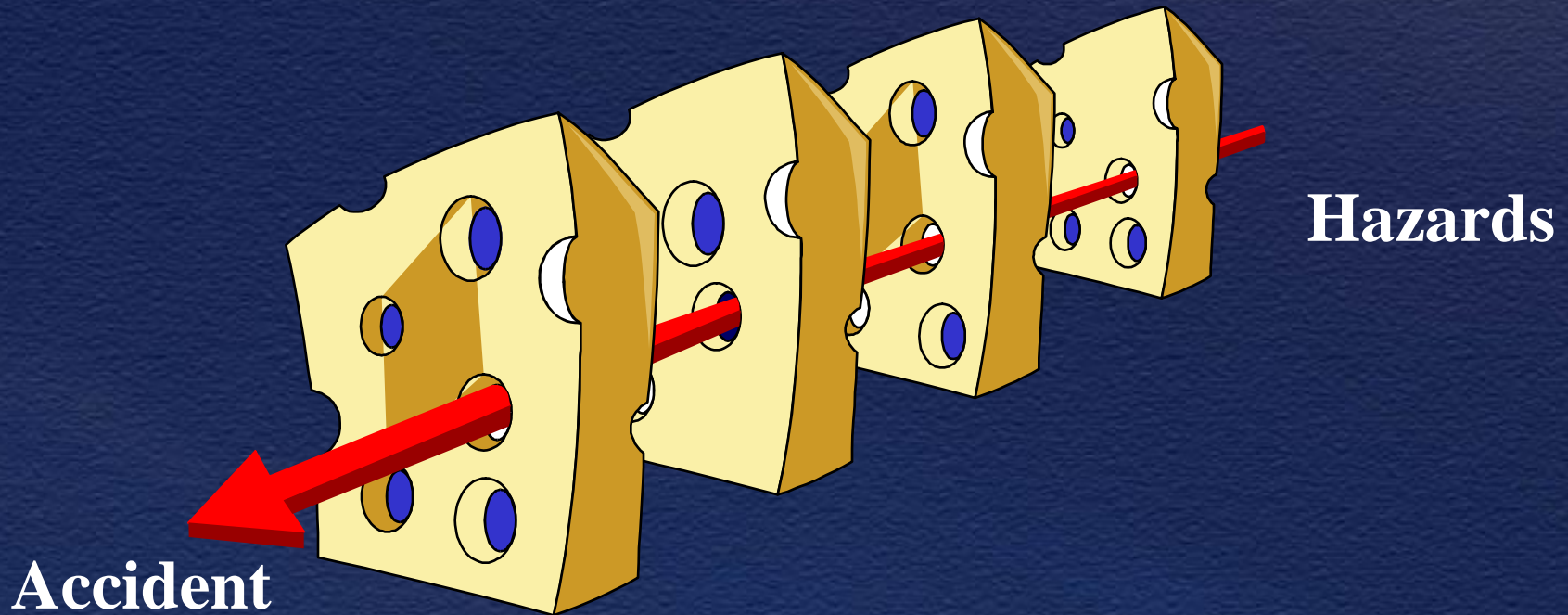


- 130,000+ accident investigations
- ~13,500 safety recommendations
  - 82% acceptance rate

# 13,454 Safety Recommendations issued since 1967

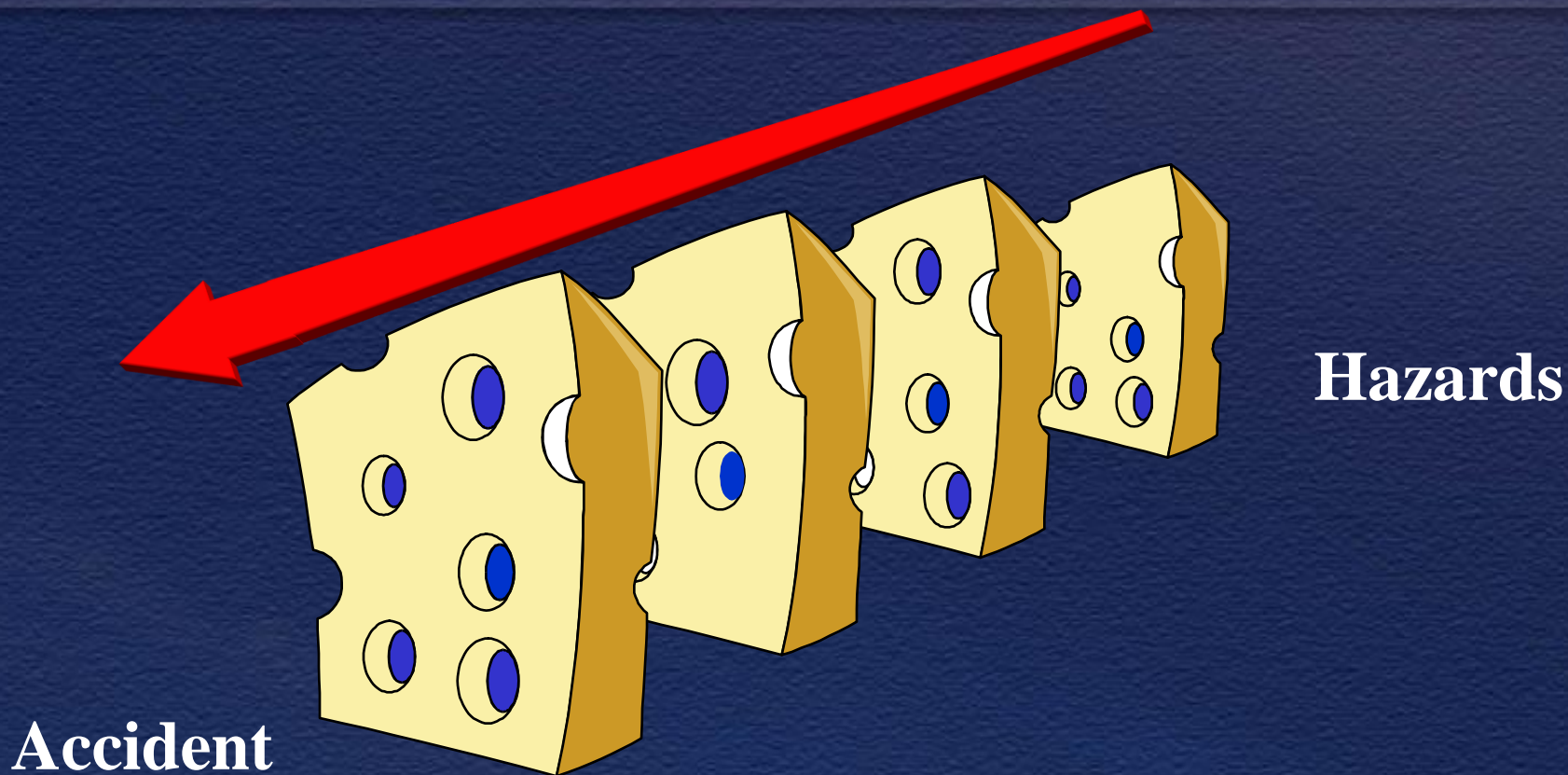


# “Swiss Cheese” Model (Reason)



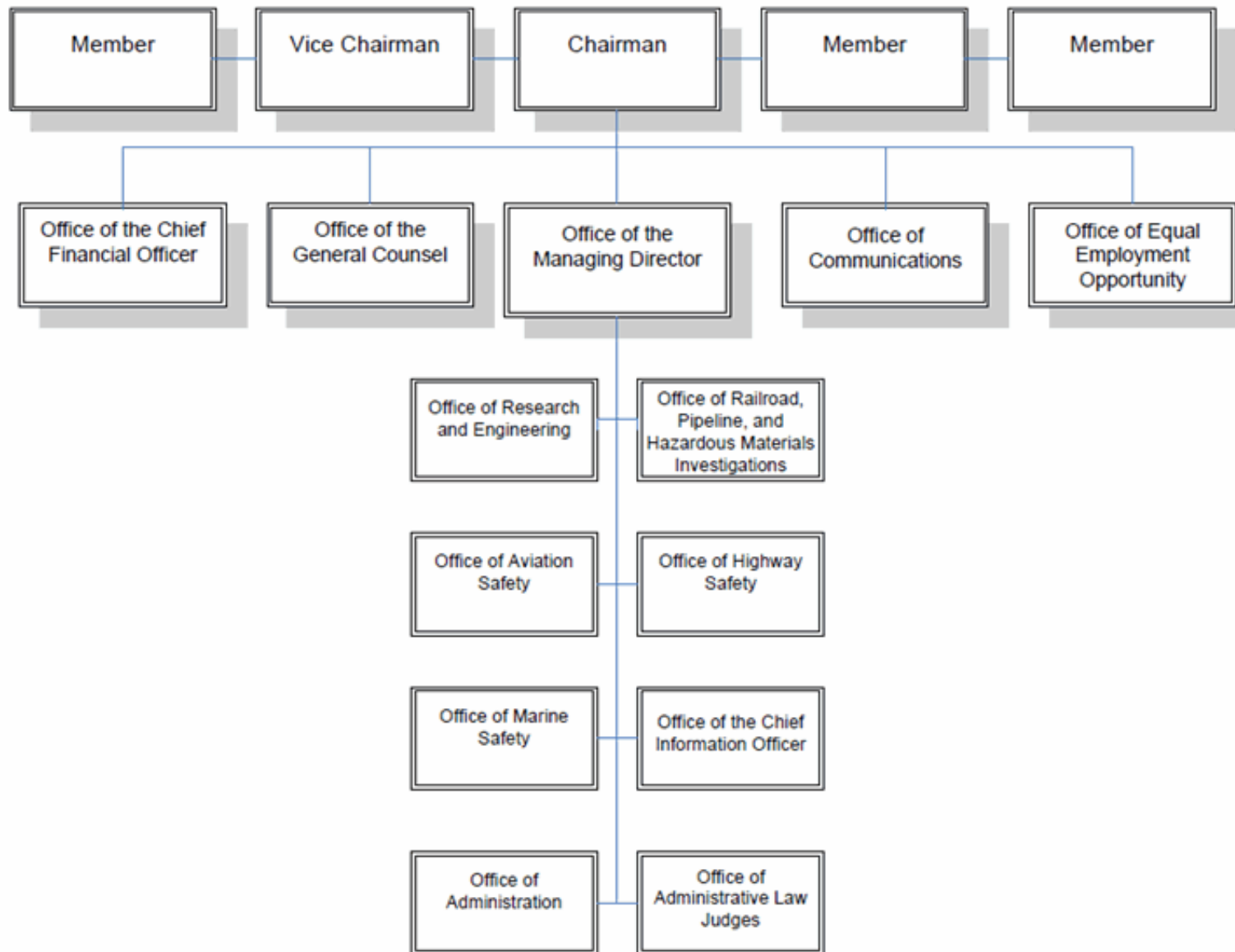
Successive layers of defenses, barriers, and safeguards

# The Challenge (Haueter)



Successive layers of defenses, barriers, and safeguards

# NATIONAL TRANSPORTATION SAFETY BOARD



# Presentation Topics

- NTSB overview
- ***Physiological fatigue factors***
- Examining role of fatigue in accidents
- Strategies to manage fatigue
- NTSB tools to enhance safety

# Fatigue Risks

Fatigue can degrade  
every aspect of  
human capability.

# Fatigue Risks





# Performance Reduced 20-50+%

Reaction time

Memory

Communication

Judgment

Attention

Mood

Impaired mood

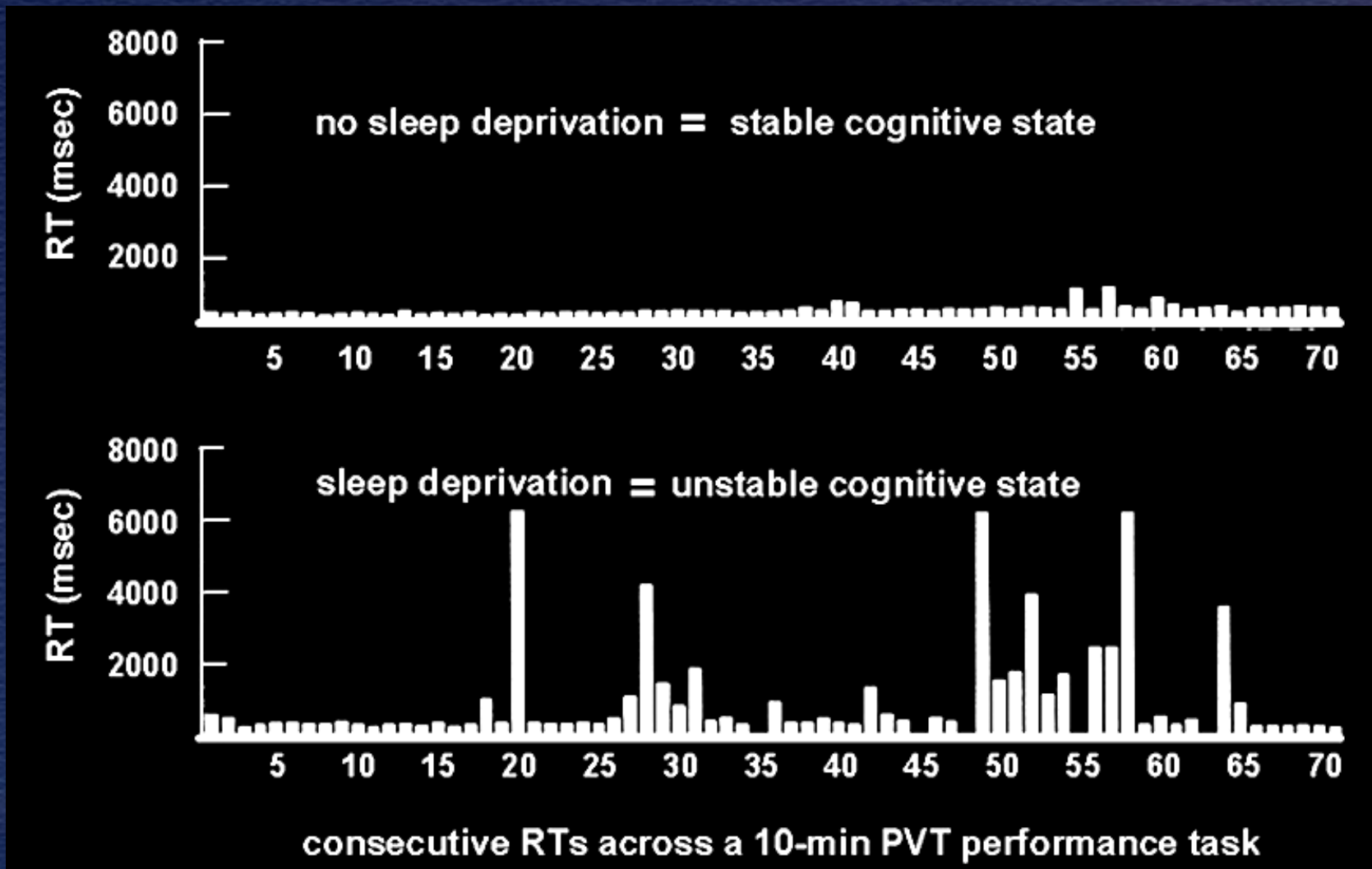
Situational awareness

Concentration

NTSB



# Fatigue and Reaction Times



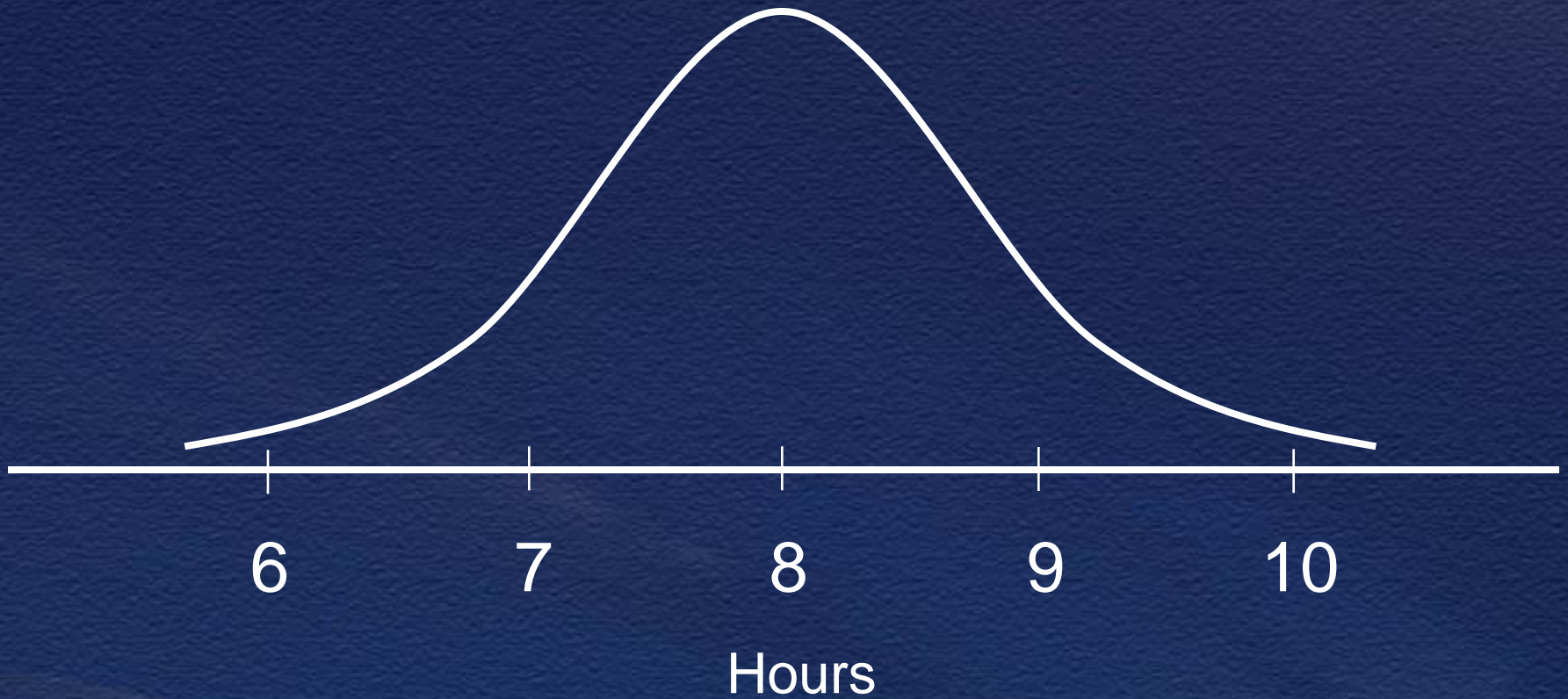
Doran SM, Van Dongen HP, Dinges DF. Sustained attention performance during sleep deprivation: evidence of state instability. *Archives of Italian Biology: Neuroscience* 2001;139:253-267.



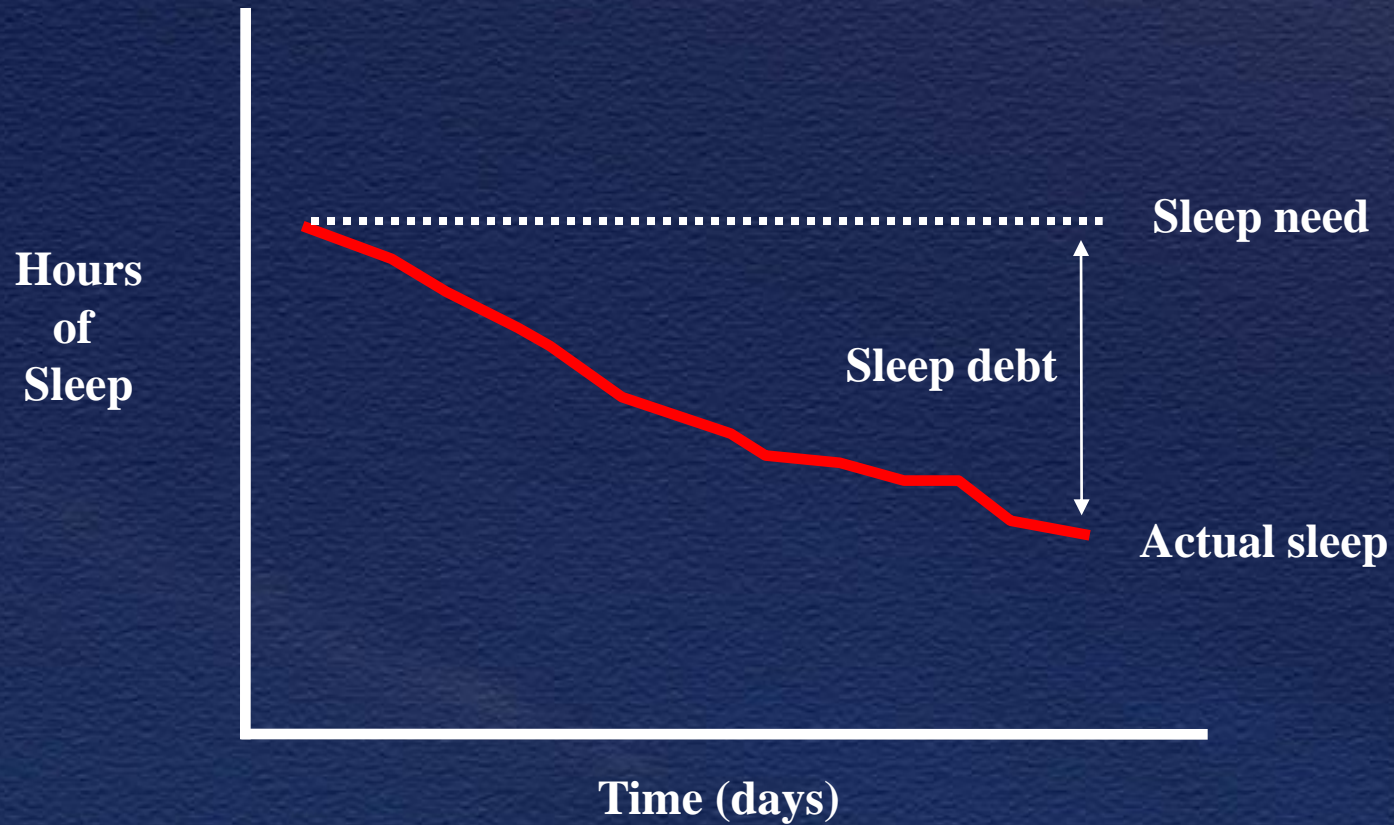
# Fatigue Factors

- sleep
- circadian clock
- hours awake
- sleep disorders

# Sleep Requirement



# Cumulative 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

# NASA Long-Haul Study

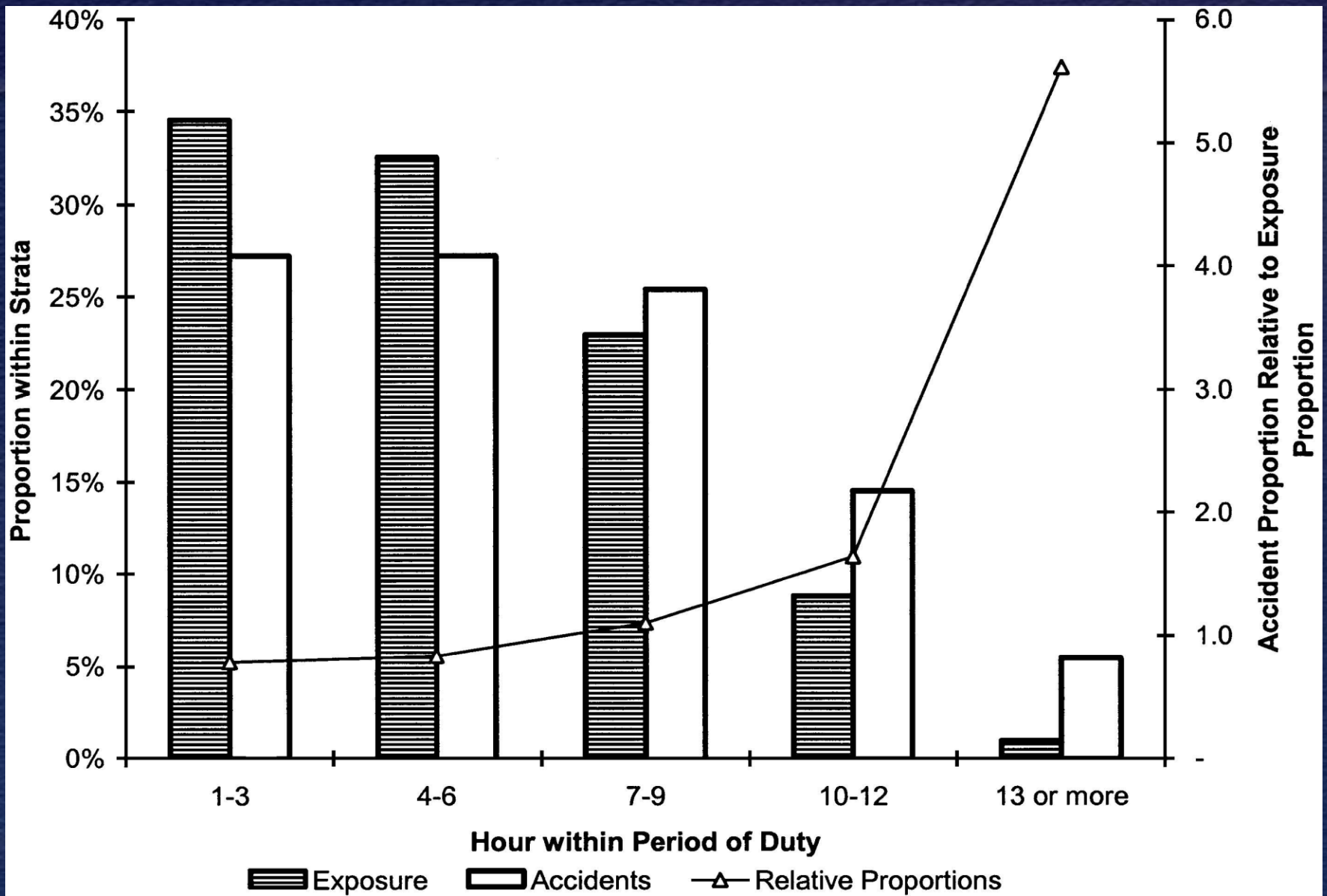
## Circadian Results

- 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





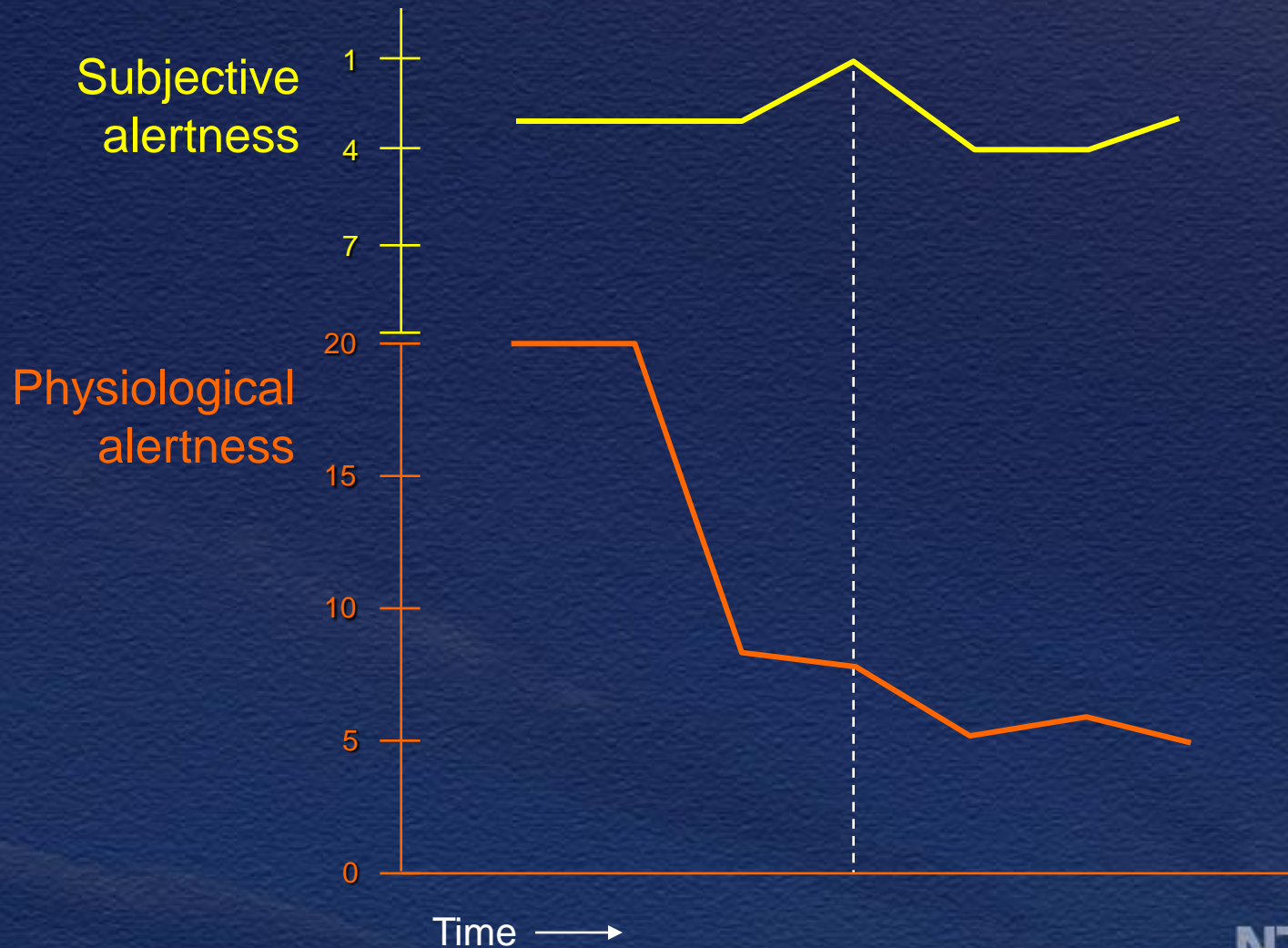
# Fatigue Factors

- sleep
- circadian clock
- hours awake
- sleep disorders
  - ~ 90 sleep disorders

# Sleep Apnea is a Safety Risk

- > 6 times increased risk for car crash
- SA performance = .06 - .08 BA

# Alertness Reports Often Inaccurate



Adapted from Sasaki et al., 1986

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# Honorable John K. Lauber:

No Accident  $\neq$   
Safe Operation

# Go! Flight 1002



- early starts, multiple segment days, sleep apnea

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# Four Fatigue Factors +

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



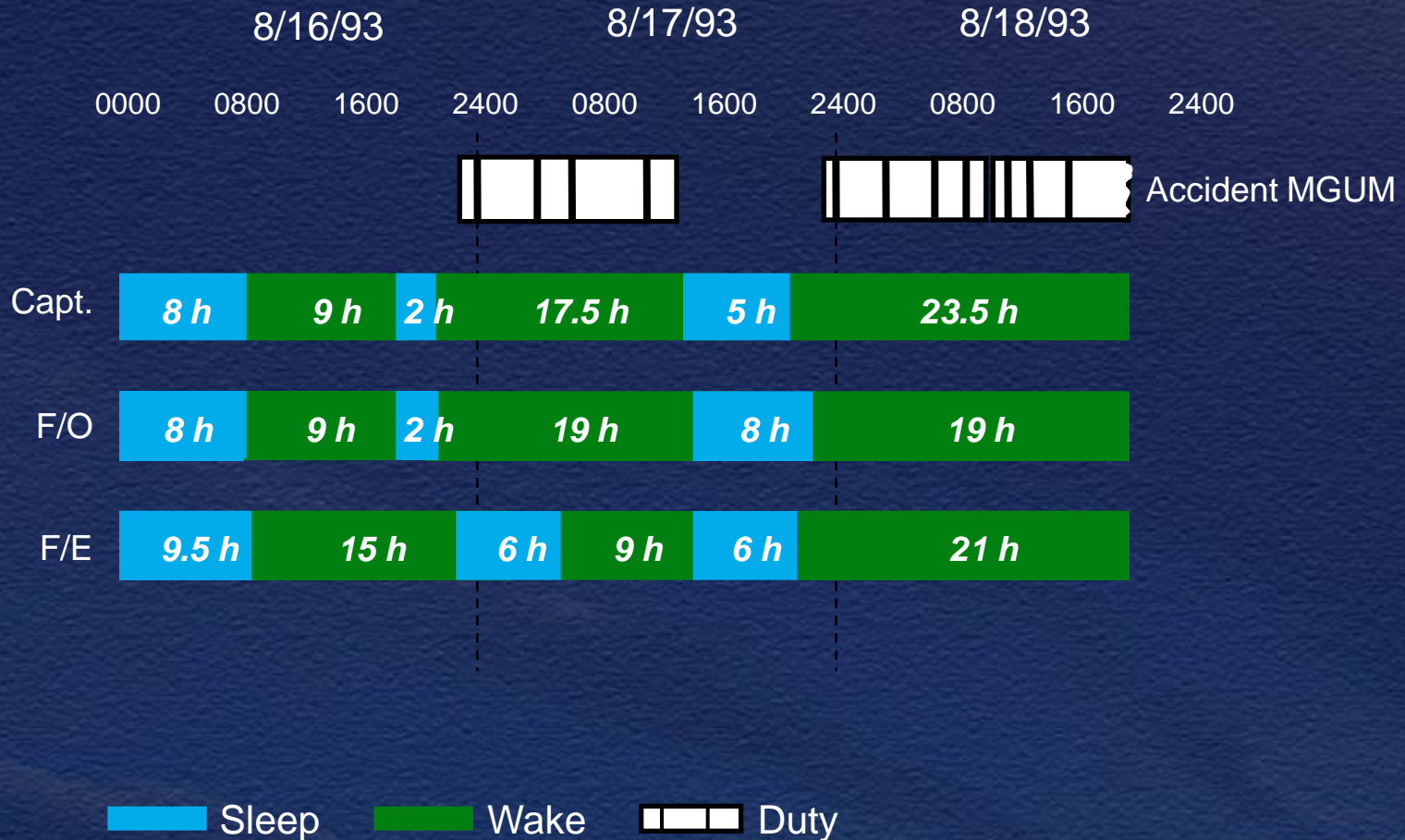
# Guantanamo Bay Cuba

First NTSB aviation accident to cite fatigue as probable cause



- acute sleep loss, sleep debt, circadian disruption

# Crew Sleep History



# Observed Performance Effects

- Degraded decision-making
- Visual/cognitive fixation
- Poor communication/coordination
- Slowed reaction time

**Uncontrolled In-Flight Collision with Terrain  
AIA Flight 808, Douglas DC-8-61, N814CK  
U.S. NAS, Guantanamo Bay, Cuba, August 18, 1993**

“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

NTSB



# 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)

# Probable Cause/Contributing Factors

“Contributing to the accident were . . .  
(2) fatigue, which likely impaired both  
pilots’ performance; . . .”

# Lubbock, TX (January 27, 2009)



2 injuries

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# Probable Cause/Contributing Factors

“Contributing to the accident were . . .

4) fatigue due to the time of day in which the accident occurred and a cumulative sleep debt, which likely impaired the captain’s 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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Home > Transportation Safety > Most Wanted List

SHARE   

## 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



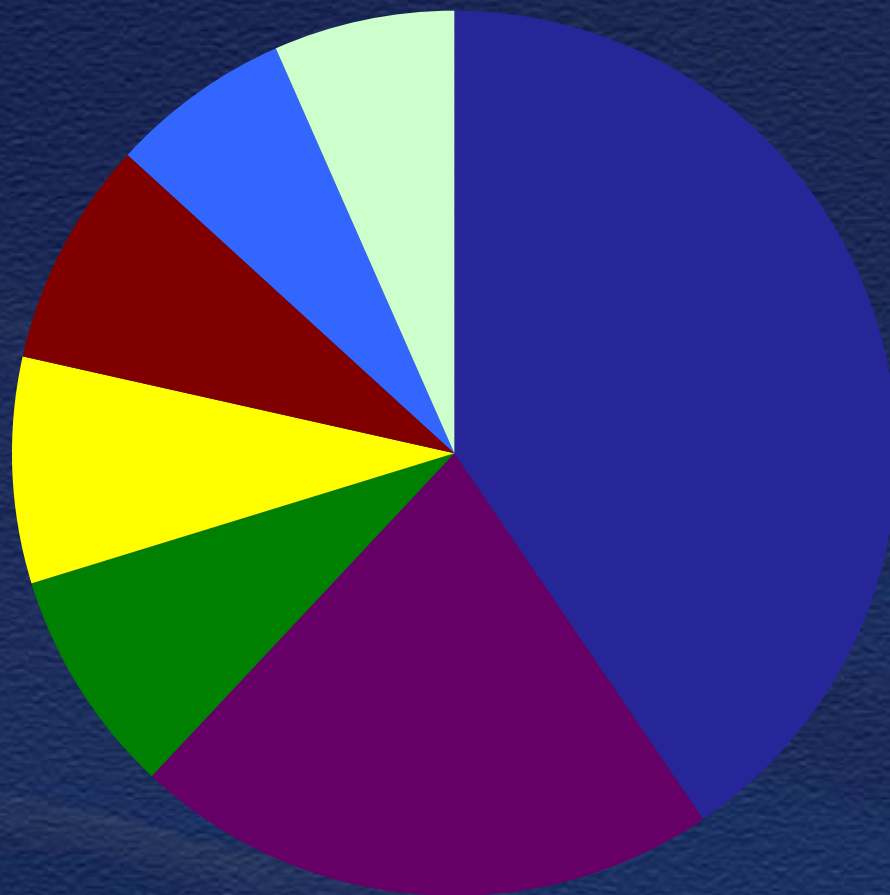
Motorcycle Safety



# 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

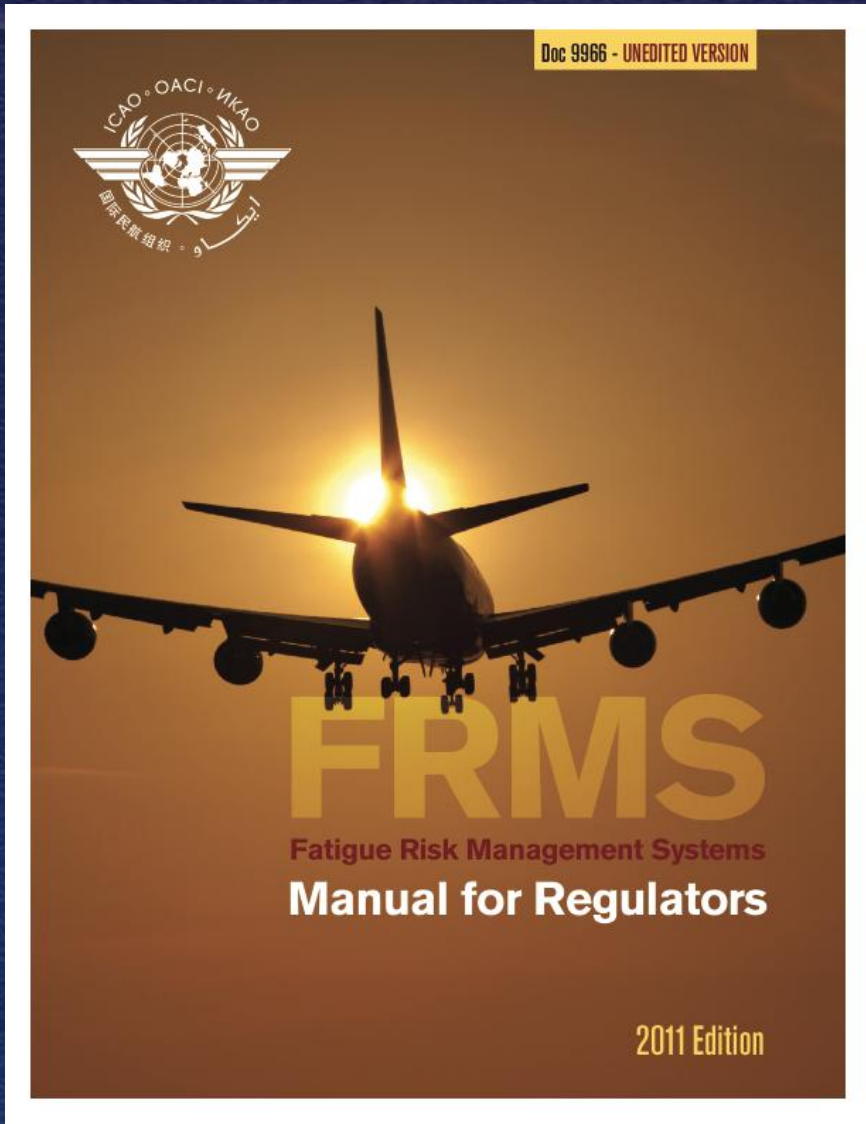
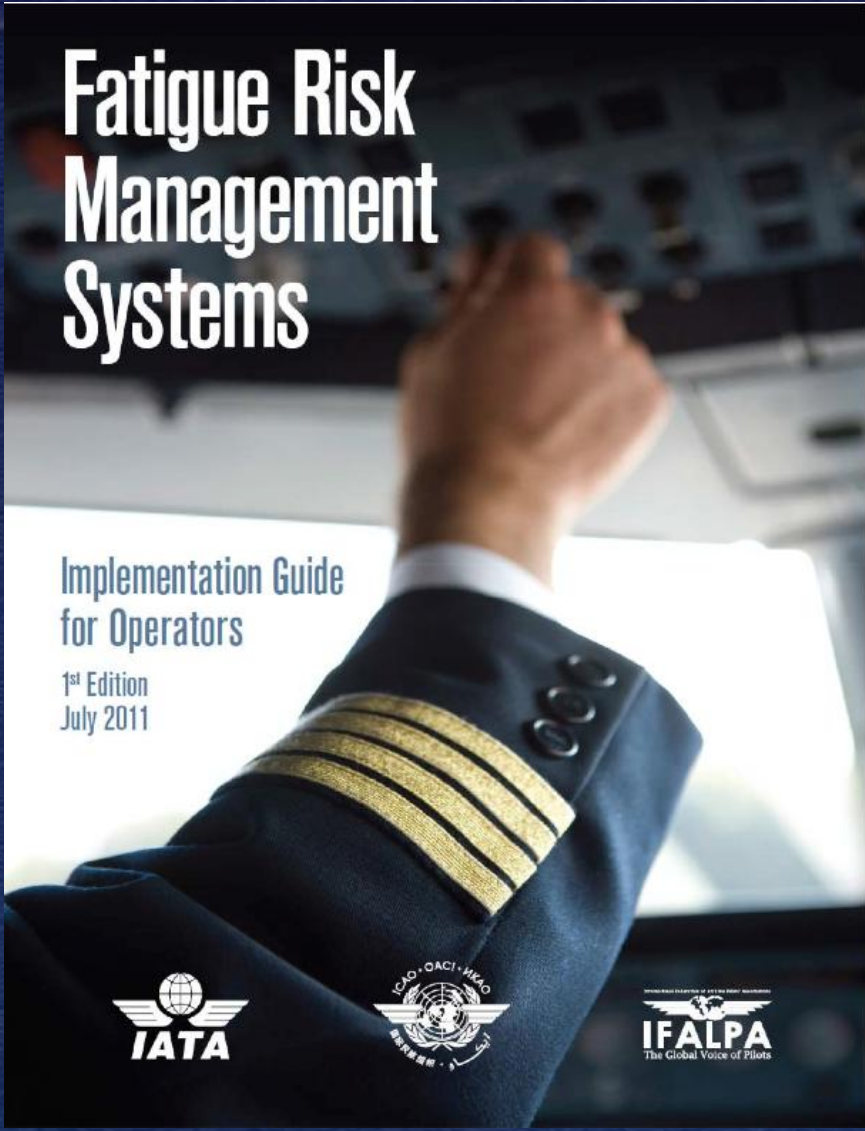
- Science-based hours of service
- Allow for at least 8 hours of uninterrupted sleep
- Reduce schedule irregularity and unpredictability

# 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



# Example



# 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

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# NTSB Tools to Enhance Safety: Five Examples (ntsb.gov)

- Accident reports
- Safety recommendations
- Most Wanted List
- Forums and symposia
- NTSB Training Center

# Changing Safety Culture

Safety goal . . .

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