



Understanding the Role of Fitness for Duty in Accident Investigations

Katherine Wilson, PhD

Senior Human Performance Investigator

National Transportation Safety Board

Office of Aviation Safety

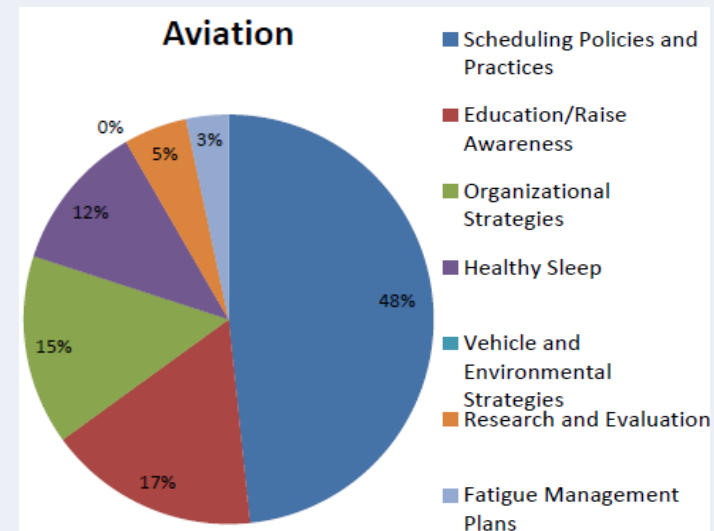


Fatigue Management Seminar
FAR 117 Fitness for Duty and Responsibilities



300+
Aviation
accidents
occurring in the
U.S. that have
been associated
with fatigue
since 1982

50+
Aviation fatigue-related
recommendations issued
by the NTSB between
1972 and 2018



What definition do we use?

- Fit for duty means physiologically and mentally prepared and capable of performing assigned duties at the highest degree of safety.
- Per § 117.5 Fitness for duty.
 - (a) Report for any flight duty period rested and prepared.
 - (b) Don't assign/accept a flight duty period if too fatigued to safely perform duties.
 - (c) Don't permit a flightcrew member to continue a flight duty period if reported too fatigued to continue.
 - (d) Affirmatively state he or she is fit for duty prior to flight.



What do we know?

- Fatigue is the largest *identifiable* and *preventable* cause of 15-20% of all accidents in transport operations (27% in aviation).
- Fatigue causes more accidents than alcohol or drugs across all modes of transportation.
- Official statistics often underestimate fatigue's contribution.

What do we know?

- The primary effect of shift work/ irregular work schedules is sleep deprivation and fatigue.
 - Secondary effects include cardiovascular and gastrointestinal diseases
- Performance decrements at 2 hours sleep loss.
- 17 hours awake = 0.05% BAC.



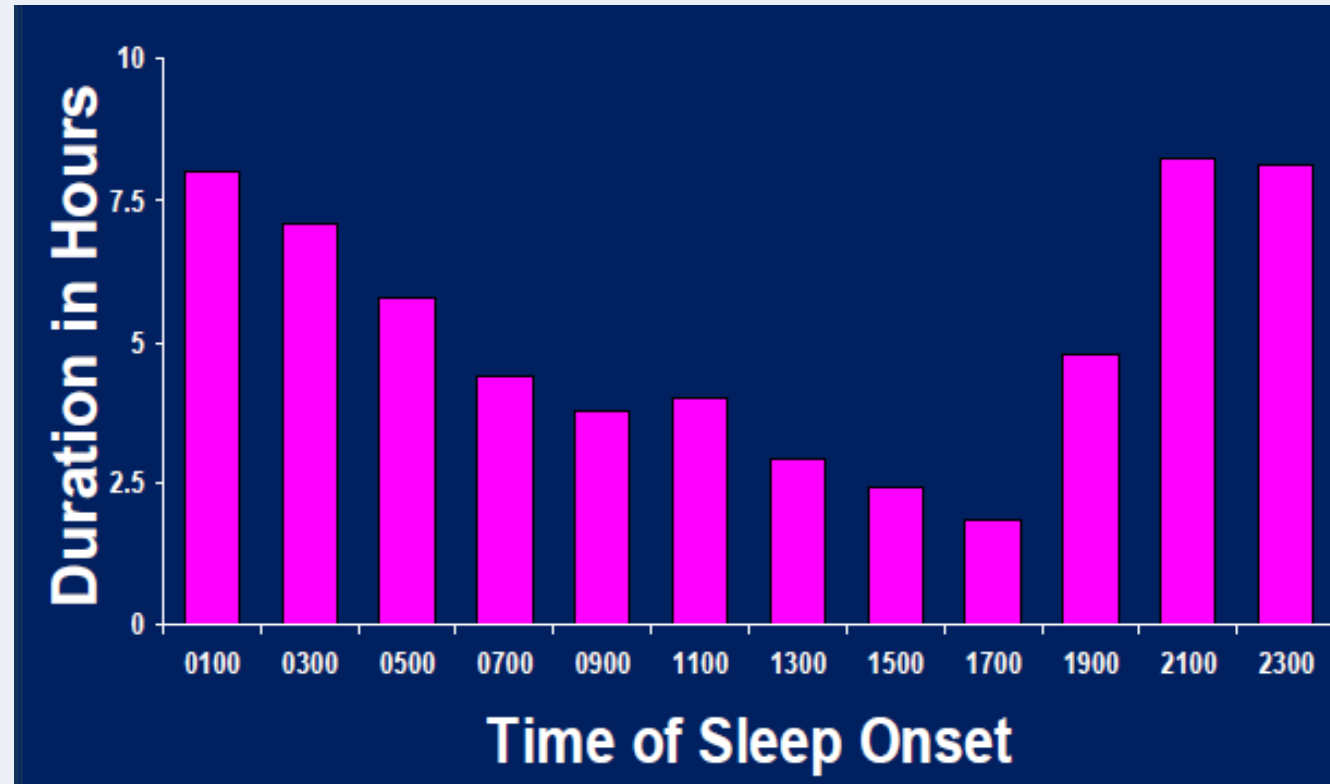
Are we getting enough sleep?



National Sleep Foundation. 2013 international bedroom poll: Summary of findings.



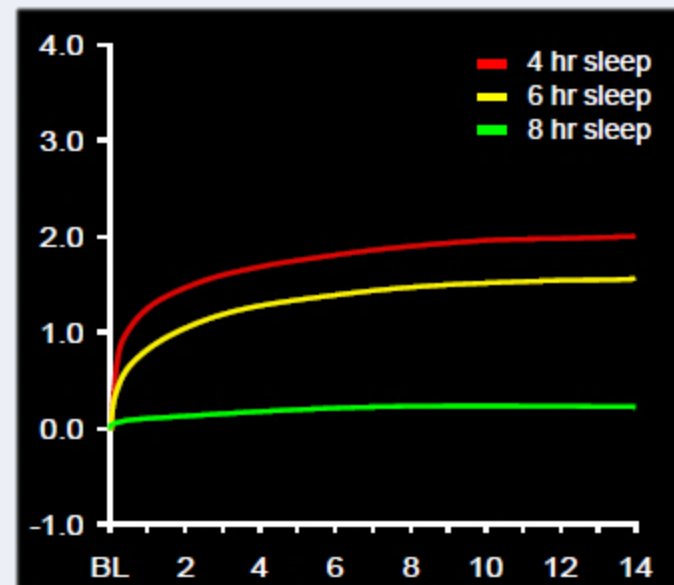
Is daytime sleep as good as nighttime sleep?



Kogl, K. (1985). Introduction to the problems of shift work. In Folkard, S. and Monk, T.H. (eds) Hours of Work -Temporal Factors in Work Scheduling. John Wiley, New York, pp 165-184.



Objective vs. subjective fatigue



Van Dongen et al. (2003). The cumulative cost of additional wakefulness: Dose-response effects on neurobehavioral functions and sleep physiology from chronic sleep restriction and total sleep deprivation. *Sleep*, 26(2), 117-126; Caldwell, J.L. (2016). *Fatigue causes and consequences*. Presented at NTSB Investigating Human Fatigue Factors course, Ashburn, VA, November 30, 2016.

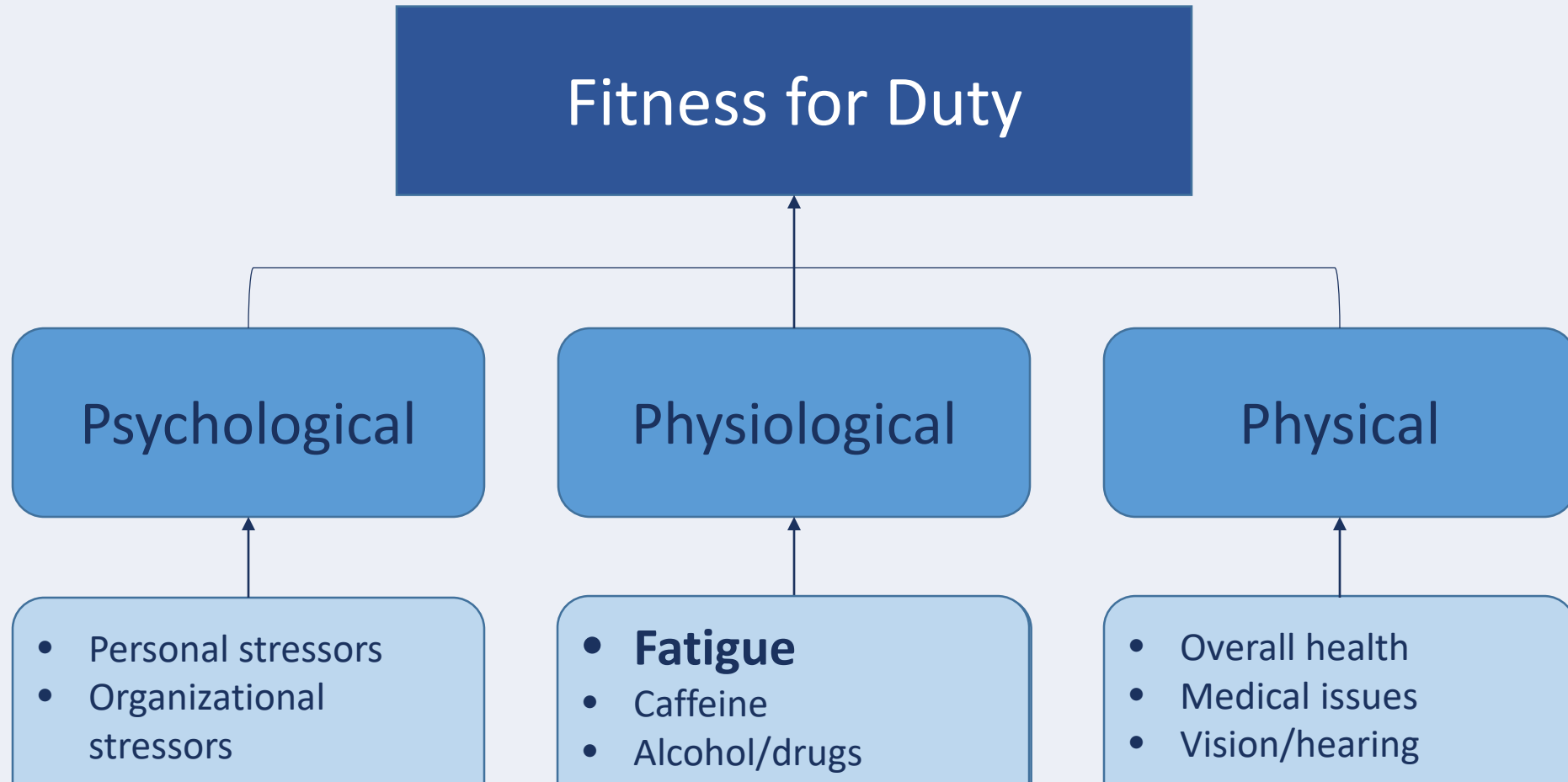


Why do we ignore fatigue?

- Sleep is an underappreciated necessity
- We underestimate the impact fatigue has on us
 - “Fatigue happens to others, not me!”
- Difficulty verifying the contribution of fatigue
- Tired people are reluctant to admit “falling asleep on the job”
- No one wants to “tattletale” on their buddies
- Leaders are reluctant to say that their personnel are over-tasked or improperly scheduled



Investigating fitness for duty

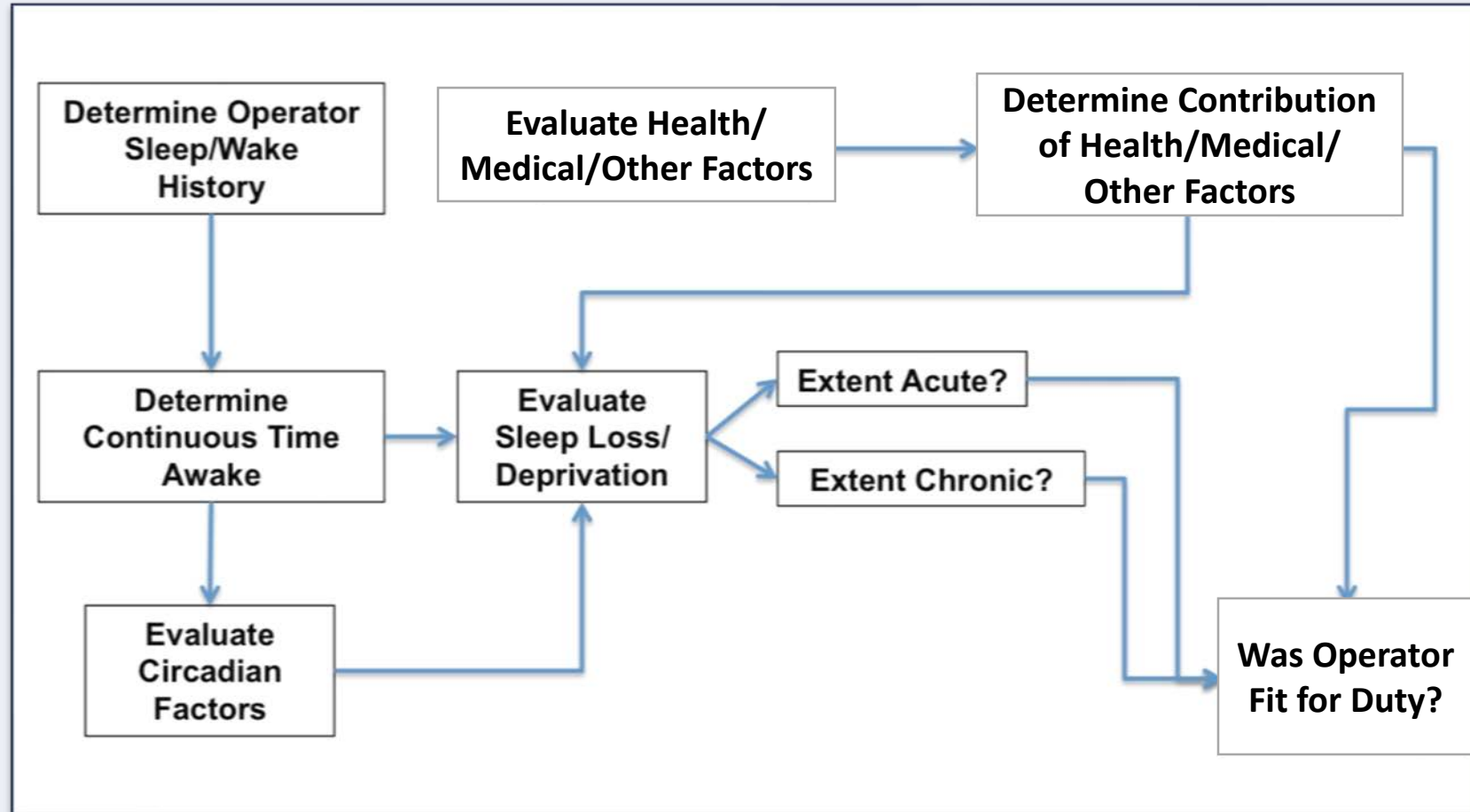


How is fitness for duty determined?

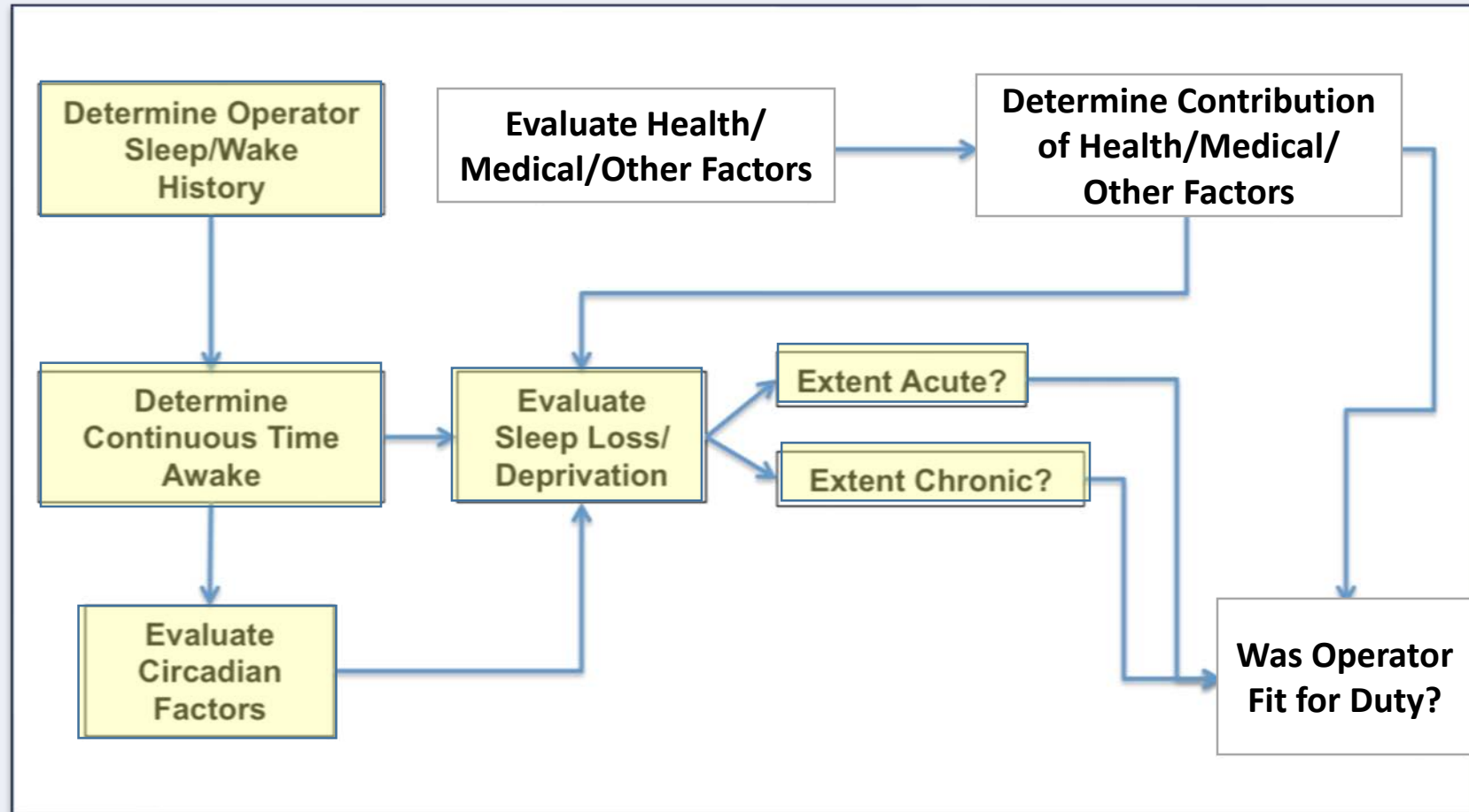
- Fatigue
 - Time since awakening
 - Quantity of sleep
 - Quality of sleep
 - Time of day
 - Pre-accident activities
 - Commuting
 - Work schedules
 - Napping
- Medical issues
 - Medications
 - Acute/chronic illness
 - Sleep disorders
- Personal or organizational pressures/stressors
- Overall health
 - Meals
 - Exercise
 - Alcohol/tobacco use
 - Caffeine use



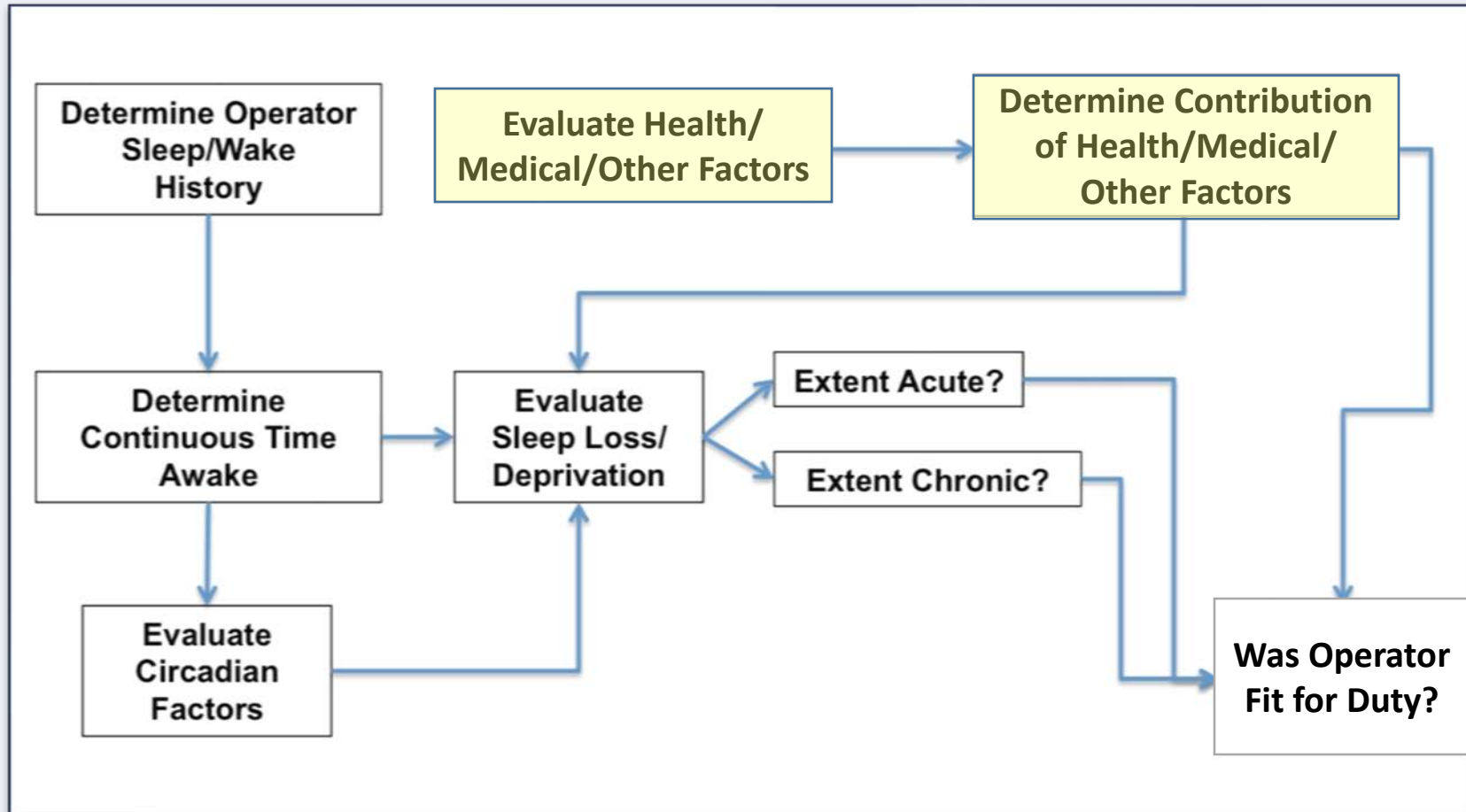
Step 1: Was the operator fit for duty?



Operator sleep/wake history



Evaluate operator health/medical/ other factors



What data do we collect?

- Interviews (operator, family, colleagues)
- Work schedules
- Log books
- Cell phone data (from phone and carrier)
- Hotel records
- Receipts
- Audio/video/data recordings
- Alarm clock settings
- Crew bags
- Medical records (FAA, general practitioner, specialist)
- CPAP usage
- Toxicology reports
- Other time-stamped records



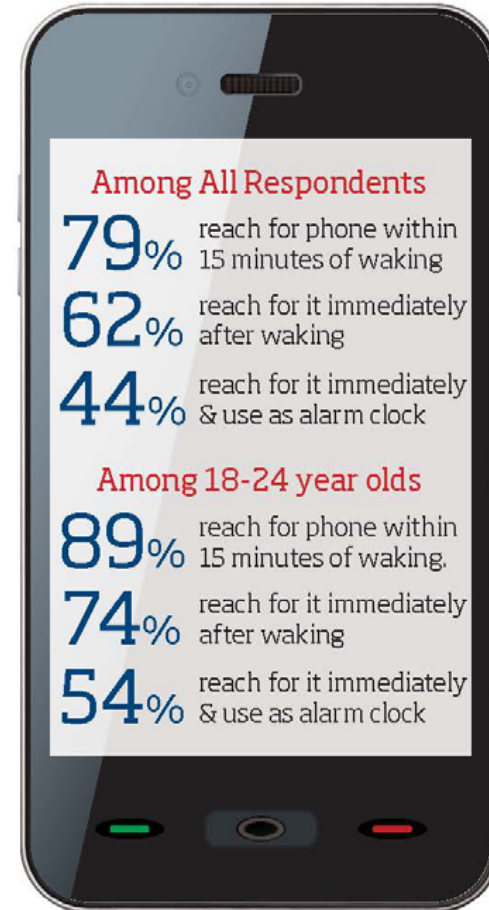
Are cellphones the new actigraph?!

What Do You Do When You First Wake Up?

Our interaction with each other through our phones begins as soon as we awake. Within the first 15 minutes of waking up, **4 out of 5** smartphone owners are checking their phones and among these people, nearly 80% reach for their phone before doing anything else. These statistics alone drive home the utility of and reliance on smartphones.



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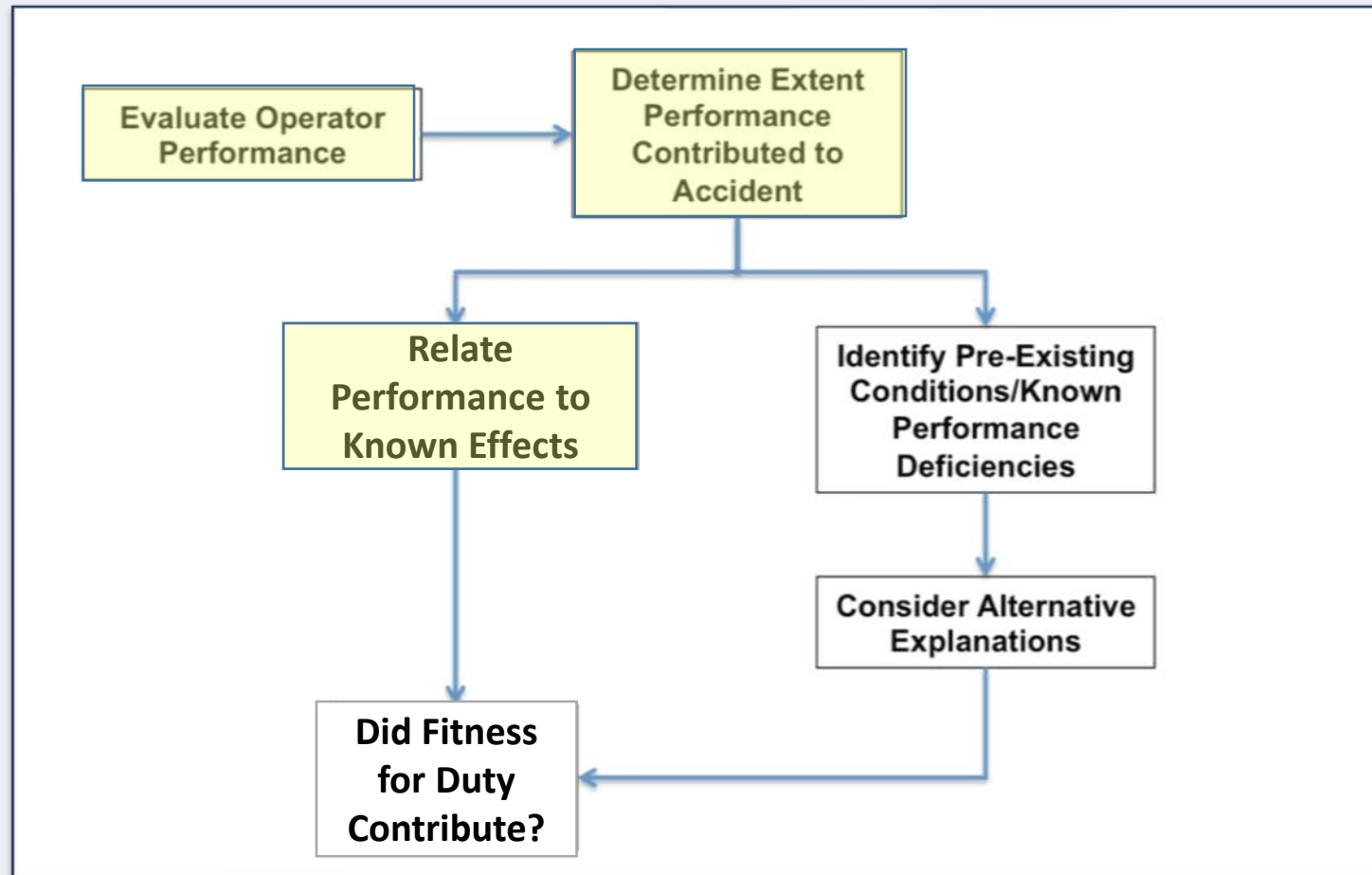


Compiling the data

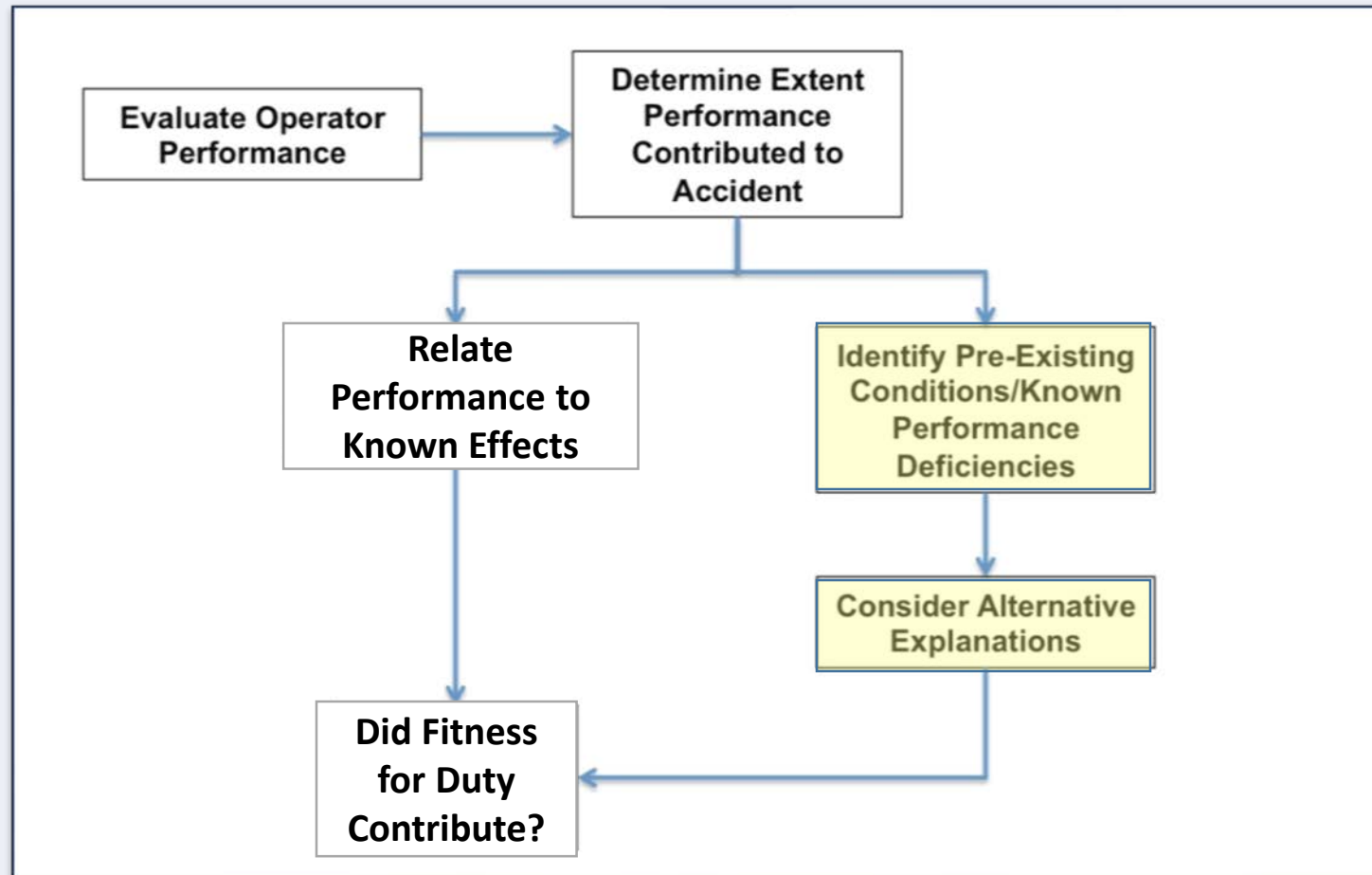
- Organize data chronologically
- Eliminate irrelevant data
- Quality control check data
 - Put all time stamped information into the same time zone.
 - Consider credibility of source
- Deal with inconsistent data



Step 2: Did fitness for duty contribute to the event?



Step 2: Did fitness for duty contribute to the event?



Analyzing the data

- Was the operator fit for duty at the time of the accident?
- Are the actions that led to the accident consistent with known decrements of fitness for duty (fatigue)?
- Are there any other explanations for performance?



What performance decrements?

- Slowed reaction time
- Reduced scanning
- Preoccupation with single tasks
- Attention/memory deficits
- Missed steps
- Poor communication
- Impaired decision making
- Lethargy/complacency
- Nodding off/microsleep
- Risk taking behaviors



UPS 1354 - Overview



Crash During a Nighttime Nonprecision Instrument
Approach to Landing
UPS Flight 1354
Airbus A300-600, N155UP
Birmingham, Alabama
August 14, 2013



Accident Report

NTSB/AAR-14/02
PB2014-107898



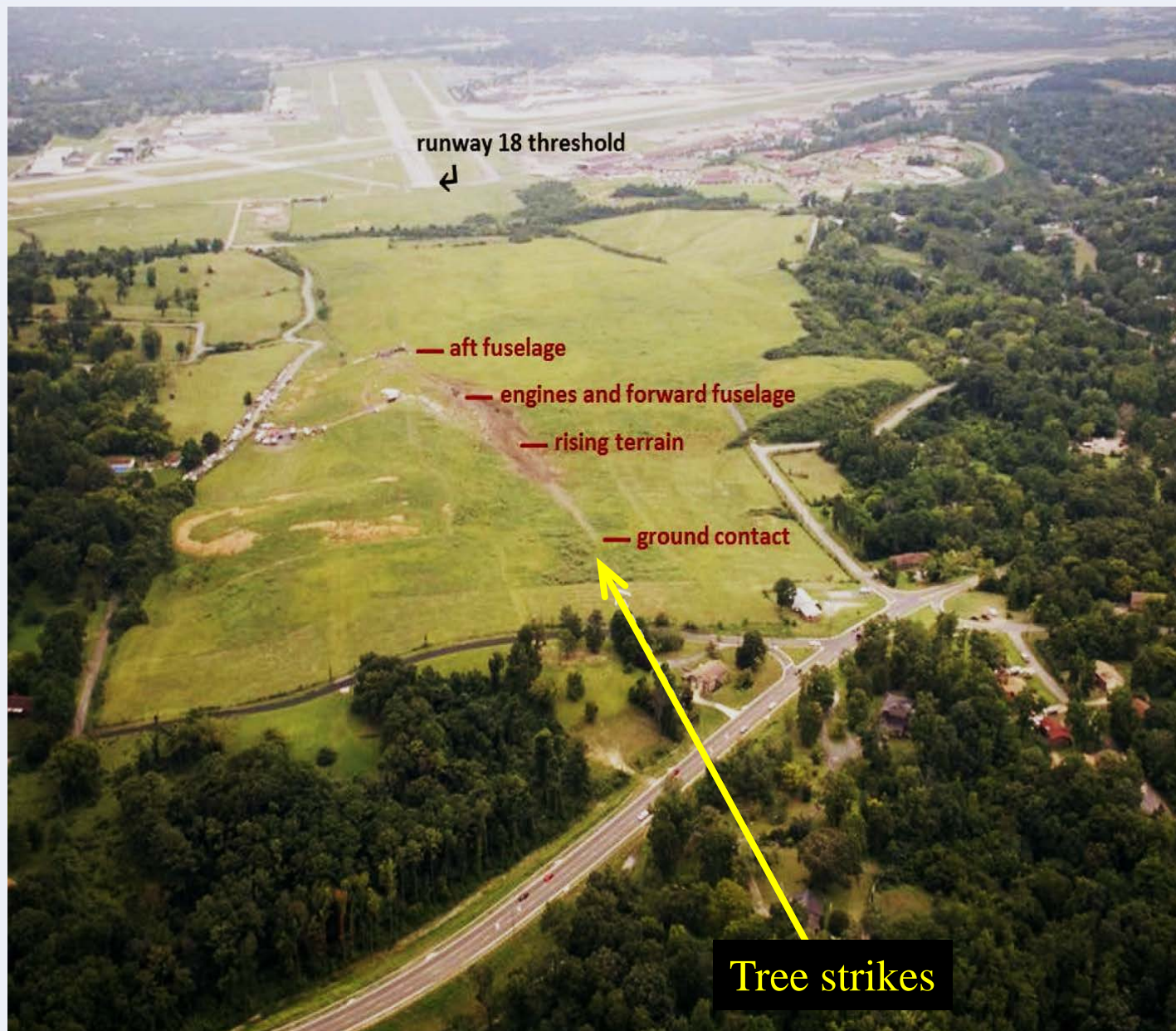
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Transportation
Safety Board



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UPS 1354 - Overview





U.P.S. Cargo Plane Crashes in Alabama



Upon impact, the tail section of the United Parcel Service Airbus A300 was engulfed by a fire that took about 90 minutes to extinguish. Photograph by Gary Tramontina



On Demand News video dated Aug. 14, 2013

Aerial Views Of UPS Plane Crash Site In Birmingham Alabama August 14, 2013

Posted on August 14, 2013 12:31 PM | Updated August 14, 2013 1:02 PM



Frank Couch

UPS Plane Crash

Aerial views of a UPS plane crash site at the Shuttlesworth Birmingham International Airport in Birmingham, Alabama Wednesday August 14, 2013. The crash claimed the lives of two pilots according to the Birmingham Mayors office. (Frank Couch/al.com/fcouch@al.com)

1 / 35

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Initial launch

- Full NTSB Go Team launched to Birmingham
 - Parties/Tech Advisors – FAA, UPS, IPA, BEA/Airbus
- What data do we collect?
- What questions do we ask?
- What we knew initially -
 - Crash short of runway – weather, mechanical/system failure, fitness for duty, training deficiencies?
 - Accident occurred at 0447 – fitness for duty?



Mechanical issues



Flight crew performance

- Crew did not verify the approach
- Captain started the approach higher than recommended
- Captain changed to vertical speed without communicating his intentions to first officer



Flight crew performance (cont.)

- Crew did not monitor flight path
 - Did not recognize cues that approach not set up properly
 - Continued unstable approach
 - Did not recognize at minimum altitude
- First officer did not make required minimum altitude callouts
- Captain descended below minimums



On scene



On scene

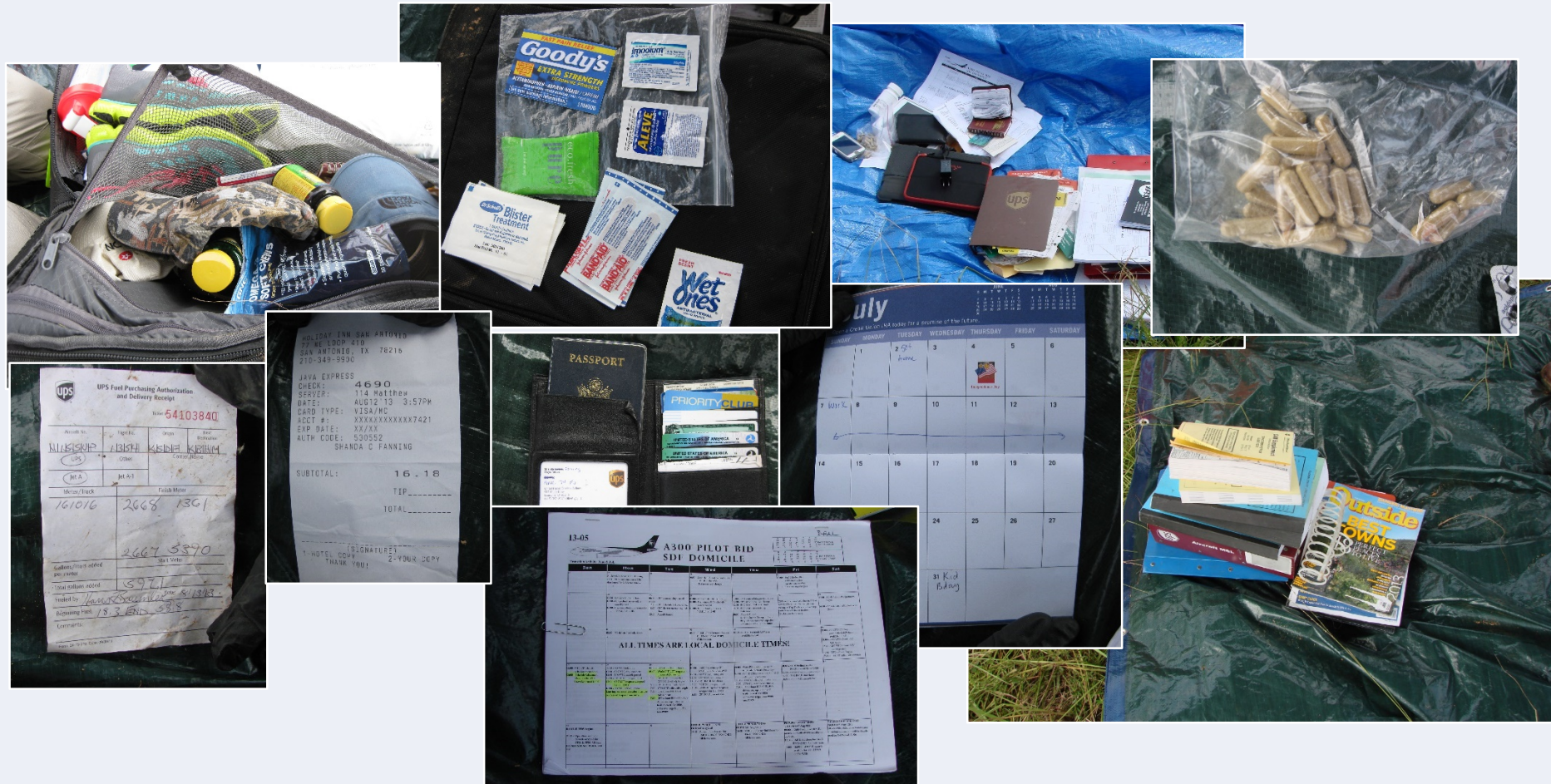
- Company asks
 - Background/experience
 - 30-day work schedule
 - Manuals/documents
- Interviews/statements
 - Anyone who interacted with crew
 - Ramp personnel
 - Dispatch
 - Witnesses to accident
 - Other pilots flying to BHM
- Toxicology coordination
- Crew bags
- Electronic devices
- Hotel asks
 - Shuttle van logs
 - Receipts
 - Check in/out records
 - Key swipe records
 - Staff interviews



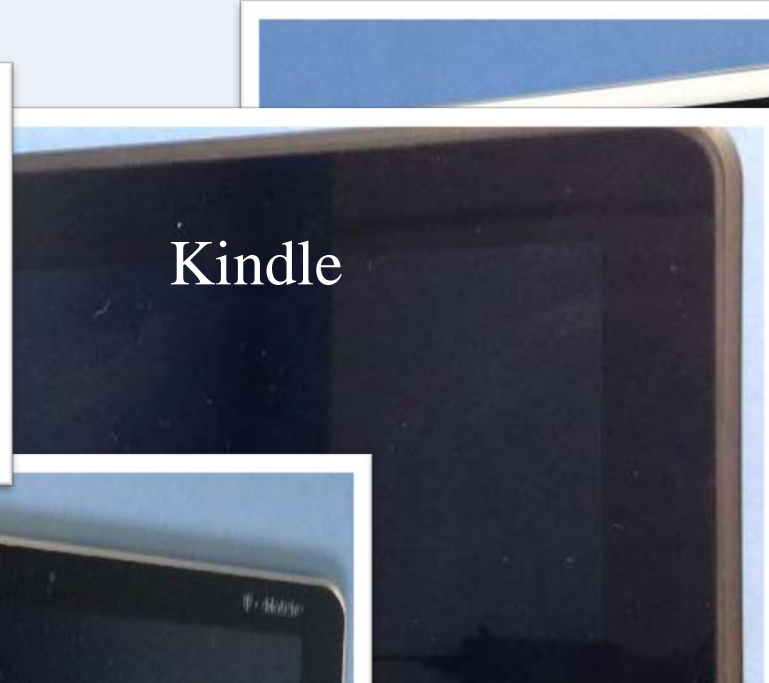
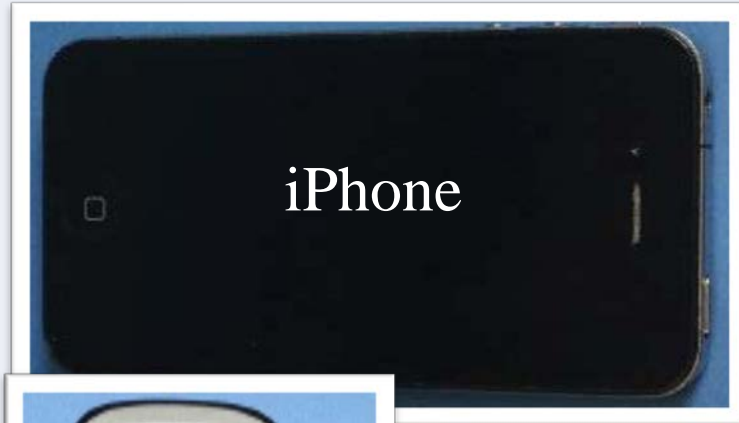
On scene



On scene



Electronic devices



Those who interacted with crew

The FO seemed perfectly fine for someone who had just flown in. She wanted a sleep room. She did not remember seeing her go to the room, and the next time she saw her was when she was doing her preflight paperwork, and that was about 0315. She did not see her yawning or act any way concerning.

[The captain] always had a smile on his face and was upbeat. He received his key, and stopped to talk to several other pilots. She never heard him voice any concerns about the company or airplane. She did not see him yawning. She also saw him when she was leaving at about 0315.

•Pilots who previously flew a/c

He met the crew at the airplane. He talked with the crew "a little bit." The FO was already settled in her seat, and was working on the radios. He went up to the cockpit about 0443 (edt)...for 2-3 minutes at most. [The captain's] mood seemed fine. He did not see either pilot yawning, and they did not seem to be tired. The captain seemed to be in a good mood. The FO did not say much.



Witnesses to accident



RECORD OF CONVERSATION

Ralph E. Hicks
Senior Air Safety Investigator
Eastern Region Aviation

Date: August 15, 2013 @ 1115 EDT
Person Contacted: Barbara Benson
NTSB Accident Number: DCA13MA133 – Birmingham, AL

Narrative:

This investigator interviewed Mrs. Benson at her residence ([REDACTED]) in Birmingham, AL ([REDACTED]). Also present during the interview was Mr. David Hargett from the Birmingham, AL Flight Standards District Office.

Mrs. Benson was asleep at the time, and the crash woke her up. It was a loud noise and it made her sit straight up. She saw a glow through the bedroom window, and knew it could not be lightning. It was an orange-yellow glow. After the loud "boom," it was really dark since the power was out to the house. The alarm company called to check on them since the power was out.

A few minutes later her brother called from Atlanta asking about the plane crash at the Birmingham airport and she then realized what had happened. It was still dark at the time, and she could see the wires down in the yard. She saw a lot of debris in the yard. She did not see the airplane crash.

The weather was "fairly decent...normal for this time of year."

They left all the yard debris as it was and did not disturb anything.

GAT Airline Ground Support

Post Incident Witness Statement

Name Carisha Turner Company GAT Today's Date 8/17/2013
Date/Time of Accident 8/13/2013 @ 5:03 am Phone # [REDACTED]

Describe in detail exactly what you witnessed, please be clear and concise.

I heard and felt the explosion's twice
and saw a little lightning from the area.

Where were you when the accident happened? Standing in the
parking lot next to my car.

Describe any special circumstances or conditions (rain, snow, high winds,
etc.) calm

Witness Signature [REDACTED]

Directions to Witness: Please print. Be very neat. Use ink. Put down as much as you can remember. What was going on? Describe conditions. Was it raining, cold, snowing, windy, etc.? Provide a sequence of events. Was other equipment involved? Were other people involved? Why? Use an extra sheet of paper, if needed.

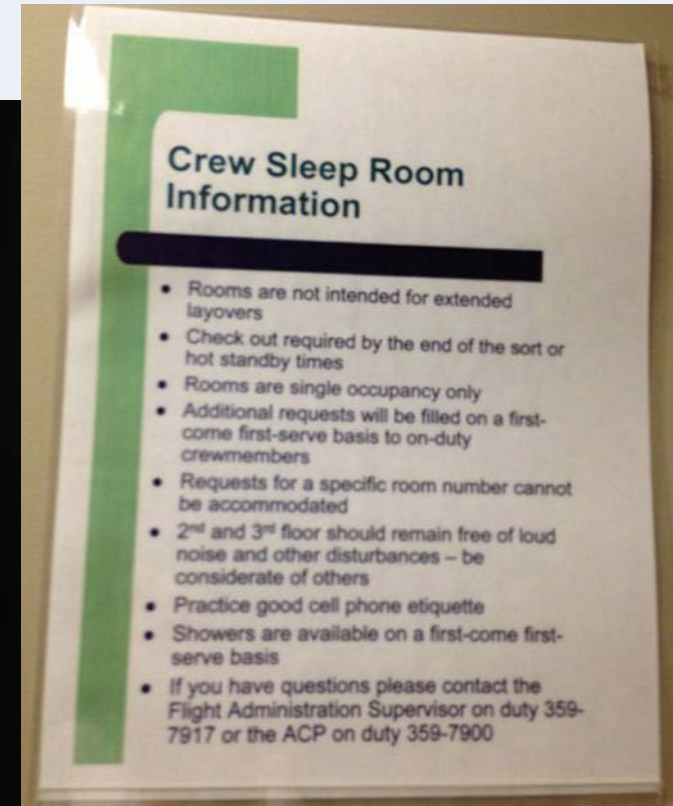


Follow up activities

- Visit to operator
- Interviews continued
 - Next of kin
 - Company management
 - Pilots who previously flew a/c
 - Instructors
- Review of records received
- CVR audition
- Simulator testing



UPS sleep room



Medical considerations

DEPARTMENT OF TRANSPORTATION

CERTIFICATE OF TRUE COPY

I HEREBY CERTIFY that the attached is a true copy of the official medical records of [REDACTED]

in file in the Aerospace Medical Certification Division and that I am the legal custodian thereof.

Signed and dated at Oklahoma City, Oklahoma

this [REDACTED]

by [REDACTED]

Manager, Medical Systems Branch
Aerospace Medical Certification Division
(Title)
Civil Aerospace Medical Institute

I HEREBY CERTIFY that JACQUELINE D. BROWN

who signed the foregoing certificate is now, and was, at the time of signing the legal custodian of the aforesaid records,

and that full faith and credit should be given this certificate as such.

IN WITNESS WHEREOF, I have hereunto subscribed my name and caused the seal of the Department of Transportation to be affixed this 6th day of [REDACTED] at [REDACTED]

(Signature)
Manager, Aerospace Medical Certification Division
(Title)
Civil Aerospace Medical Institute
Department of Transportation

FAA-AAM-True Copy (3-16)



Medical considerations

FINAL FORENSIC TOXICOLOGY FATAL ACCIDENT REPORT

CARBON MONOXIDE: The carboxyhemoglobin (COHb) saturation is determined by spectrophotometry with a 10% cut off and confirmed by chromatography.

>> NO CARBON MONOXIDE detected in Blood (Cavity)

CYANIDE: The presence of cyanide is screened by Conway Diffusion, when the COHb level is equal to or greater than 10% or upon special request. Cyanides are quantitated by spectrophotometry and confirmed by chromatography. The reporting cutoff for cyanide is 0.25 ug/mL. Normal blood cyanide concentrations are less than 0.15 ug/mL, while lethal concentrations are greater than 3 ug/mL.

>> NOT PERFORMED

VOLATILES: The volatile concentrations are determined by headspace gas chromatography at a cut off of 10 mg/dL. Where possible, positive ethanol values are confirmed by Radiative Energy Attenuation.

>> NO ETHANOL detected in Urine

DRUGS: Specimens are analyzed using immunoassay, chromatography, GC/MS, HPLC/MS, or GC/FTIR. Concentrations (ug/mL) at or above those in () can be determined for, but not limited to, the following drugs: amphetamines (0.010), opiates (0.010), marijuana (0.001), cocaine (0.020), phencyclidine (0.002), benzodiazepines (0.030), barbiturates (0.060), antidepressants (0.100), and antihistamines (0.020). Drugs and/or their metabolites, that are not impairing or abused, may be reported from the initial tests. See the CAMI Drug Information Web Site for additional information (<http://jag.cami.jccbi.gov/toxicology/>).

>> NO DRUGS listed above detected in Blood (Cavity)

UPS Airlines pilots died from crash, not medical problem, coroner rules

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UPS Airlines Flight 1354 crashed during its landing at the Birmingham, Ala., airport on Aug. 14.

www.bizjournals.com



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CAREER & WORKPLACE

Here are Louisville's new executives named in 2019 (GALLERY)



RESIDENTIAL REAL ESTATE

The most expensive home sales in Jefferson County in October



Crew pre-accident activities

- Cell phone records
- Hotel records
- Interviews
- CCTV
- Company logs



Duty schedule - captain

| | On Duty | Off Duty | Time on Duty |
|--------------|---------|-----------------|--------------|
| Aug. 10 | NA | Sick Leave | NA |
| Aug. 11 | NA | Sick Leave | NA |
| Aug. 12 | 2115 | 2232 | 1:17 |
| Aug. 13 (AM) | 0214 | 0553 | 3:39 |
| Aug. 13 (PM) | 2036 | 2357 | 3:21 |
| Aug. 14 | 0314 | 0447 (accident) | 1:33 |



Interviews with captain's family/colleagues

- Wife: captain in good health, he exercised often and was very happy in the days preceding the accident.
- Wife: no complaints about schedules
- Colleagues: schedules were “killing” him and becoming more difficult.
- Pilots who flew with captain: “average to above average” in flying ability, gave good briefings, followed procedures, concerned about schedules



Captain activities – Aug. 10-11

- Canceled scheduled trip because “sick”
- August 10
 - Family reunion 1300-0000
 - PED use: 0923, 1019-1022; 1611
- August 11
 - Family reunion 1300-1800
 - PED use: 1715
 - Log in UPS crew system: 1836



Captain activities – Aug. 12

- Log in UPS crew system: 0552, 0859, 2023, 2244
- Napped at home (time unknown)
- 2030: Departed home for airport (jumpseat to SDF)
- 2247: Secured sleep room
- 2256: Entered sleep room (exit unknown)



Captain activities – Aug. 13

- 0230 (Aug. 13): chat w/colleague
- 0326: Departed SDF for RFD
- Shuttle to hotel: 0548
- Key swipes: 0621, 1834
- Spoke with wife: 1930 (reported rested during day)
- Shuttle to airport: 2006
- PED use: 0057; 0157-0200; 1047; 1510-1645; 1835-1959

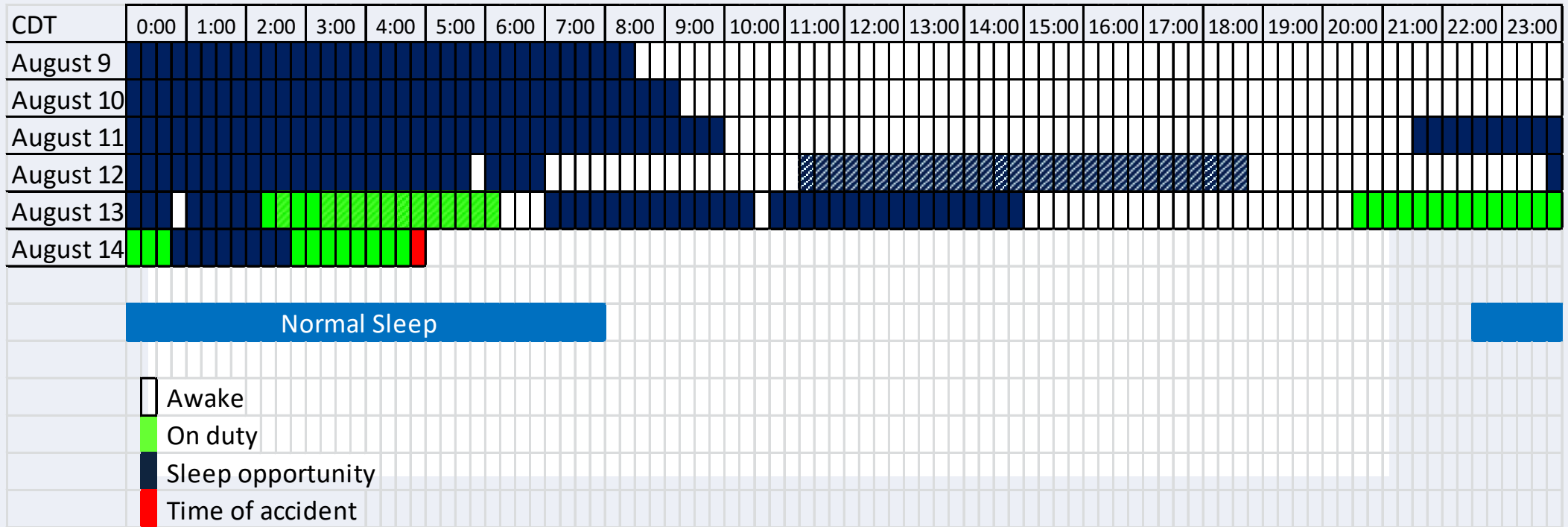


Captain activities – Aug. 14

- Secured a sleep room: 0009
- Entered sleep room: 0016
- Exited sleep room: 0247
- PED use: 0044; 0349



Captain's sleep/wake history



Interviews with FO's family/colleagues

- Husband: never complained about schedules
- Colleague/Friend: FO wanted to “fly under the radar”
- Colleague: saw FO exhausted in crew room before a flight
- Pilots who flew with FO: “top notch person,” followed procedures, efficient, approachable, dependable, professional



FO activities – August 10

- On duty – 0256-0625
- Off duty in SAT for 62:30 hours
 - 0657: Hotel check in in SAT
 - 0825: SWA flight to Houston, TX
 - 1105: Arrive Houston
 - PED use most of day
 - Unknown bedtime



FO activities – Aug. 11

- Unknown wake (PED use begins 0858)
- PED use much of day
- Text to husband – tired and resting
- Unknown bedtime (PED use until 0117 on Aug. 12)




FO activities – Aug. 12

- Unknown wake (PED use begins at 0744)
- Log in to UPS crew system at 0927 and 0942
- Intermittent PED use until 1325
- 1325: SWA flight to SAT
- PED use until 1841, and then becomes intermittent
 - Text to friend: “pay big money to sleep” but it’s time to get ready
- 2030: Depart on hotel shuttle
- 2053: On duty (depart SAT)



FO text messages – Aug. 12

| | | |
|---------------------|----------|--|
| 8/12/13 19:29:38 | outgoing | Im getting sooo tired |
| 8/12/13 19:35:30 | outgoing | And its time i get ready |
| 8/12/13 21:22:58 | outgoing |  Hey, bak in the ol office, and im sleepy as a # :) |

FO activities – Aug. 13

- 0022: Arrive SDF
- 0025: Chat with colleague
- 0026-0106: PED use
- 0326: Depart SDF for RFD
- 0553: Off duty
- 0601: Hotel check in
- 0620: Key swipe into room
- 0642: Log in to UPS crew system
- 0645-0649: PED use



FO text messages – Aug. 13

| | | |
|---------------------|----------|---|
| 8/13/13 0:26:48 | outgoing | Waitin on van |
| 8/13/13 11:06:56 | outgoing | Hey just dual fmc ⁷ failure last nite, thats always nice on ur ' first' nite ;) |
| 8/13/13 11:07:09 | outgoing | Just ol school navin |
| 8/13/13 11:16:36 | incoming | Oh yeah...that's great when ur tired as hell. I was snoozing by 830 but up at 5 to come to work. I'm still tired today. We are to old for that #. Lmao |
| 8/13/13 11:18:26 | outgoing | U got that rite, i fell asleep on every damn leg last nite- n rfd now, got here at 6 am n bed by 645 ish , now # ⁸ up, slept like 4 # hrs.... Van isnt till 8 tonite so hoping i will nap again this afternoon |
| 8/13/13 11:19:29 | incoming | Yeah u can get a nap in this afternoon. Grab some lunch and hit the bed again |
| 8/13/13 11:20:31 | outgoing | Thats da plan: sleep eat sleep eat sleep eat- works nice diet wise ha |



FO activities – Aug. 13 (cont)

- 1100: Sighting in hotel restaurant
- 1100-1148: PED use
- 1343-1705: PED use
- 1522: Key swipe back into room
- 1827-2124: PED use (1915 spoke with husband)
- 2006: Hotel shuttle to airport
- 2036: On duty
- 2134: Departed RFD
- 2357: Arrived SDF
- 2358: Shuttle from a/c to UPS facility

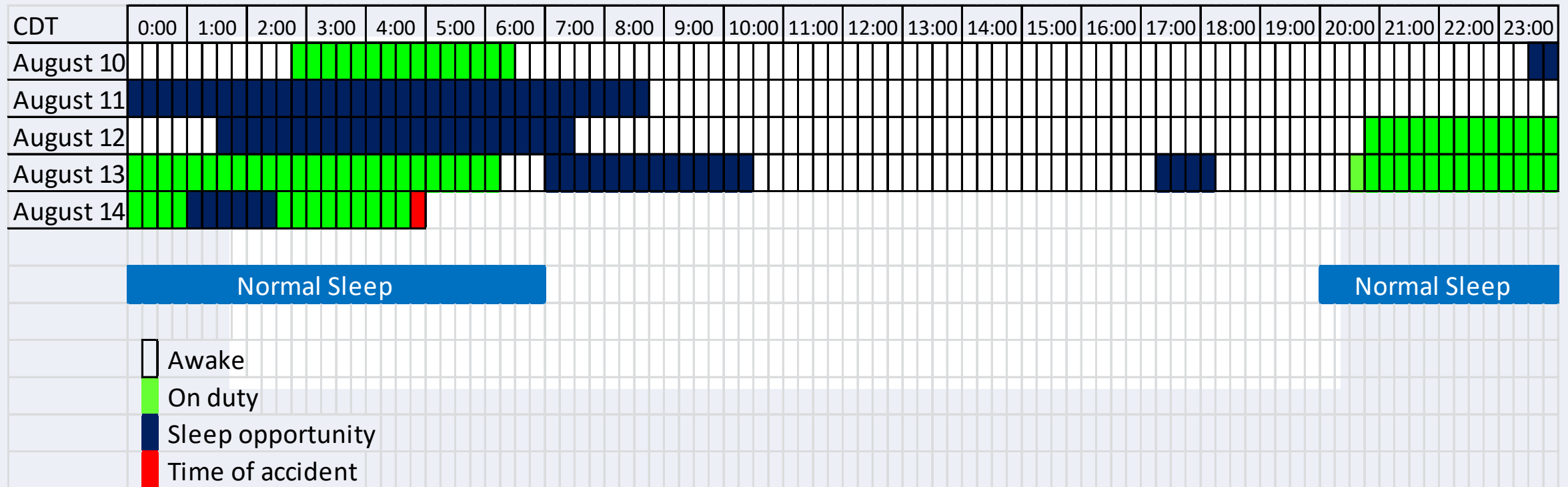


FO activities – Aug. 14

- 0009: Log in to UPS crew system
- 0011: Check in for sleep room
- 0020: Chat with colleague
- 0048: Entered sleep room (key swipe)
- 0241: Exit sleep room (CCTV)
- 0244: Log in to UPS crew system
- 0306: Shuttle to aircraft
- 0355: Departed SDF on accident flight (CVR comment: slept but still tired)



FO's sleep/wake history



A note about cell phone records

- No text message content from cell company
- Unclear data usage
- No web-based activity (iMessage, Whatsapp, Google Hangouts)
- Could miss out on substantial amount of data without access to device
- FO's device – 9 FB messages, 250 iMessages, 4500+ FB swipes



Cell phone records

| Network Element Name | Mobile Directory Number | Dialed Digit Number | Call Direction | Seizure Dt Tm | Seizure Duration | Calling Party Number |
|----------------------|-------------------------|---------------------|----------------|-----------------|------------------|----------------------|
| Louisville | 6153908xxx | 6153194xxx | 3 | 7/15/2013 14:28 | 27 | 6153908xxx |
| Louisville | 6153908xxx | 6153908xxx | 6 | 7/15/2013 14:31 | 1050 | 6153194xxx |
| Louisville | 6153908xxx | 8002282xxx | 3 | 7/15/2013 14:59 | 95 | 6153908xxx |
| Louisville | 6153908xxx | 6153908xxx | 6 | 7/15/2013 16:58 | 39 | 6617480xxx |
| Whites_Creek | 6153908xxx | *676152607371 | 3 | 7/15/2013 9:19 | 58 | 6153908xxx |
| Whites_Creek | 6153908xxx | 19313896xxx | 3 | 7/15/2013 9:25 | 282 | 6153908xxx |
| Whites_Creek | 6153908xxx | 6153908xxx | 6 | 7/15/2013 10:29 | 1000 | 6153194xxx |
| Whites_Creek | 6153908xxx | 6153908xxx | 6 | 7/15/2013 10:59 | 247 | 6153194xxx |
| Whites_Creek | 6153908xxx | 2707726xxx | 5 | 7/15/2013 11:37 | 318 | 6153194xxx |
| Louisville | 6153908xxx | 6153194xxx | 3 | 7/16/2013 1:11 | 552 | 6153908xxx |
| Louisville | 6153908xxx | 5025501xxx | 3 | 7/16/2013 1:24 | 75 | 6153908xxx |
| Tampa_Bay | 6153908xxx | 6153194xxx | 3 | 7/16/2013 6:45 | 32 | 6153908xxx |
| Tampa_Bay | 6153908xxx | 6153908xxx | 6 | 7/16/2013 7:09 | 25 | 6153194xxx |
| Tampa_Bay | 6153908xxx | 9317597xxx | 3 | 7/16/2013 10:20 | 241 | 6153908xxx |
| Tampa_Bay | 6153908xxx | 9316840xxx | 3 | 7/16/2013 10:34 | 276 | 6153908xxx |

Flight crew schedules – Part 117 comparison

| | Part 121 Subpart Q | UPS EDW Operations | Part 117 | Accident Crew Schedule |
|--------------------|-----------------------|-----------------------|----------|---------------------------|
| Duty time | N/A | 11 hours | 11 hours | 8:11 |
| Flight hours | 8 hours | 8 hours | 8 hours | 2:29 |
| Rest requirements | 9 hours | 10.5 hours | 10 hours | 14:28 |
| Consecutive nights | N/A | N/A | 3 nights | 2 nights |

NTSB conclusion: the schedule the flight crew was flying would have been in compliance with 14 CFR Part 117 requirements had those requirements been in effect and applied to all-cargo operators.



Other explanations?

- FO workload
 - Had to mentally process change in autopilot mode
 - No shared expectation of approach
 - 1500 fpm descent was twice as fast as normal descent rate
 - Pace of duties increased
- Captain training
 - Previous difficulties in training and upgrading to captain



Other explanations?



Other explanations?

- Expectation of visual meteorological conditions (VMC) – Flight crew
 - Weather crew received indicated ceiling at 1000 feet
 - Crew not alerted to variable ceiling
 - Incomplete weather increased crew's expectation of VMC
 - Cloud base encountered was about 350 feet



Was fitness for duty a factor?

- Both pilots in good health
- Toxicology results negative
- No pre-existing illness
- No medications influencing performance



Was fitness for duty a factor?

- Accident occurred at 0447 (window of circadian low)
- Both pilots on duty about 8.5 hours
- Both pilots got a sleep room
- Captain had adequate opportunity to rest but...captain described difficulties flying at beginning of trip
- First officer had 13+ hour sleep debt



Was fitness for duty a factor?

- Step 1 – Was the crew fit for duty?
 - Captain – possibly
 - FO – NO!
- Step 2a – are the performance decrements seen in the accident consistent with the known effects when not fit for duty?
 - Yes!
- Step 2b – are there other possible explanations?
 - Yes!
 - Poor crew communication, unexpected weather, error setting up approach, training deficiencies



Probable cause

The flight crew's continuation of an unstabilized approach and their failure to monitor the aircraft's altitude during the approach, which led to an inadvertent descent below the minimum approach altitude and subsequently into terrain. Contributing to the accident were (1) the flight crew's failure to properly configure and verify the flight management computer for the profile approach; (2) the captain's failure to communicate his intentions to the first officer once it became apparent the vertical profile was not captured; (3) the flight crew's expectation that they would break out of the clouds at 1,000 feet above ground level due to incomplete weather information; (4) the first officer's failure to make the required minimums callouts; (5) the captain's performance deficiencies likely due to factors including, but not limited to, fatigue, distraction, or confusion, consistent with performance deficiencies exhibited during training; and (6) the first officer's fatigue due to acute sleep loss resulting from off-duty time management and circadian factors.



Recommendations

- Require...flight crews performing...overnight operations brief the threat of fatigue before each departure, particularly those during WOCL.
- UPS/IPA to conduct an independent review of the fatigue event reporting system to determine the program's effectiveness as a nonpunitive mechanism...[and] implement changes to enhance the safety effectiveness of the program.
- UPS/IPA to counsel pilots who call in fatigued and whose sick bank is debited to understand why the fatigue call was made and how to prevent it from recurring.

