



NTSB National Transportation Safety Board

Chronobiology and Transportation Safety: Risks and Opportunities

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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 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. At the end of the term, the President may appoint a member 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 member 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



Major product: safety recommendations

Moral compass and industry conscience

Risks: Physiological 'Fatigue' Factors

- Sleep/wake
- Circadian
- Sleep disorders

Guantanamo Bay Cuba

First NTSB aviation accident to cite fatigue as probable cause

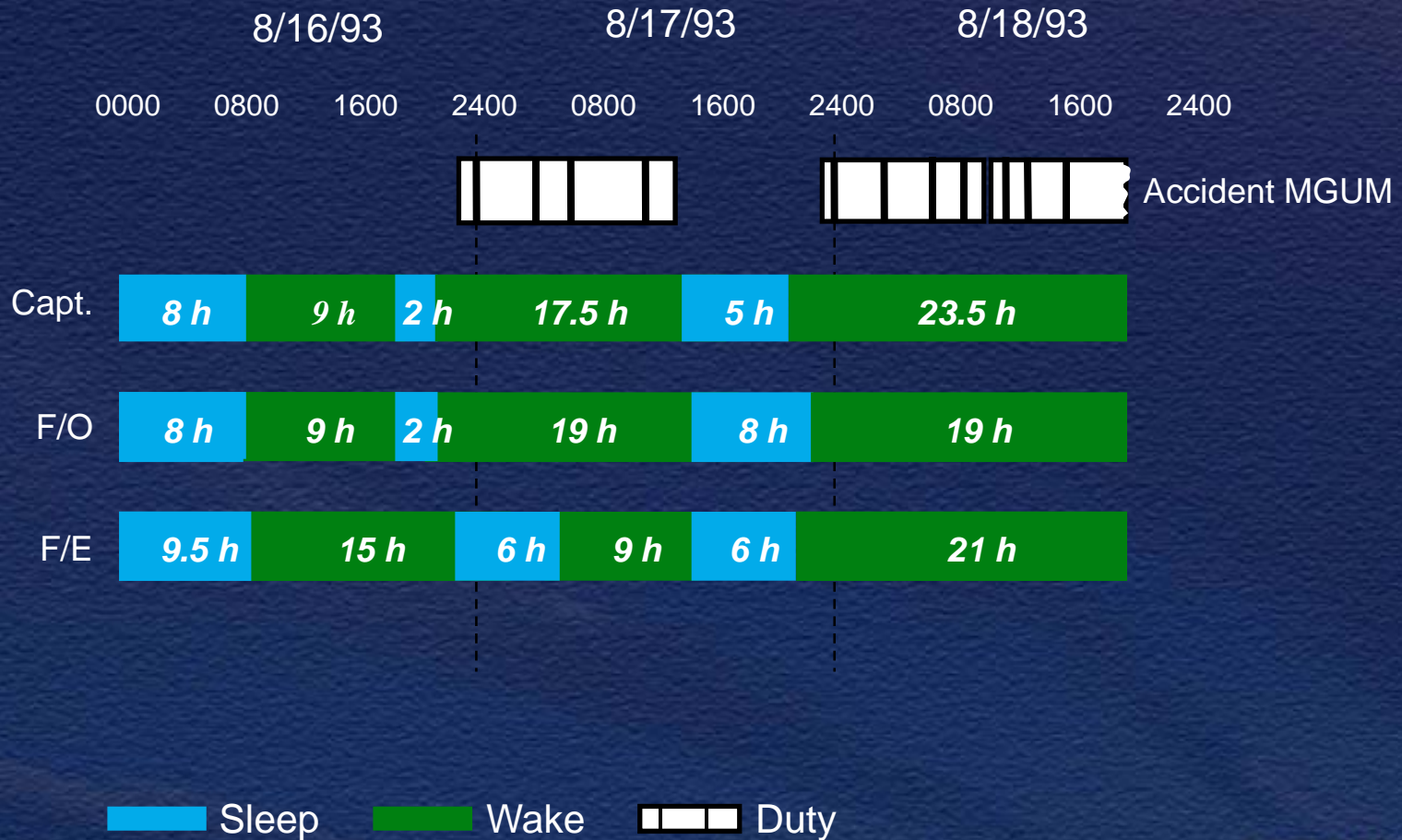


- acute sleep loss, sleep debt, circadian disruption

NTSB



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

- early start time (Capt/FO)
- acute sleep loss (Capt/FO)
- cumulative sleep debt (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

NTSB



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.”

Miami, OK (June 26, 2009)

10 fatalities
3 serious injuries
2 minor injuries
5 no injuries

**Ford
Windstar**



**Hyundai
Sonata**

**Kia
Spectra**

Source: Oklahoma State Police

Fatigue Factors

- Off work for 3 weeks
- Kept day active/night sleep schedule when off
- 3am to 3pm shift work/drive schedule (since 1997)
- Early bedtime (2 hr phase advance in sleep time)
- Obtained min 3 hrs/max 5 hrs sleep prior to accident
- Subsequently diagnosed with mild sleep apnea

Probable Cause (fatigue)

“ . . . driver’s fatigue, caused by the combined effects of acute sleep loss, circadian disruption associated with his shift work schedule, and mild sleep apnea, which resulted in the driver’s failure to react to slowing and stopped traffic ahead by applying the brakes or performing any evasive maneuver to avoid colliding with the traffic queue. . . . ”

Circadian Disruption

- Inverted sleep/wake schedule (acute/chronic)
- Rapidly rotating sleep/wake schedule
- Transitions to different sleep/wake schedule
- Sleep phase: advanced/delayed (acute/changing)
- Time zone changes (#/direction/acute/chronic)
- Incomplete circadian adjustment
- Sleep/wake schedule instability
- Sleep/wake schedule predictability
- On-call/on-demand

Risks: Physiological 'Fatigue' Factors

- Multiple factors
- Interactions
- Unknowns

Opportunities to Enhance Safety

- NTSB recommendations
- Circadian policies/strategies
- Chronobiology change agents

NTSB Most Wanted List

Critical changes needed to reduce transportation accidents and save lives.



NATIONAL TRANSPORTATION SAFETY BOARD

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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



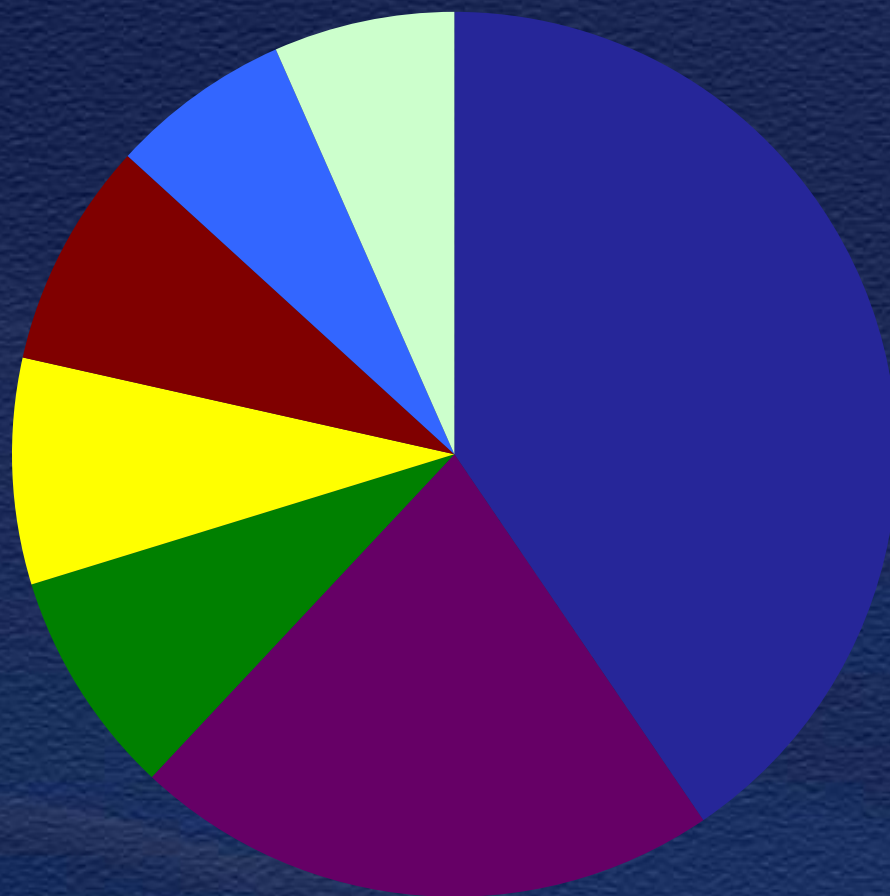
Motorcycle Safety



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

Scheduling Policies and Practices

Victoria, Texas, January 2, 2008



Victoria, Texas Fire Department

- 1 fatality, 47 injuries; day sleep, night drive, ~ 4 am WOCL

NTSB



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

Circadian Policies/Strategies

- Translate/transfer laboratory findings
- Conduct operationally relevant science
- Implement science-based policies/strategies
- Continuing evaluation/evolution/innovation

Chronobiology Change Agents

- Need a culture change that supports different attitudes and behaviors
- Chronobiology scientists:
 - translate/transfer relevant work
 - educate, inform, advocate
 - be a role model for change!



NTSB