



NTSB National Transportation Safety Board

Managing Fatigue in Aviation Ops: An NTSB Perspective

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Board Member

Bombardier Safety Standdown
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UNITED STATES CODE, TITLE 49

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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 successor may not be a successor 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 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



The NTSB is Responsible for Investigating:

**Aviation, highway, rail, marine, pipeline,
and hazardous material accidents**



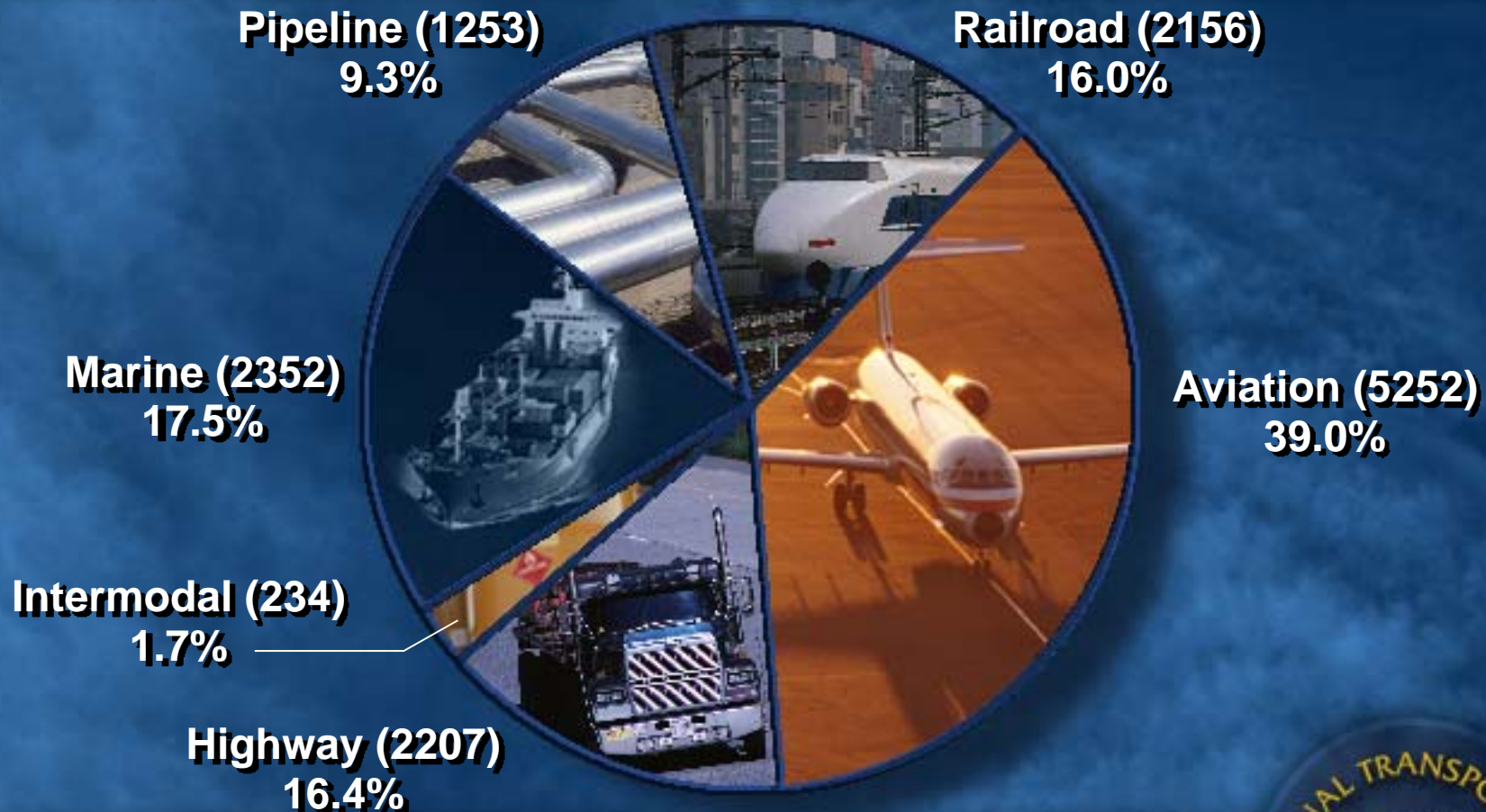
PG&E/San Bruno Gas Pipeline Explosion





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

13,454 Safety Recommendations issued since 1967

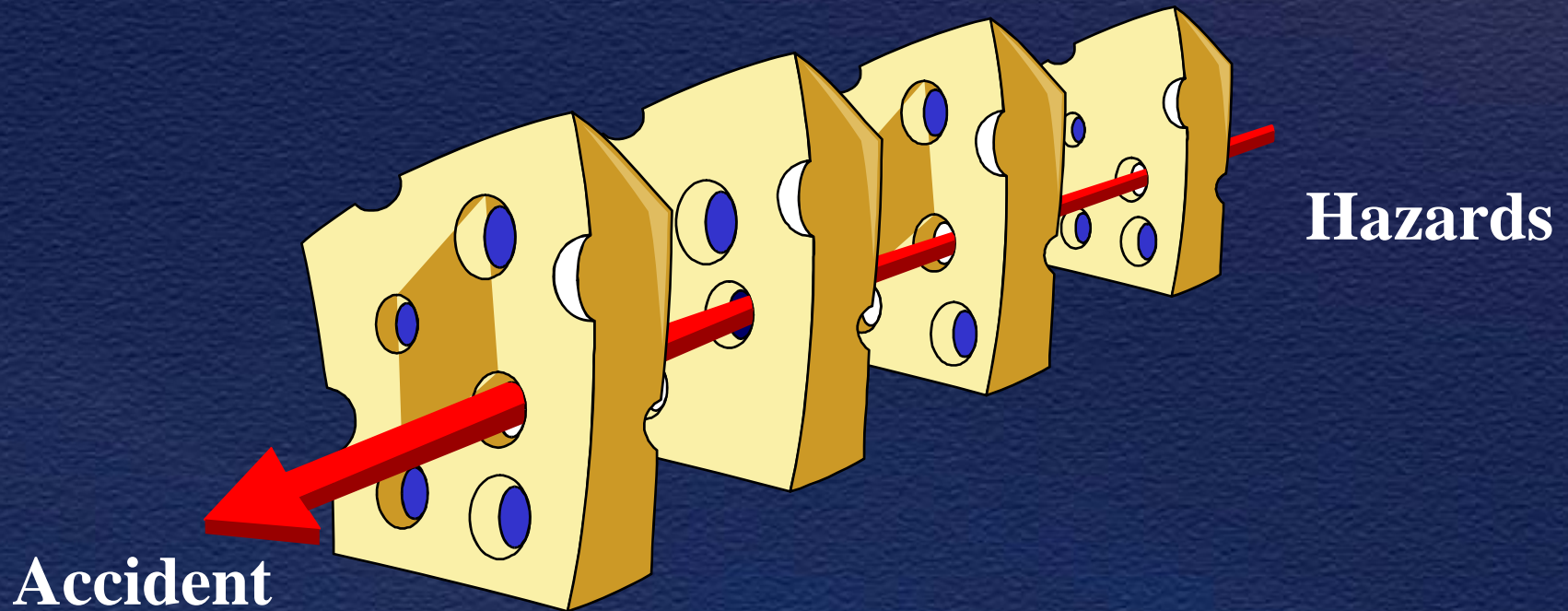




Major product: safety recommendations

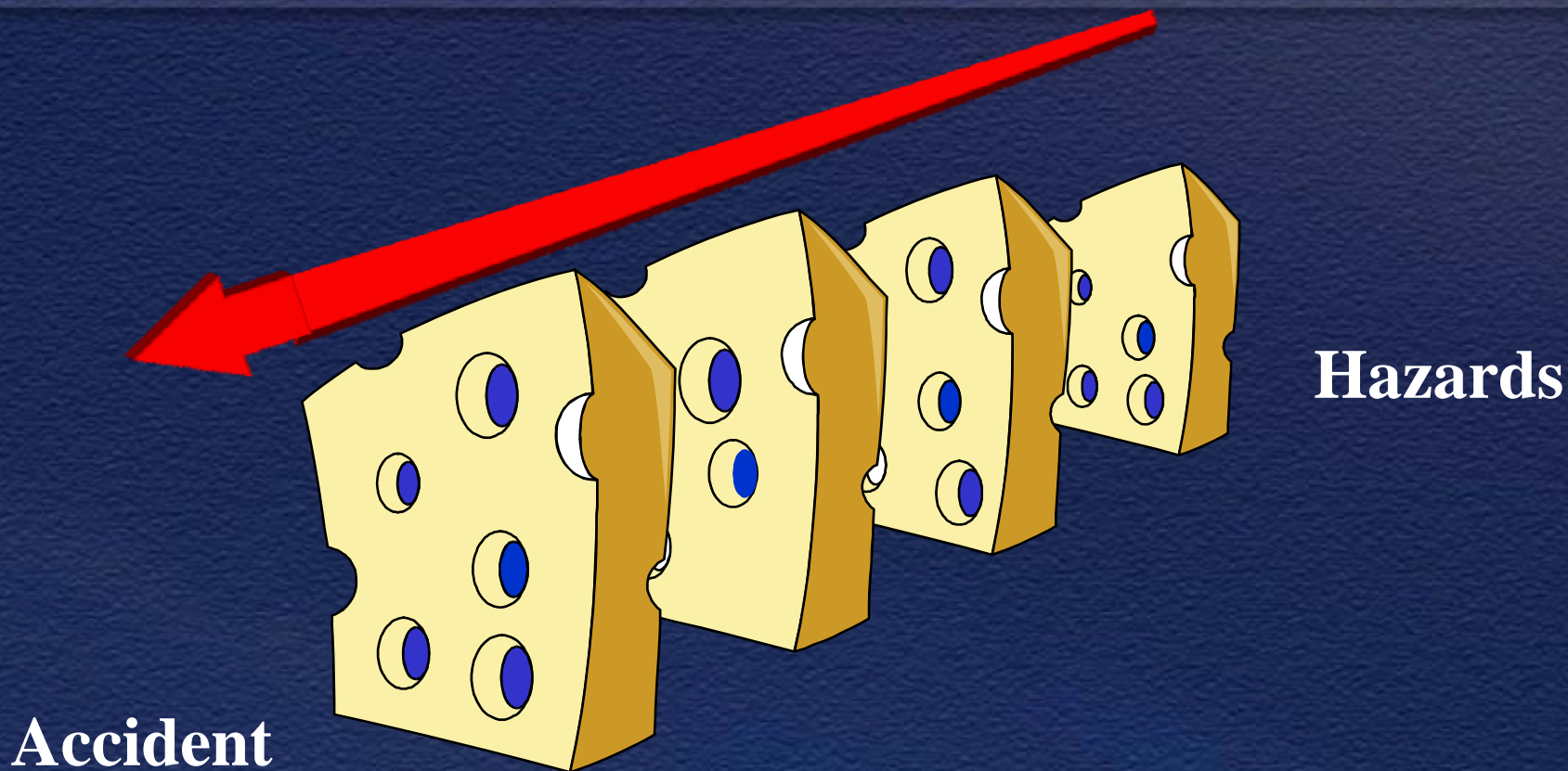
Moral compass and industry conscience

“Swiss Cheese” Model (Reason)



Successive layers of defenses, barriers, and safeguards

The Challenge (Haueter)



Successive layers of defenses, barriers, and safeguards

Go! Flight 1002



- early starts, multiple segment days, sleep apnea

NTSB



Honorable John K. Lauber:

No Accident \neq
Safe Operation

Guantanamo Bay Cuba

First NTSB aviation accident to cite fatigue as probable cause



- acute sleep loss, sleep debt, circadian disruption

NTSB



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.”

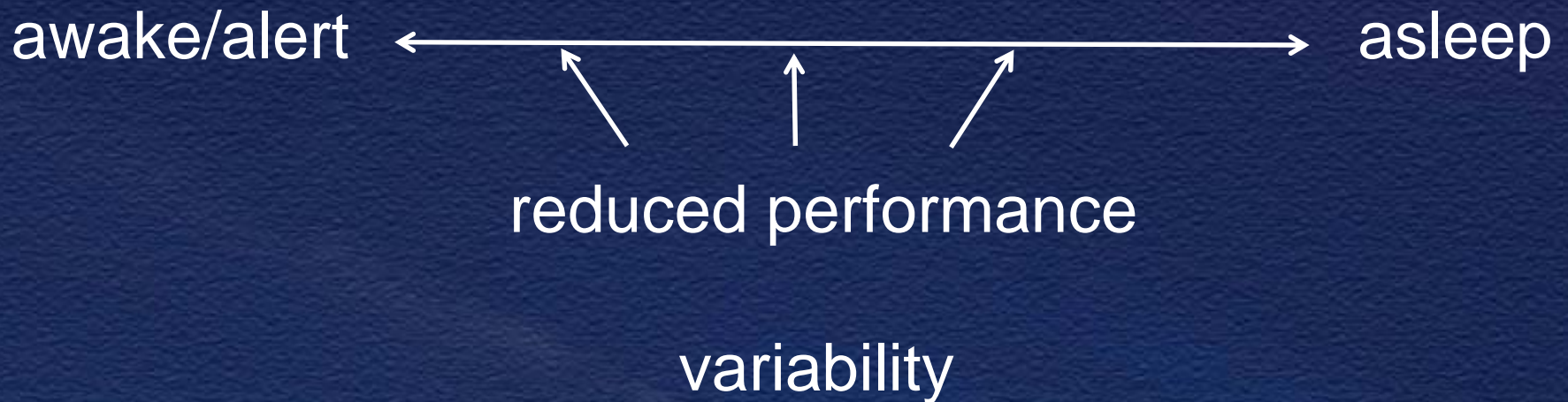
Fatal Airline Accidents (Examples) (fatigue cited)

- 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

Fatigue Risks

Fatigue can degrade
every aspect of
human capability.

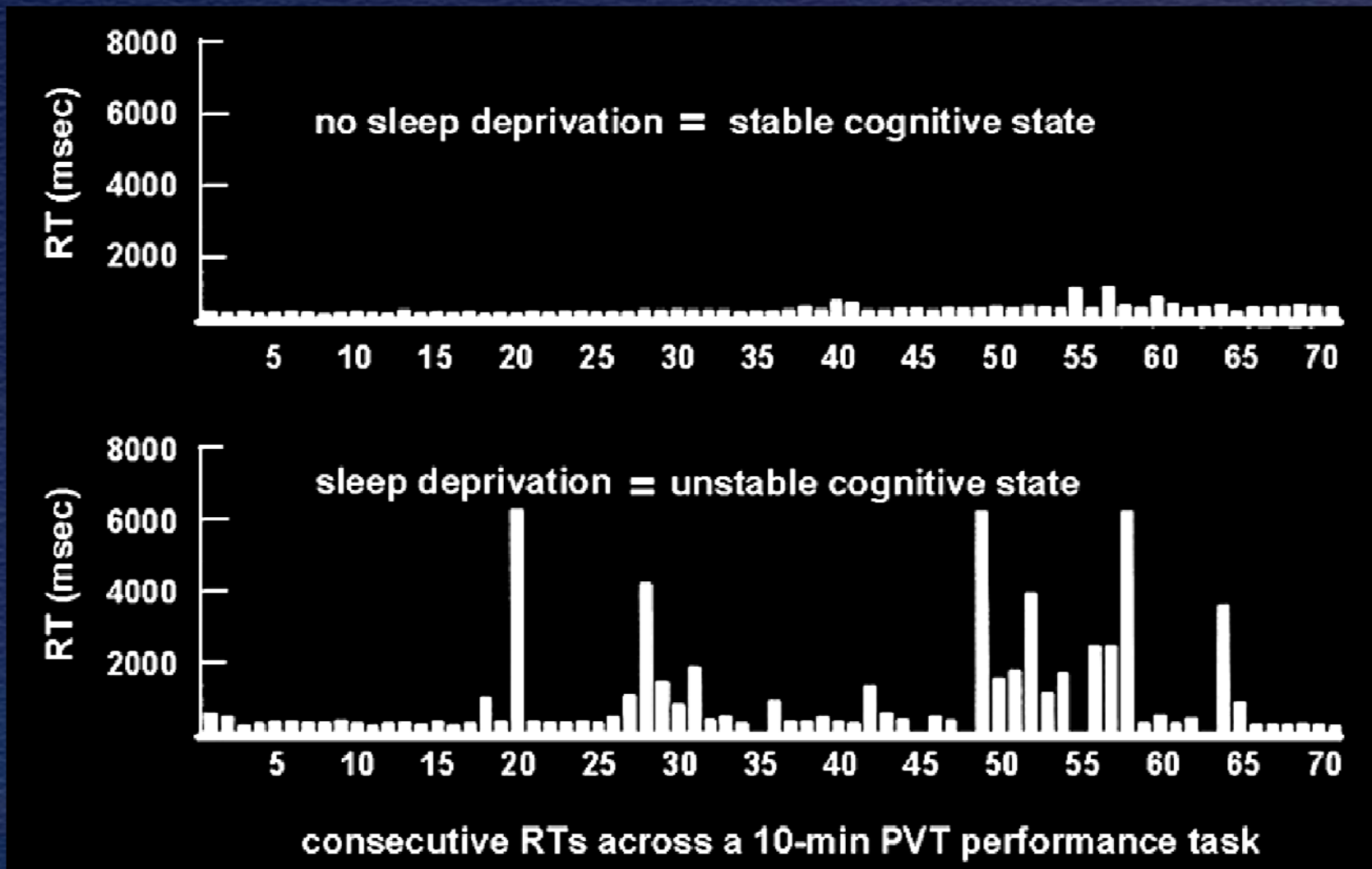
Fatigue Risks



Fatigue Risks

- reduced (20 – 50%+):
 - reaction time
 - memory
 - communication
 - situational awareness
 - judgment
 - attention
 - mood
 - more . . .
- increased:
 - irritability
 - apathy
 - attentional lapses
 - microsleeps

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.



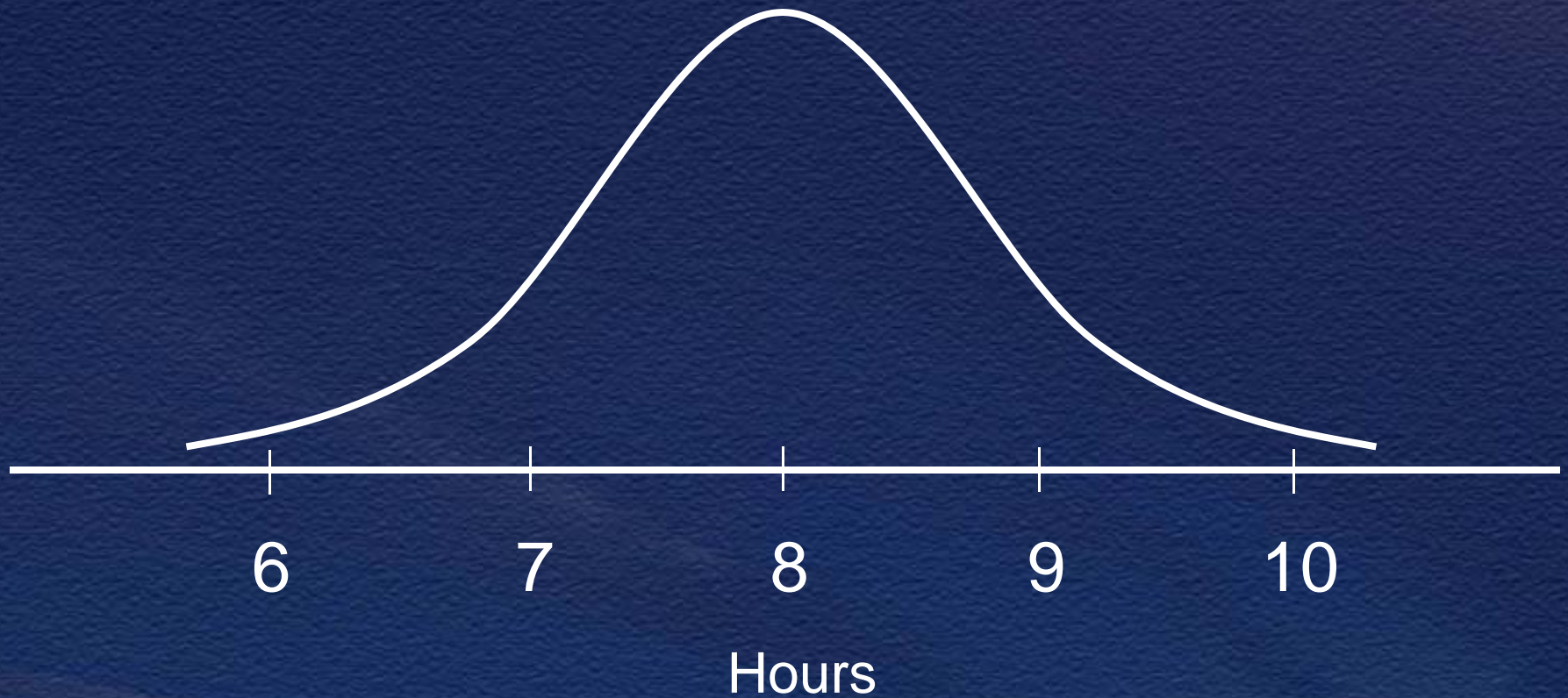
Fatigue Factors

- sleep
- circadian clock
- hours awake
- sleep disorders

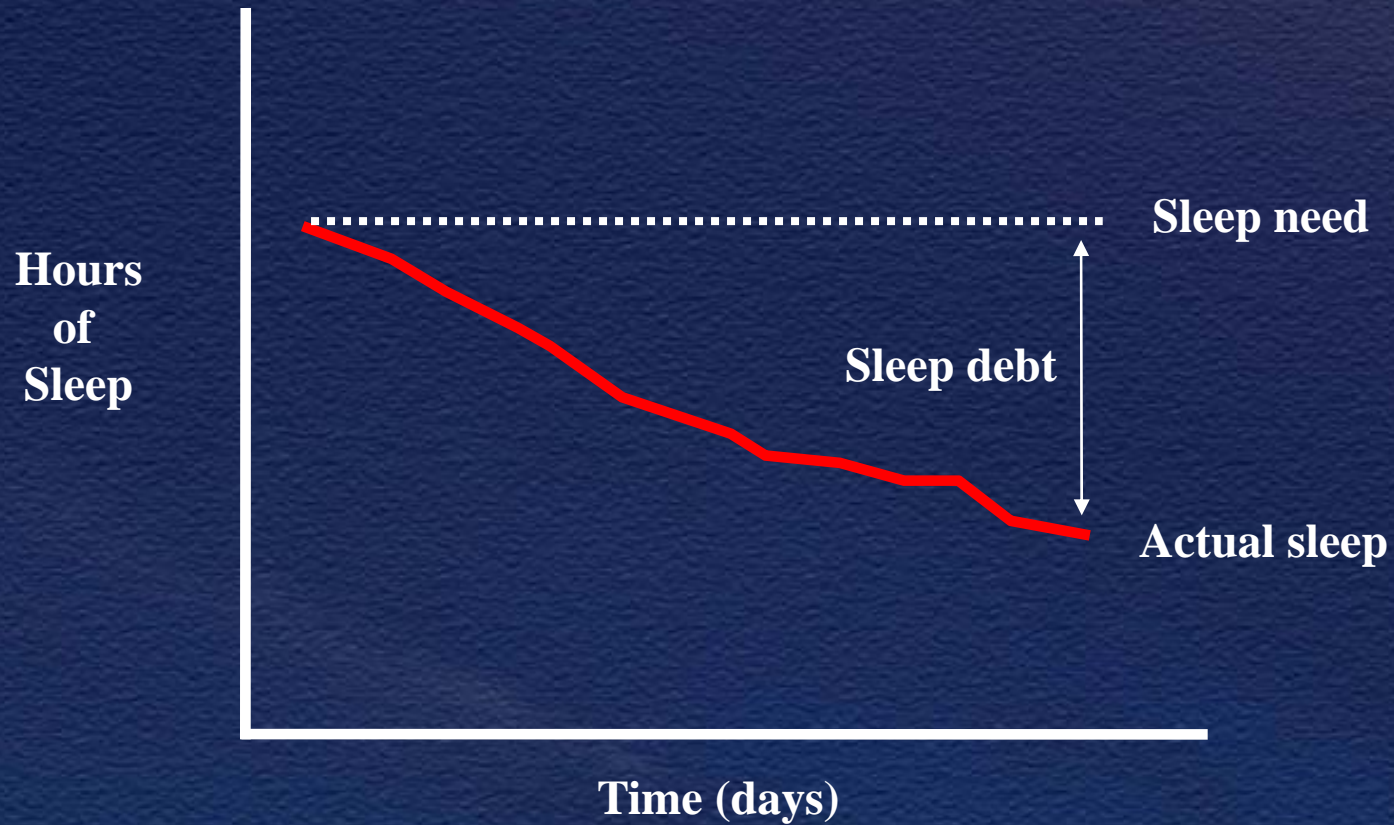
Fatigue Factors

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

Sleep Requirement



Cumulative Sleep Debt



Sleep Need – Actual Sleep = Sleep Debt

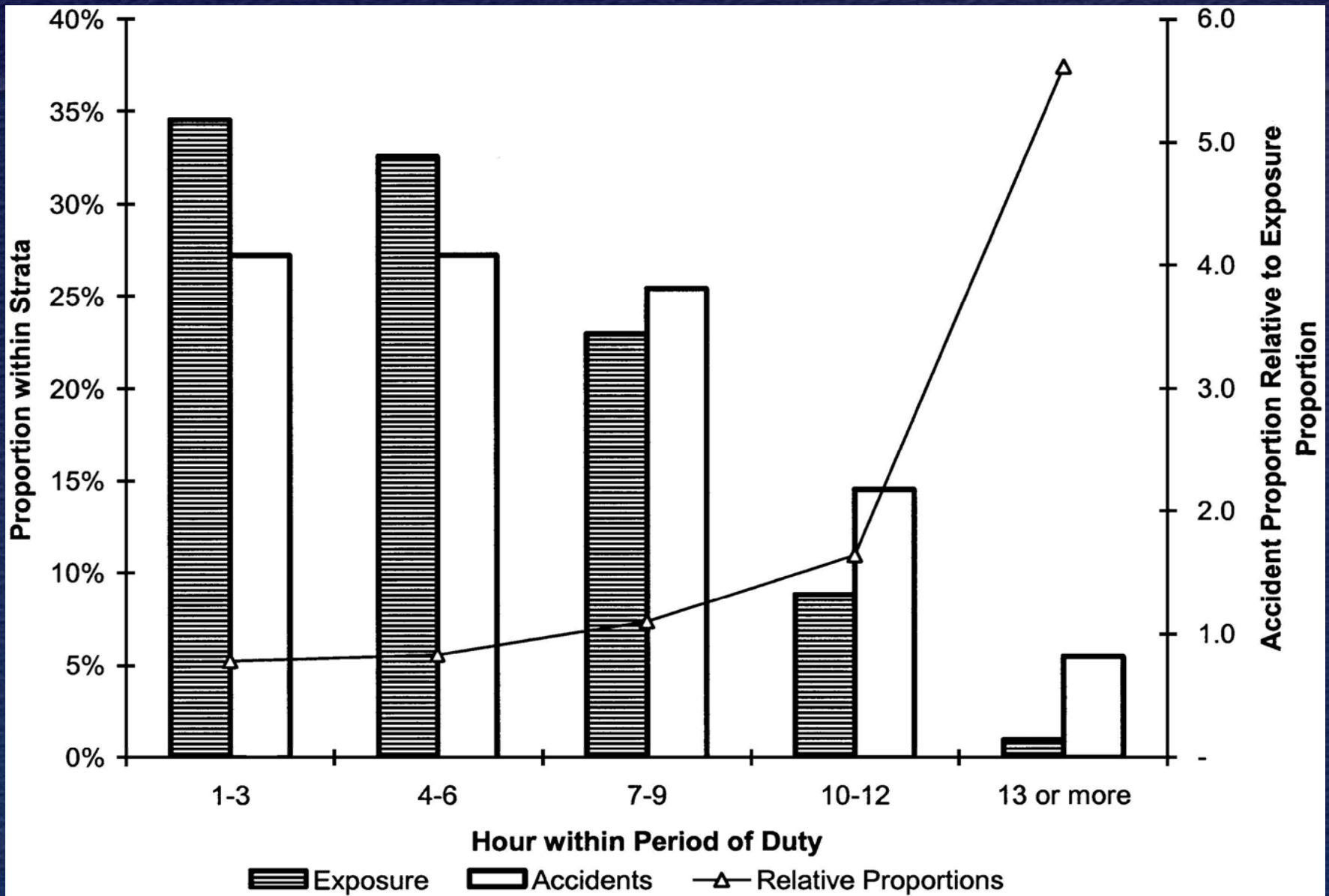
Sleep debt grows cumulatively over time

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



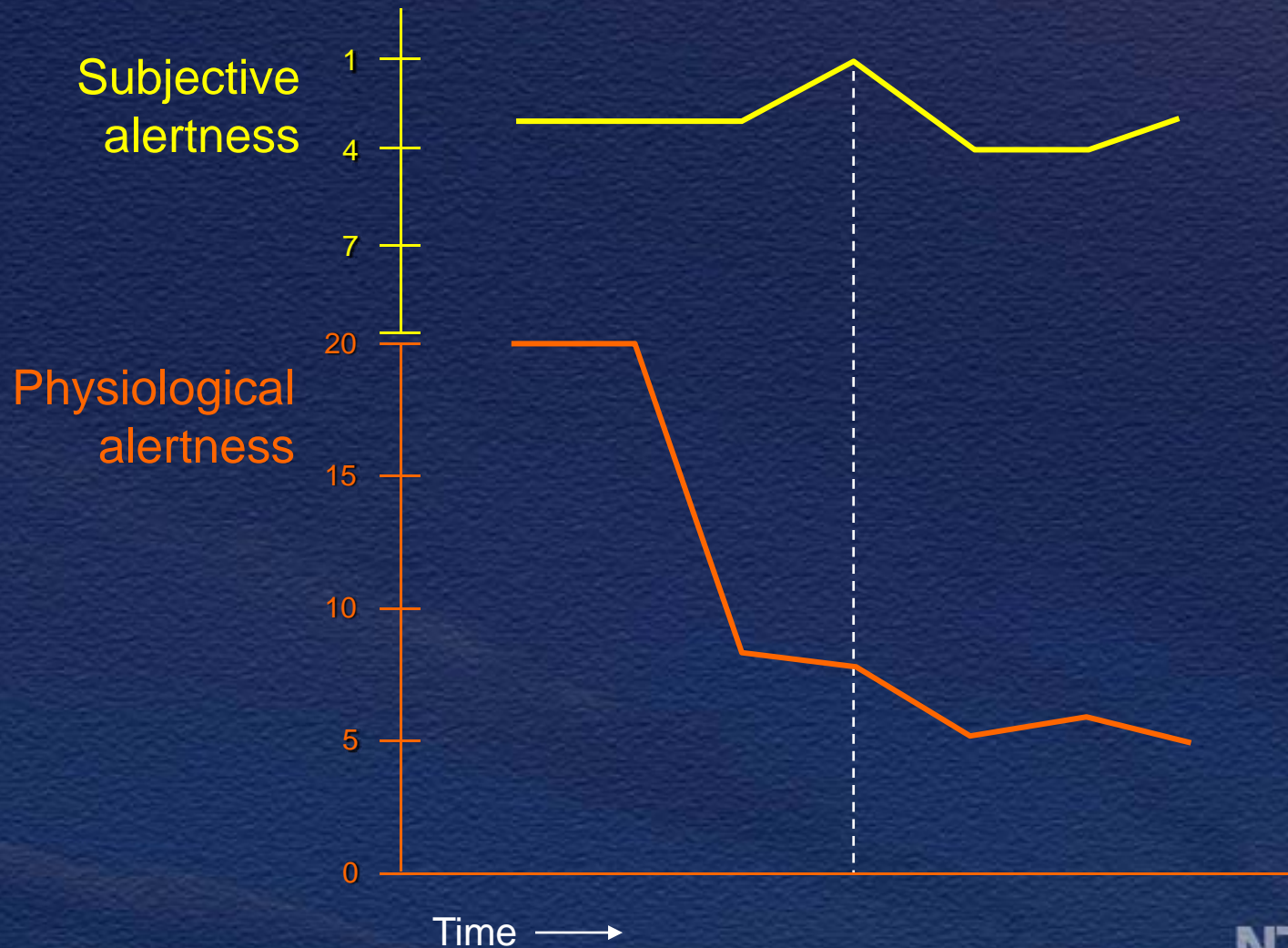
Fatigue Factors

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

Sleep Apnea is a Safety Risk

- > 6 times increased risk for crash
- > 7 times increased risk for multiple crashes
- SA performance = .06 - .08 BAC

Alertness Reports Often Inaccurate



Adapted from Sasaki et al., 1986

NTSB Most Wanted List

Critical changes needed to reduce transportation accidents and save lives.



NATIONAL TRANSPORTATION SAFETY BOARD

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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



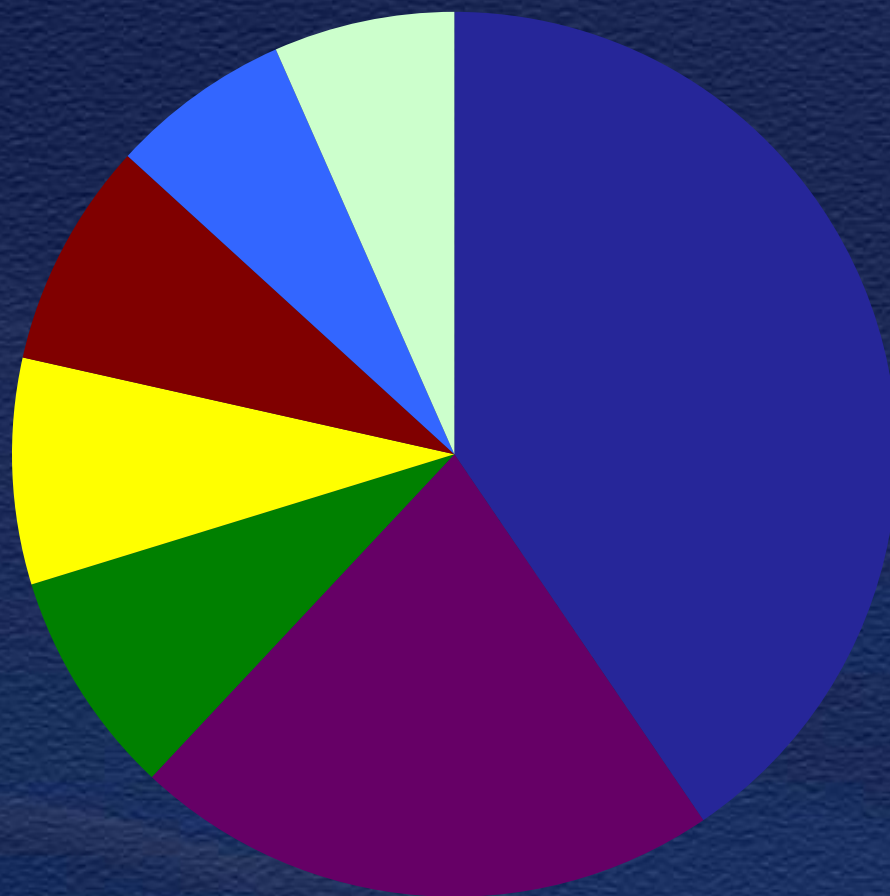
Motorcycle Safety



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

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

Education

- Education vs. awareness
- Science based information
- Foundation for any fatigue efforts
- Address broad/applied content:
 - how fatigue affects performance
 - how to minimize fatigue risks
 - fatigue countermeasures/strategies
 - support with policies

Hours of Service / Scheduling

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

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

Fatigue Risk Management Systems

Implementation Guide
for Operators

1st Edition
July 2011



Doc 9966 - UNEDITED VERSION



FRMS

Fatigue Risk Management Systems
Manual for Regulators

2011 Edition

NTSB



Fatigue Management Programs

- Comprehensive approach
- Multiple components
- Science based
- Continuously evaluated and updated
- Complements HOS regulations

Bombardier Safety Standdown: 15 Years Changing Safety Culture

Embrace change . . .

Honor knowledge with action . . .

Be Safer!

NTSB





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