FY02

Department of the Interior Aviation Accident Review

Robert Galloway
Larry Brosnan
Steve Rauch
Office of Aircraft Services

Ground Rules

The National Transportation Safety Board

- **NTSB 831.13 Flow and dissemination of accident or incident information.**

  (b) … Parties to the investigation may relay to their respective organizations information necessary for purposes of prevention or remedial action.

  … However, no (release of) information… without prior consultation and approval of the NTSB.

Ground Rules

The National Transportation Safety Board

- Avoid discussion of "Probable Cause", unless determined and published by the NTSB
- This presentation is provided for accident prevention purposes only

Ground Rules

Each accident is unique

Although the results may be very similar the causal factors leading up to an accident are seldom exactly alike.

Therefore it is unlikely that any two sets of findings, recommendations, or presentations will ever be the same.

It is imperative that you focus your attention on the underlying "root" causes for each unique accident and avoid comparing one investigation or presentation against another.

"The PROCESS"

Accident Investigation involves asking three questions

What happened?

(gather facts)

Why did it happen?

(causal analysis)

What can we do to prevent it?

(develop recommendations)

The 3W's of accident investigation

Aviation Accident Review

?








Houma, LA
October 3, 2001

Cessna 185
Amphibian

Mission
Repositioning flight

Damage
Substantial

Injuries
None

Procurement
Fleet

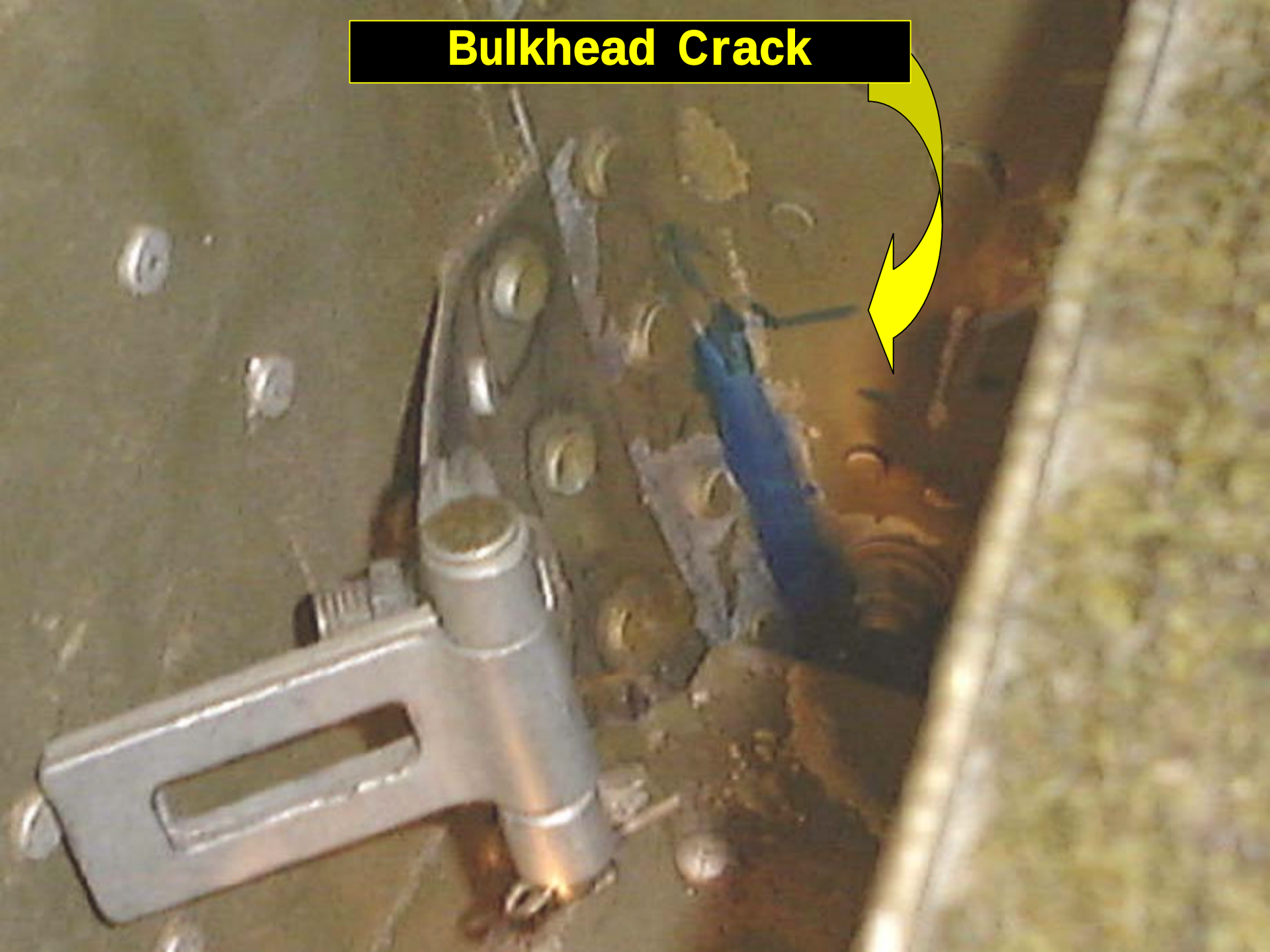
NTSB ID
FTW02LA007

Houma, LA
October 3, 2001

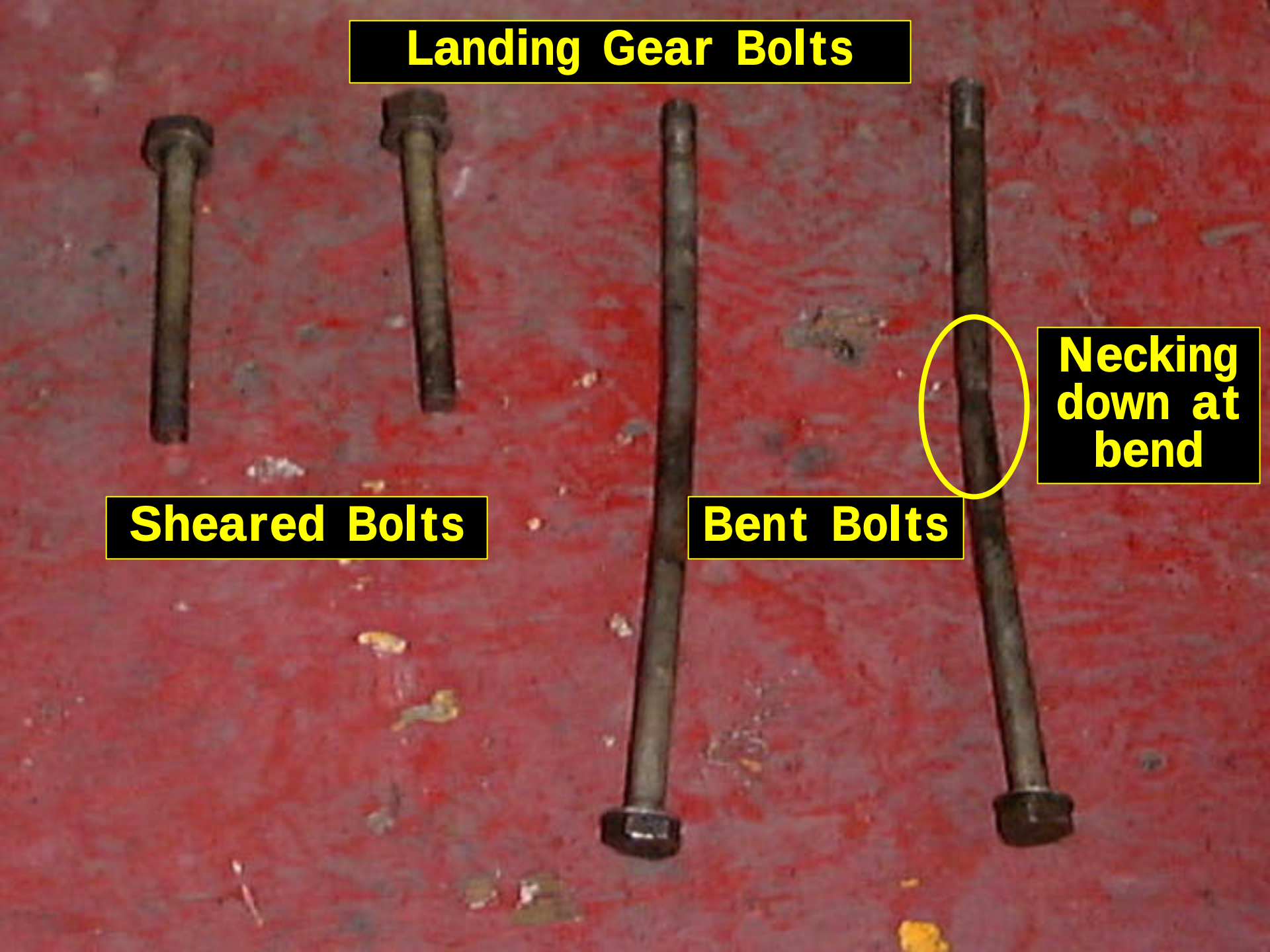
The amphibian configured aircraft was inbound for landing at the Houma-Terrebonne Airport, LA, when the pilot "flared too high and made a hard landing."

The commercial pilot, who was the sole occupant, was not injured.

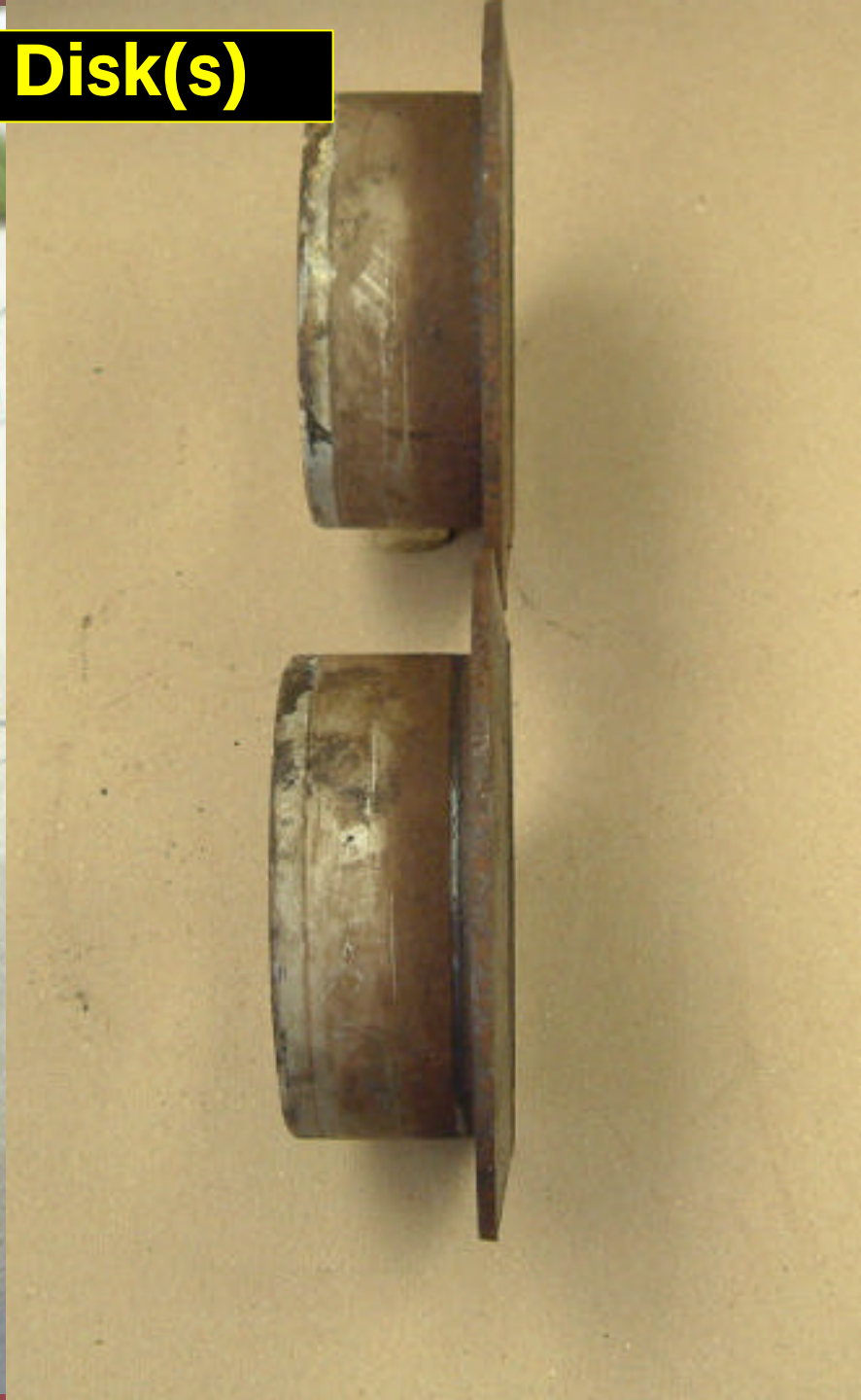
Inspection revealed one of the fuselage bulkheads sustained substantial damage.


Bulkhead Crack

Indentation in Skin


Landing Gear Bolts
Sheared Bolts
Bent Bolts
Necking down at bend

Bent Brake Disk(s)



NTSB Probable Cause
Houma, LA, Oct 3, 2001

The National Transportation Safety Board

The National Transportation Safety Board determined that the probable cause of this accident was …

Probable Cause

“The pilot's high flare, which resulted in a hard landing”

OAS Observations
Houma, LA, October 3, 2001

Issue

Pilot flared too high

Discussion

- Would landing in a level attitude (pitch) with power be a more appropriate procedure for landing an amphibian configured aircraft on hard surfaced runways ?

OAS Observations
Houma, LA, October 3, 2001

Issue

Preflight inspections are important

Discussion

- What do you check on your aircraft before each flight to ensure that there is no structural damage ?

OAS Observations
Houma, LA, October 3, 2001

Issue

Emergency Locator Transmitter

Discussion

- Do you know how to check the emergency locator transmitter (ELT) in the aircraft you're flying in ?

Bethel, AK
October 5, 2001

Cessna 185

Mission
Wildlife tracking

Damage
Substantial

Injuries
None

Procurement
Fleet

NTSB ID
ANC02TA001

Bethel, AK
October 5, 2001

During approach to a large paved runway, the pilot did not adequately compensate for the crosswind and lost directional control of the aircraft.

There were no noted mechanical deficiencies and the environmental conditions were not excessive.

The aircraft's left wing, left elevator, and left wheel were damaged.


STOL


Yukon Delta
NATIONAL WILDLIFE REFUGE
Hangar Facility

NTSB Probable Cause
Bethel, AK, October 5, 2001

The National Transportation Safety Board

The National Transportation Safety Board determined that the probable cause of this accident was …

Probable Cause

"The pilot's inadequate compensation for wind conditions.

Factors associated in the accident were a crosswind, and a worn tailwheel steering horn."

OAS Observations
Bethel, AK, October 5, 2001

Issue

Pilot proficiency in aircraft configuration (tires vs. floats)

Discussion

Did the pilot take an unnecessary risk when he chose to take an aircraft that had just been reconfigured from floats to wheels on an operational mission (with passengers) without first having taken the aircraft on a re-familiarization flight ?

Could he have reduced the risk by landing to the gravel runway instead of the paved runway ?

Would using the Bureau's Mentor Pilot Program help pilots avoid hazards such as this ?

Richland, WA
April 11, 2002

Hughes 369C (MD500D)

Mission

Wildlife capture

Damage

Substantial

Injuries

None

Procurement

End-Product Contract (improper)

NTSB ID

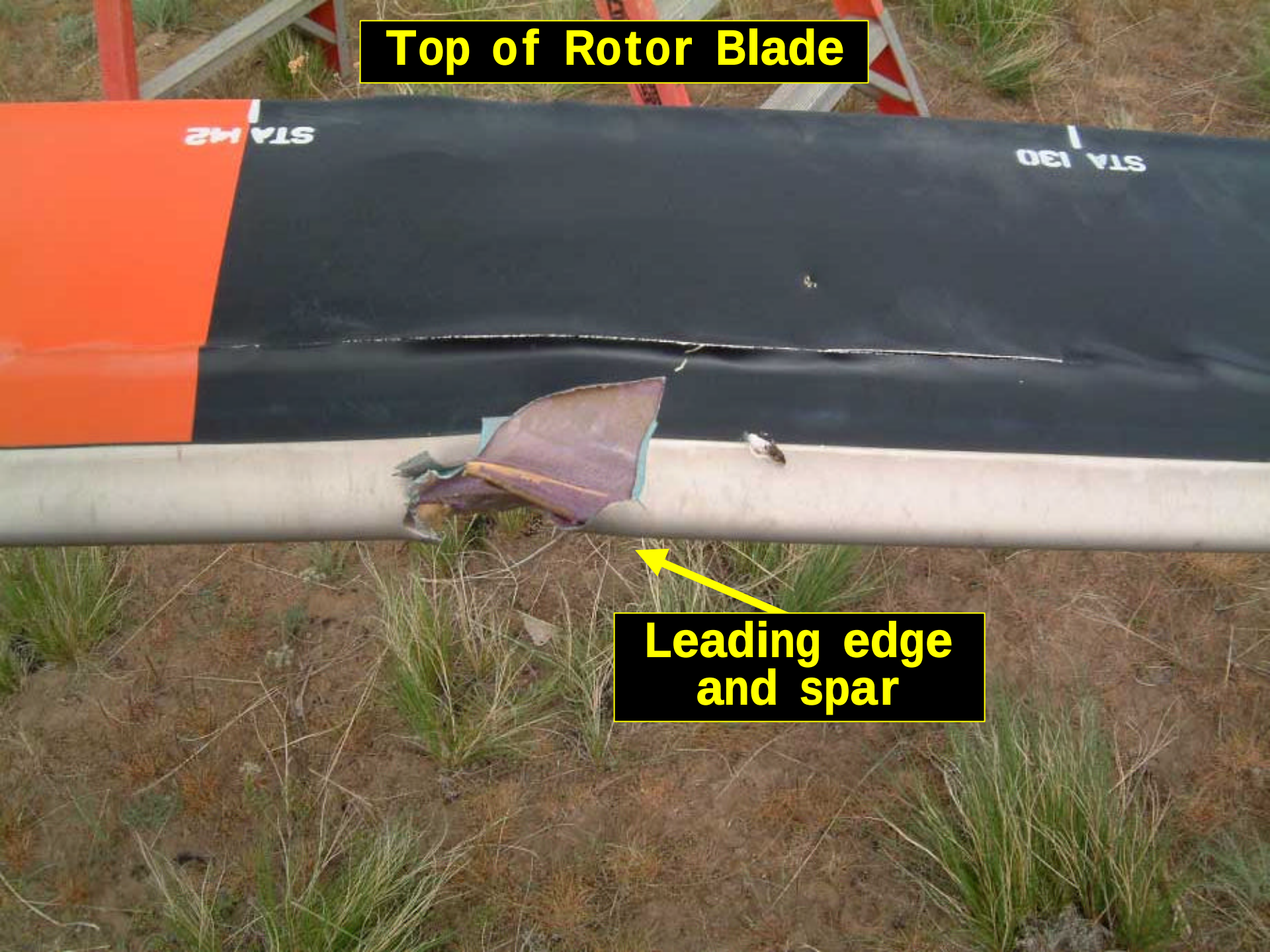
SEA02TA067

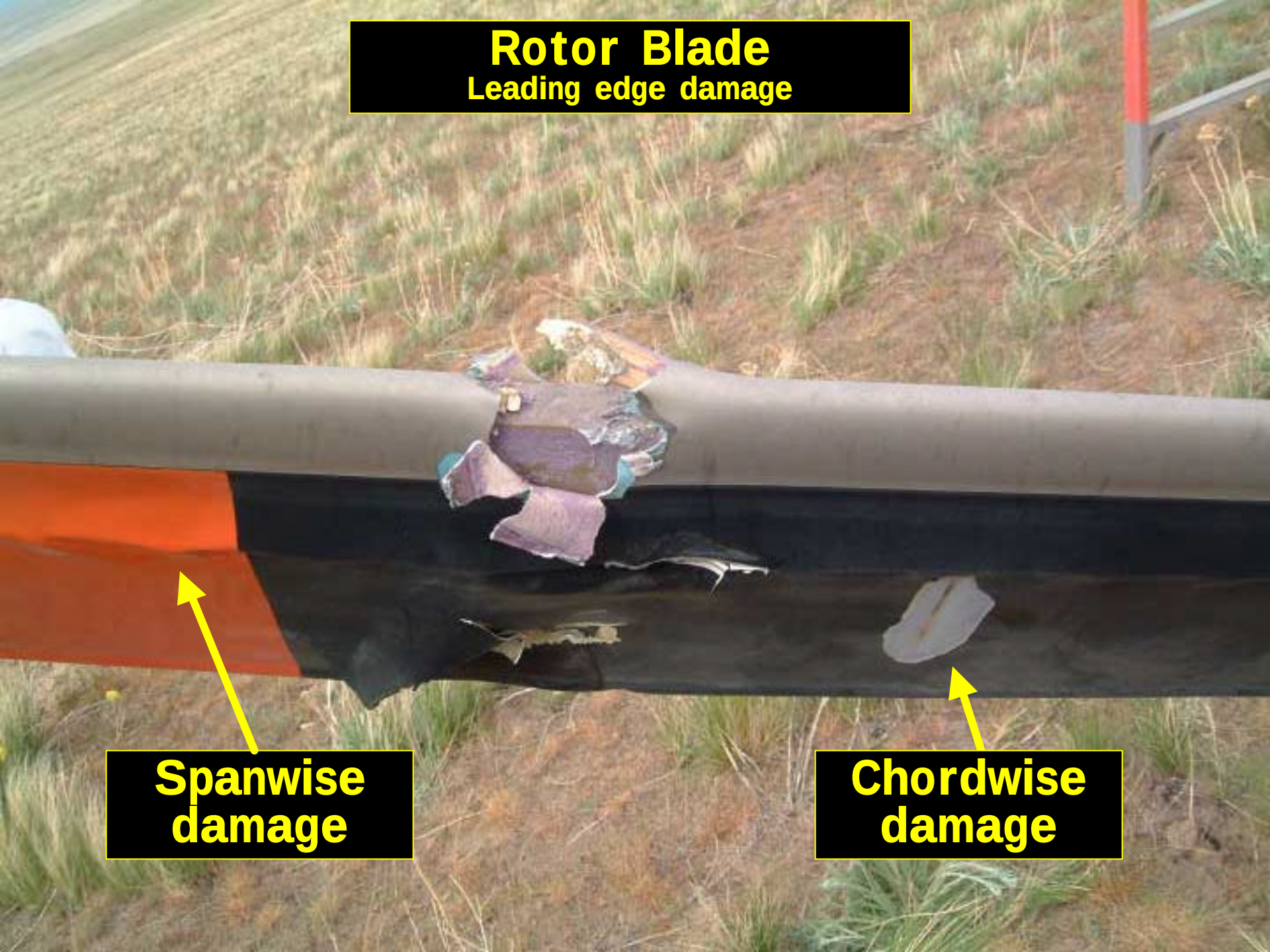
Richland, WA
April 11, 2002

While using a net gun on an elk capture mission one of the net's weights struck the red main rotor blade causing substantial damage.

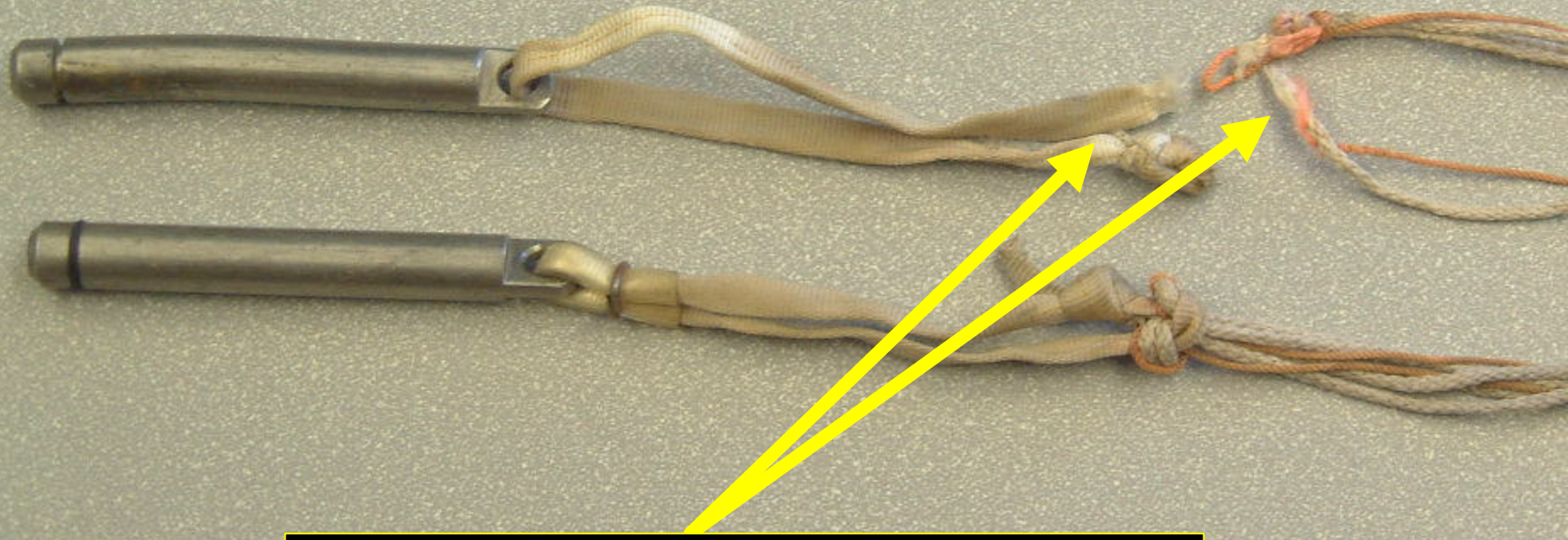
The pilot landed immediately.

There were no injuries and no further damage to the aircraft.


Top of Rotor Blade
STA 130
Leading edge and spar


Rotor Blade
Leading edge damage
Spanwise damage
Chordwise damage

Net Weight with Lanyard and Net



Note two points of failure

Proper Firing Position

NTSB Probable Cause
Richland, WA, April 11, 2001

The National Transportation Safety Board

The National Transportation Safety Board determined that the probable cause of this accident was …

Probable Cause

"Failure of the netting material securing a net weight while maneuvering.

The net weight was a factor."

OAS Observations
Richland, WA, April 11, 2001

Issue

Risk Management strengths

Discussion

- Very experienced crew
- Pilot flew as conservative a profile as possible
- Very good crew coordination

OAS Observations
Richland, WA, April 11, 2001

Issue

Risk Management weaknesses

Discussion

- Lack of standards for gunner training
- Gunners are not carded
- Last minute mission request and lack of understanding resulted in the flight being conducted as a flight services contract rather than an end-product contract (they *assumed operational control*)

Cantwell, AK
May 16, 2002

Robinson R-44

Mission

Wildlife tracking

Damage

Substantial

Injuries

None

Procurement

ARA

NTSB ID

ANC02TA035

Cantwell, AK
May 16, 2002

While herding caribou out of an area of trees the low rotor annunciator sounded. The pilot said he did not have sufficient power available to climb away from his position and the helicopter settled into low bushes.

After an additional loss of rotor RPM the pilot was able to regain enough rotor RPM to fly to a nearby river bed.

After landing the pilot found damage to both main rotor blades.


NEVER PULL DOWN
PUSH UP


NEVER P

NTSB Probable Cause
Cantwell, AK, May 16, 2002

The National Transportation Safety Board

The National Transportation Safety Board determined that the probable cause of this accident was …

Probable Cause

"A failure of the pilot-in-command to maintain adequate main rotor rpm during an out-of-ground-effect hover.

OAS Observations
Cantwell, AK, May 16, 2002

Issue

Performance planning (Gross Weight)

Discussion

- Maximum gross weight of the R-44 is 2,400 lbs.
- Planned operating weight was 2,396.35 lbs. (3.65 lbs. to spare)
- Are we accepting necessary (or unnecessary) risk when we chose to operate this close to the limit?

OAS Observations
Cantwell, AK, May 16, 2002

Issue

Performance planning (Power Required)

Discussion

- In the operating environment (2000' PA / 10°C) the maximum continuous power was limited to 23.4" Hg.
- Power check indicated 24.1" Hg. required for HOGE.
- Pilot chose to use the max T/O power limitation (5 min limit) by adding 1.6" Hg. for a total of 25" Hg.
- Are we accepting necessary (or unnecessary) risk when we choose to operate this close to the limit...once again?

Swan River, Manitoba, Can.

May 27, 2002

TSB Investigation On-Going
Preliminary Information

Cessna 206
Amphibian

Mission
Waterfowl Survey

Damage
Destroyed

Injuries
1 Minor

Procurement
Fleet

TSB ID
A02C0105

NTSB ID
WAS02WA044

Swan River, Manitoba, Can.

May 27, 2002

Shortly after takeoff the pilot felt a vibration and noticed the manifold pressure slowly and progressively decreasing.

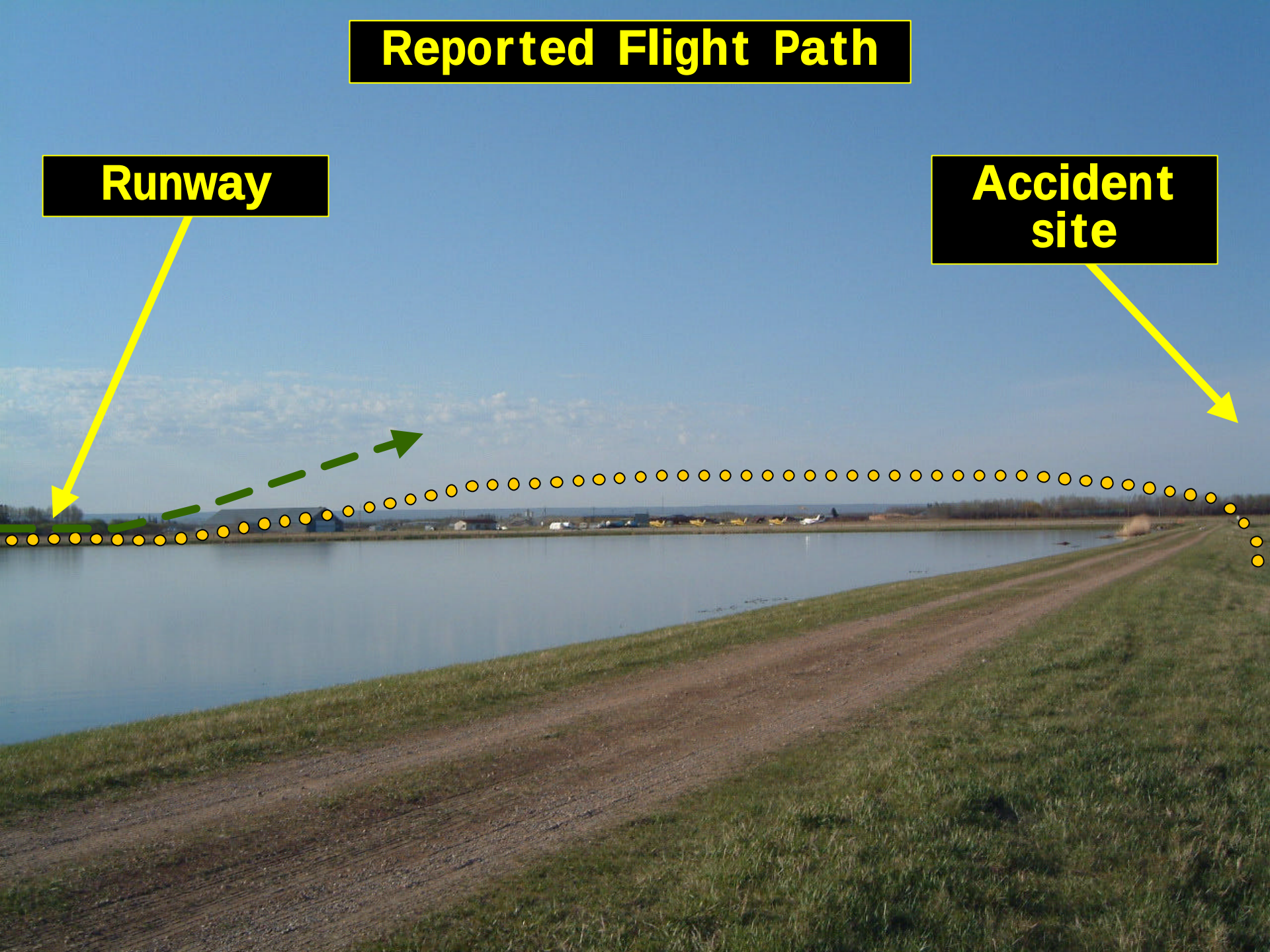
The pilot turned downwind to return to the airport but was unable to maintain altitude and performed a forced landing.

The aircraft was destroyed in a post-crash fire.

The pilot received minor injuries and the passenger was not injured.

Swan River, Manitoba, Can.

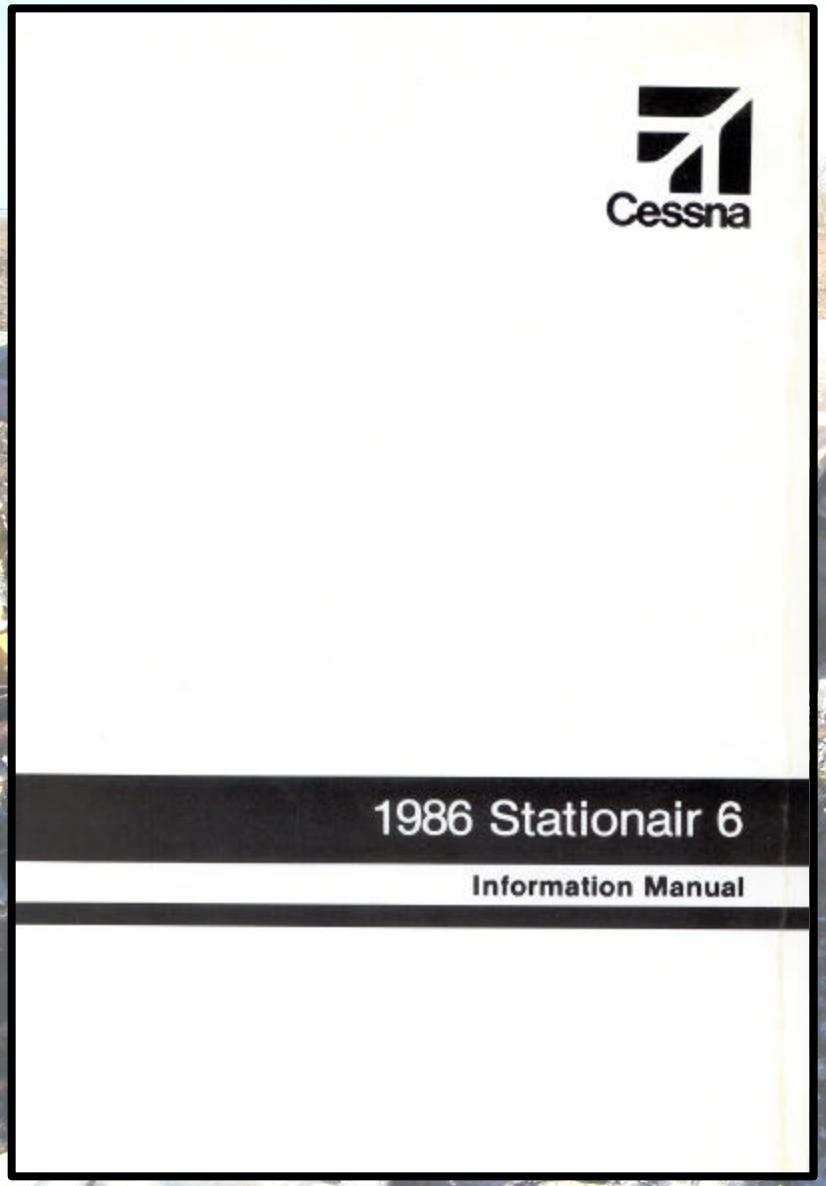
Winnipeg


Reported Flight Path
Runway
Accident site


Float impact


Prop impact

Cessna U206F Amphibian POH Supplement



Takeoff on Land...

9. Landing Gear . . . RETRACT

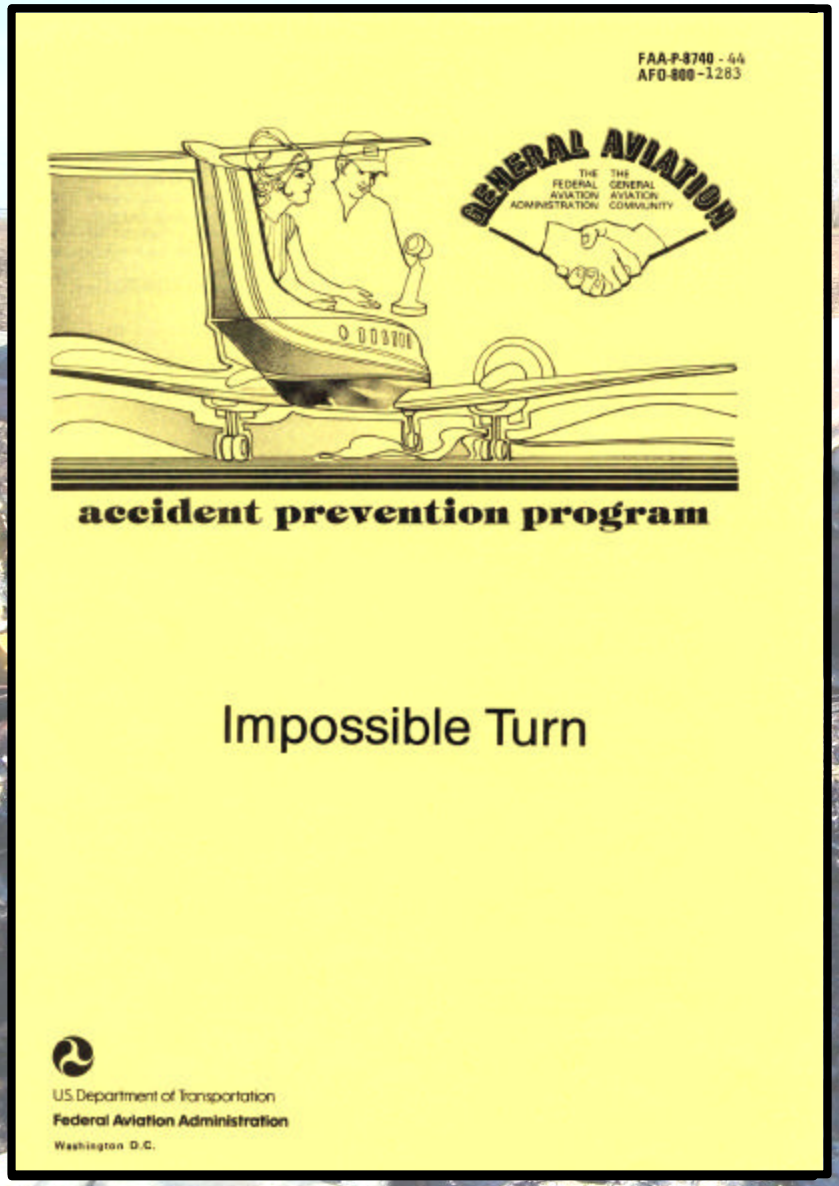
Emergency Landing on Land *without* Engine Power

2. Landing Gear . . .

DOWN . . for Smooth Terrain

UP . . . . for Rough Terrain

FAA Pamphlet



FAA Accident Prevention
FAA-P-8740-44

If you suffer a loss of power on takeoff, any maneuvering (i.e. returning to the runway) sacrifices airspeed and altitude.

FAA recommends not returning to the airport, but rather choosing a landing area within 60° of your flight path.

OAS Observations
Swan River, Manitoba Can., May 27, 2002

Issue

Crew Resource Management

Discussion

- Why didn't the pilot request assistance during the emergency ?

- Why didn't the passenger offer assistance to the pilot during the emergency ?

OAS Observations
Swan River, Manitoba Can., May 27, 2002

Issue

Situational awareness

Discussion

- Runway 20 – 4130 feet
- Aircraft took off in the first 1/3 of the runway.
- With more than one half mile of runway plus another 1000 feet of pasture available to the pilot, why did the pilot attempt to return to the airport ?

OAS Observations
Swan River, Manitoba Can., May 27, 2002

Issue

Pilot and passenger were not wearing personal protective equipment.

Discussion

- Pilot was not wearing a flight helmet or gloves and suffered first-degree burns on his hand during the egress.
- Why did the pilots choose to not use available PPE ? (helmets and gloves were stowed in the back of the aircraft)

OAS Observations
Swan River, Manitoba Can., May 27, 2002

Issue

Critical checklist items were not completed

Discussion

- **Why did the pilot fail to retract the landing gear in accordance with the Takeoff and the Emergency Landing checklists ?**

OAS Observations
Swan River, Manitoba Can., May 27, 2002

Issue

OAS accident reporting hotline number was improperly used as the flight plan point-of-contact number

Discussion

- OPM 02-02 requires flight plans and flight following.
- The 1-888-4MISHAP number is an Interagency Aviation Accident Reporting Hotline and not to be used for flight following.
- The 888 number would not have worked in Canada anyway.

Kaktovik, AK
June 7, 2002

Cessna 185
(Wheel-Ski)

Mission
Point-to-Point

Damage
Substantial

Injuries
None

Procurement
Fleet

NTSB ID
ANC02TA045

Kaktovik, AK
June 7, 2002

The airplane received substantial damage during the landing roll on a remote, ice covered lake, about 45 miles southwest of Kaktovik, Alaska.

The airplane was being operated as a visual flight rules (VFR) local area public use flight. Visual meteorological conditions prevailed. The pilot reported landing to the west with a 5-7 knot tailwind.

The pilot and sole passenger were not injured.


Field repair
to leading edge
of right wing


Damage to leading edge
of right wing
(duct tape removed)

NTSB Probable Cause
Houma, LA, Oct 3, 2001

The National Transportation Safety Board

The National Transportation Safety Board determined that the probable cause of this accident was …

Probable Cause

"The pilot's inadequate evaluation of the weather conditions during landing at a remote lake, resulting in a downwind landing.

Factors contributing to the accident were the presence of a tailwind, and an icy lake surface.

OAS Observations
Kaktovik, AK, June 7, 2002

Issue

Aircraft damage was repaired and the aircraft was moved to Fairbanks in violation of 49 CFR 830.10

Discussion

Title 49 CFR 830.10

- **"The operator of an aircraft involved in an accident…is responsible for preserving to the extent possible any wreckage, cargo, and mail aboard the aircraft and all records…until the Board takes custody thereof or a release is granted pursuant to 831.12b of this chapter."**

OAS Observations
Kaktovik, AK, June 7, 2002

Issue

The pilot landed to the west with a 5-7 knot tailwind

Discussion

- The pilot mistakenly thought he was landing into the wind which had been out of the west during earlier takeoff and landings.

- A subsequent change in wind direction was not detected by the pilot resulting in a downwind landing.

OAS Observations
Kaktovik, AK, June 7, 2002

Issue

The pilot configured the aircraft for landing using skis

Discussion

- **Would a wheel landing have been a better choice… which would have allowed the pilot to use brakes to slow the aircraft ?**

OAS Observations
Kaktovik, AK, June 7, 2002

Issue

Once the pilot realized he was not going to be able to stop he elected not to execute a go-around.

Discussion

- **Would planning for, and executing, a go-around have prevented this accident ?**

Yosemite NP, CA
June 13, 2002

Navy and OAS Investigations On-Going
Preliminary Information

Navy UH-1N (Bell 212)

Mission
Hoist Rescue

Damage
Minor

Injuries
1 Fatal
1 Serious

Procurement
MOU with Navy

Operational Control
US Navy

Yosemite NP, CA

June 13, 2002

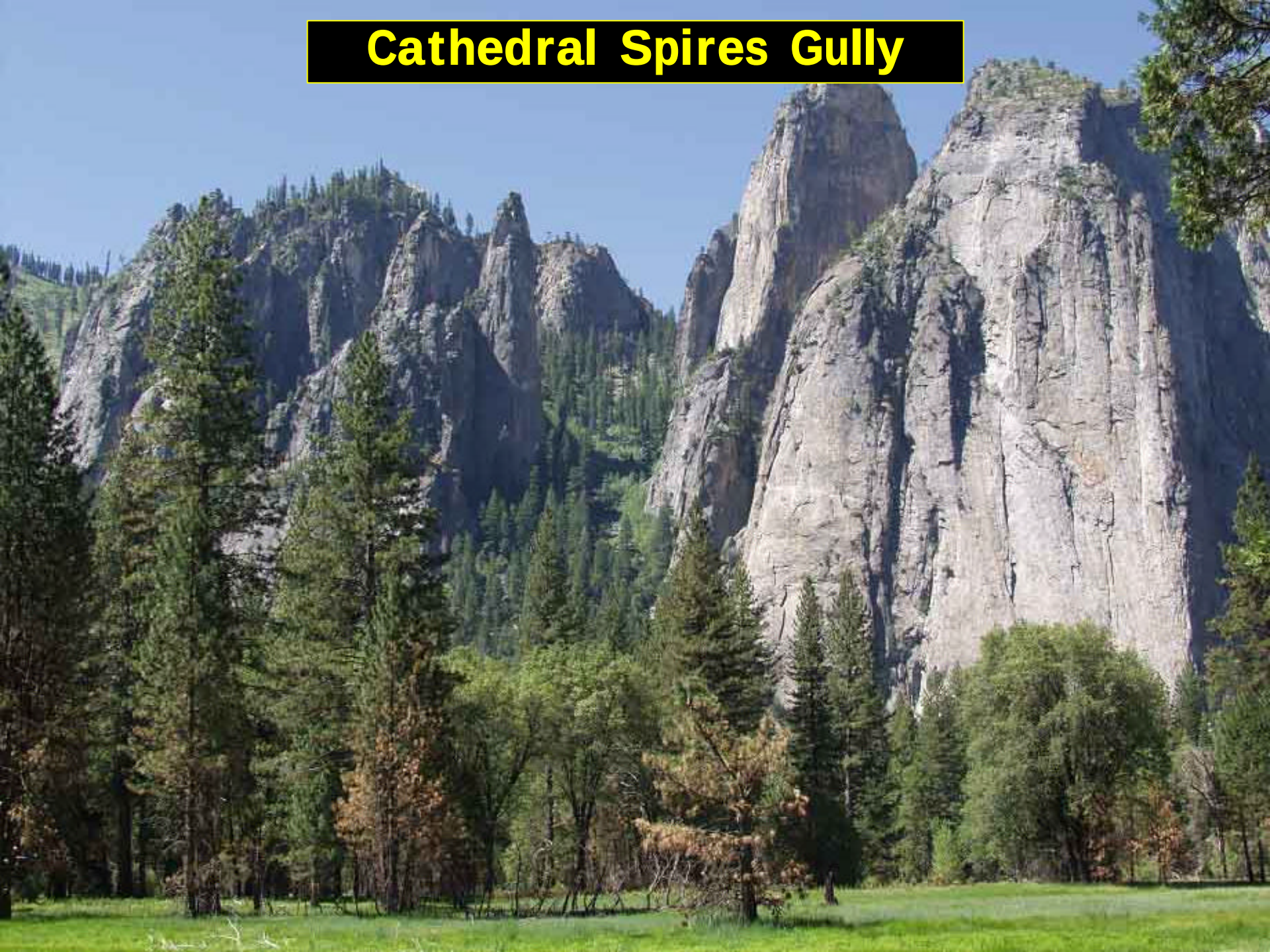
While using their rescue hoist to evacuate a seriously injured climber from the Cathedral Spires Gully the aircraft experienced a decay in main rotor RPM with a resulting loss of heading control and altitude.

As the crew worked to control the aircraft the hoist cable struck a tree and separated.

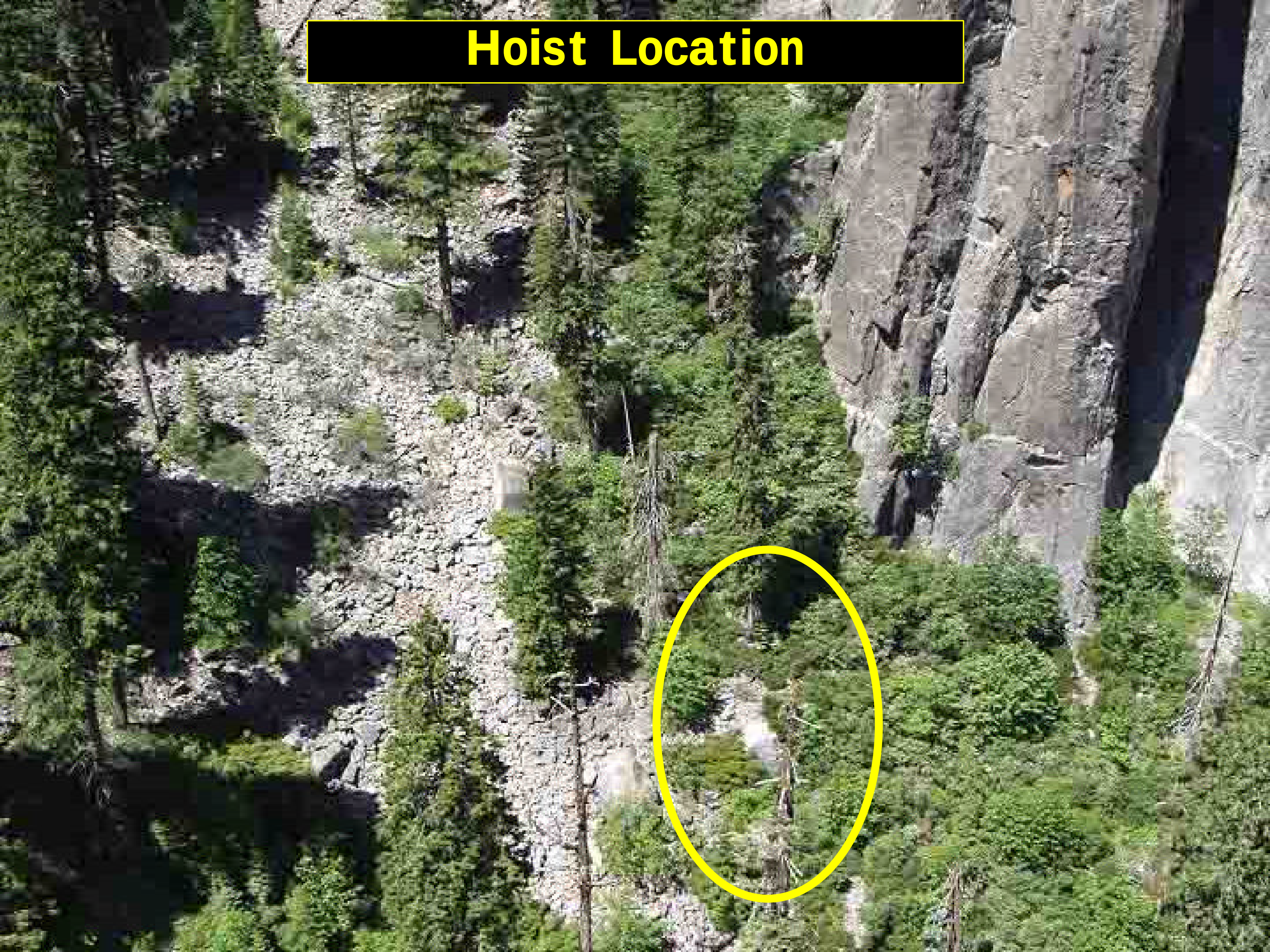
The rescue corpsman and climber were retained by the belay line.

Pre-Mission Coordination

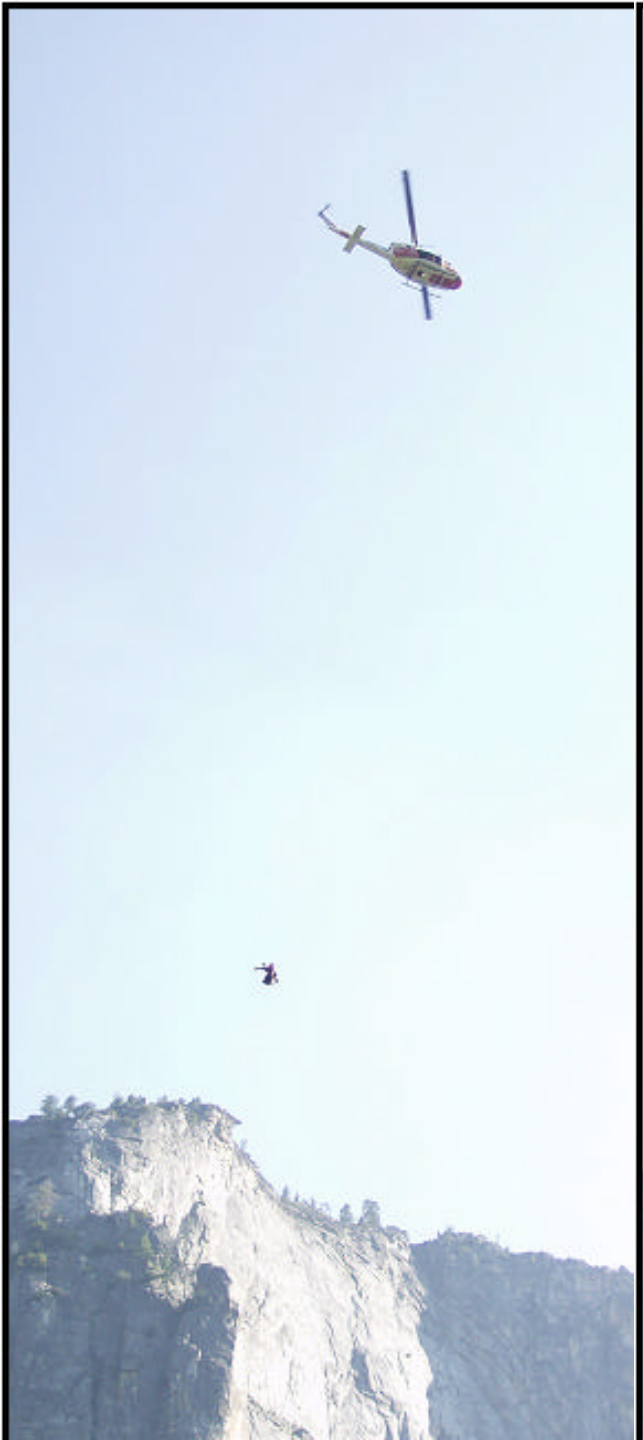
Pre-Mission Coordination

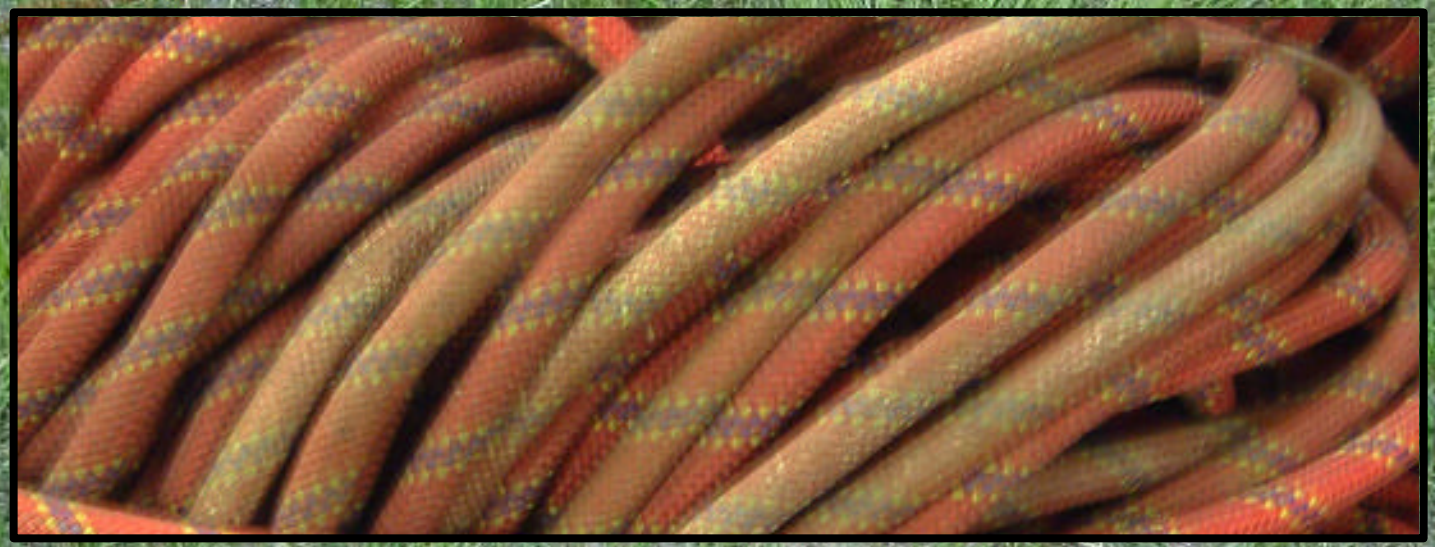

Cathedral Spires Gully

Hoist Location



Tree Impacts





Main Rotor Damage

Main Rotor Damage

OAS Observations
Yosemite NP, CA, June 13, 2002

Issue

Risk Management strengths

Discussion

- Comprehensive training program and aviation plan
- Weighed the risks of ground vs. air evacuation
- Lessons learned were rapidly implemented within the Region
- Excellent post-accident response and reporting
- Excellent post-accident involvement by all levels of Park leadership

OAS Observations
Yosemite NP, CA, June 13, 2002

Issue

Risk Management weaknesses

Navy SAR Operations

Discussion

- Navy SAR pilots are not normally qualified in SAR operations or the aircraft (Bell 212) until assignment to a SAR detachment.

- **How can we minimize the risks when working with Navy SAR ?**

- have no school that teaches mountain-flying techniques

- Navy policy requires a large crew thus increasing the aircraft's gross weight.
  (and we don't require a load calc)

OAS Observations
Yosemite NP, CA, June 13, 2002

Issue

Risk Management weaknesses

Navy SAR Operations

Discussion

- How can we:
  - ✓ Improve the interface between Park and Navy SAR (or other) personnel prior to actual rescue missions ?
  - ✓ Improve identification of key personnel ?
  - ✓ Increase or improve training opportunities ?
  - ✓ Identify and correct communication problems ?

OAS Observations
Yosemite NP, CA, June 13, 2002

Issue

Risk Management weaknesses

Navy pilot performance

Discussion

- **Would a high recon of the site have allowed the pilot to:**
  - ✓ **Identify hazards (terrain and obstructions) ?**
  - ✓ **Identify winds and turbulence ?**
  - ✓ **Confirm power required vs. power available ?**

Mount Rainier, WA
June 25, 2002

Bell 206B-III

Mission
- Personnel Transport

Damage
- Destroyed

Injuries
- None

Procurement
- ARA

NTSB ID
- SEA02TA110

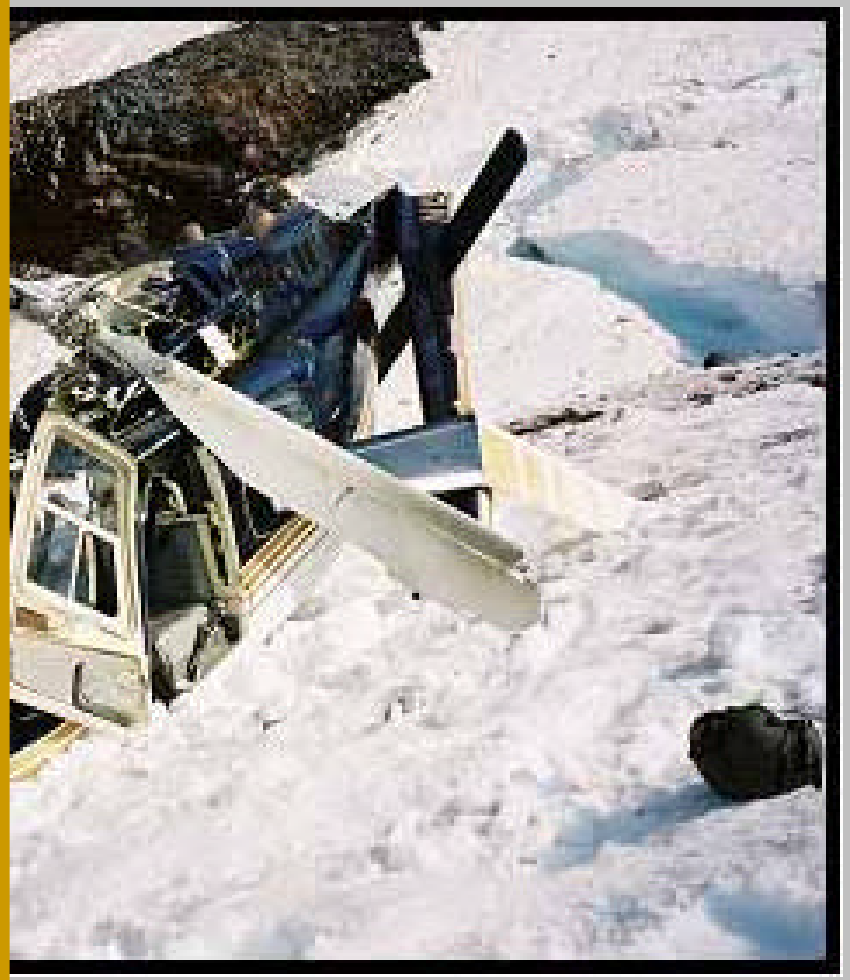
Mount Rainier, WA

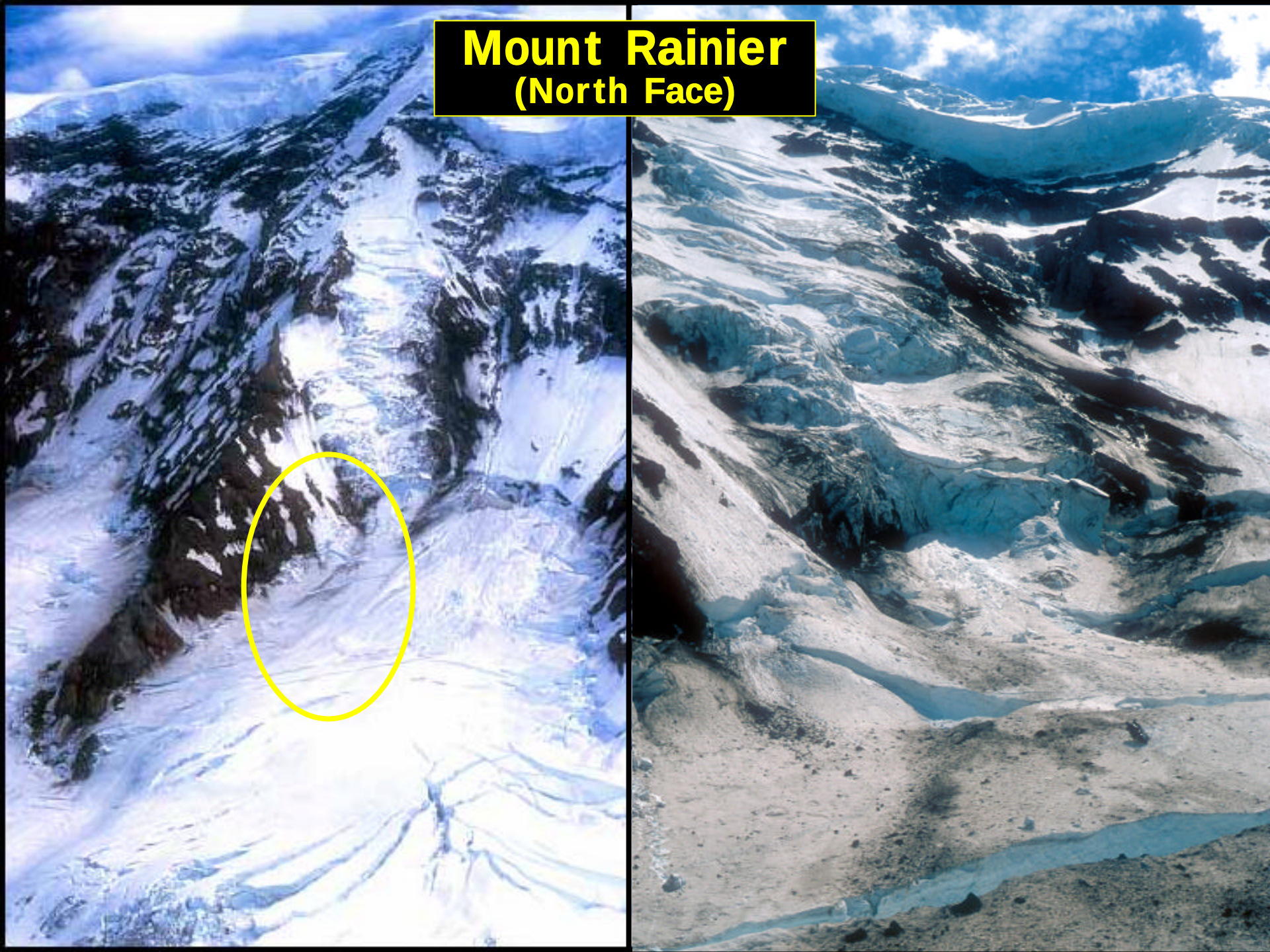
June 25, 2002

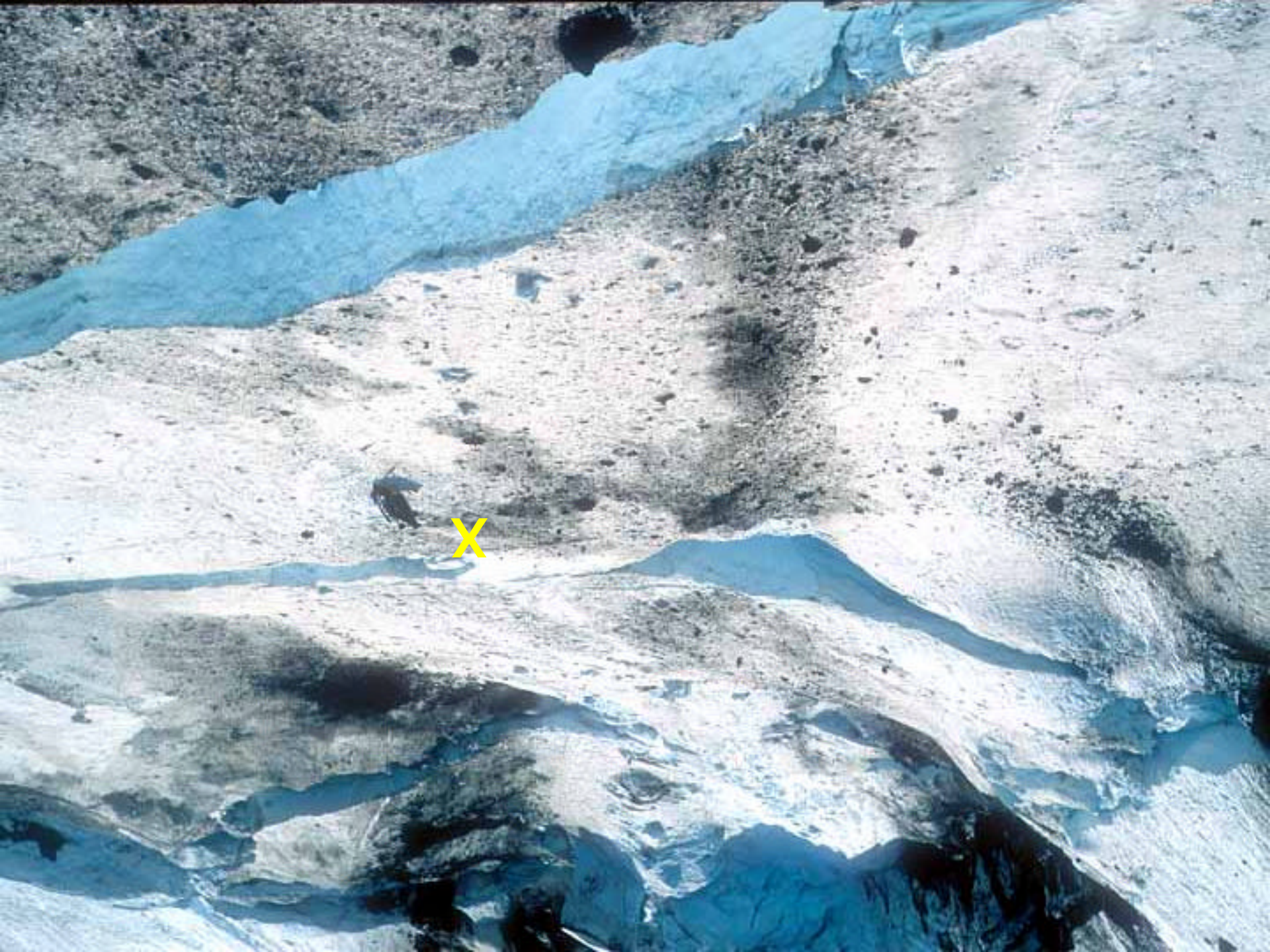
While landing on a glacier to insert two personnel to support a rescue operation the aircraft pitched nose up, the pilot attempted to correct with forward cyclic, and a knocking/banging was heard.

The pilot rapidly increased collective to come back to a hover but the aircraft began an uncontrolled rapid yaw to the right. The pilot lowered the collective and the aircraft impacted and remained upright.

There were no injuries.




Mount Rainier
(North Face)

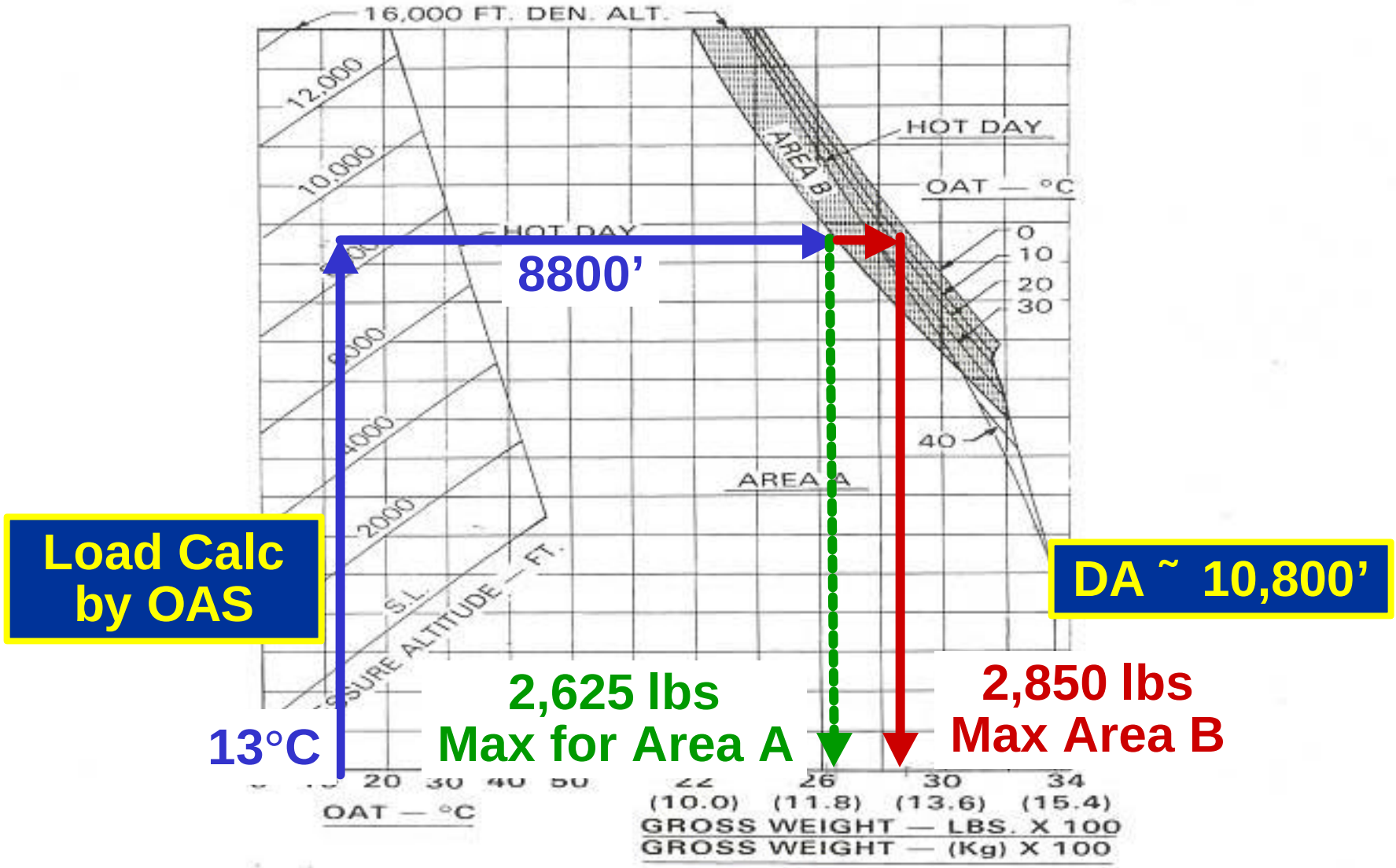

X

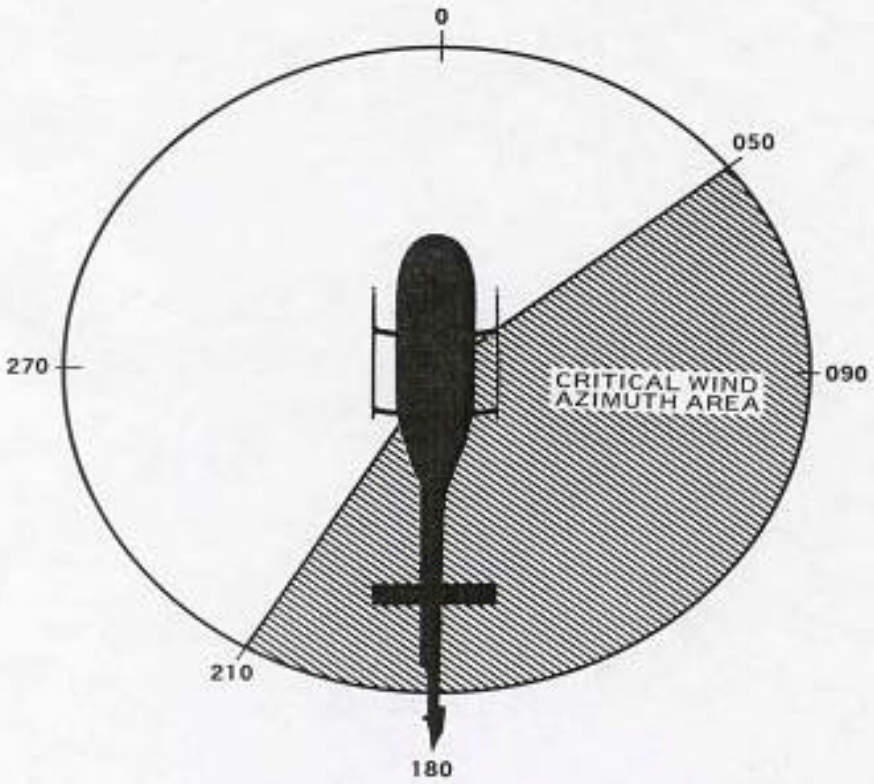

X

HOVER CEILING OUT OF GROUND EFFECT
TAKEOFF POWER 0° TO 46°C

GENERATOR 22.3 AMPS
SKID HEIGHT 40 FT (12.2 METERS)
WITH ANTI-ICE ON GROSS WEIGHT IS 260 LBS (117.9 Kg) LESS
PARTICLE SEPARATOR WITH CARGO HOOK

ANTI-ICE OFF
N2 ENGINE RPM 100%





CRITICAL RELATIVE WIND AZIMUTH AREA

Figure 4-5. Critical relative wind azimuth area

The Hover Ceiling In Ground Effect charts (figure 4-3) and Hover Ceiling Out of Ground Effect charts (figure 4-4) present hover performance (allowable gross weight) for conditions of pressure altitude and OAT. The charts are divided into two areas.

AREA A (White area) as shown on the hover ceiling charts presents hover performance for which controllability has been demonstrated in sideward and rearward relative wind conditions up to 20 MPH (17 knots).

CAUTION

ENGINE TOT WILL RISE NOTICEABLY WHEN HOVERING DOWNWIND. AVOID HOVERING DOWNWIND WHEN OPERATING NEAR TOT LIMITS.

AREA B (Shaded area) as shown on Hover Ceiling charts presents hover performance that can be realized in CALM WINDS or winds outside the CRITICAL RELATIVE WIND AZIMUTH AREA in figure 4-5.

U.S. DEPARTMENT OF THE INTERIOR
HELICOPTER LOAD CALCULATION

HELICOPTER MODEL: Bell 206 BIII
NO. 874

Pilot | Project: SAR | Date: 6-25-02 | Time: 1445

		IGE	OGE
1.	Departure Base: Kautz — Pressure ALT 2385, Temperature 25°		
2.	Destination Base: Upper Carbon Col — Pressure ALT 9000, Temperature 10		
3.	Helicopter Equipped Weight	1850	
4.	Flight Crew Weight	180	
5.	Fuel (Gals. 40 x 7 lbs.)	280	
6.	Operating Weight	2310	
7.	Computed Gross Weight	3200	2950
8.	Fixed Weight Reduction	130	130
9.	Adjusted Weight (7 Minus 8)	3070	2820
10.	Takeoff/Landing Limits (Handbook Limitation Section)	3200	
11.	Selected Weight (Lowest of 9 or 10 for Nonjettisonable)	3070	2820
12.	Operating Weight (Line 6)	2310	2310
13.	Allowable Payload	760	510
14.	Passengers and/or Cargo		
	Names / Weight:	245	
		225	
	02 pack	20	
15.	Actual Payload	490	
16.	Actual Gross Weight (12 Plus 15) (Must Not Exceed Line 11)	2800	

U.S. DEPARTMENT OF THE INTERIOR
HELICOPTER LOAD CALCULATION

HELICOPTER MODEL: Bell 206B3
NO.

Pilot | Project | Date | Time

		OGE
	Pressure ALT / Temperature	
	Pressure ALT / Temperature 8800'/13°C	
		1830 ~~1850~~
		180
		280
		2290
7.	Computed Gross Weight	2,625
8.	Fixed Weight Reduction	130
		2,495
	3,200 (internal)	
11.	Selected Weight (Lowest of 9 or 10 for Nonjetti	2,495
12.	Operating Weight (Line 6)	2,290
13.	Allowable Payload	205
14.	Passengers and/or Cargo	
	Passenger #1	245
	Passenger #2	225
	Oxygen Bottle	20
		490

Allowable Load 205 lbs

Actual Load 490 lbs

U.S. DEPARTENT OF THE INTERIOR
HELICOPTER LOAD CALCULATION

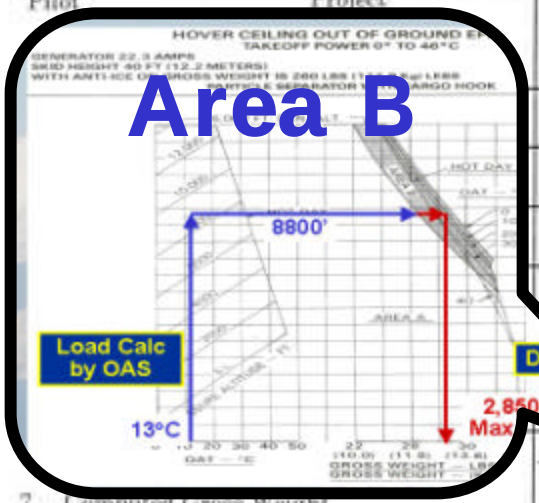
HELICOPTER MODEL: Bell 206 BIII
NO. 874

Pilot	Project: SAR	Date: 6-25-02
		Time: 1445
1. Departure Base: Kautz		Pressure ALT: 2385 / Temperature: 25°
2. Destination Base: Upper Carbon Col		Pressure ALT: 9000 / Temperature: 10
3. Helicopter Equipped Weight		1850
4. Flight Crew Weight		180
5. Fuel (Gals. 40 x 7 lbs.)		280
6. Operating Weight		2310
	IGE	OGE
7. Computed Gross Weight	3200	2950
8. Fixed Weight Reduction	130	130
9. Adjusted Weight (7 Minus 8)	3070	2820
10. Takeoff/Landing Limits (Handbook Limitation Section)	3200	
11. Selected Weight (Lowest of 9 or 10 for Nonjettisonable)	3070	2820
12. Operating Weight (Line 6)	2310	2310
13. Allowable Payload	760	510
14. Passengers and/or Cargo		
Names / Weight	245	
	225	
6 pack	20	
15. Actual Payload	490	
16. Actual Gross Weight (12 Plus 15) (Must Not Exceed Line 11)	2800	

U.S. DEPARTENT OF THE INTERIOR
HELICOPTER LOAD CALCULATION

HELICOPTER MODEL: Bell 206B3
NO.

Pilot	Project	Date
		Time
		Pressure ALT / Temperature
		Pressure ALT / Temperature: 8800'/13°C
		1830 ~~1850~~
		180
		280
		2290
		OGE
7. Computed Gross Weight		2,850
8. Fixed Weight Reduction		130
		2,720
		3,200 (internal)
11. Selected Weight (Lowest of 9 or 10 for Nonjetti		2,720
12. Operating Weight (Line 6)		2,290
13. Allowable Payload		430
14. Passengers and/or Cargo		
Names / Weight — Passenger #1		245
Passenger #2		225
Oxygen Bottle		20
		490



Allowable Load 430 lbs

Actual Load 490 lbs


X

NTSB Probable Cause
Mount Rainier, WA, June 25, 2002

The National Transportation Safety Board

The National Transportation Safety Board determined that the probable cause of this accident was …

Probable Cause

"The pilot's failure to maintain aircraft control while trying to land.

Rough/uneven terrain, inaccurate performance data calculations, inadequate in-flight planning and lack of familiarity with the geographic area were factors.

OAS Observations
Mount Rainier, WA, June 25, 2002

Issue

Risk Management strengths

Discussion

- Involved Park leadership
- Weighed the risks of ground vs. air evacuation
- Appropriate sense of urgency
- Pro-active training program
- Excellent post-accident response actions and recovery planning

OAS Observations
Mount Rainier, WA, June 25, 2002

Issue

Risk Management weaknesses

Pilot qualification and experience

Discussion

- Pilot qualification
  - ✓ Why was a pilot who was not carded to fly for the vendor not identified by the HEMG, the pilot, or the vendor ?
  - ✓ Did the lack of a standard definition for “deep snow” operations contribute to this accident ?
  - ✓ Was this mission too complex for a pilot’s first flight to Mount Rainier ?

OAS Observations
Mount Rainier, WA, June 25, 2002

Issue

Risk Management weaknesses

Crew qualification and experience

Discussion

- Crew qualification
  - ✓ Would periodic joint training between vendor pilots, vendor guides, and Park employees have precluded communication and Crew Resource Management failures ?
  - ✓ Should DOI require vendor climbing guides to receive aviation training (i.e. Basic Aviation Safety Training B3) ?

OAS Observations
Mount Rainier, WA, June 25, 2002

Issue

Risk Management weaknesses

Culture of risk acceptance

Discussion

- Was the mishap pilot pressured into accepting the mission because the company's other two pilots routinely performed this type of mission ?
- Why did Helibase Management not act on the warnings offered by the Army helicopter crew ?
- Why did senior Park managers believe landing a Bell 206B-III on the Glacier was less risky than hoisting with a CH-47 ?

OAS Observations
Mount Rainier, WA, June 25, 2002

Issue

Risk Management weaknesses

Discussion

- How can we ensure that passengers wear proper personal protective equipment (PPE) or have a waiver to the PPE requirements?
- Was the passenger briefing adequate ?
- How can we manage/minimize the risks to local aviation operations when key aviation personnel are resourced to fire / law enforcement assignments ?

OAS Observations
Mount Rainier, WA, June 25, 2002

Issue

Risk Management weaknesses

Discussion

- How can we ensure that passengers and crew who have been involved in an aircraft accident are medically cleared before returning to duty?

- How could this site have been secured without placing the guards at risk ?

Fillmore, UT
July 7, 2002

PZL M-18 (Dromader)

Mission

Aerial Suppression

Damage

Destroyed

Injuries

None

Procurement

CWN

NTSB ID

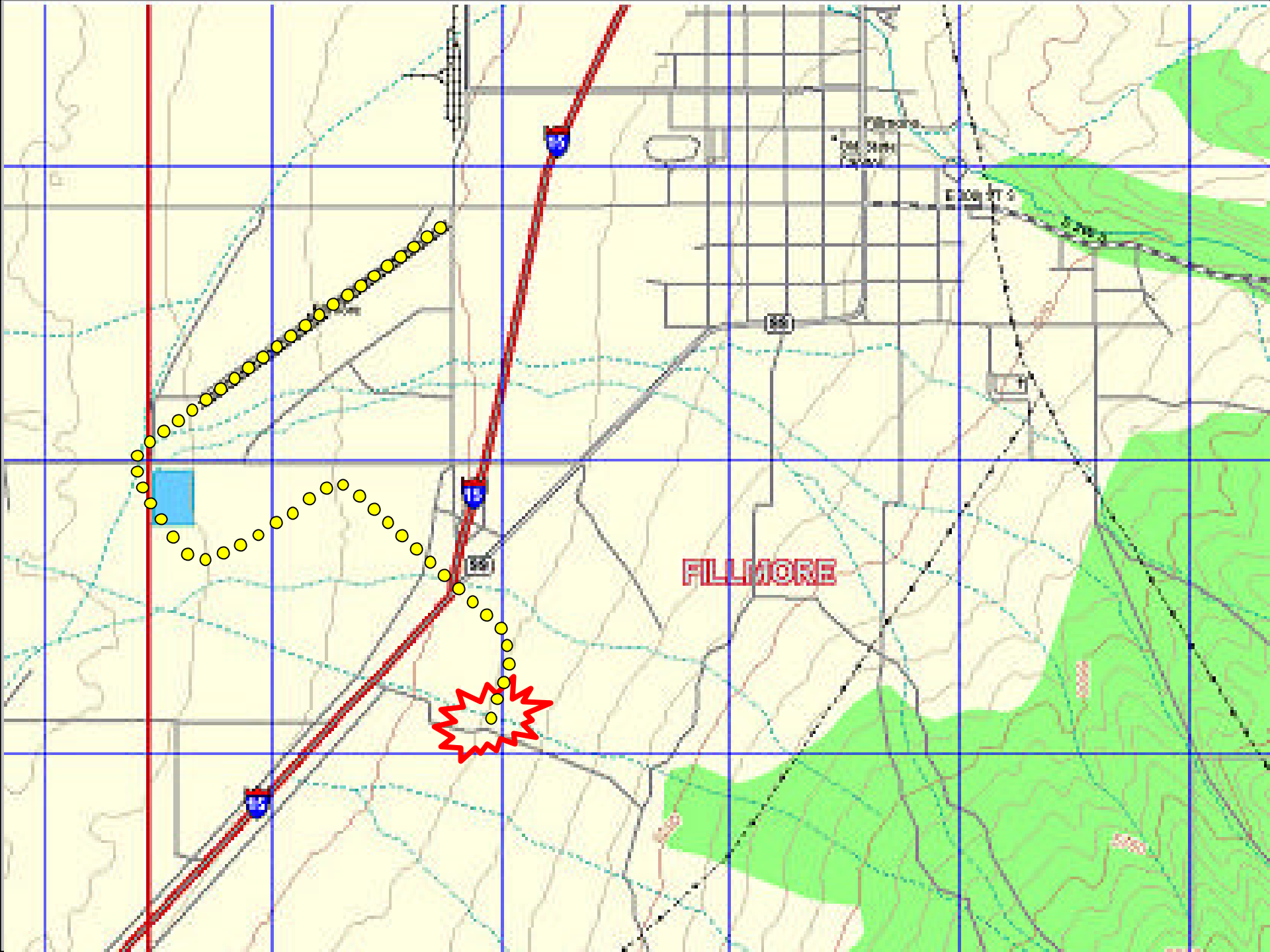
DEN02TA069

Fillmore, UT
July 7, 2002

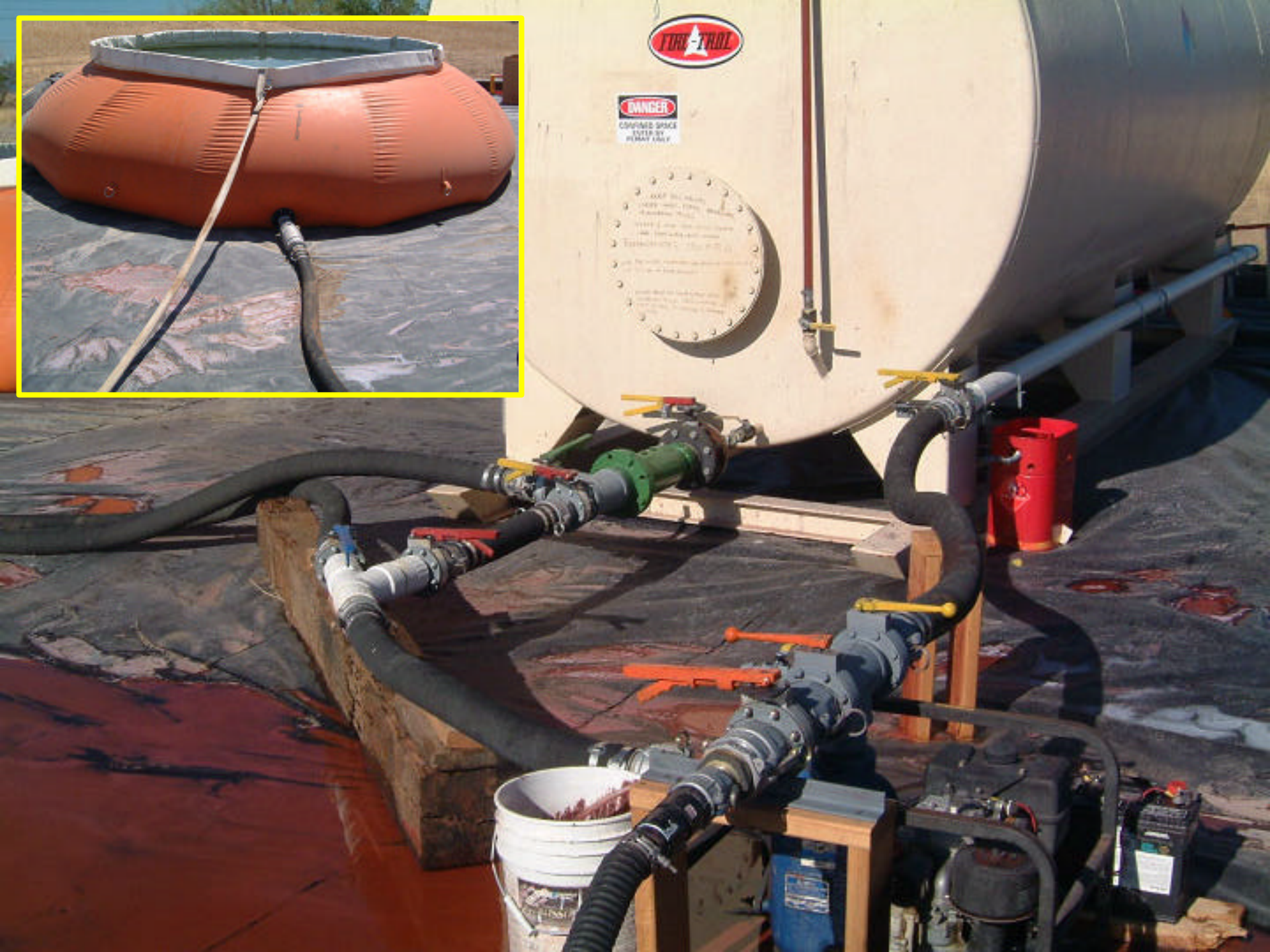
After takeoff the aircraft climbed to 400 feet and turned crosswind.

The pilot noted the manifold pressure was less than desired and that the aircraft was slowly descending. As the pilot attempted to stop the descent he failed to release the retardant and the aircraft impacted the terrain with the right wing and came to rest 180º from touchdown heading.

The pilot was not injured.


FILLMORE

N5198Y


FIRE-TROL
DANGER

MTDC Lot Acceptance/Quality Assurance Analysis

Date:	
Subject:	LAQA Results
To:	Mark Bickham, National Interagency Fire Center

Thank you for submitting your sample under the lot acceptance and quality assurance program. Results of laboratory tests are within the acceptable range (refractometer=13.0-15.0) for **Fire-Trol LCA-R**.

The sample received by our lab was LCA-R concentrate. The refractometer and density are both indicators of salt content. The viscosity and density are within the parameters that we expect to see in an unmixed sample of LCA. Typically, an LC concentrate is mixed with water in our lab to get the refractometer reading. The refractometer results are within acceptable parameters for the mixed product.

These results indicate that no water was added to this sample before it was received at our lab. Fire-Trol LCA-R has a specific weight of 9.12 lb/gal and 12.10 lb/gal, respectively, for mixed retardant and liquid concentrate. We would expect to see a density of 1.090-1.105 g/mL for a mixed product (water added). In an 800 gallon tank at 1.105 g/mL, the weight should be about 7296 lbs. A density of 1.466 g/mL equates to 12.2 lb/gal. of LCA-R, which translates to 9760 lbs.

Quality control values obtained in our laboratory are shown below.

Sample Number	Base Identification	Viscosity (centipoise)	Refractometer Reading	Density (g/mL)
422-LAQA-02	Accident exhibit 7/8	1400	14.5	1.466

We have moved to a new building. Please send future samples to this address:
5785 Hwy 10 W.
Missoula, MT 59808
Phone number will remain the same.

If you have any questions concerning the results of these tests or the LA/QA program, please contact me at (406) 329-4859, or email szylstra@fs.fed.us.

Shirley Zylstra
SHIRLEY ZYLSTRA
Wildland Fire Chemical Systems

These results indicate that no water was added to this sample before it was received at our lab…

…Fire-Trol LCA-R has a specific weight of 9.12 lb/gal and 12.10 lb/gal, respectively, for mixed retardant and liquid concentrate.

…A density of 1.466 g/mL equates to 12.2 lb/gal. of LCA-R…

Aircraft ID:
N5189Y

M-18A Dromader load vs. weight calculation

(Input a/c empty weight for particular N#)

A/C empty weight (lbs)	6387
A/C gross weight (lbs)	**11700**
A/C useful load (lbs)	5313

(Input pilot weight)

A/C Pilot Weight (lbs)	200
A/C Fuel Weight-AVGAS (lbs)	846
A/C Fuel Weight-JET (lbs)	0

(For A/C Fuel Weight, Enter Amount of Correct Type Fuel Below)

*For **Radial** Engine M18, **Enter** U.S.Gallons of Aviation Gasoline here:	141
Aviation Gasoline (AVGAS) Weight per gallon in lbs:	**6.0**
***For **Turbine** Engine M18, **Enter** U.S. Gallons of Aviation Jet Fuel here:	
Aviation Jet Fuel (JET) Weight per gallon in lbs:	**7.0**

(Caution: Enter gallons for only one fuel type. Jet or Avgas)

Note: M18	Extended usable fuel capacity:	188	gallons
	Standard usable fuel capacity:	106	gallons

	Material Weight in lbs/gallon		
	A= water	B=slurry/mix	C=straight LC
Hopper Load	8.3	9.12	12.2
in gallons	Hopper wt. A	Hopper wt. B	Hopper wt. C
100	830	912	1220
150	1245	1368	1830
200	1660	1824	2440
250	2075	2280	3050
300	2490	2736	3660
350	2905	3192	4270
400	3320	3648	4880
450	3735	4104	5490
500	4150	4560	6100
550	4565	5016	6710
600	4980	5472	7320

(Max. Hopper Wt. 3300 lbs. Std. Aircraft)
Note: Hopper Limit is not applicable when in compliance with STC SA01276AT.

	*Aircraft actual weight w/load condition with pilot, fuel, & hopper load A, B, or C		
Hopper Load	8.3	9.12	12.2
in gallons	Load A	Load B	Load C
100	8263	8345	8653
150	8678	8801	9263
200	9093	9257	9873
250	9508	9713	10483
300	9923	10169	11093
350	10338	10625	11703
400	10753	11081	12313
400	**10,753**	**11,081**	**12,313**
550	11998	12449	14143
600	12413	12905	14753

(*Max. Aircraft Gross Weight 11700 lbs)
*When in compliance with STC SA01276AT
Weights in red exceed max. A/C gross weight!

Various aircraft load calculations may be quickly determine

Cells highlighted in green may be changed to reflect a parti

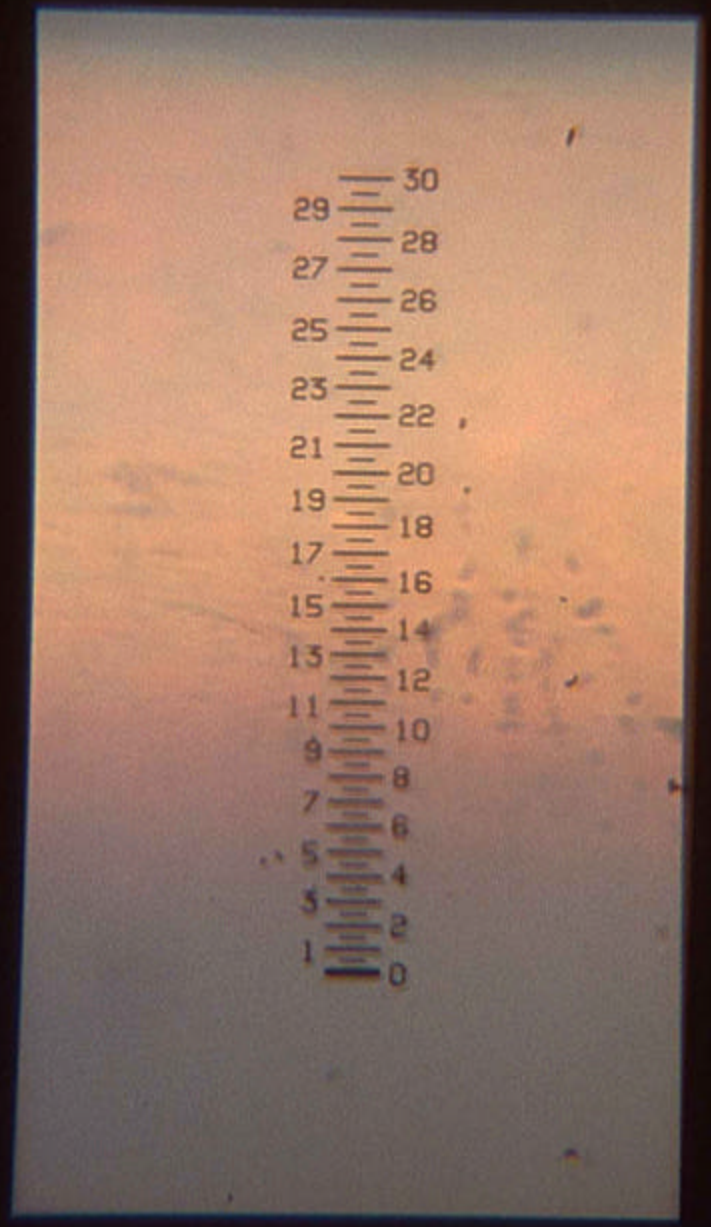
Max gross 11,700 lbs.
Over gross by 613 lbs.

NOTE: *(Pilots are responsible to insure that the aircraft does not exceed the maximum approved operational weight!)*

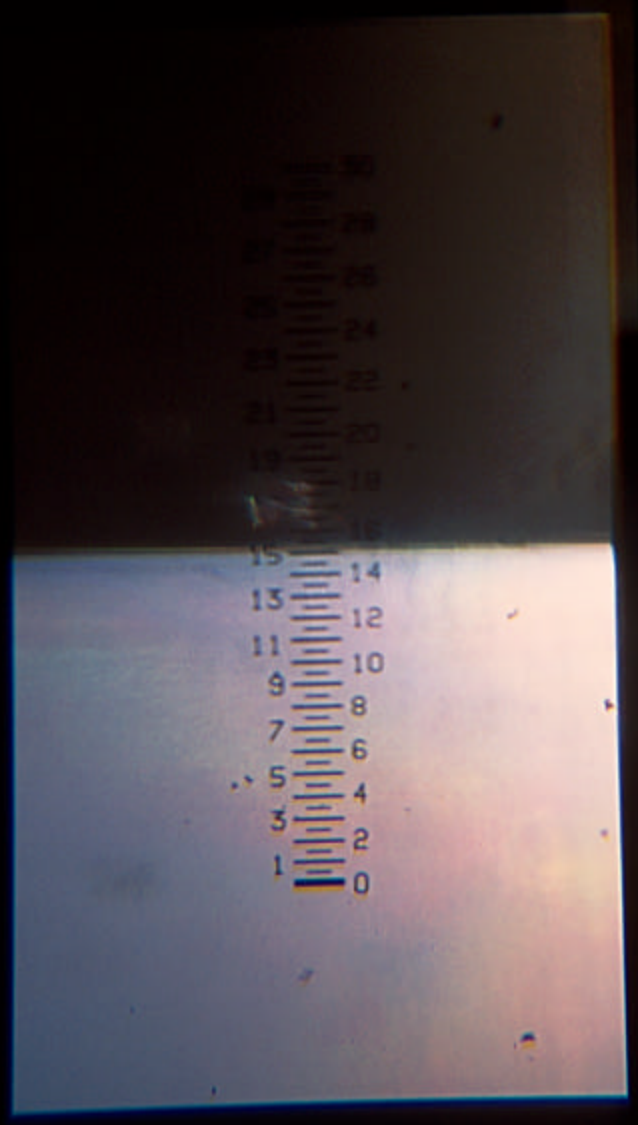

1203
3
AVGAS 100LL
NO SMOKING


MISCO
10440 0-30%
HAND REFRACTOMETER
AUTOMATICALLY TEMPERATURE
COMPENSATED
Cleveland, OH
44122
216-831-1000

Straight LC Concentrate



Acceptable Mixture 13-15



NTSB Probable Cause
Fillmore, UT, July 7, 2002

The National Transportation Safety Board

The National Transportation Safety Board determined that the probable cause of this accident was …

Probable Cause

"The pilot's failure to follow proper procedures / directives, and the airplane's inability to climb while maneuvering after takeoff.

Factors contributing to the accident were improperly mixed aerial application materials (fire retardant slurry), the high aircraft weight and balance, and the pilot's diverted attention.

OAS Observations
Fillmore, UT, July 7, 2002

Issue

Risk Management strengths

Discussion

- Excellent post-accident involvement by all levels of Bureau leadership
- Immediate, fleet-wide corrective actions
- Pro-active training program by National SEAT Program Manager
- Excellent post-accident response and reporting

OAS Observations
Fillmore, UT, July 7, 2002

Issue

Risk Management weaknesses

Discussion

- SEAT manager (SEMG)
  - ✓ How can we improve training and information dissemination for seasonal employees ?
  - ✓ Do SEMGs recognize that changes, or situations not covered in the contract must be approved by the Contracting Officer ?
  - ✓ Why did the SEMG accept the responsibility to train the vendor crew?

OAS Observations
Fillmore, UT, July 7, 2002

Issue

Risk Management weaknesses

Discussion

- SEAT manager (SEMG)
  - ✓ Why did the SEMG fail to comply with the manufacturer's recommendation for recirculating the retardant and for using the refractometer ?
  - ✓ How did the SEMG fail to notice the water valve was closed ?

OAS Observations
Fillmore, UT, July 7, 2002

Issue

Risk Management weaknesses

Discussion

- Vendor responsibilities
  - ✓ How can we ensure vendors adequately train their personnel ?
  - ✓ How should we react when vendor personnel are not adequately trained ?
  - ✓ Should loaders be evaluated and carded since their actions directly affect aviation safety ?

OAS Observations
Fillmore, UT, July 7, 2002

Issue

Risk Management weaknesses

Discussion

- **Pilot performance**
  - ✓ **Was this pilot adequately trained?**
  - ✓ **Should performance planning similar to helicopter load calcs be required for SEAT ops ?**
  - ✓ **Why did the pilot fail to release all, or part, of his load ?**
  - ✓ **How did the pilot fail to notice the water valve was closed ?**

OAS Observations
Fillmore, UT, July 7, 2002

Issue

Risk Management weaknesses

Discussion

- Aircraft issues
  - ✓ How can we be assured of adequate aircraft performance when the Pilot Operating Handbook's performance charts do not cover the temperatures we operate in ?
  - ✓ Does the variation in cockpit design and switch location create increased risk (negative habit transfer) ?