



NTSB National Transportation Safety Board

Managing Fatigue: An NTSB Perspective

Mark R. Rosekind, Ph.D.
Board Member

Cessna Safety Standdown
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1967

In 1967, the Congress created an independent NTSB within the newly formed Department of Transportation (DOT); expanded the NTSB's authority to include all modes of transportation.





In 1974, Congress made the NTSB completely independent of the DOT.

1974





**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.**





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

§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



The NTSB is Responsible for Investigating:

All U.S. aviation accidents (except those of military and intelligence agencies).





**Highway accidents
(including certain
grade-crossing
accidents) which
involve issues of
wide-ranging safety
significance.**





Railroad accidents in which there is a fatality, substantial property damage, or which involve a passenger train.





**Major marine accidents
and accidents involving
a public and a non-public
vessel or accidents
involving Coast Guard
functions.**





Pipeline accidents in which there is a fatality, significant environmental or property damage.



Transportation accidents involving the release of hazardous materials, including fatal accidents or those causing major disruptions to a community.





Major product: safety recommendations

Moral compass and industry conscience



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

Go! Flight 1002



- early starts, multiple segment days, sleep apnea

NTSB



Runway Incursion at LAX



- ATC with 5 - 6 hrs sleep

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

Shuttle America Flight 6448



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

NTSB



Kirksville, Missouri, October 19, 2004



- 2 crew + 11 PAX fatally injured, 2 serious injuries
circadian disruption, 6th flight segment

NTSB



Continental Connection (Colgan Air) Buffalo NY (February 12, 2009)



- 50 fatalities; commuting, acute sleep loss

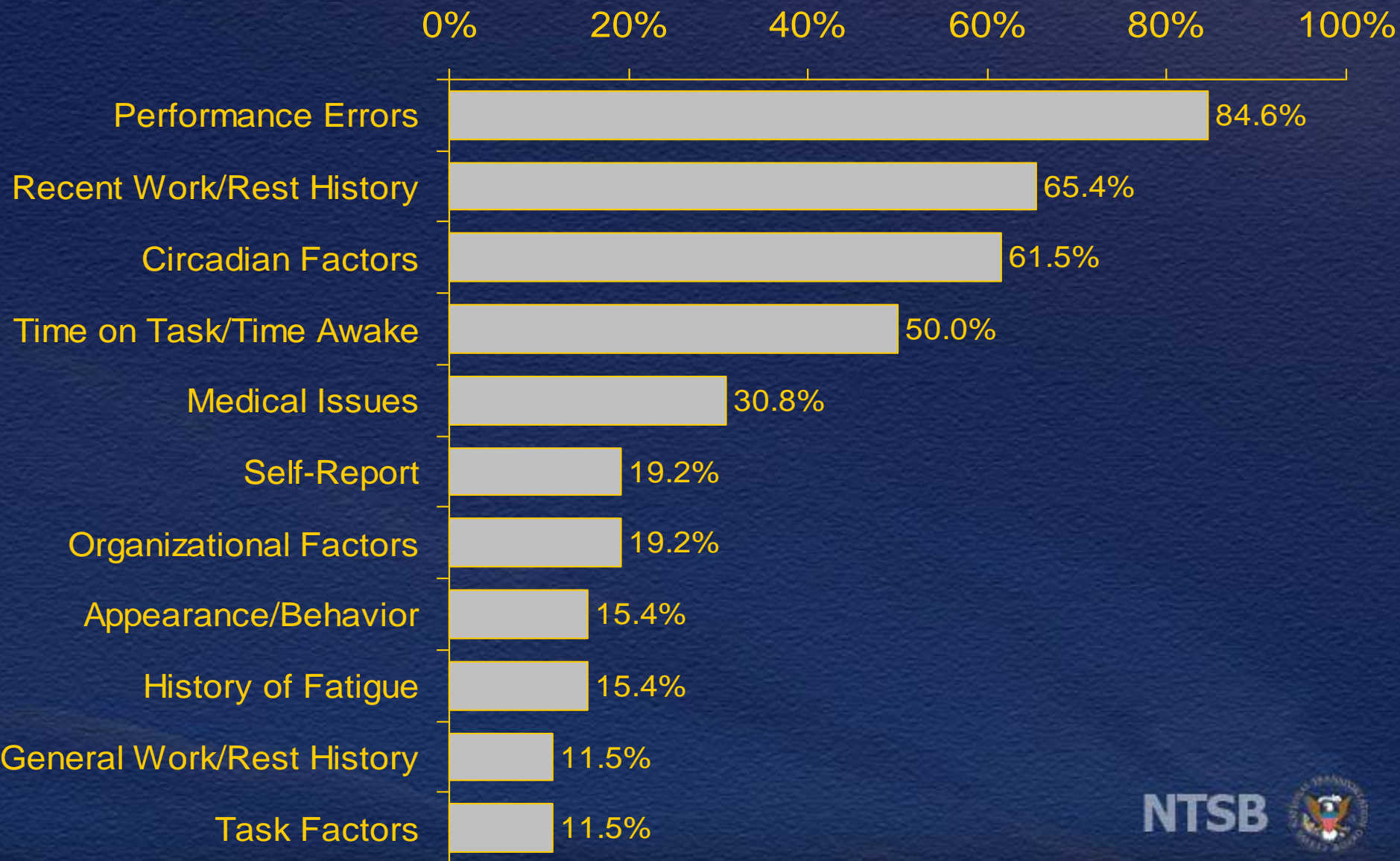
NTSB



Fatal Airline Accidents (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
- 2/09 Buffalo NY: 49 fatalities

Fatigue Indicators



Fatigue Risks

Fatigue can degrade
every aspect of
human capability.

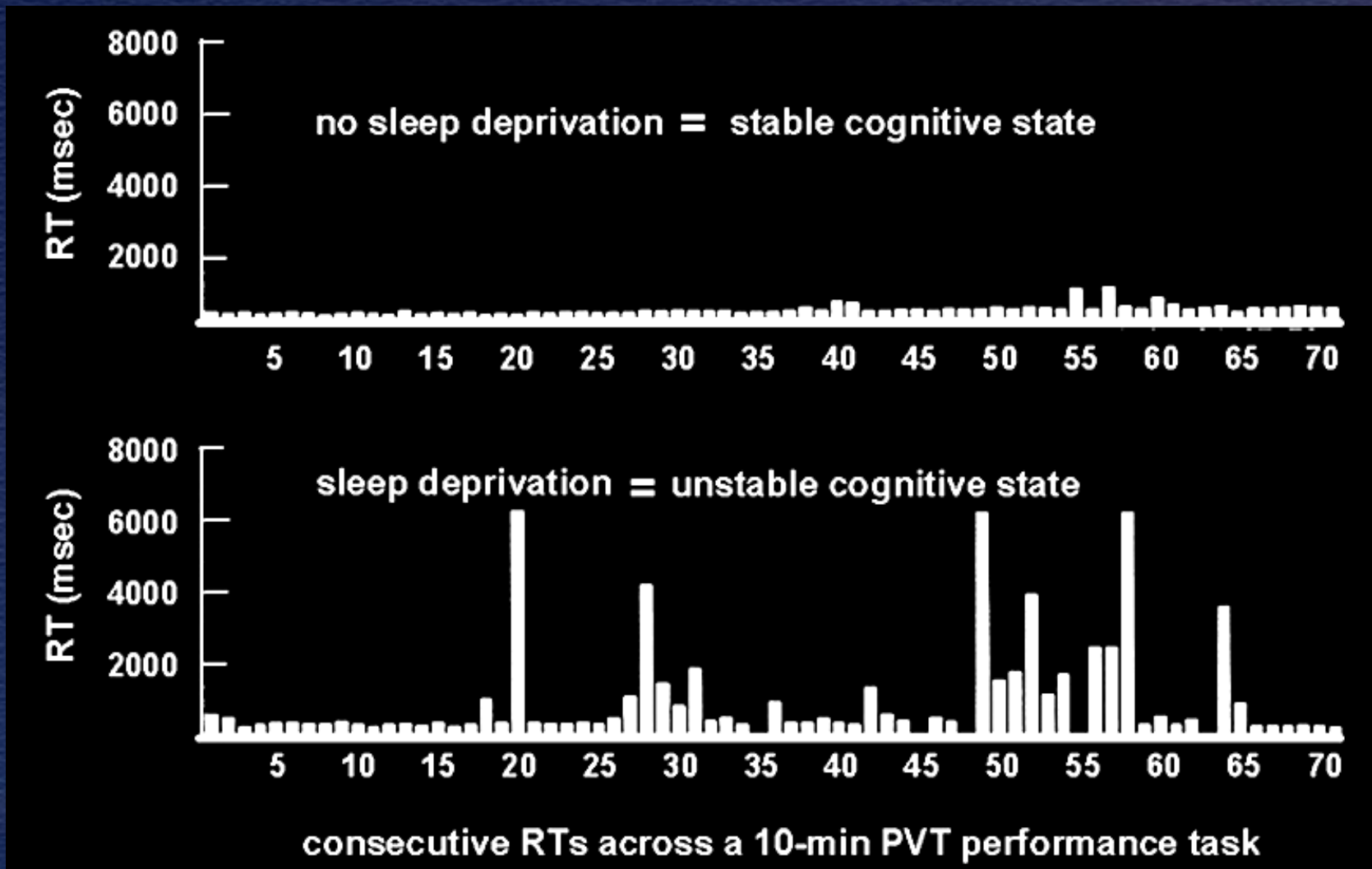
Fatigue Risks

- degraded 20 – 50%+:
 - reaction time
 - memory
 - communication
 - situational awareness
 - judgment
 - attention
 - mood
- increased:
 - irritability
 - apathy
 - attentional lapses
 - microsleeps

Fatigue Risks



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.



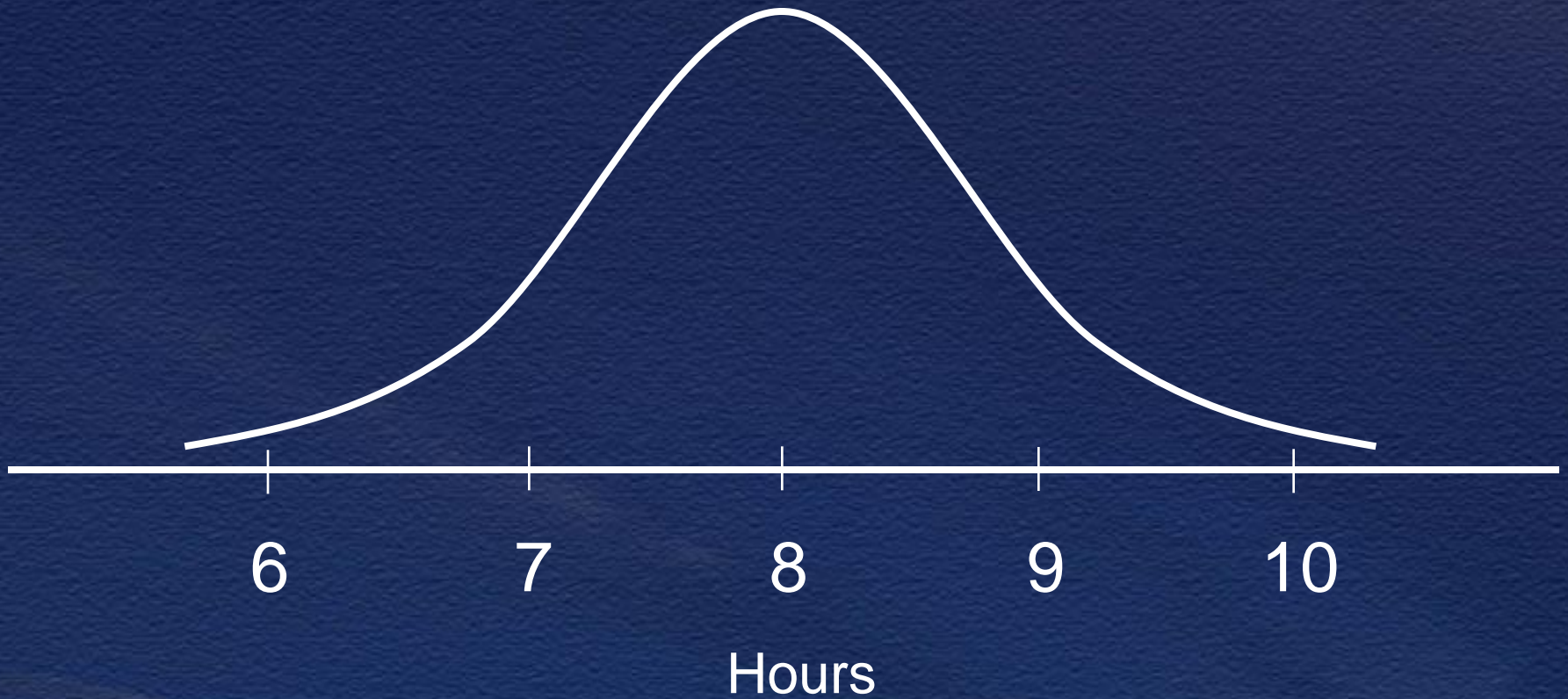
Fatigue Factors

- sleep
- circadian clock
- hours awake
- sleep disorders

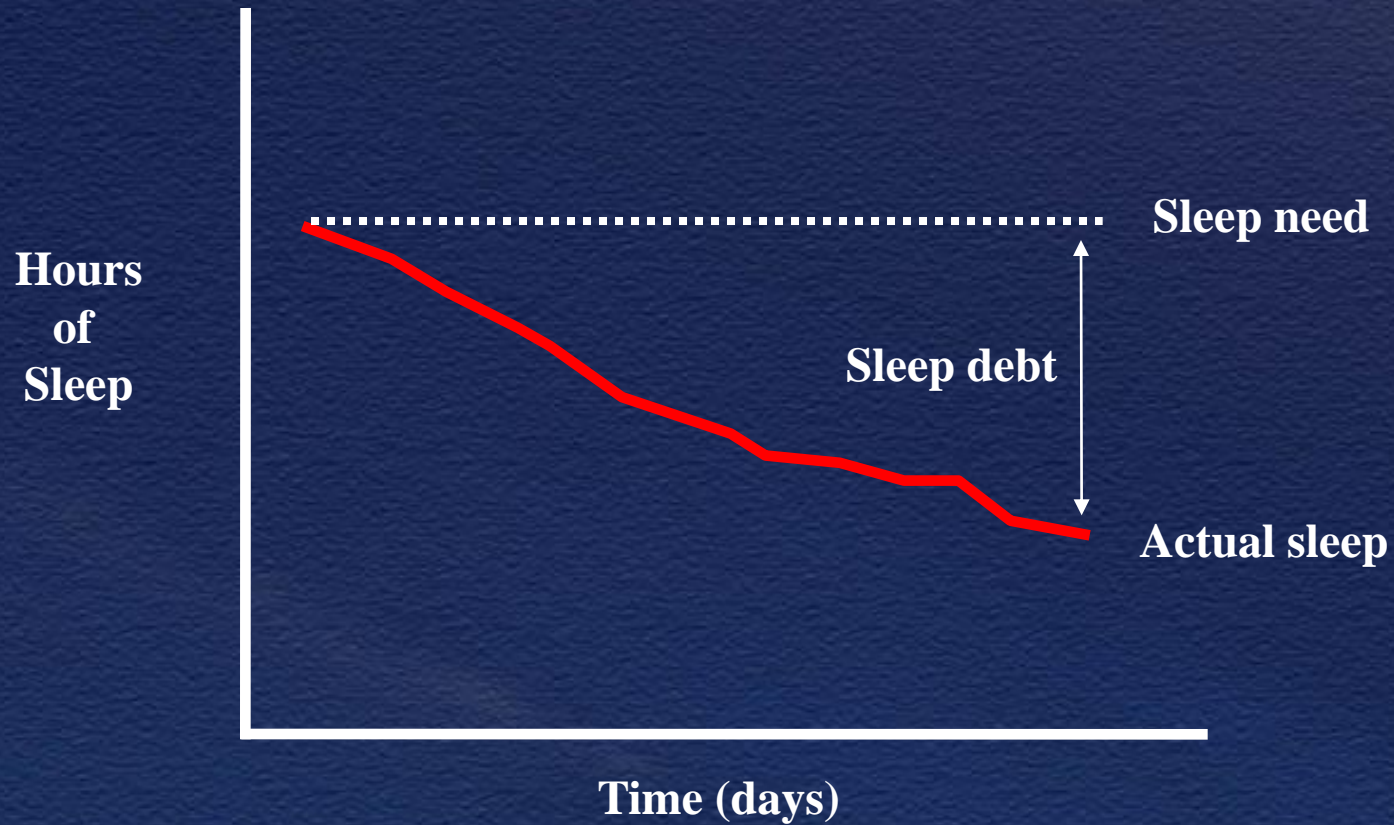
Fatigue Factors

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

Sleep Requirement



Cumulative Sleep Debt



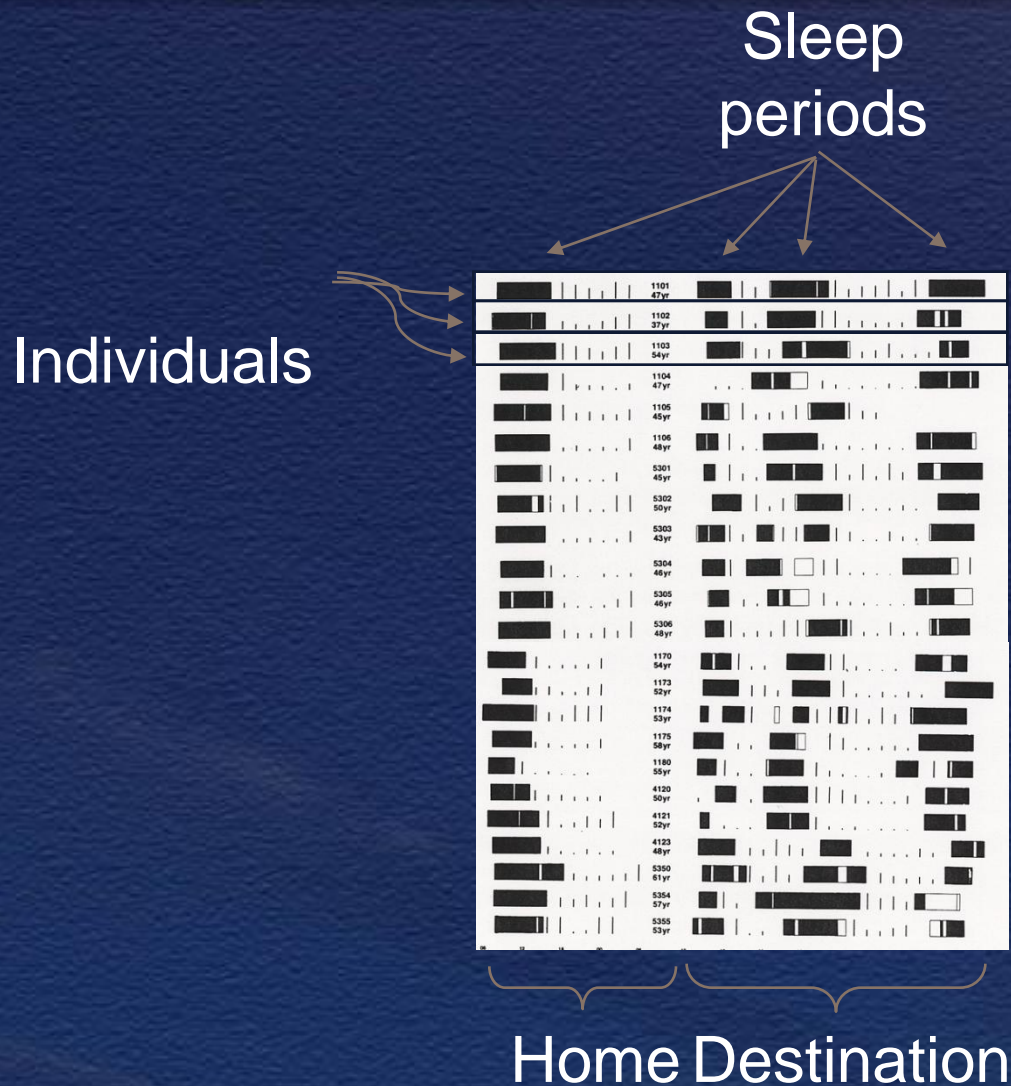
Sleep Need – Actual Sleep = Sleep Debt

Sleep debt grows cumulatively over time

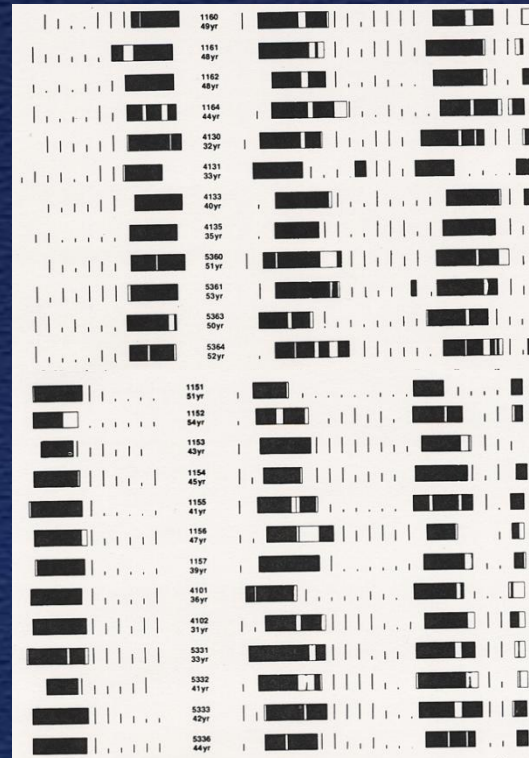
Fatigue Factors

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

After Traveling Eastward



After Traveling Westward



Home Destination

NTSB



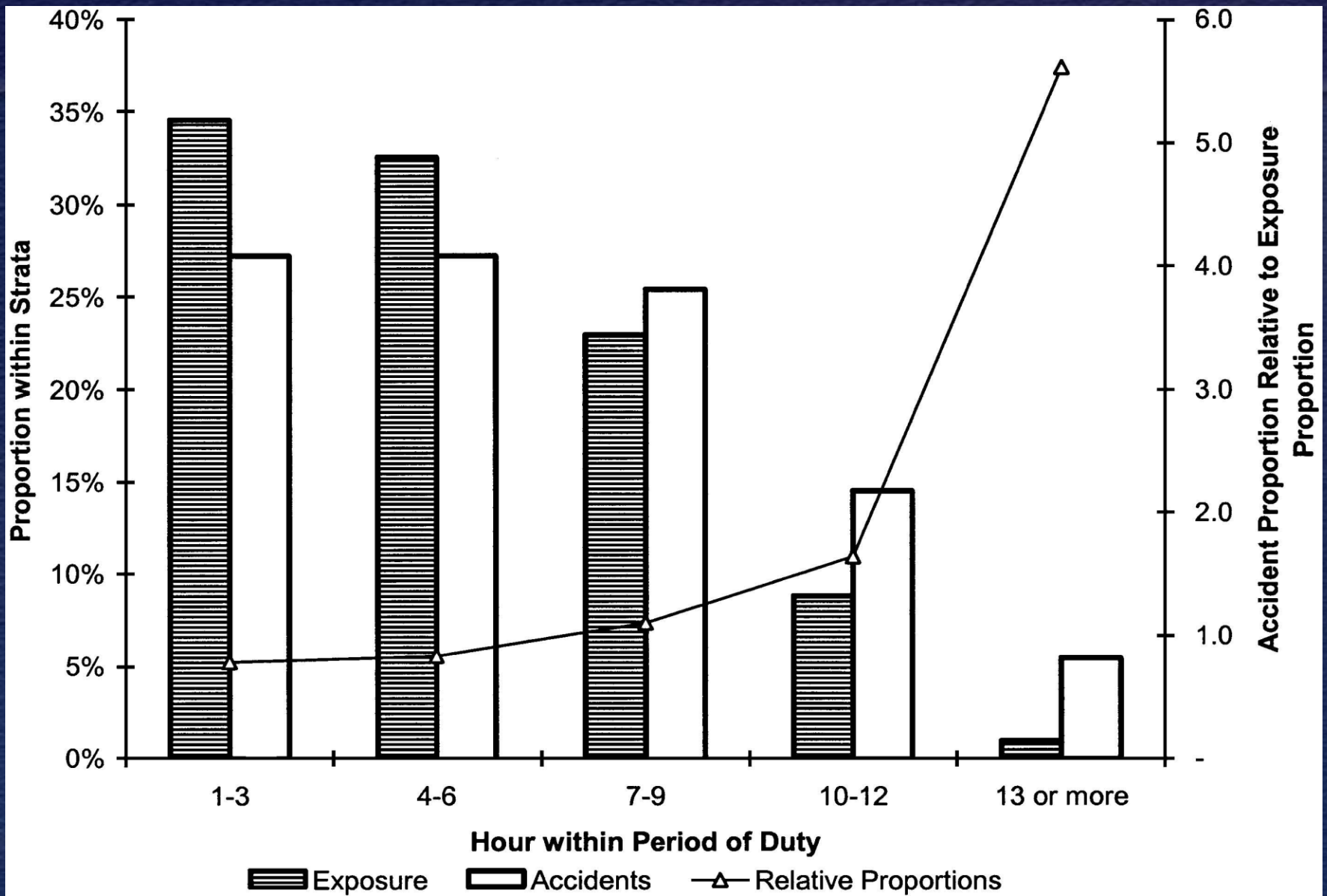
NASA Long-Haul Study

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



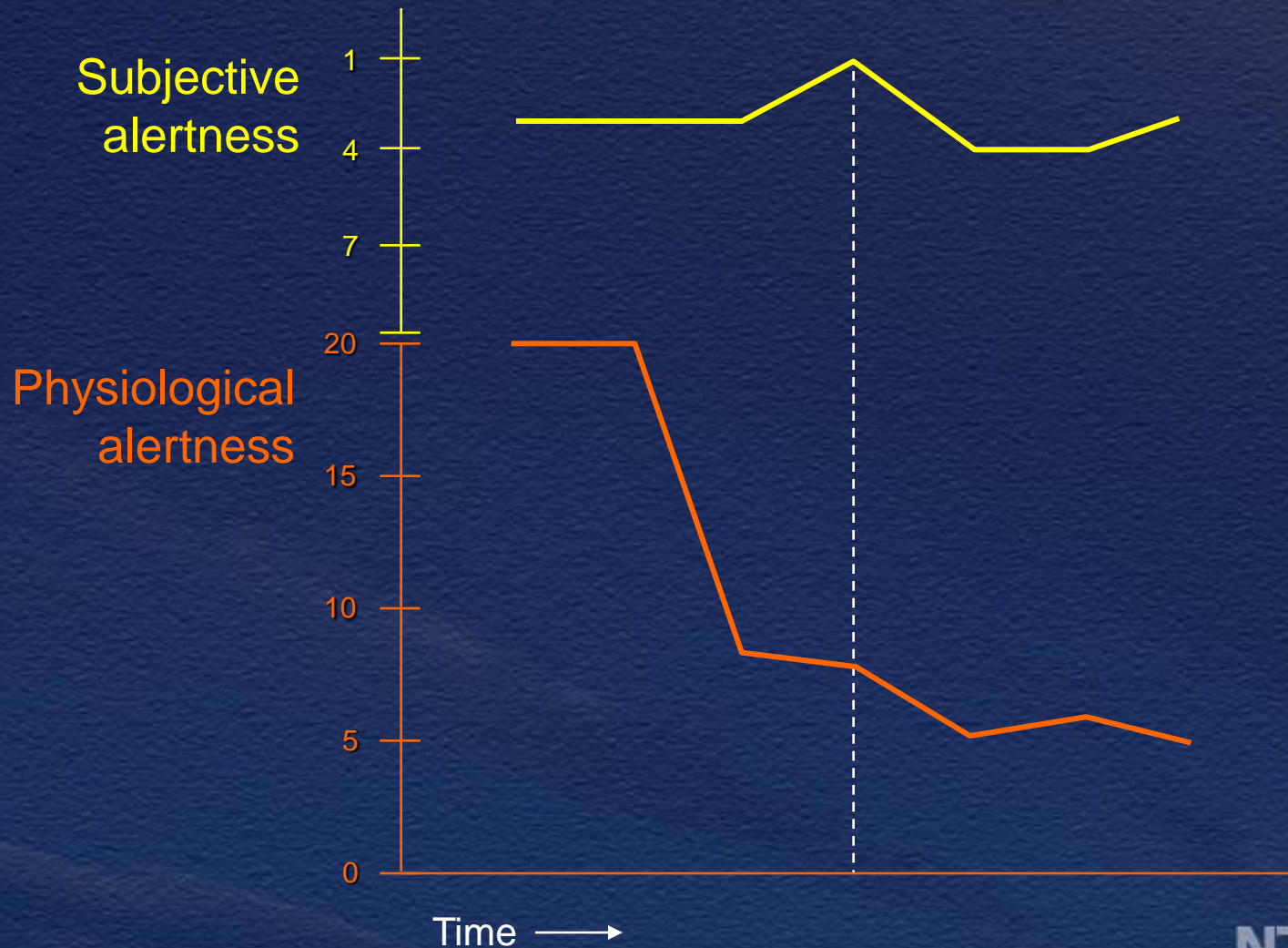
Fatigue Factors

- 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 = .06 - .08 BAC

Alertness Reports Often Inaccurate



Adapted from Sasaki et al., 1986

The Challenges . . .

Diverse operational requirements

Individual differences

Complex physiology

History (“that’s how its always been”)

Economics

The Challenges Preclude . . .

A simple solution

A single solution

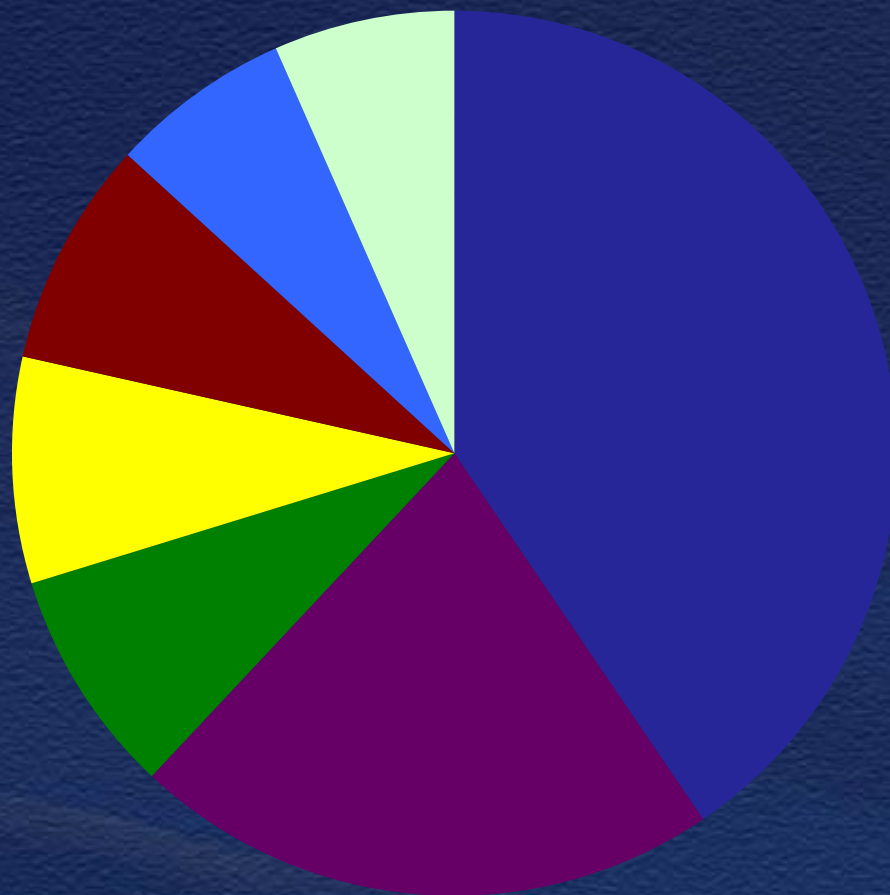
One-size-fits-all

“Magic Bullet”

NTSB Recommendations

- MOST WANTED since 1990
- 150+ 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

Hours of Service / Scheduling

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

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

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

Organizational Policies

- Implement fatigue call-in policy
- Have written policies
- Address administrative implications of fatigue calls
- On-duty mitigation strategies
- Off-duty rest

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

NTSB Continuing Fatigue Efforts

- Studies
 - Fatigue Investigation Methodology Study
- Outreach
 - Training Center Course:
Investigating Human Fatigue Factors
- Recommendations and Advocacy
- Most Wanted List

Manage Fatigue = Enhance Safety

- Culture change
- Get educated
- Acknowledge
- Act!



NTSB