



**National
Transportation
Safety Board**

Managing Fatigue in Aviation: Challenges and Opportunities

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FAA Hangar 6 Safety Standdown
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NATIONAL TRANSPORTATION SAFETY BOARD

- 1) determining the probable cause of transportation accidents**
- 2) making recommendations to prevent their recurrence**





All Modes

Independent Federal Agency: Created in 1967

- >140,500 accident investigations
- 14,000+ safety recommendations
- ~ 2,300 organizations/recipients
- 82% acceptance rate



Challenges of a 24/7 Society



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Fatigue Factors

- sleep
- circadian clock
- hours awake
- sleep disorders

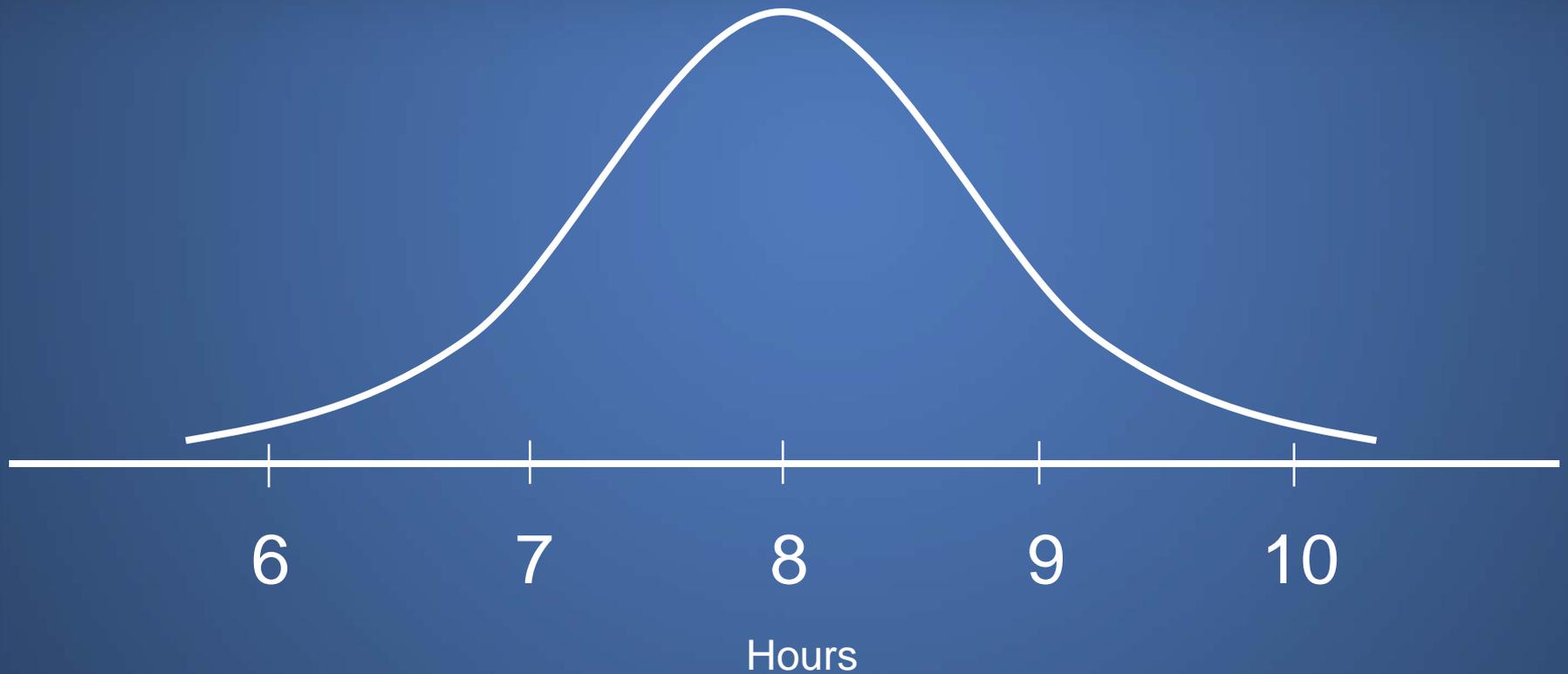


Fatigue Factors

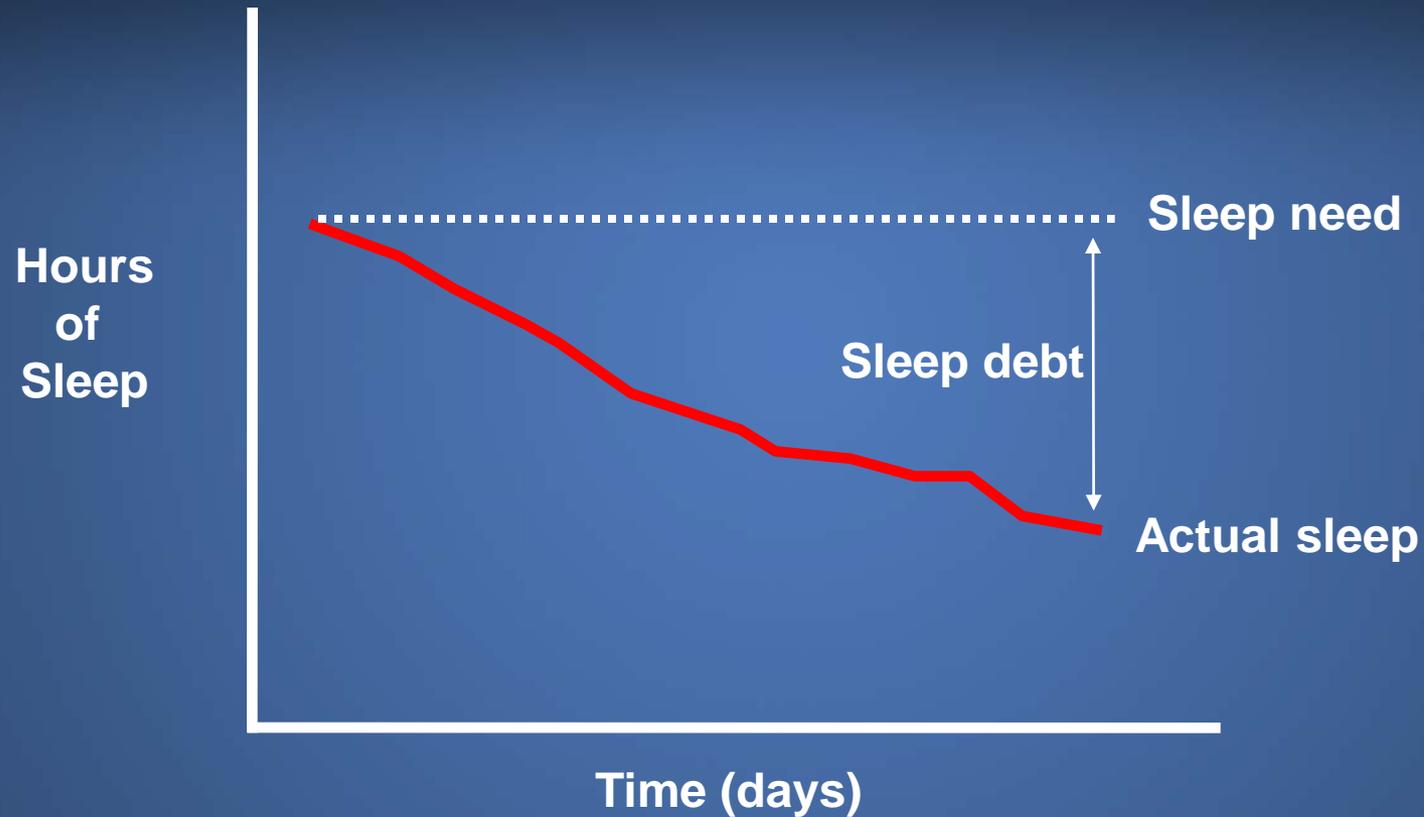
- sleep
 - acute sleep loss
 - cumulative sleep debt
- circadian clock
- hours awake
- sleep disorders



Sleep Requirement



Cumulative Sleep Debt



Sleep Need – Actual Sleep = Sleep Debt

Sleep debt grows cumulatively over time



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Sleep Loss and Alcohol: Performance Equivalents

<u>Sleep loss (hrs)</u>	<u>12oz Beers</u>	<u>BrEC%</u>
2	2 - 3	.045%
4	5 - 6	.095%
6	7 - 8	.102%
8	10 - 11	.190%

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 car crash
- SA performance = .06 - .08 BAC

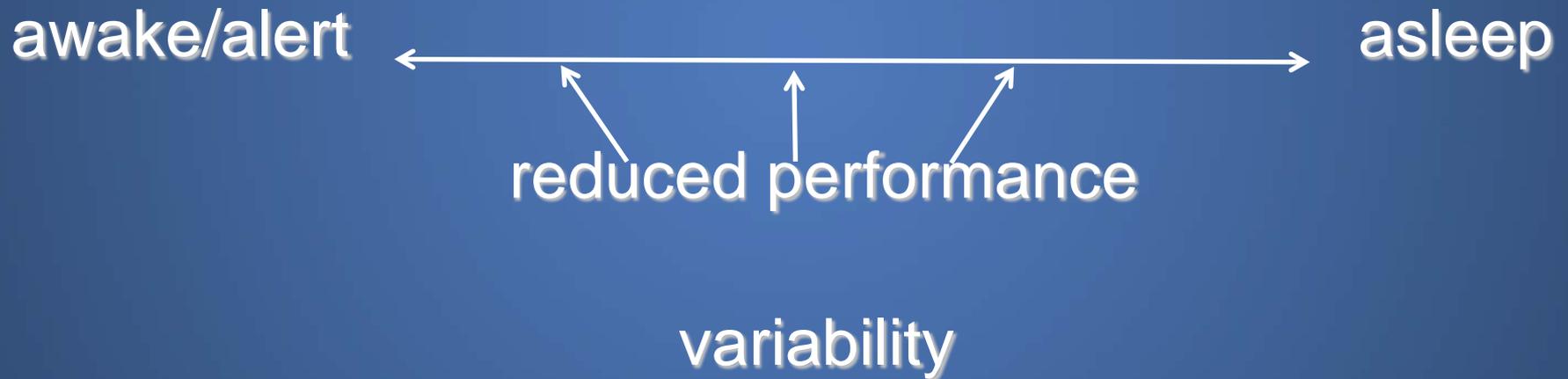


Fatigue Factors

- sleep
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Fatigue Risks

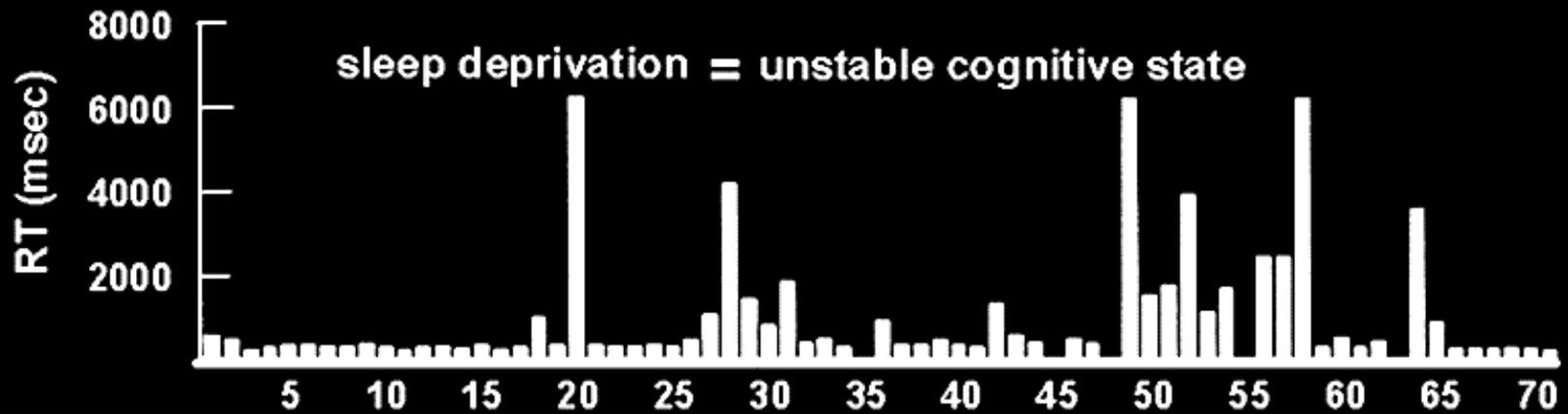
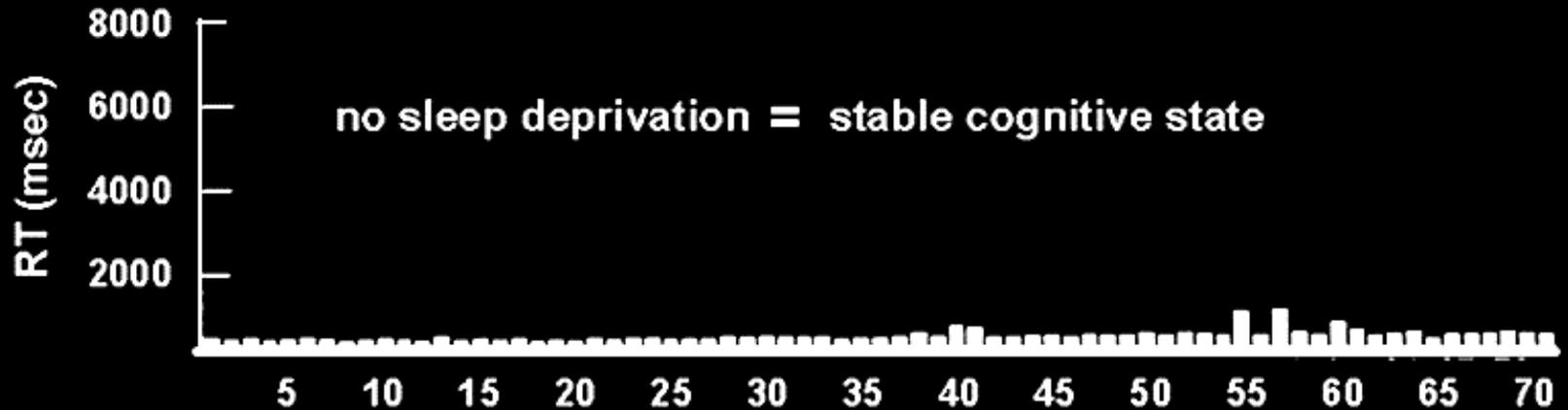


Fatigue Risks

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

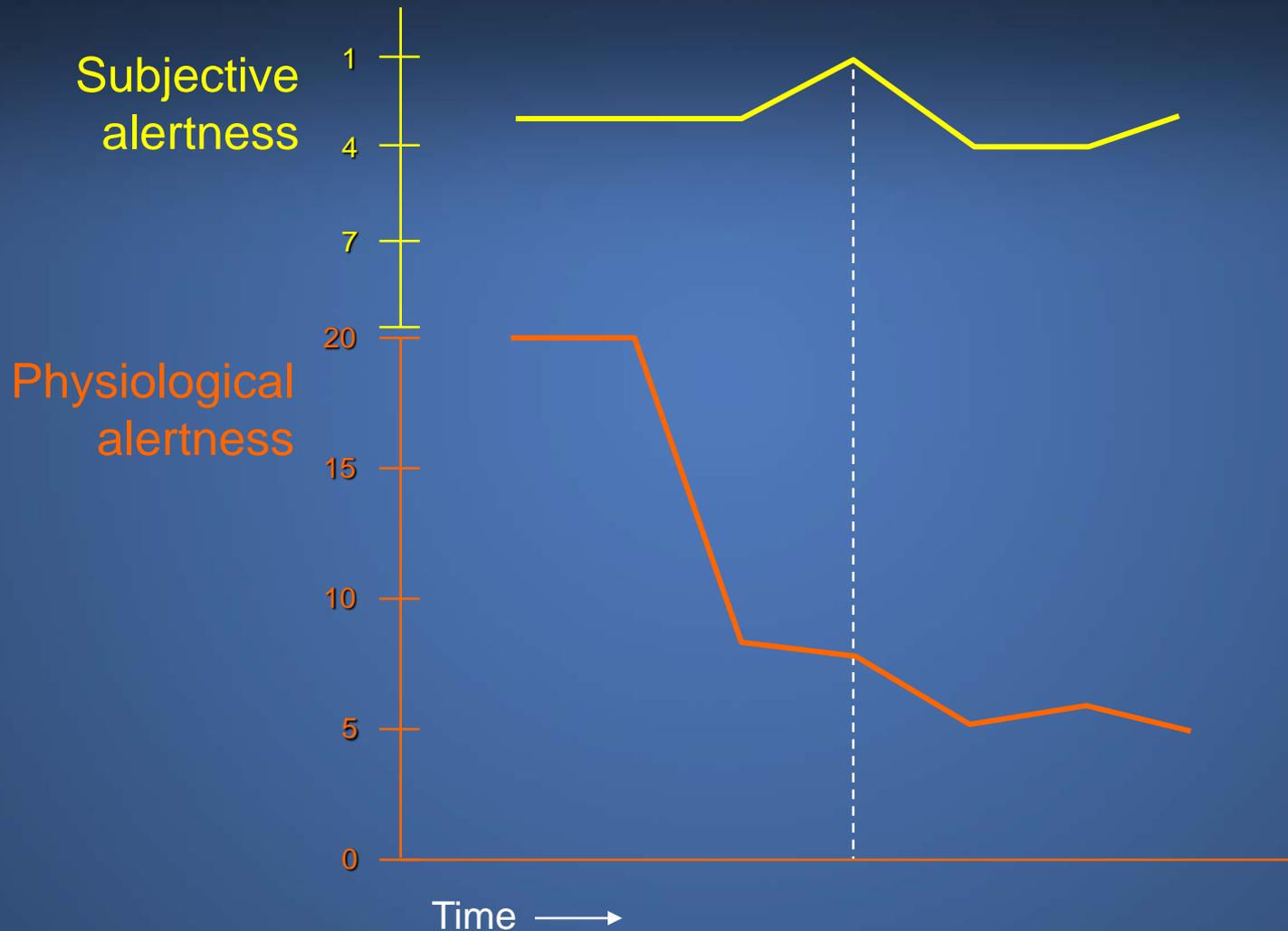


Fatigue and Reaction Times



consecutive RTs across a 10-min PVT performance task

Alertness Reports Often Inaccurate



Adapted from Sasaki et al., 1986

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

First NTSB aviation accident investigation
to cite fatigue as probable cause

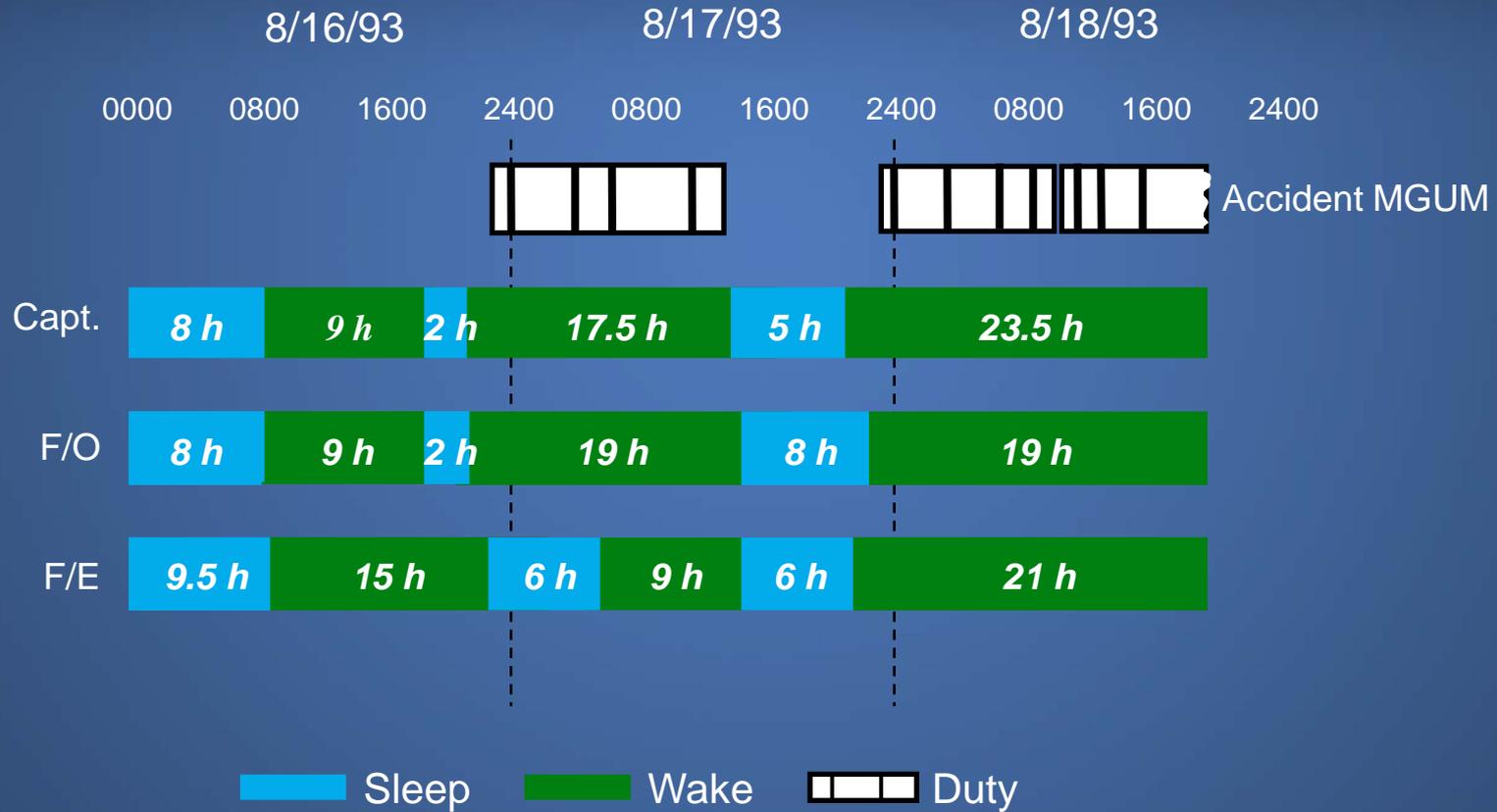


- acute sleep loss, sleep debt, circadian disruption



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Crew Sleep History



Observed Performance Effects

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





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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



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Probable Cause/Contributing Factors

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



Asiana 214 (July 6, 2013) San Francisco, CA (SFO)



3 fatalities
49 seriously injured



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Probable Cause

Contributing to the accident were . . .

(5) flight crew fatigue, which likely degraded their performance.



Fatal Aviation 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
- 6/09 Santa Fe NM: 2 fatalities
- 7/13 San Francisco, CA: 3 fatalities



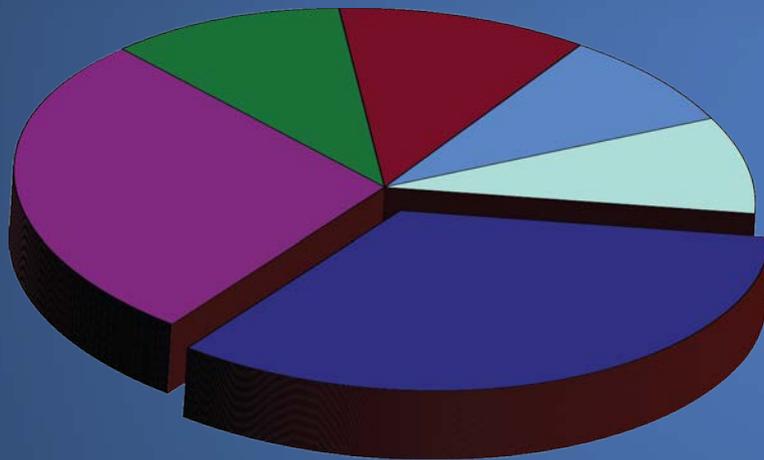
NTSB Recommendations

- MOST WANTED 1990 - 2011
- ~200 fatigue recommendations



Complex Issue:

Requires Multiple Solutions



■ Scheduling Policies and Practices

■ Education/Awareness

■ Organizational Strategies

■ Healthy Sleep

■ Vehicle and Environmental Strategies

■ Research and Evaluation



NTSB Fatigue 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 Fatigue Recommendations: Education/Strategies

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



Manage Fatigue = Enhance Safety

- Culture change
- Get educated
- Acknowledge risk
- Take action!



Good sleep, safe travels.



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