NTSB National Transportation Safety Board

Training for Enhancing Flight Crew Monitoring and Cross-checking Skills

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Monitoring and Cross Checking

- Inadequate crew monitoring or challenging was a factor in 31 of 37 (84 percent) crew-caused air carrier accidents reviewed in a NTSB safety study.

  - 76% of the monitoring/challenging errors involved failure to catch something that was <u>causal</u> to the accident

  - 17% of the monitoring/challenging errors were failure to catch something that <u>contributed</u> to the accident's cause

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October 25, 2002 Eveleth, Minnesota

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NTSB Finding

- "during the later stages of the approach, the flight crew <u>failed to monitor</u> the airplane's airspeed and allowed it to decrease to a dangerously low level (as low as about 50 knots below the company's recommended approach airspeed) and to remain below the recommended approach airspeed for about 50 seconds."

Accident Summary

- February 16, 2005
- Pueblo, CO
- Cessna Citation 560
  - Owned by Circuit City, Operated by Martinair
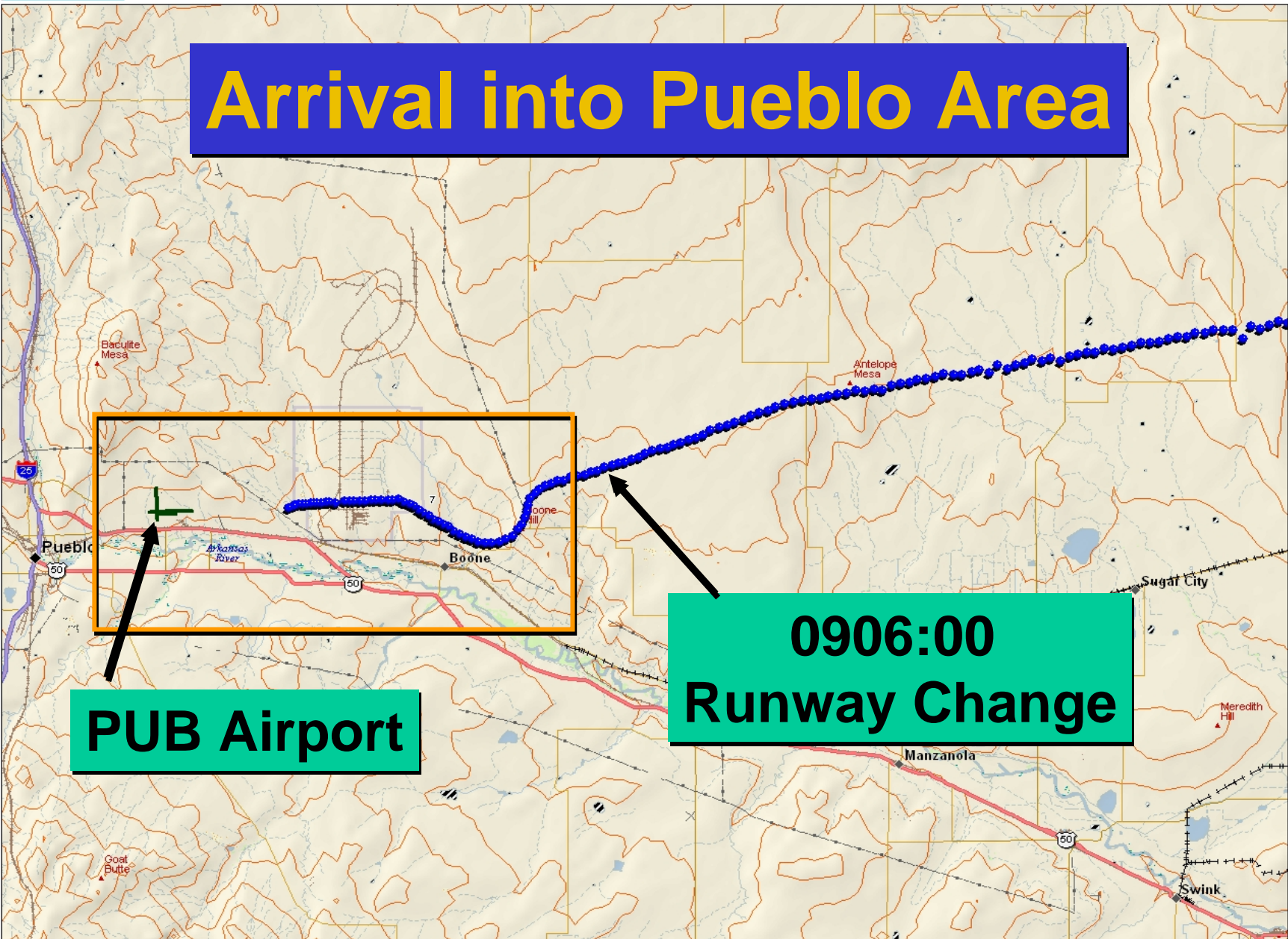- Eight fatalities
- Part 91 flight

Key Findings

- Icing encountered on descent and approach

- Airspeed not maintained on approach

- De-icing boots not operated on approach

- No stall warning before stall
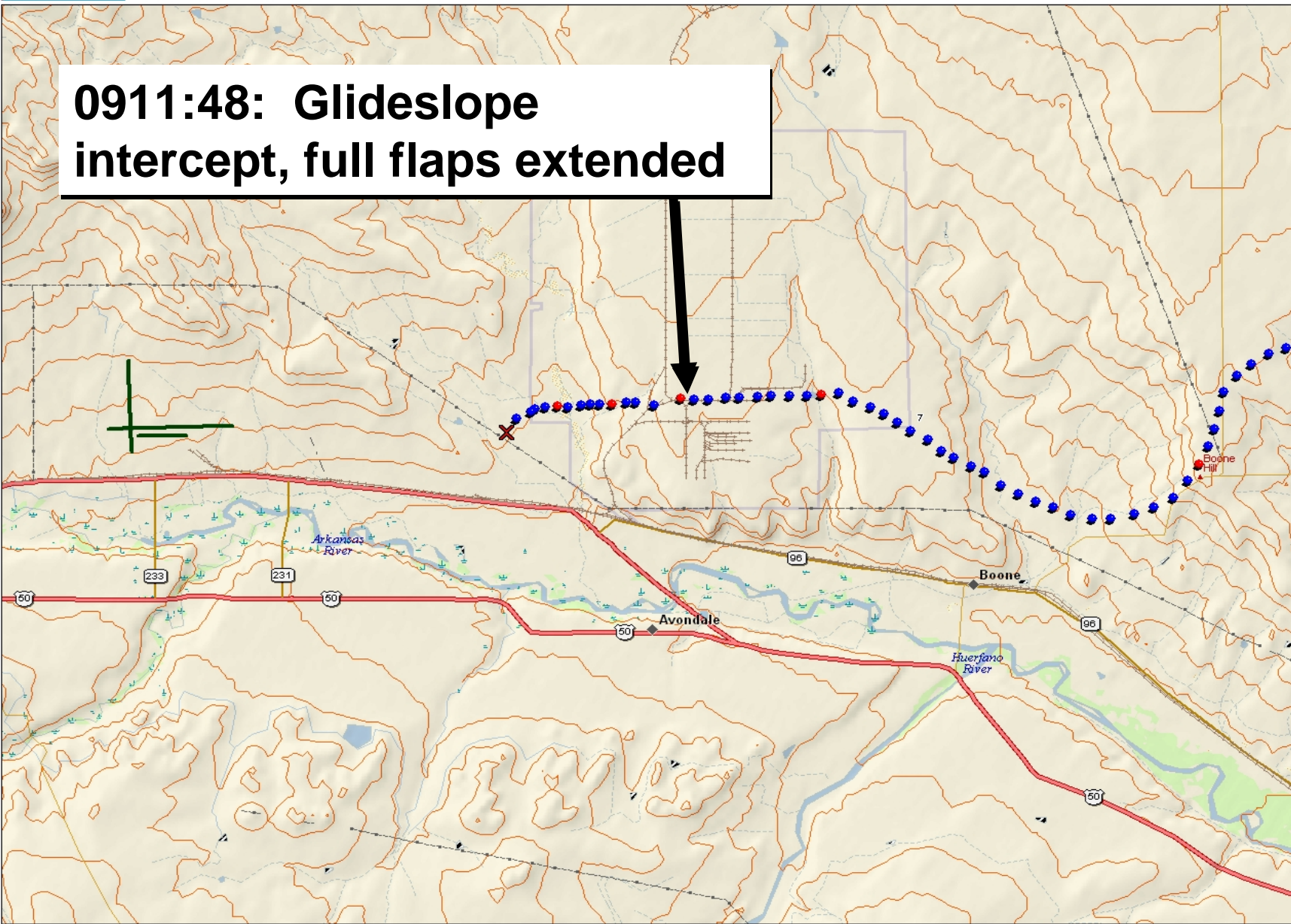
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Arrival into Pueblo Area

PUB Airport

0906:00
Runway Change

0911:48: Glideslope intercept, full flaps extended
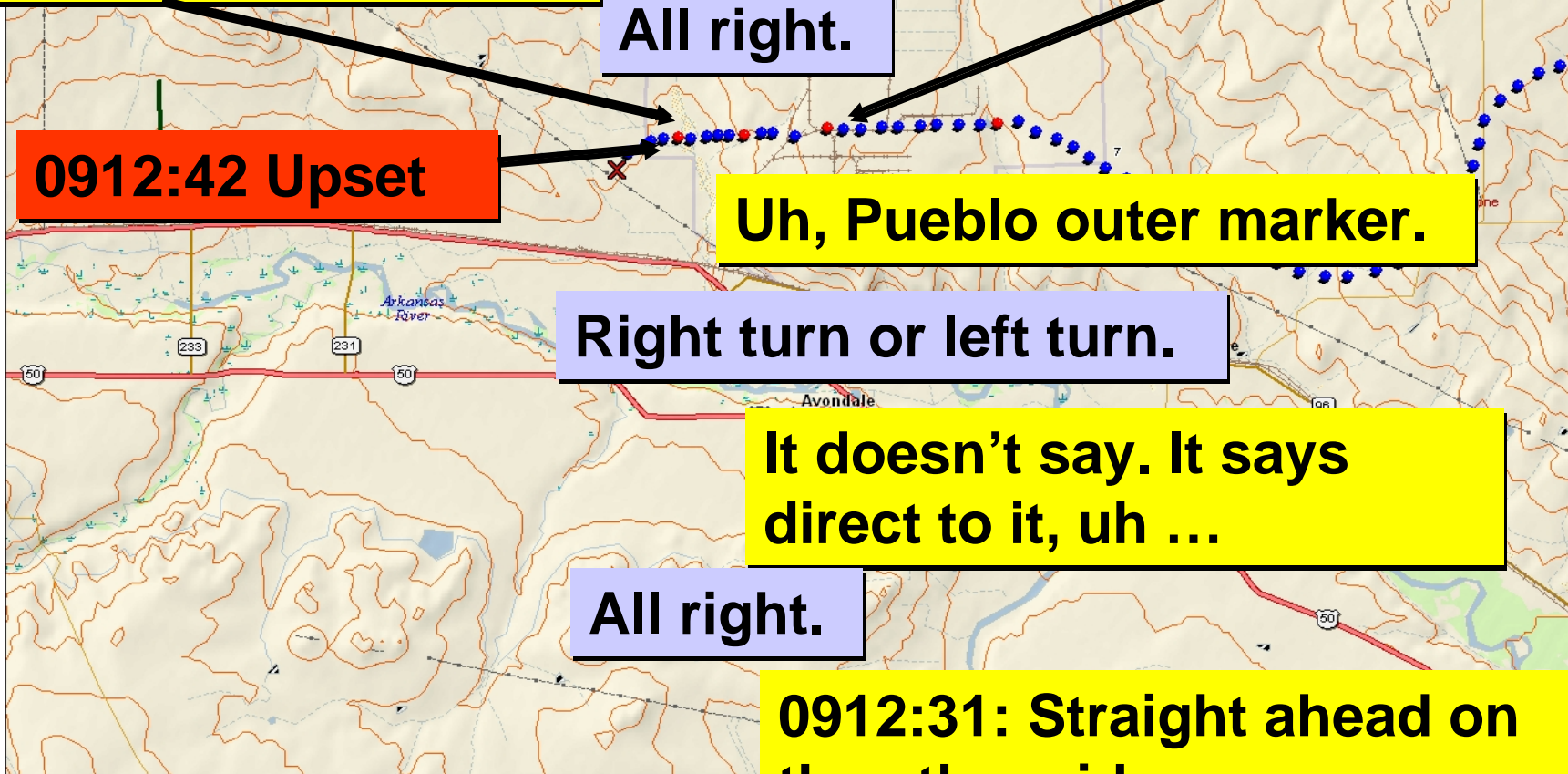
Upset Sequence

- Stall occurred at 1500 ft AGL
- Sudden left roll, A/P disconnect
- Airspeed at stall approx. 90 kts
- No stall warning before stall due to ice on wings

Probable Cause

"Flight crew's failure to effectively monitor and maintain airspeed and comply with procedures for deice boot activation on the approach, which caused an aerodynamic stall from which they did not recover."

NTSB Finding

- "All operators would benefit from an increased focus on providing monitoring skills in their training programs…"

NTSB Recommendation to FAA:

Require pilot training programs be modified to contain modules that teach and emphasize monitoring skills and workload management and include opportunities to practice and demonstrate proficiency in these areas.

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How?

- SOPs to support monitoring
- Training
- Practicing Monitoring

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A good place to start

Advisory Circular

U.S. Department of Transportation
Federal Aviation Administration

Subject: STANDARD OPERATING PROCEDURES FOR FLIGHT DECK CREWMEMBERS

Date: 2/27/03 AC No: 120-71A
Initiated By: AFS-210

1. PURPOSE.

a. General. Standard operating procedures (SOPs) are universally recognized as basic to safe aviation operations. Effective crew coordination and crew performance, two central concepts of crew resource management (CRM), depend upon the crew's having a shared mental model of each task. That mental model, in turn, is founded on SOPs. This advisory circular (AC) presents background, basic concepts, and philosophy in respect to SOPs. It emphasizes that SOPs should be clear, comprehensive, and readily available in the manuals used by flight deck crewmembers.

b. Using this Advisory Circular. This AC is designed to provide advice and recommendations about the development, implementation, and updating of SOPs. Appendix 1, Standard Operating Procedures Template, provides many important topics that should be addressed in SOPs. Stabilized Approach, characterized by a constant-angle, constant-rate of descent ending near the touchdown point where the landing maneuver begins, is among the SOPs specifically identified in this AC and is described in Appendix 2, Stabilized Approach: Concepts and Terms. These and the other appendices represent a baseline and a starting point. Start-up certificate holders and existing certificate holders should refer to the Template in Appendix 1, to Stabilized Approach in Appendix 2, and to the other appendices in developing comprehensive SOPs for use in training programs and in manuals used by their flight deck crewmembers.

c. What's New in this Advisory Circular. AC 120-71A revises and supersedes the earlier version, AC 120-71. Many minor changes have been made to improve clarity, accuracy, completeness, and consistency. Two significant changes are the conversion of the term pilot not flying (PNF) to pilot monitoring (PM) and the addition of a related Appendix addressing "Crew Monitoring and Cross-Checking." It is increasingly acknowledged that it makes better sense to characterize pilots by what they *are* doing rather than by what they are not doing. Hence, pilot flying (PF) remains an appropriate term and is unchanged in this AC. But the term pilot not flying misses the point. Studies of crew performance, accident data, and pilots' own experiences all point to the vital role of the non-flying pilot as a monitor. Hence, the term pilot monitoring (PM) is now widely viewed as a better term to describe that pilot. The term PM is used liberally throughout this AC. In those instances where the older term PNF appears, it should be understood that pilot monitoring (PM) is the preferred meaning.

- AC 120-71A, "Standard Operating Procedures for Flight Deck Crewmembers" – Appendix 19

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Developing SOPs

- Perform non-essential duties/activities during lowest workload periods (e.g., cruise altitude or level flight)

- When able, brief anticipated approach prior to top-of-descent

- PF will brief PM where or when delayed climb or descent will begin

- During the last 1000 feet of altitude change, both pilots will focus on making sure the aircraft levels at the assigned altitude

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Training monitoring skills

"First, we must change our approach to monitoring. Instructors must [teach and] insist that the non-flying crewmember monitors the flier effectively."

"Good monitoring skills are not inherent in pilots as they progress in their careers. Therefore, effective monitoring techniques must be trained and rewarded."

-   Captain Frank J. Tullo
"Aviation Week and Space Technology," May 21, 2001

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Training monitoring skills

- Starting from day 1 of training, ensure all monitoring/cross-checking SOPs are followed.

- Discuss how barriers are cut in half with one pilot out of the loop.

- Train workload management so at least one pilot is always monitoring during low workload and both pilots are monitoring as much as possible during high workload.

- Acknowledge good monitoring.

  – Introduction of occasional subtle failures in simulator training, such as failure of automation to level-off at proper altitude
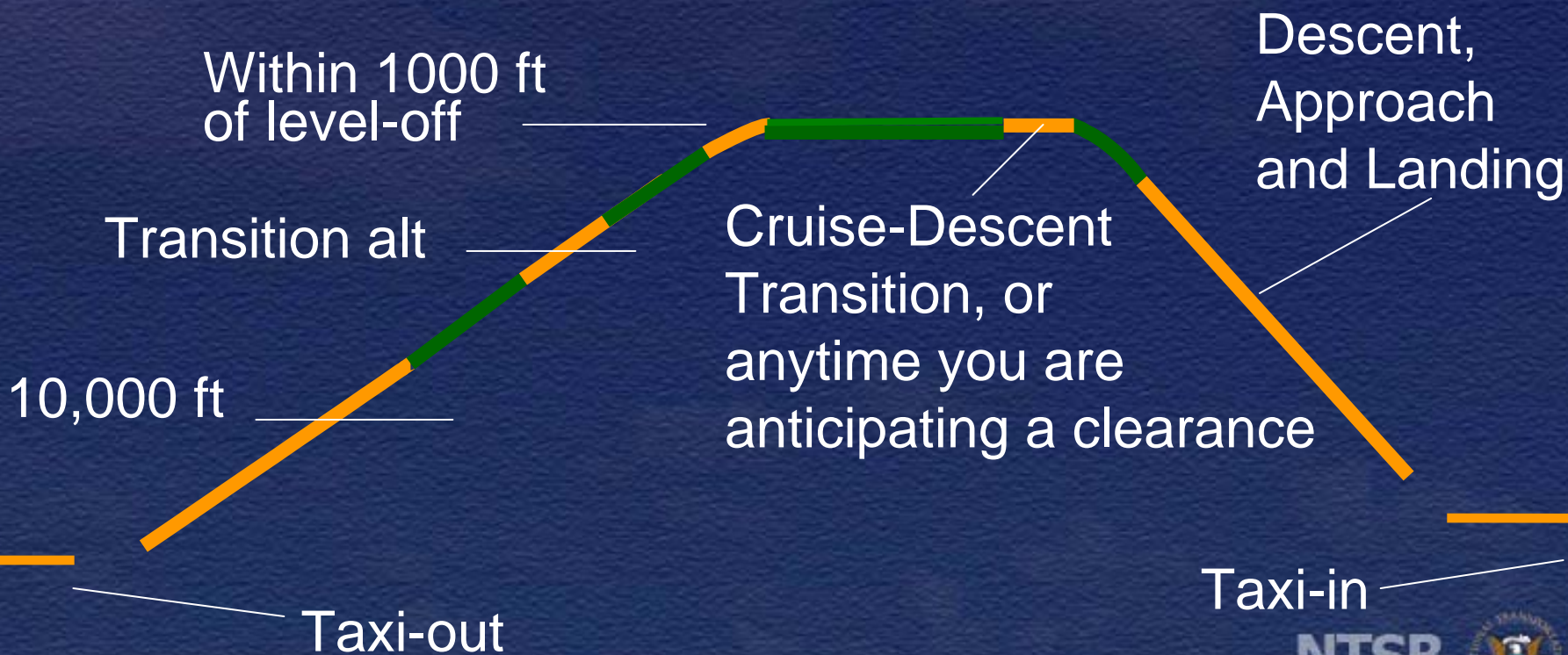
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Practicing monitoring skills

- In approximately one-third of the cases studied by researchers, pilots "failed to monitor errors, often because they had planned their own workload poorly and were doing something else at a critical time."

    – Jentsch, Martin, Bowers (1997)

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Practicing monitoring skills

- Pilots should recognize those flight phases where poor monitoring can be most problematic.

- Strategically plan workload to maximize monitoring during those areas of vulnerability (AOV)

  – Examples of non-monitoring tasks that should be conducted during lower AOV include stowing charts, programming the FMS, getting ATIS, accomplishing approach briefing, PA announcements, non-essential conversation, etc.

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Areas of Vulnerability

Within 1000 ft of level-off

Transition alt

10,000 ft

Cruise-Descent Transition, or anytime you are anticipating a clearance

Descent, Approach and Landing

Taxi-out

Taxi-in

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Practicing monitoring skills

- One way of assessing your current monitoring ability is to ask: "How often do I miss making the 1,000' to level-off altitude callout?"

  - When this callout is missed, chances are that you are not actively monitoring the aircraft.

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Paradigm shift

. It must become accepted that monitoring is a "core skill," just as it is currently accepted that a good pilot must posses good "stick and rudder" and effective communicational skills.

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Summary

- Inadequate flight crew monitoring has been cited by a number of sources as a problem for aviation safety.

- While it is true that humans are not naturally good monitors, crew monitoring performance can be significantly improved through policy changes, training and by pilots following an active monitoring concept.

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The challenge

Integrate monitoring and cross checking training into your training curricula.