



**NTSB** National Transportation Safety Board

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# **Managing Fatigue in Helicopter Operations: Risks and Recommendations**

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Board Member

HELI-EXPO  
February 11, 2012



UNITED STATES CODE, TITLE 49  
**CHAPTER 11—NATIONAL TRANSPORTATION SAFETY BOARD**

**SUBCHAPTER 1—GENERAL**

Sec.  
1101. Definitions.

**SUBCHAPTER 2—ORGANIZATION AND ADMINISTRATIVE**

1111. General organization.  
1112. Special boards of inquiry on air transportation safety.  
1113. Administrative.  
1114. Disclosure, availability, and use of information.  
1115. Training.  
1116. Reports and studies.  
1117. Annual report.  
1118. Authorization of appropriations.

**SUBCHAPTER 3—AUTHORITY**

1121. General authority.  
1122. Civil aircraft accident investigations.  
1123. Review of other agency action.  
1124. Inspections and audits.  
1125. Secretary of Transportation's responses to safety recommendations.

**SUBCHAPTER 4—ENFORCEMENT AND FINALITIES**

1131. Aviation enforcement.  
1132. Injurer and intervention in aviation proceedings.  
1133. Judicial review.  
1134. Discovery and use of cockpit voice and other material.  
1135. Aviation penalties.

**SUBCHAPTER 5—GENERAL**

§1181. Definitions

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

**SUBCHAPTER 6—ORGANIZATION AND ADMINISTRATIVE**

§1183. General organization

(a) ORGANIZATION.—The National Transportation Safety Board is an independent constitutional body of the Government.

(b) APPOINTMENT OF MEMBERS.—The Board is composed of 5 members appointed by the President, by and with the advice and consent of the Senate. Not more than 3 members may be appointed from the same political party. Members shall be appointed on the basis of technical qualification, professional standing, and demonstrated expertise in 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. At the end of the term, to fill a vacancy occurring before the expiration of the term for which the predecessor of that member was appointed for the remainder of that term. When the term of office of a member ends, the President may reappoint a successor if the member is appointed and qualified. The President may remove a member for inefficiency, neglect of duty, or other cause in office.

(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 his or her duties, the Vice Chairman shall act as Chairman.

# 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**



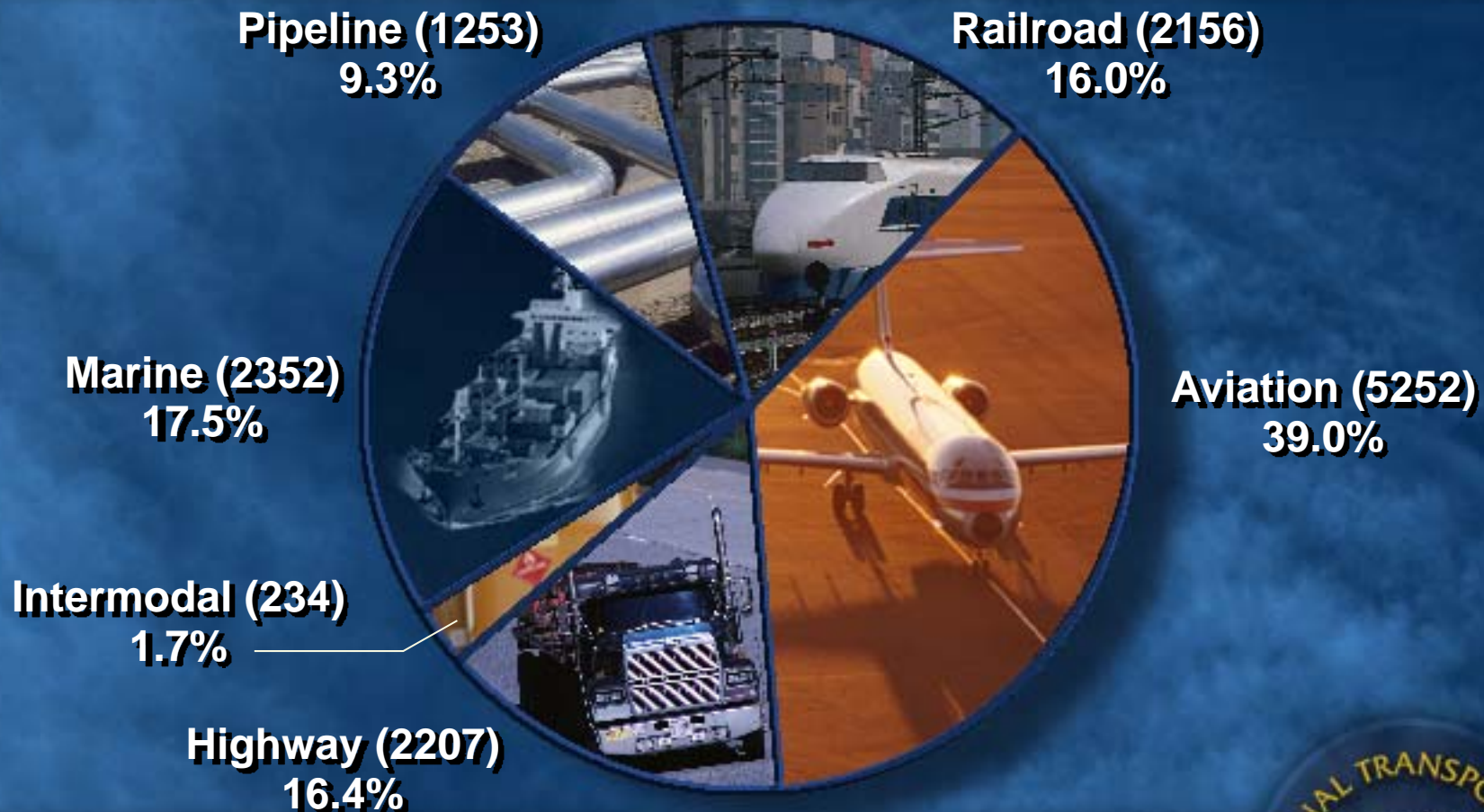
# PG&E/San Bruno Gas Pipeline Explosion





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

# 13,454 Safety Recommendations issued since 1967

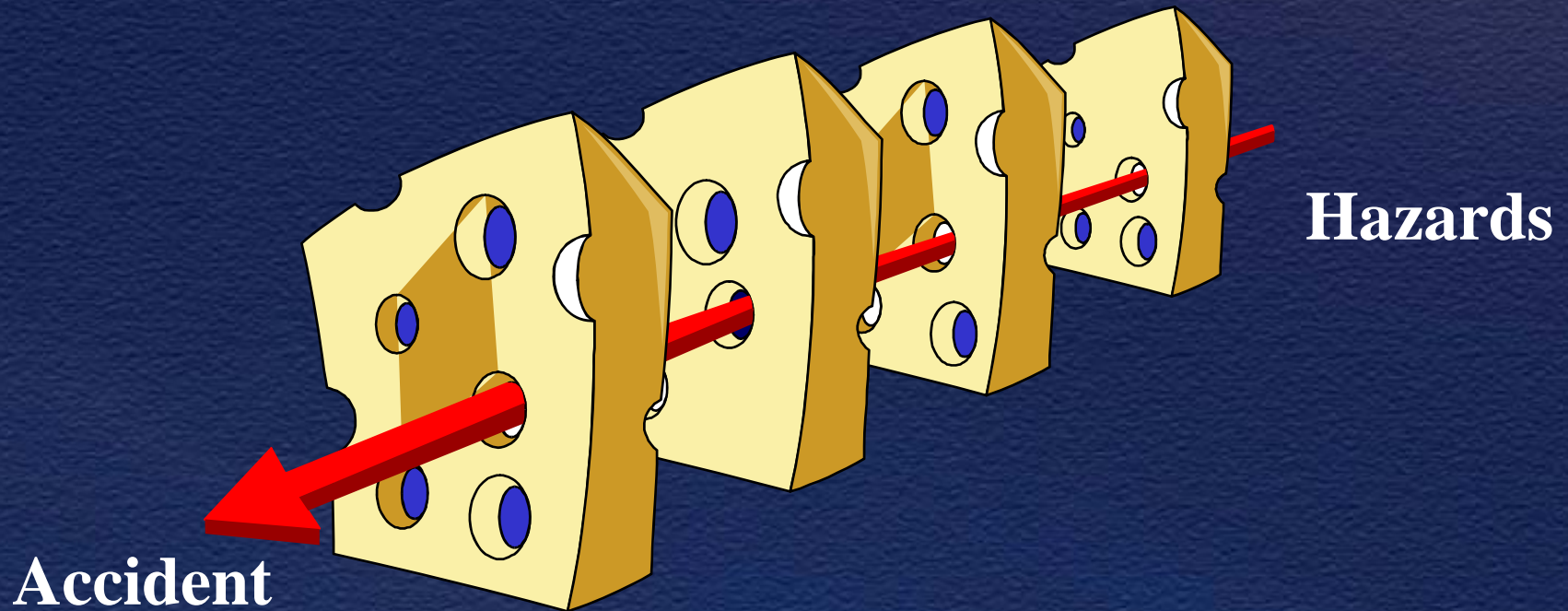




Major product: safety recommendations

Moral compass and industry conscience

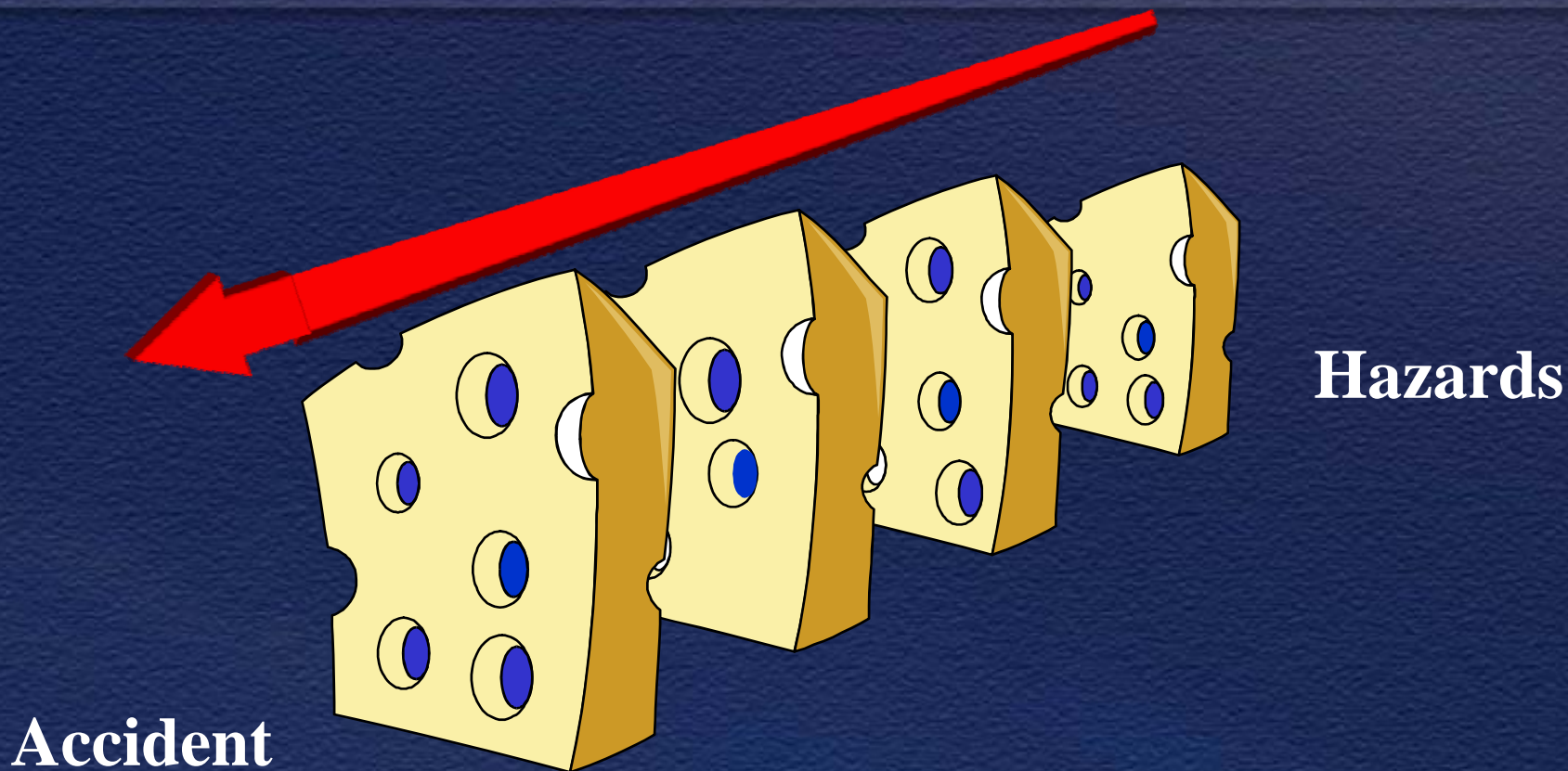
# “Swiss Cheese” Model (Reason)



Successive layers of defenses, barriers, and safeguards



# 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  $\neq$   
Safe Operation

# Kalaheo, Hawaii (September 24, 2004)



Honolulu Advertiser

5 fatalities

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# 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

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# 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.”

# Santa Fe, NM (June 9, 2009)



2 fatalities, 1 serious injury

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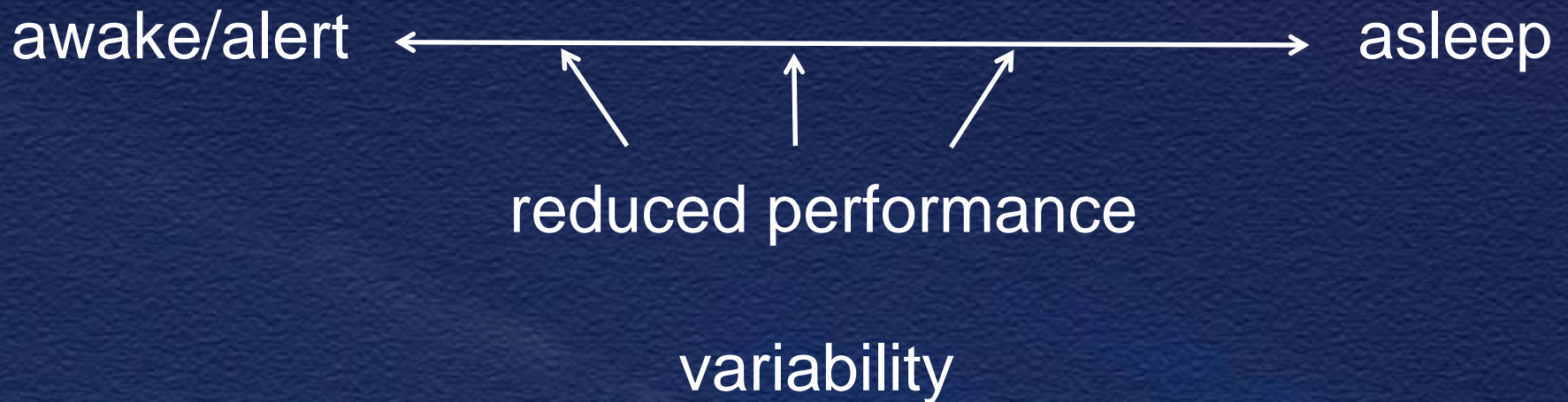
# Contributing Factors (Fatigue)

. . . . “the pilot’s fatigue” . . . .

# Fatigue Risks

Fatigue can degrade  
every aspect of  
human capability.

# Fatigue Risks



# Performance Reduced 20-50+%

Reaction time

Memory

Communication

Judgment

Mood

Attention

Impaired mood

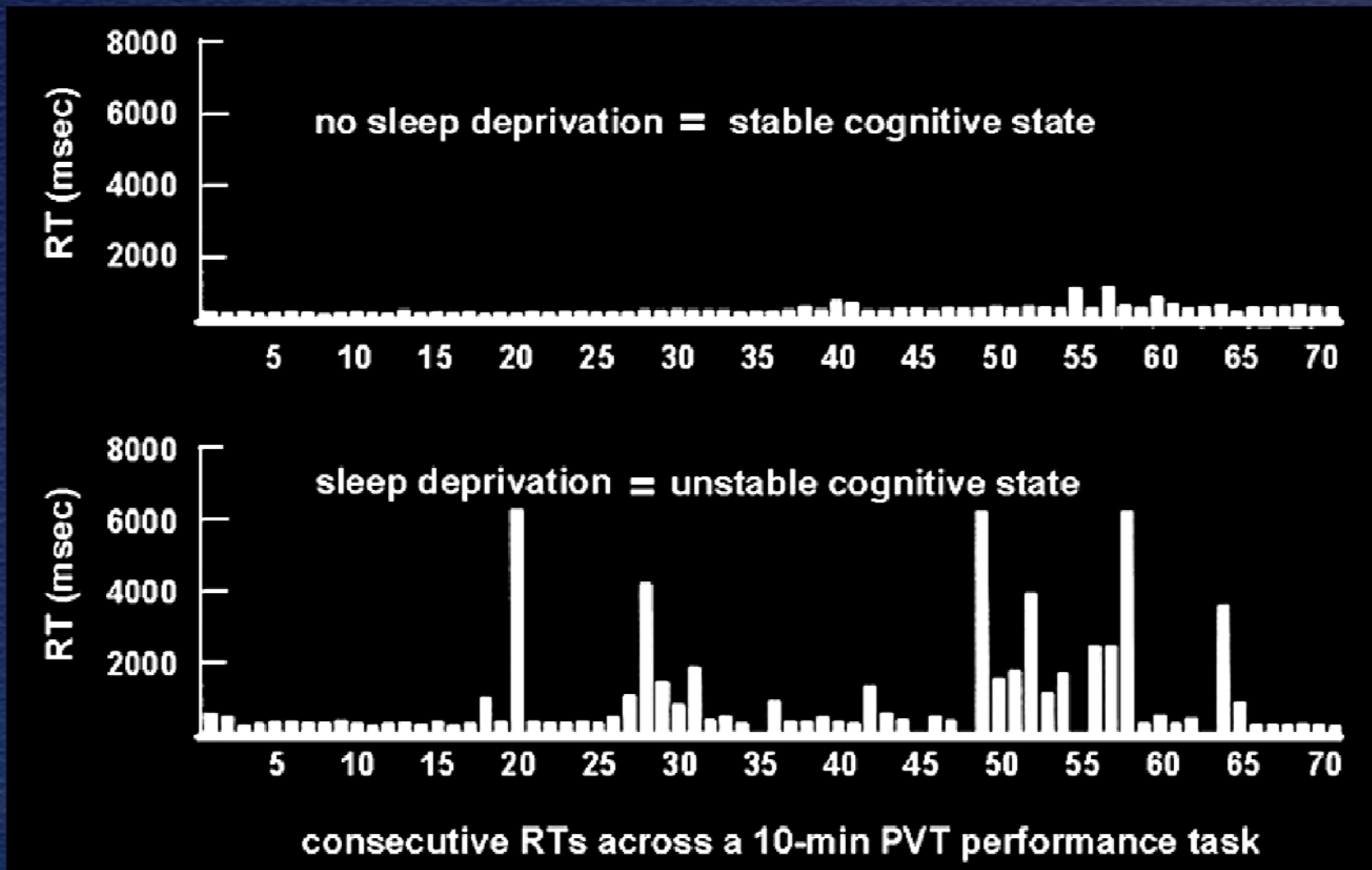
Situational awareness

Concentration

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# Fatigue and Reaction Times



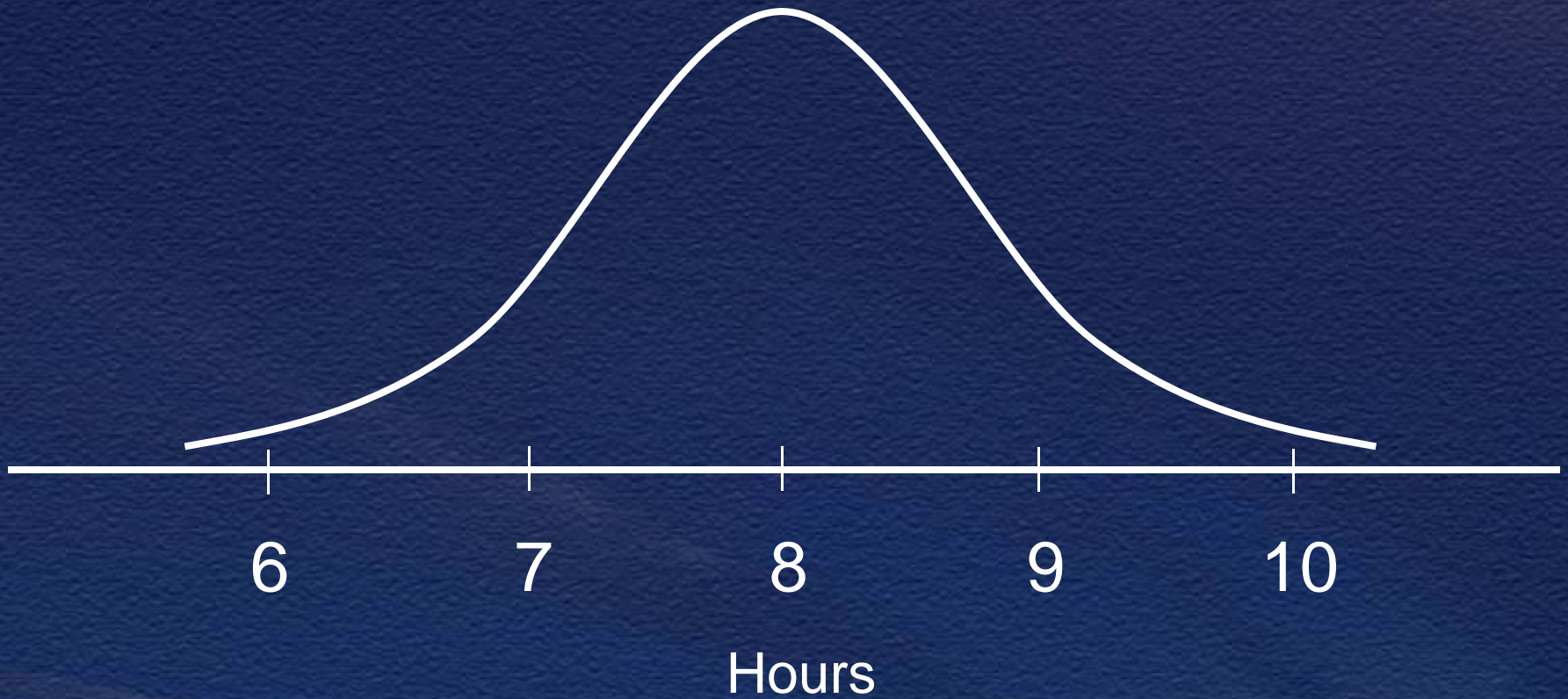
Doran SM, Van Dongen HP, Dinges DF. Sustained attention performance during sleep deprivation: evidence of state instability. *Archives of Italian Biology: Neuroscience* 2001;139:253-267.



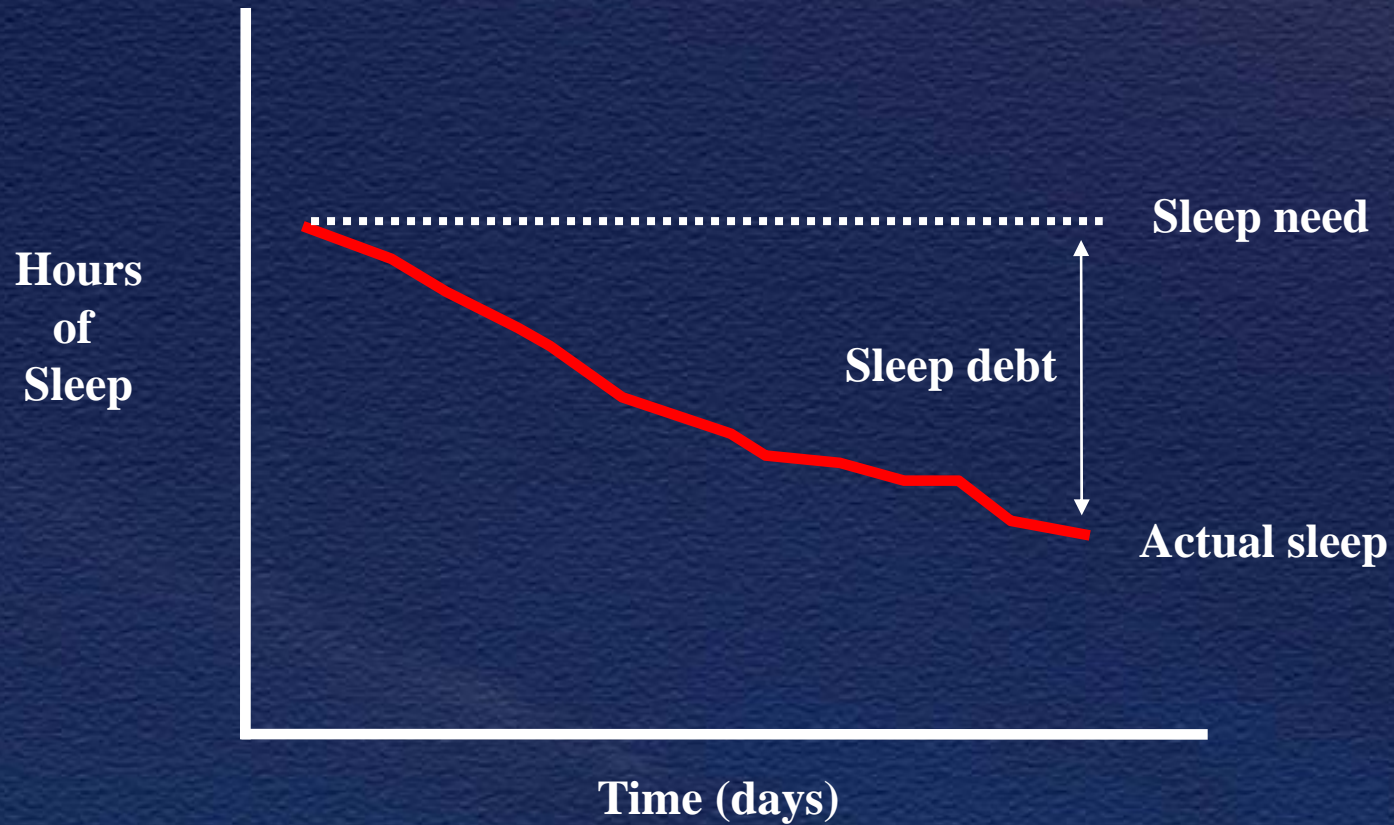
# Fatigue Factors

- sleep
  - acute sleep loss
  - cumulative sleep debt
- circadian clock
- hours awake
- sleep disorders

# Sleep Requirement



# Cumulative Sleep Debt



Sleep Need – Actual Sleep = Sleep Debt

Sleep debt grows cumulatively over time

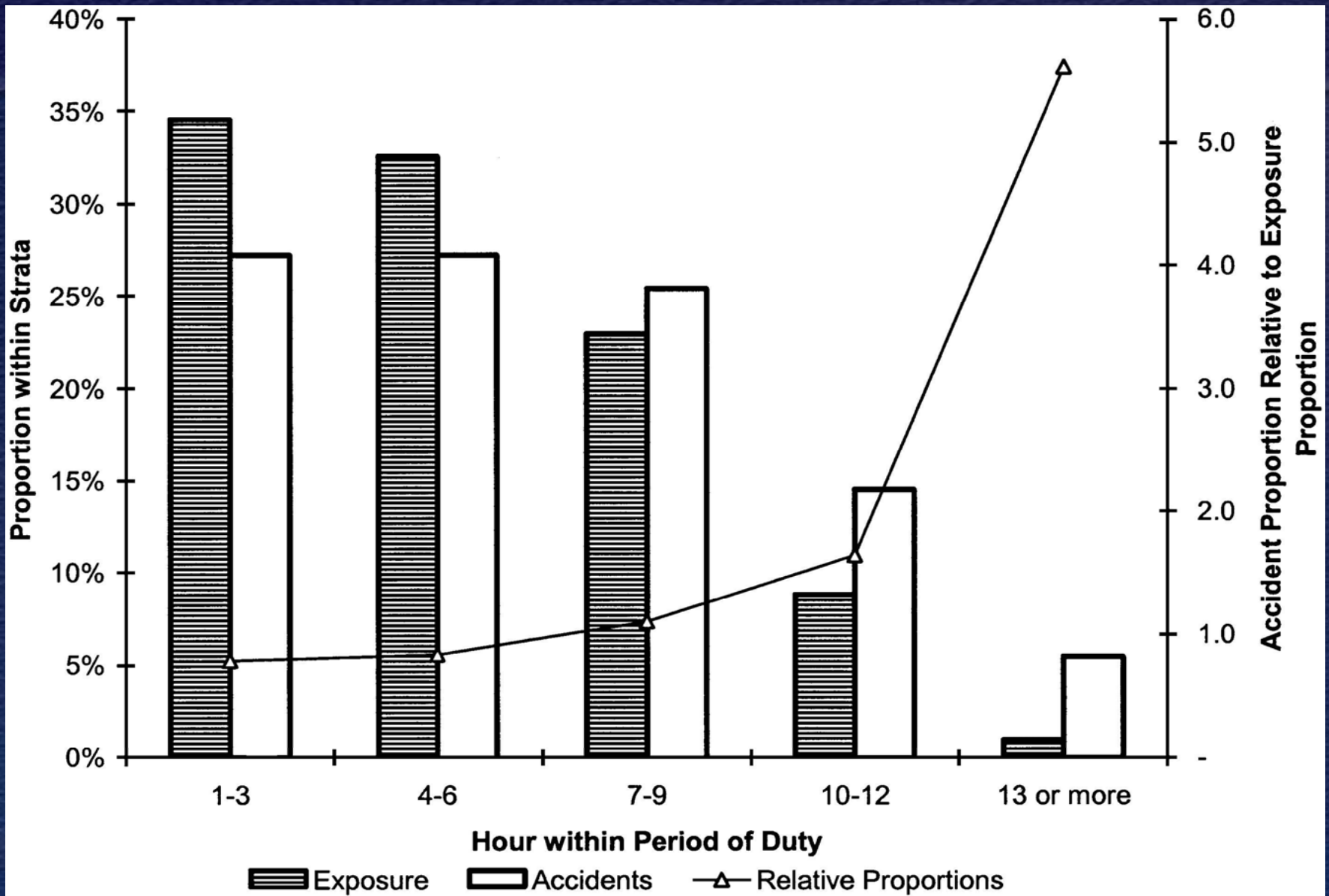


# Fatigue Factors

- sleep
- circadian clock
  - 'sleepy' windows
  - 'alert' windows
  - irregular schedule
  - time zones
- hours awake
- sleep disorders

# Fatigue Factors

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



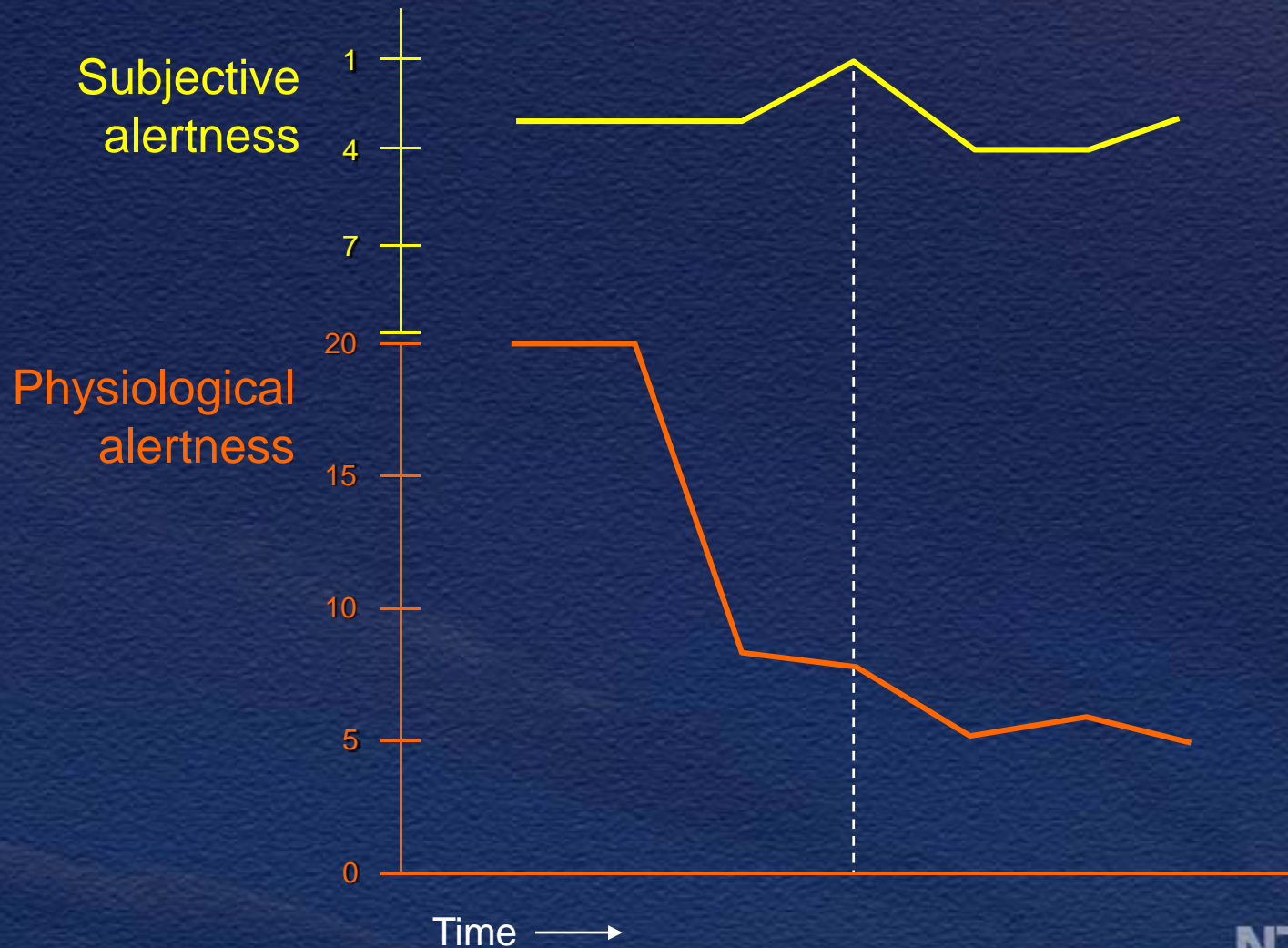
# Fatigue Factors

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

# Fatigue Factors: Environmental

- Helicopters:
  - noise
  - vibration

# Alertness Reports Often Inaccurate



Adapted from Sasaki et al., 1986

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# NTSB Most Wanted List

Critical changes needed to reduce transportation accidents and save lives.



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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

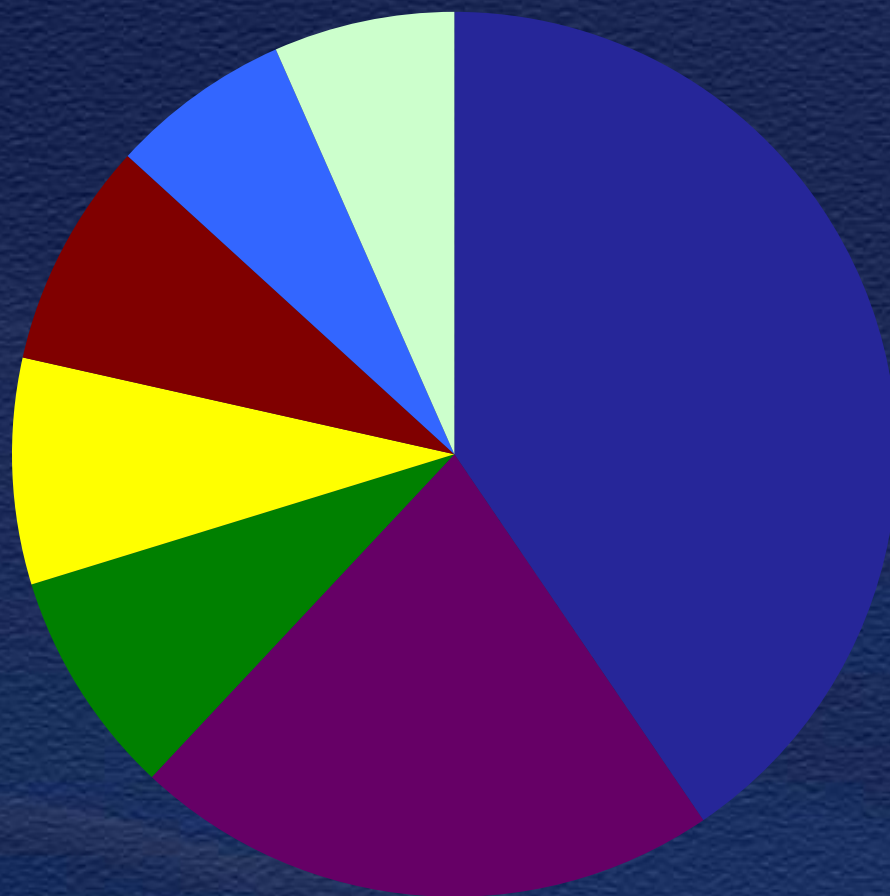


# NTSB Recommendations

- 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

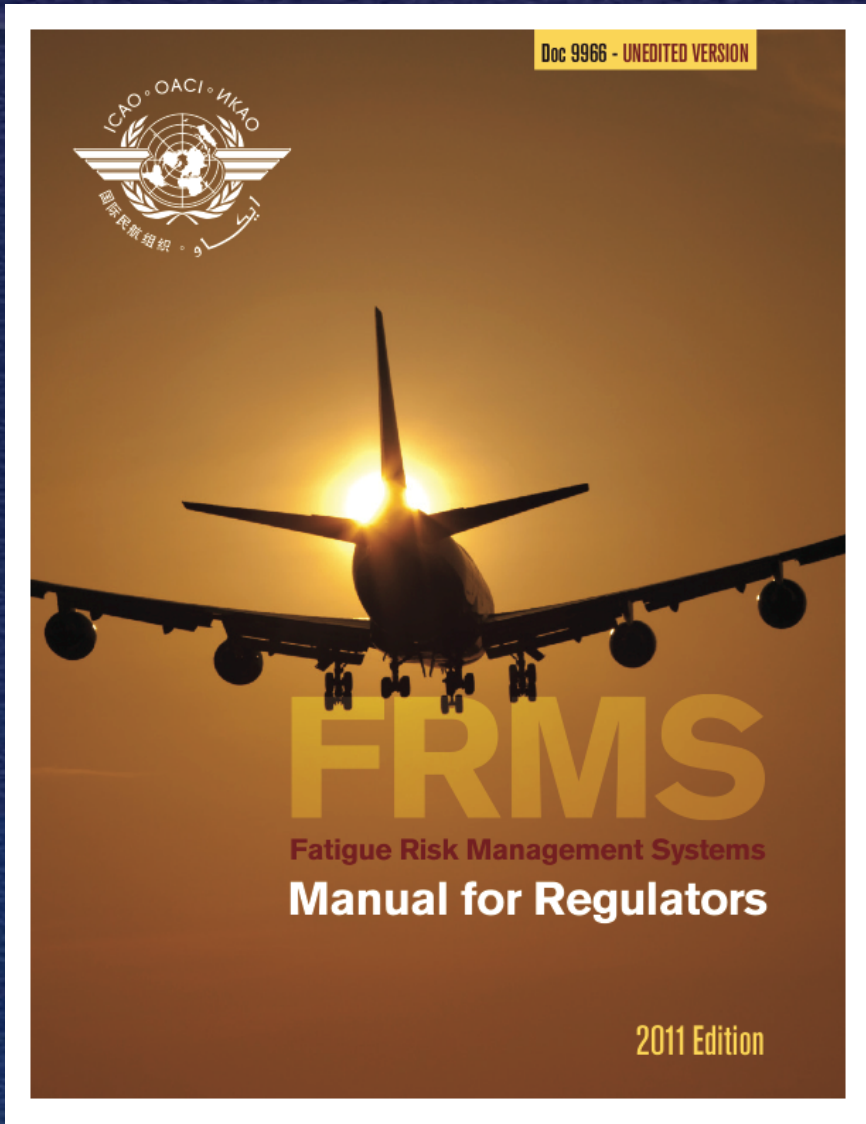
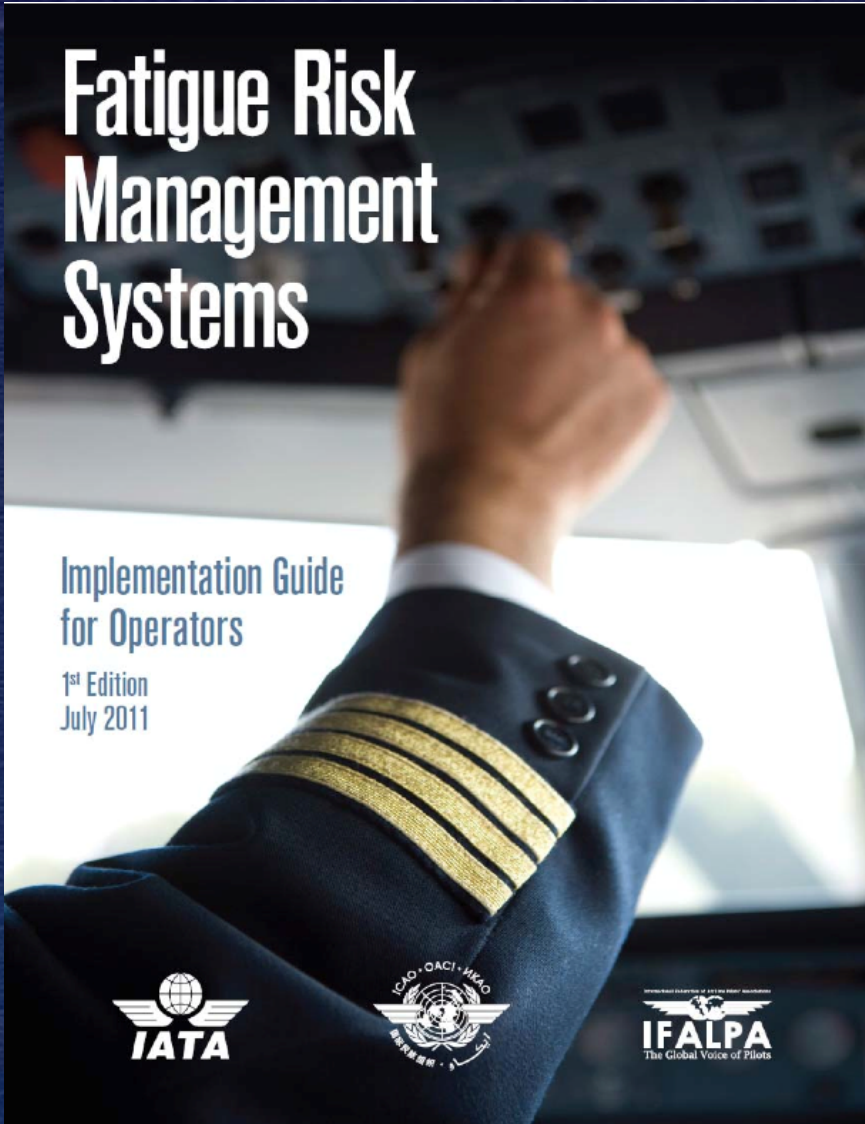
# NTSB Recommendations: Hours of Service / Scheduling

- 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



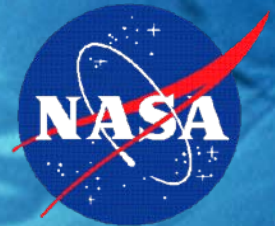
# NTSB Recommendations: Education/Strategies

- 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

# NTSB Recommendations: Education/Strategies

- Include information on use of strategies: naps, caffeine, etc.
- No recommendations on specific personal strategies

# Example: NASA Planned Rest Study



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# Changing Safety Culture

Safety goal . . .

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