Civilian Spatial Disorientation Mishap Experience

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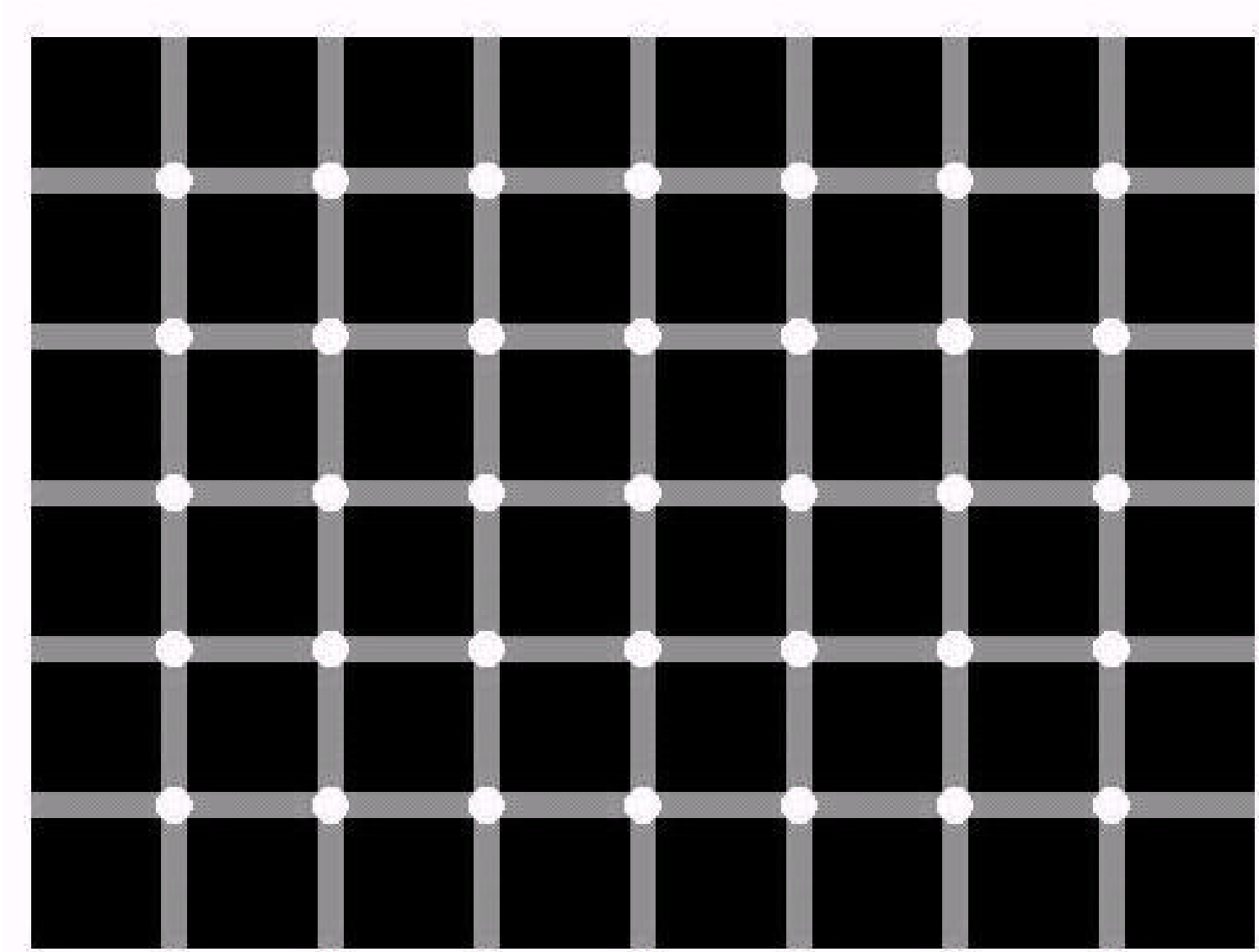
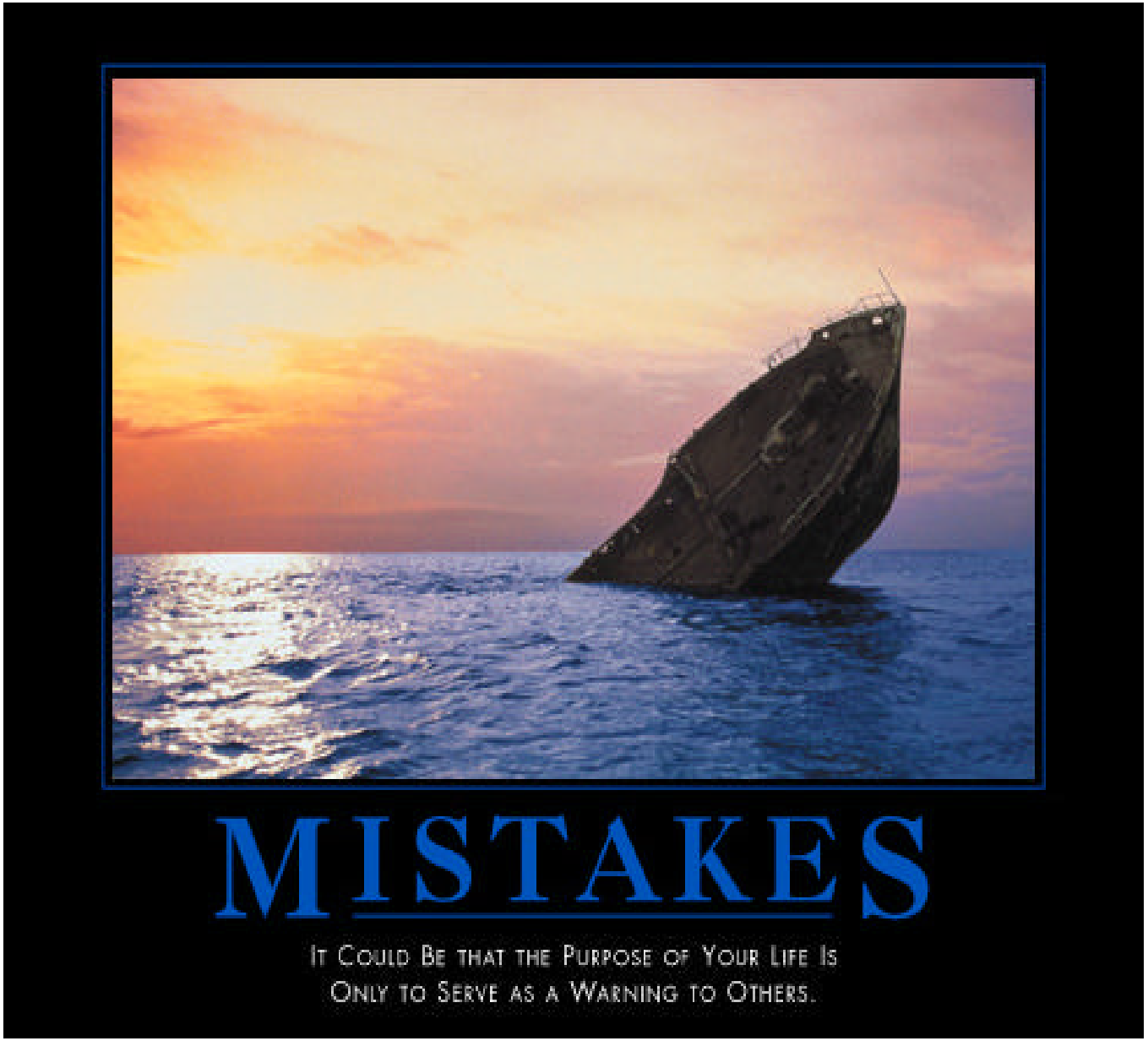
Find the Black Spot



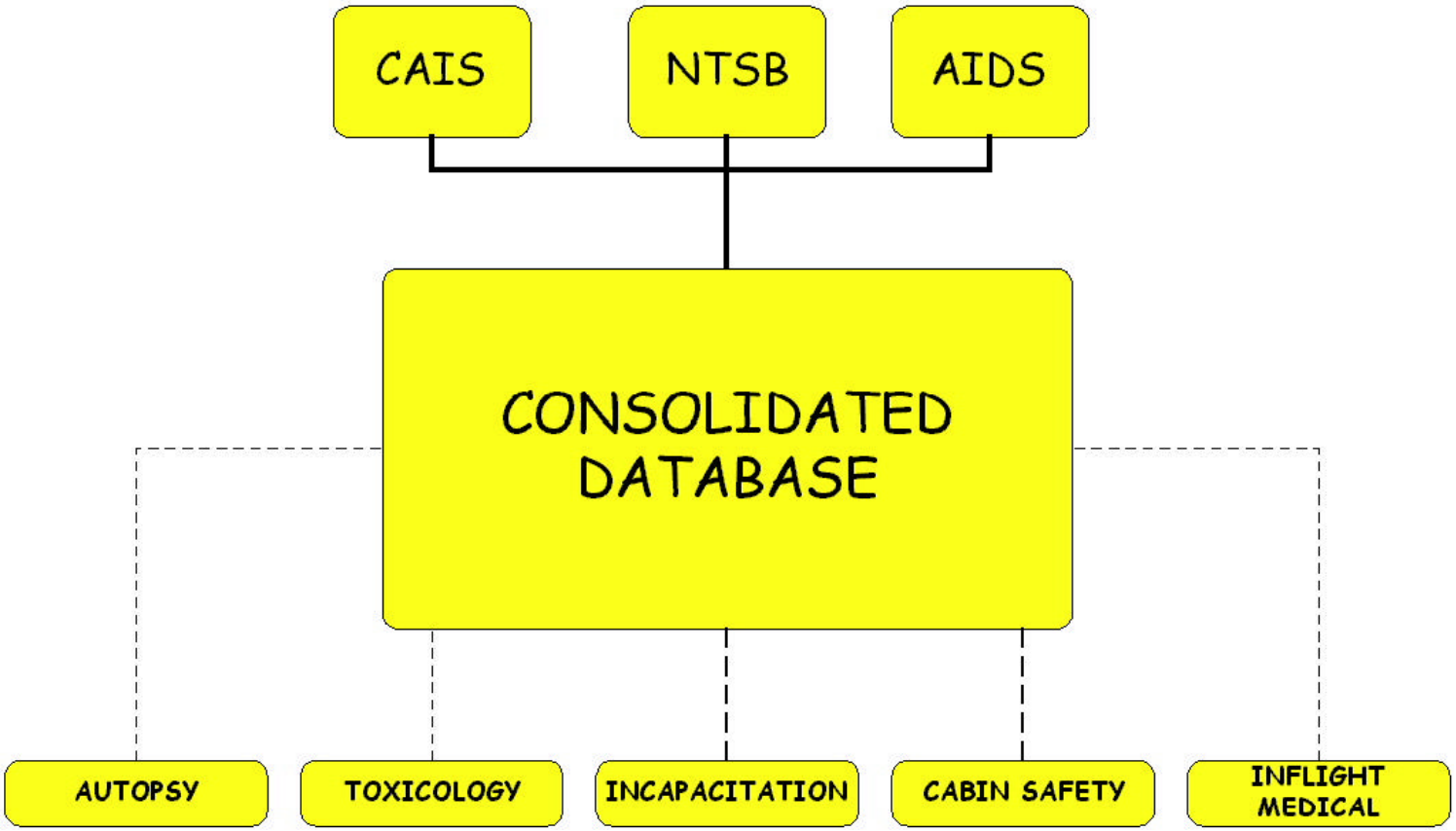
Civilian Spatial Disorientation Mishap Experience

- NTSB statistics regarding spatial disorientation (SD) mishaps will be presented along with several spatial disorientation accident reconstructions. There are differences between the commercial and general aviation accident investigation procedures regarding spatial disorientation. These differences may be due to the data available from the investigation and from the resources allotted to the various types of investigations. Awareness of SD patterns and investigatory techniques needs to be maintained among accident investigators to ensure thorough investigations and accurate information regarding the epidemiology of SD mishaps.

Prevention

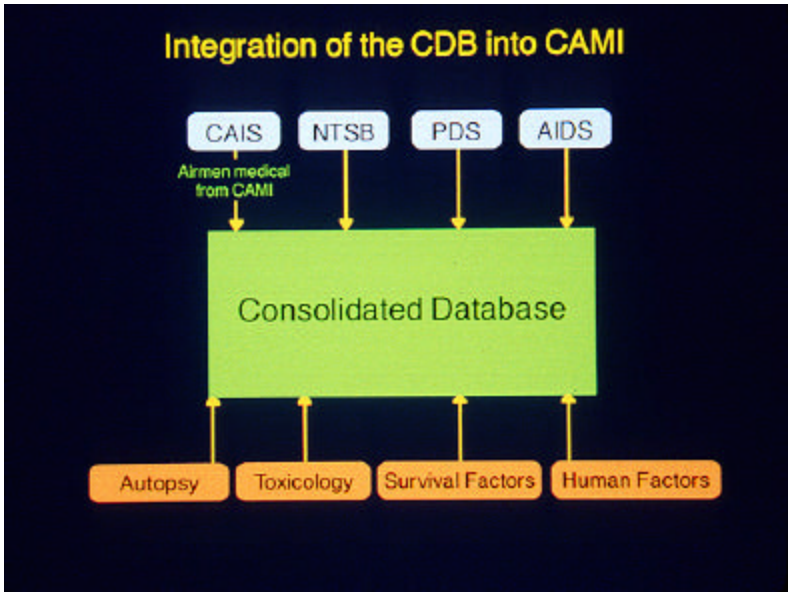

MISTAKES
It Could Be that the Purpose of Your Life Is
Only to Serve as a Warning to Others.

CAMI Safety Database



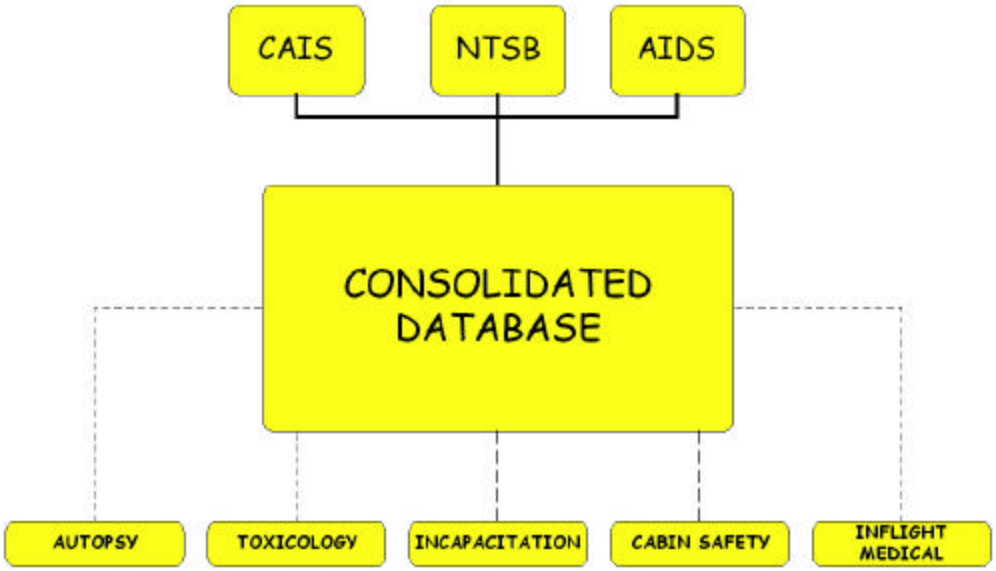
Aircraft Accident Safety Database

- FAS support
  - ground fatalities
- ATA
- Jessica Dubroff accident
- Cabin Safety, David Palmerton
- Autopilot related mishaps, Dr Beringer
- Toxicology support
- Update of the MI and Cardiovascular in flight mishaps



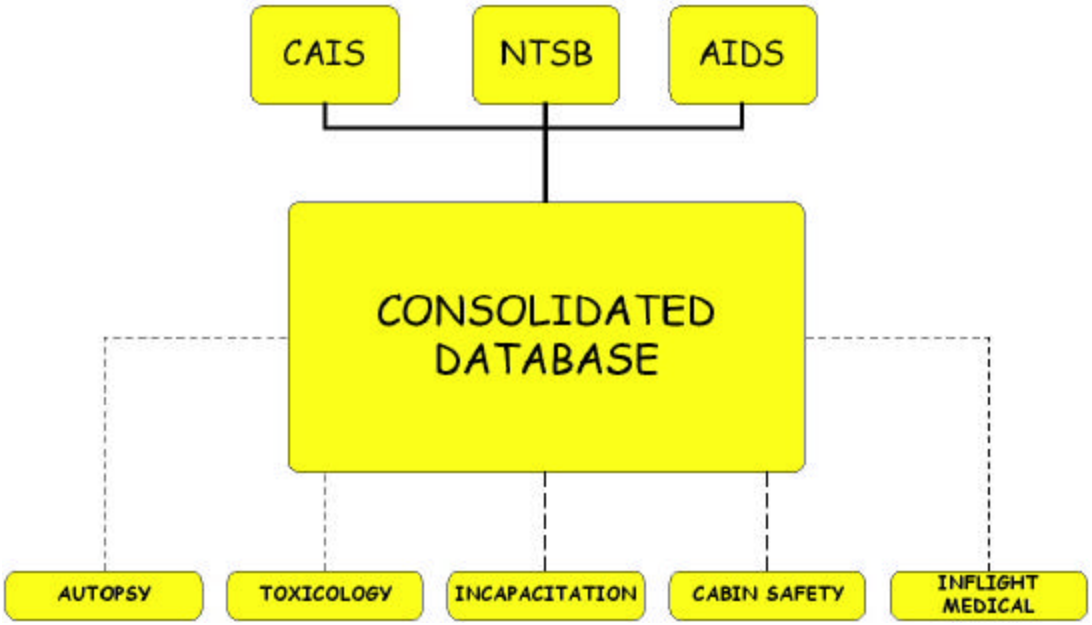
Methods

- Using the CAMI CDB
- Examine the NTSB database for spatial disorientation accidents (direct person codes) and for aircraft control not maintained



Methods

- NTSB data dictionary has listings of the codes used in the NTSB database
- SD code 33400 has note to also look at 24566 Aircraft Control, 3127 not maintained



Methods (SQL)

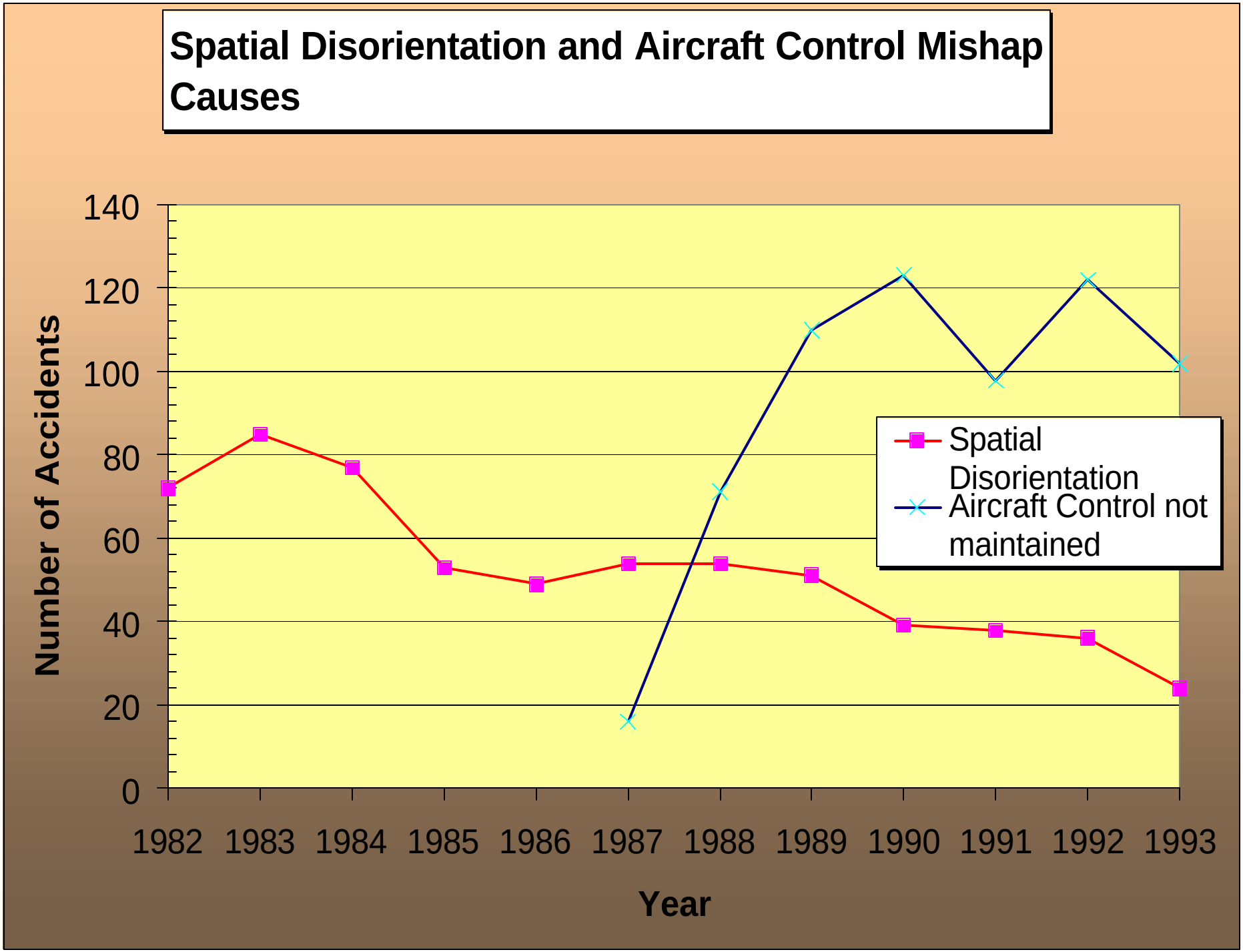
```
WHERE NTSB_SOE_CAUSES.NSC_b_subject_code =
    24566
AND ntsb_soe_causes.nsc_b_modifier_code = 3127

WHERE NTSB_SOE_CAUSES.NSC_DIRECT_CODE IN
    ('33400','43400','53400','63400')
```

Methods

- 1982 to 1993 available online, with data to 1999 to follow later
- SD cases = 632 over the time 1982-1993
- Aircraft Control/ not maintained cases = 642, however these codes only appear in 1987-1993 data

Year	Spatial Disorientation		Aircraft Co
1982	72		
1983	85		
1984	77		
1985	53		
1986	49		
1987	54		16
1988	54		71
1989	51		110
1990	39		123
1991	38		98
1992	36		122
1993	24		102
	Total		Total
	632		642


Spatial Disorientation and Aircraft Control Mishap Causes
Number of Accidents
140
120
100
80
60
40
20
0
1982
1983
1984
1985
1986
1987
1988
1989
1990
1991
1992
1993
Year
Spatial Disorientation
Aircraft Control not maintained

Results

- Many times the flight FAR field was empty
- Part 91
- Part 135 (1)
- Part 137 (2)
- Part 129 (2)
- Part 121 (3)

Results (to 1993)

Part 121cases

- DCA84AA002 HS-748-2A
- DCA84AA024 Lockheed L-188
- DCA92MA022 DC-8-63

- DC-9 at Charlotte, NC July 1994

Results (to 1993)

Part 121cases

- DCA84AA002 HS-748-2A 10 fatal
- ABOUT 1.5 MIN AFTER DEPARTING SPRINGFIELD, IL, THE FLTCREW REPORTED A SLIGHT ELECTRICAL PROBLEM, BUT THEY CONTINUED ON COURSE. ABOUT 33 MIN LATER & A FEW MIN BEFORE THE ACFT SHOULD HAVE REACHED ITS DESTINATION, THE ACFT CRASHED. IMPACT OCCURRED WHILE THE ACFT WAS DESCENDING IN A RIGHT WING LOW ATTITUDE. BEFORE CRASHING, THE PLANE'S HEADING HAD CHANGED ABOUT 180 DEG. A CVR TRANSCRIPT REVEALED THE L GENERATOR (GEN) HAD FAILED AFTER TAKEOFF & THE 1ST OFFICER HAD MISTAKENLY ISOLATED THE R GEN. ATTEMPTS TO RESTORE THE R GEN WERE UNSUCCESSFUL. THE CAPTAIN ELECTED TO CONTINUE TO THE DESTINATION RATHER THAN RETURN TO THE NEARBY DEPT ARPT. THE CLD BASES WERE AT 2000' MSL, BUT ATC COULD NOT PROVIDE AN IFR CLNC BELOW 3000 FT. JUST BEFORE CRASHING, THE CREW INDICATED A TOTAL LOSS OF ELECTRICAL POWER. THE L GEN DRIVE SHAFT HAD SHEARED. THE REASON FOR THE R GEN NOT TO RESET WAS NOT DETERMINED. THERE WAS EVIDENCE THAT RECURRENT FLTCREW TRAINING DID NOT PREPARE THE CREW TO UNDERSTAND & COPE WITH THE ELEC PROBLEM & THAT FAA SURVEILLANCE DID NOT DETECT THE TRNG DEFICIENCY.
- Probable Cause

  In-flight planning/decision..Improper..Pilot in command
  Spatial disorientation..Pilot in command

- Contributing Factors

  Electrical system,generator..Failure,partial
  Electrical system,generator..Switched off
  Electrical system,generator..Failure,total
  Self-induced pressure..Pilot in command
  Inadequate recurrent training..Company/operator management
  Inadequate surveillance of operation..FAA(organization)

Results (to 1993)

Part 121cases

- DCA84AA024 Lockheed L-188 4 fatal
- AFTER DEPARTING THE BALTIMORE-WASHINGTON ARPT, THE ACFT HAD CLIMBED TO FL 220. ACCORDING TO INFO ON THE COCKPIT VOICE RECORDER (VCR), THE CREW EXPERIENCED GYRO PROBLEMS DURING THE CLIMB. THEY SELECTED THE #1 VERTICAL GYRO TO DRIVE BOTH APPROACH HORIZONS (ATTITUDE INDICATORS), SINCE THERE WAS AN INDICATION OF A MALFUNCTION IN THE #2 VERTICAL GYRO SYS. ABOUT 7 MIN AFTER LEVELING AT FL 220, THE FLT WAS CLEARED TO THE DRYER VOR. SHORTLY AFTER THAT, THERE WERE INDICATIONS OF CONFUSION IN THE COCKPIT WHICH INCLUDED THE STATEMENTS, "WHAT'S HAPPENING HERE," "YOU GOT IT?" & "NO." THE ACFT ENTERED A RIGHT DESCENDING SPIRAL; THE INDICATED AIRSPEED INCREASED FROM APRX 205 TO 317 KTS; THEN AN IN-FLT BREAKUP OCCURRED. THE WRECKAGE WAS FOUND SCATTERED OVER AN AREA APRX 2 MI LONG BY 1 MI WIDE. AN EXAM OF THE WRECKAGE REVEALED THAT THE IN-FLT STRUCTURAL FAILURE HAD OCCURRED DUE TO OVERLOAD, THEN A FIRE IGNITED IN THE RIGHT WING AFTER IT HAD FAILED. THE ACFT WAS NOT EQUIPPED WITH AN INDEPENDENT STANDBY ATTITUDE INDICATOR.
- Probable Cause

  Flight/nav instruments,attitude gyro..Undetermined
  Airplane handling..Not maintained..Pilot in command
  Spatial disorientation..Pilot in command
  Design stress limits of aircraft..Exceeded..Pilot in command
- Contributing Factors

  Light condition..Dark night

Results (to 1993)

Part 129

- NYC91FA239 Convair 580
- ATL89MA072 HS-748-2A

1991 crash blamed on co-pilot

Report: Belvidere crash came in turn

By Shay Totten
Free Press Staff Writer

A co-pilot's mistake sent a Canadian cargo plane spiraling out of control 17 months ago, killing two people in a crash that scattered frozen fish and parcels across acres of farm land.

Canair cargo Flight 401 was carrying a load of frozen seafood and Federal Express packages to Hamilton, Ontario, from Moncton, New Brunswick, at 9:50 p.m. Sept. 18, 1991, when it broke apart in flight and crashed.

Pilot John McDougall, 30, of Mississauga, Ontario, and co-pilot Leonard Zilvytis, 31, of Mount Hope, Ontario, were killed, and their bodies were found the following morning.

According to a recently released National Transportation Safety Board investigation, Zilvytis was changing the plane's direction when he became disoriented during a 30-degree left turn. Instead of straightening out the plane, Zilvytis continued turning.

Investigators think he could not see the horizon and possibly became confused about direction because of an imbalance in his inner ear fluids, caused by the turn's force. He was turning and had nothing to anchor his gaze on, they said. At the same time, he was listening to a radio transmission of weather reports, which might have distracted him.

After several repetitions of the left turn, the plane entered into a "graveyard spiral," Stephen Veronneau, one of the investigators, said in the report. McDougall was checking on the cargo at the time of the crash, the report said.

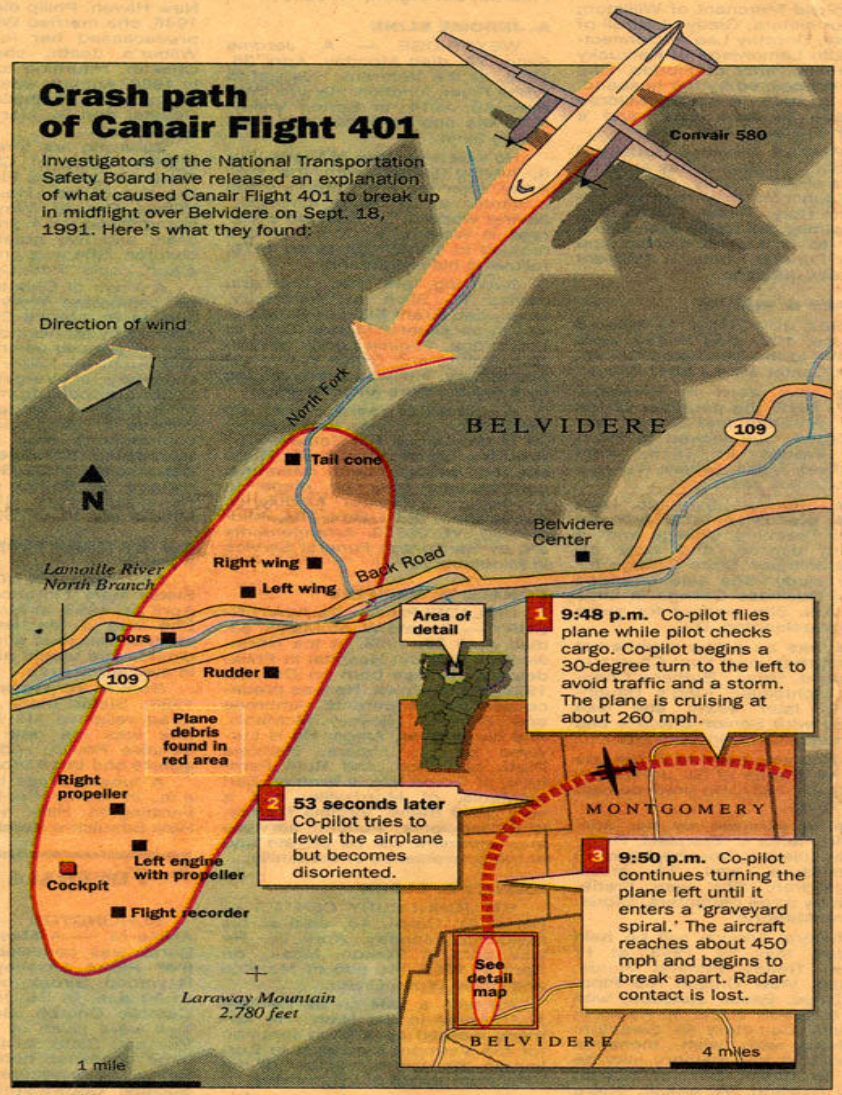
The crash scattered wreckage over a 4-mile by ½-mile stretch between Cold Hollow and Laraway Mountains west of the North Branch River in Belvidere. The cockpit was found on Laraway Mountain along with the cockpit voice recorder. Frozen lobster was found as far as 6 miles away, the report said.

Gloria and Fred Allard, whose home is in the flight path, were among several residents who saw and reported the plane crash.

"The plane went right over our house," Gloria Allard said. "The tip part of the right wing was found on our property, and a tail section was found on the property above us."

"We were all sitting here watching television when we heard it going overhead. It was a tremendous roar and shook the house," Fred Allard said. "I ran outside to see what it was, and I saw it go across Route 109 and into the mountain."

Gordon Smith, fire chief of the Johnson Fire Department, said local rescuers didn't know what type of plane they were searching for or whether there were



Source: NTSB

CHRIS WILLIS, *Free Press*

gers," Smith said. "You're trained for a fire, but you don't expect a commercial plane to come down in your area."

Rescue teams from Stowe, Cambridge and Johnson; the state police; Red Cross; Vermont Civil Air Patrol; and Lamoille Ambulance squad assisted in the search. Within two days, most of the plane was recovered, but small search teams combed the area for about a week, Smith said. Federal investigators and Canair officials arrived at the scene the

Smith said. "They know that mountain like the back of their hands. So we had a firefighter with a radio in each group so we could keep track of everyone."

Eventually the searchers were sent home, left to wonder what caused the small plane crash.

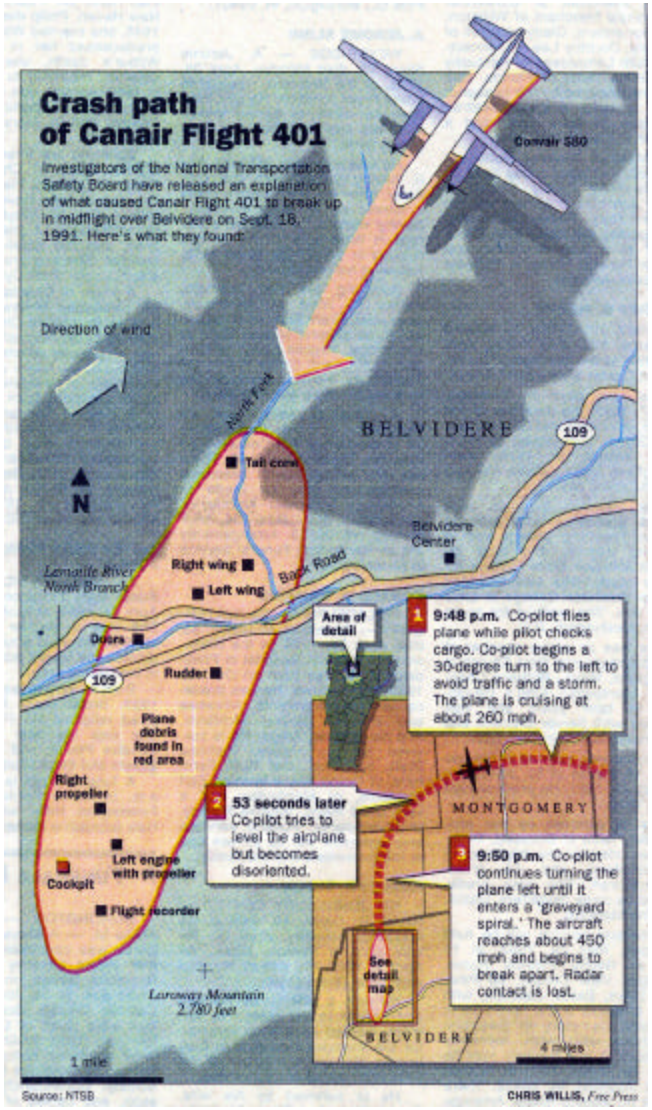
A year and a half later, several said they were glad to find out what happened so they could put the nighttime disaster to rest.

"We'd always wondered what had

NYC91FA239 Convair 580

- 18-SEP-91 NYC91FA239
- THE AIRPLANE WAS CRUISING IN NIGHT INSTRUMENT METEOROLOGICAL CONDITIONS WHEN IT ENTERED A LEFT TURN AND EXCEEDED THE DESIGN AIRFRAME LIMITS. THE AIRPLANE BROKE UP IN THE DESCENT DUE TO AERODYNAMIC FORCES AND WAS DESTROYED. THE OUTBOARD WING PANELS HAD FAILED DOWNWARD AND CENTER WING SECTION SEPARATED FROM THE FUSELAGE. THE HORIZONTAL STABILIZER AND ELEVATORS HAD FAILED DOWN AND AFT. THE CAPTAIN WAS FOUND OUT OF THE COCKPIT WITH NO EVIDENCE OF HIM BEING IN THE SEAT AT IMPACT A HUMAN FACTORS STUDY FOUND THE AIRCRAFT'S LAST MINUTE OF FLIGHT MATCHED A PROFILE OF A PILOT EXPERIENCING SPATIAL DISORIENTATION.

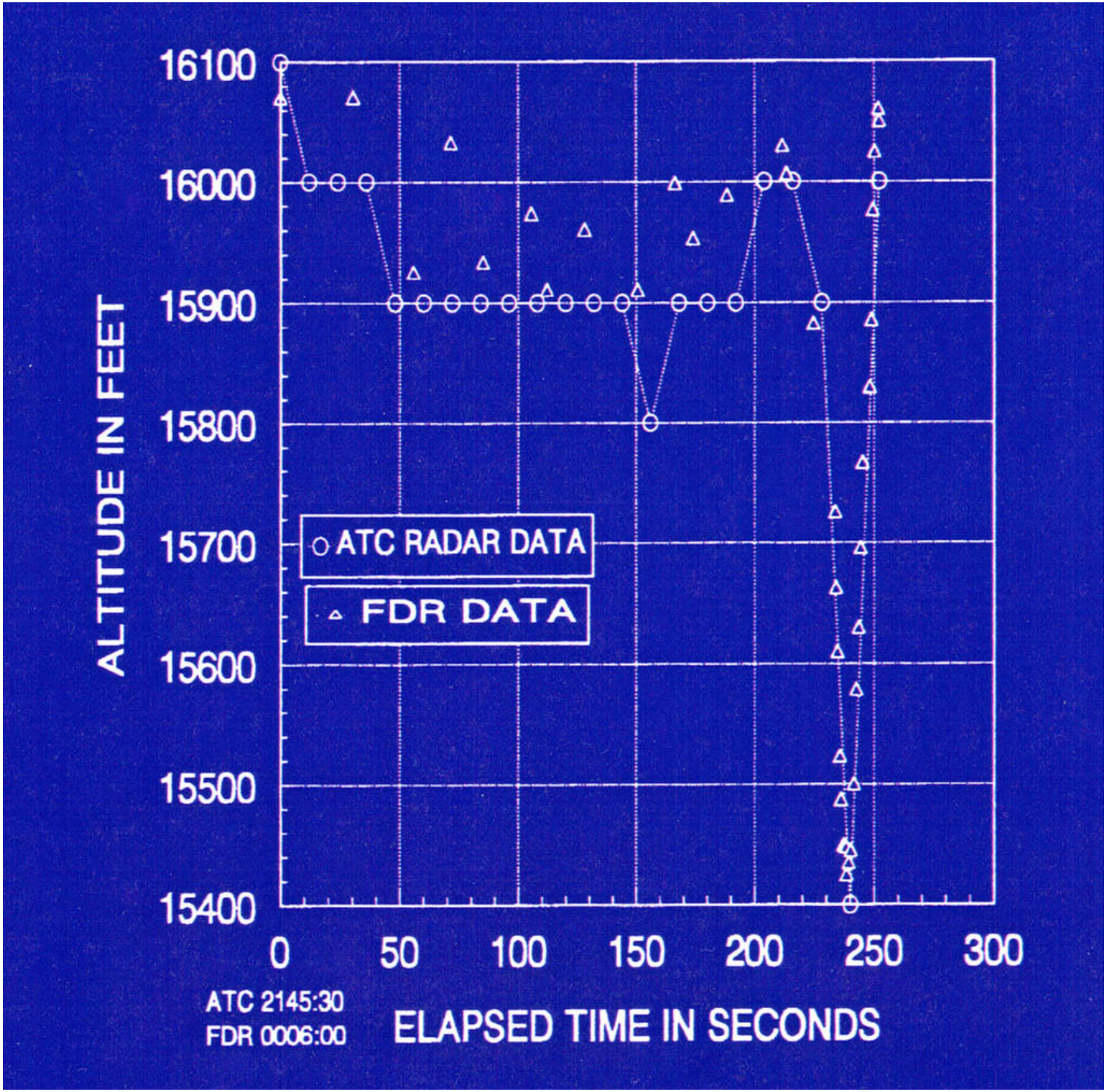
NYC91FA239 Convair 580

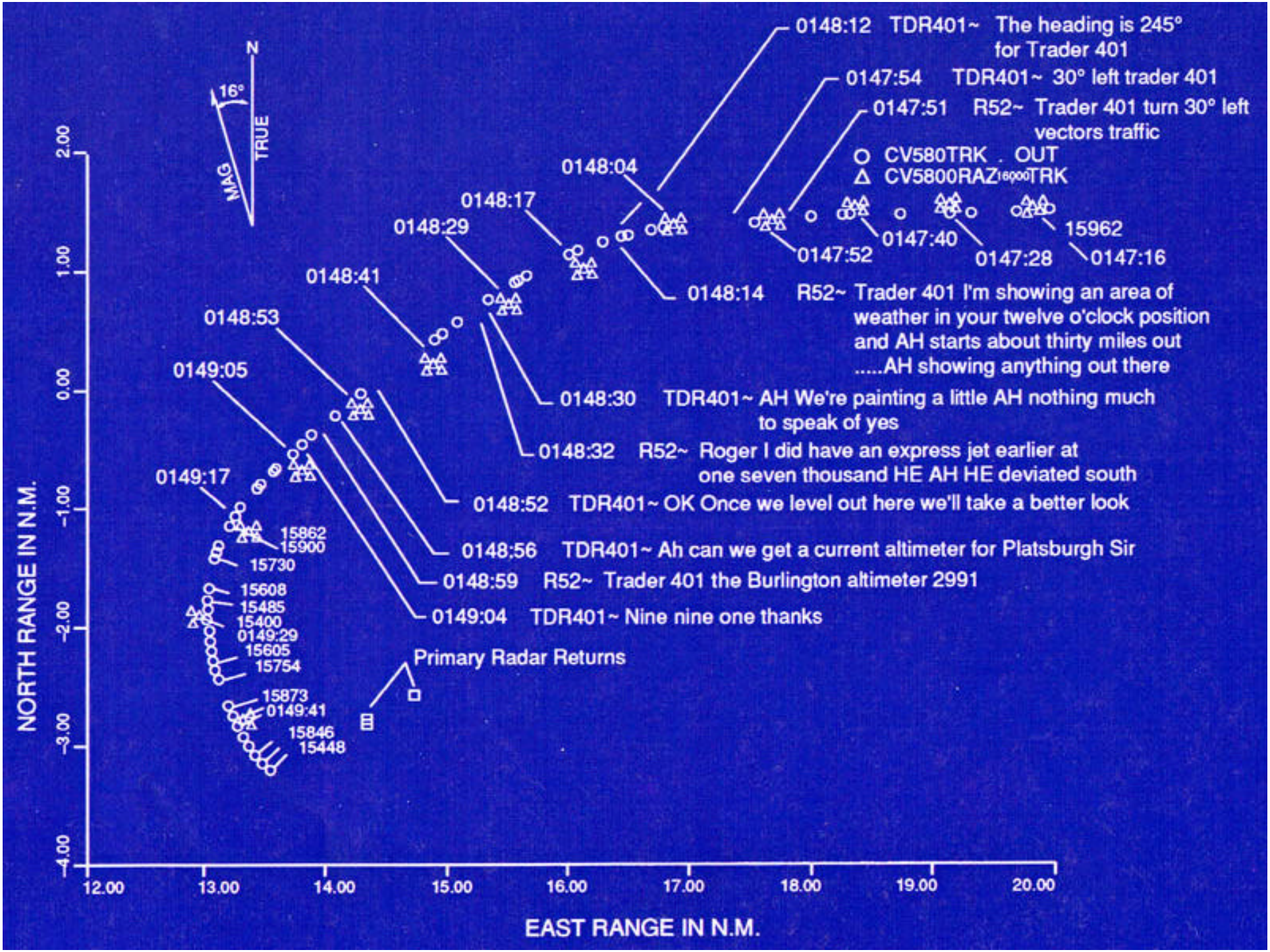


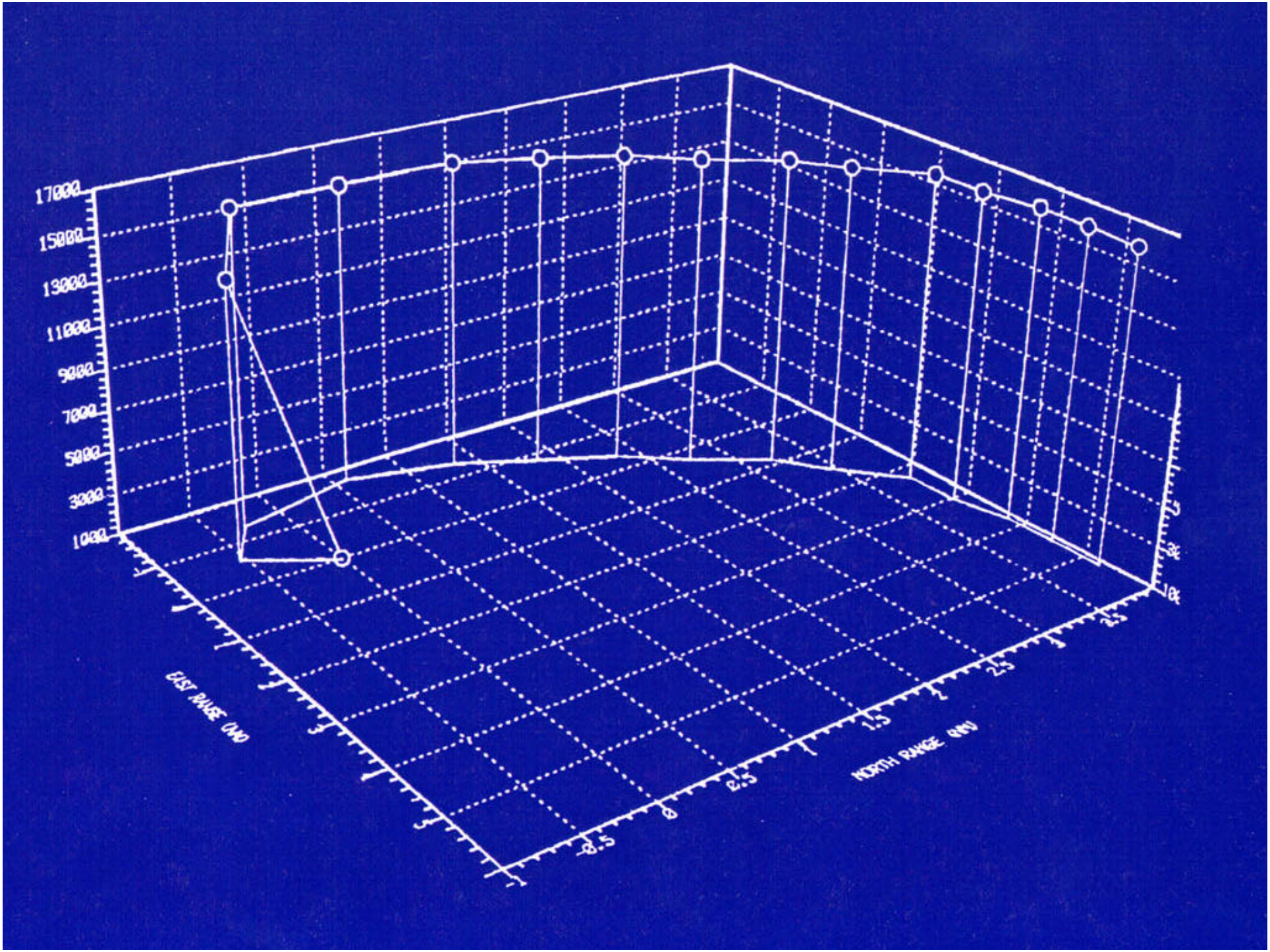
- 18-SEP-91 NYC91FA239
- Probable Cause

  FAILURE OF THE FIRST OFFICER (CO-PILOT) TO MAINTAIN CONTROL OF THE AIRCRAFT AFTER BECOMING SPATIALLY DISORIENTED, AND HIS EXCEEDING THE DESIGN STRESS LIMITS OF THE AIRCRAFT. FACTORS RELATED TO THE ACCIDENT WERE: THE LACK OF TWO PILOTS IN THE COCKPIT, DARKNESS, AND INSTRUMENT METEOROLOGICAL CONDITIONS

  (IMC) AT FLIGHT ALTITUDE.


16100
16000
15900
15800
15700
15600
15500
15400
ALTITUDE IN FEET
ATC RADAR DATA
FDR DATA
0
50
100
150
200
250
300
ATC 2145:30
FDR 0006:00
ELAPSED TIME IN SECONDS


N
16°
MAG
TRUE
0148:12 TDR401~ The heading is 245° for Trader 401
0147:54 TDR401~ 30° left trader 401
0147:51 R52~ Trader 401 turn 30° left vectors traffic
CV580TRK . OUT
CV5800RAZ16000TRK
0148:04
0148:17
0148:29
0148:41
0148:53
0149:05
0149:17
0147:52
0147:40
0147:28
0147:16
15962
0148:14 R52~ Trader 401 I'm showing an area of weather in your twelve o'clock position and AH starts about thirty miles out .....AH showing anything out there
0148:30 TDR401~ AH We're painting a little AH nothing much to speak of yes
0148:32 R52~ Roger I did have an express jet earlier at one seven thousand HE AH HE deviated south
0148:52 TDR401~ OK Once we level out here we'll take a better look
0148:56 TDR401~ Ah can we get a current altimeter for Platsburgh Sir
0148:59 R52~ Trader 401 the Burlington altimeter 2991
0149:04 TDR401~ Nine nine one thanks
Primary Radar Returns
15862
15900
15730
15608
15485
15400
0149:29
15605
15754
15873
0149:41
15846
15448
2.00
1.00
0.00
-1.00
-2.00
-3.00
-4.00
12.00
13.00
14.00
15.00
16.00
17.00
18.00
19.00
20.00
NORTH RANGE IN N.M.
EAST RANGE IN N.M.


17000
15000
13000
11000
9000
7000
5000
3000
1000
EAST RANGE (NM)
NORTH RANGE (NM)

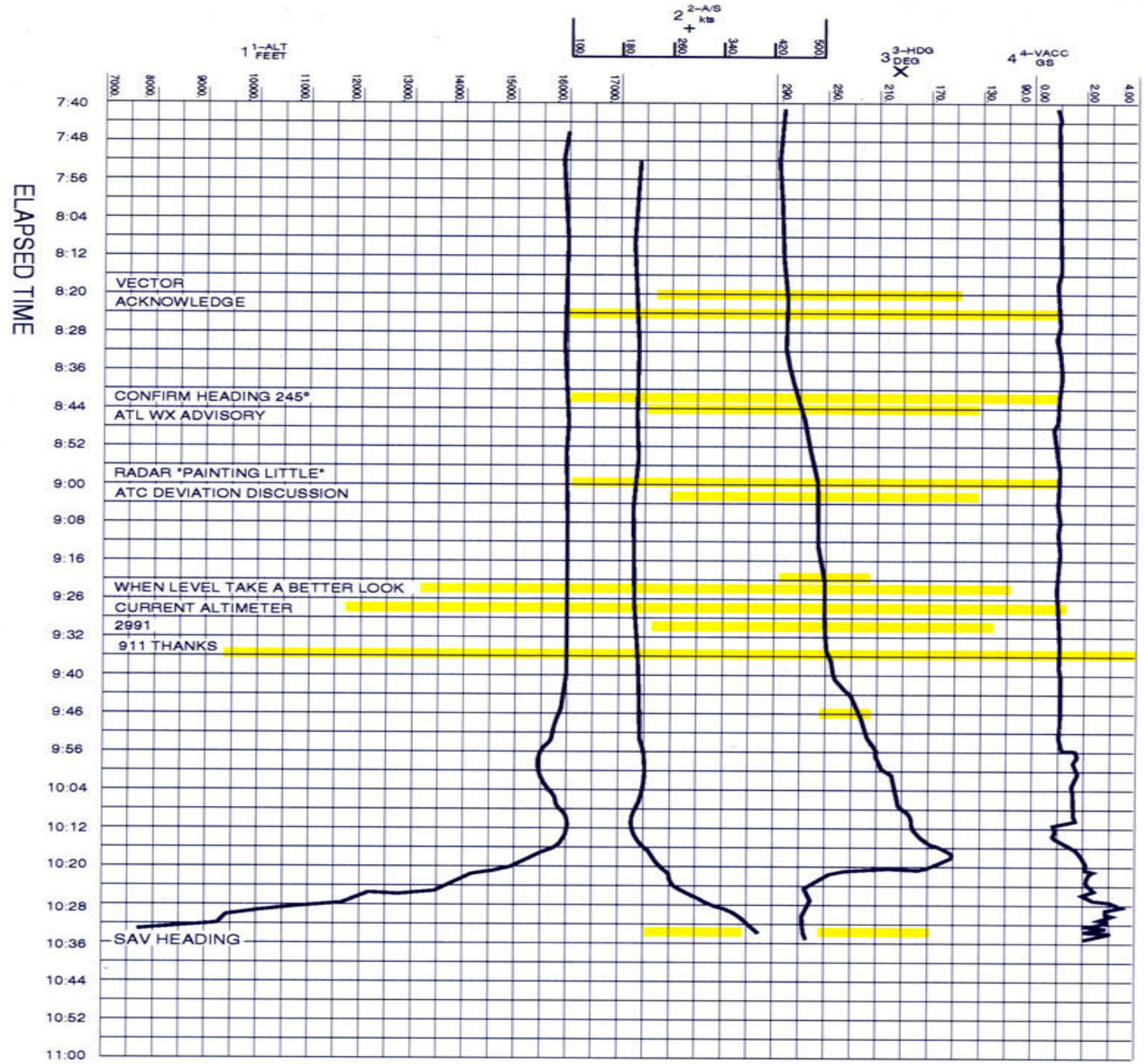
This transcription is a rough draft. It is not the final certified copy.

Agencies Making Transmission	Abbreviation
Boston Center Montpieller Sector Radar Position	R52
Trader Four Zero One	TDR401

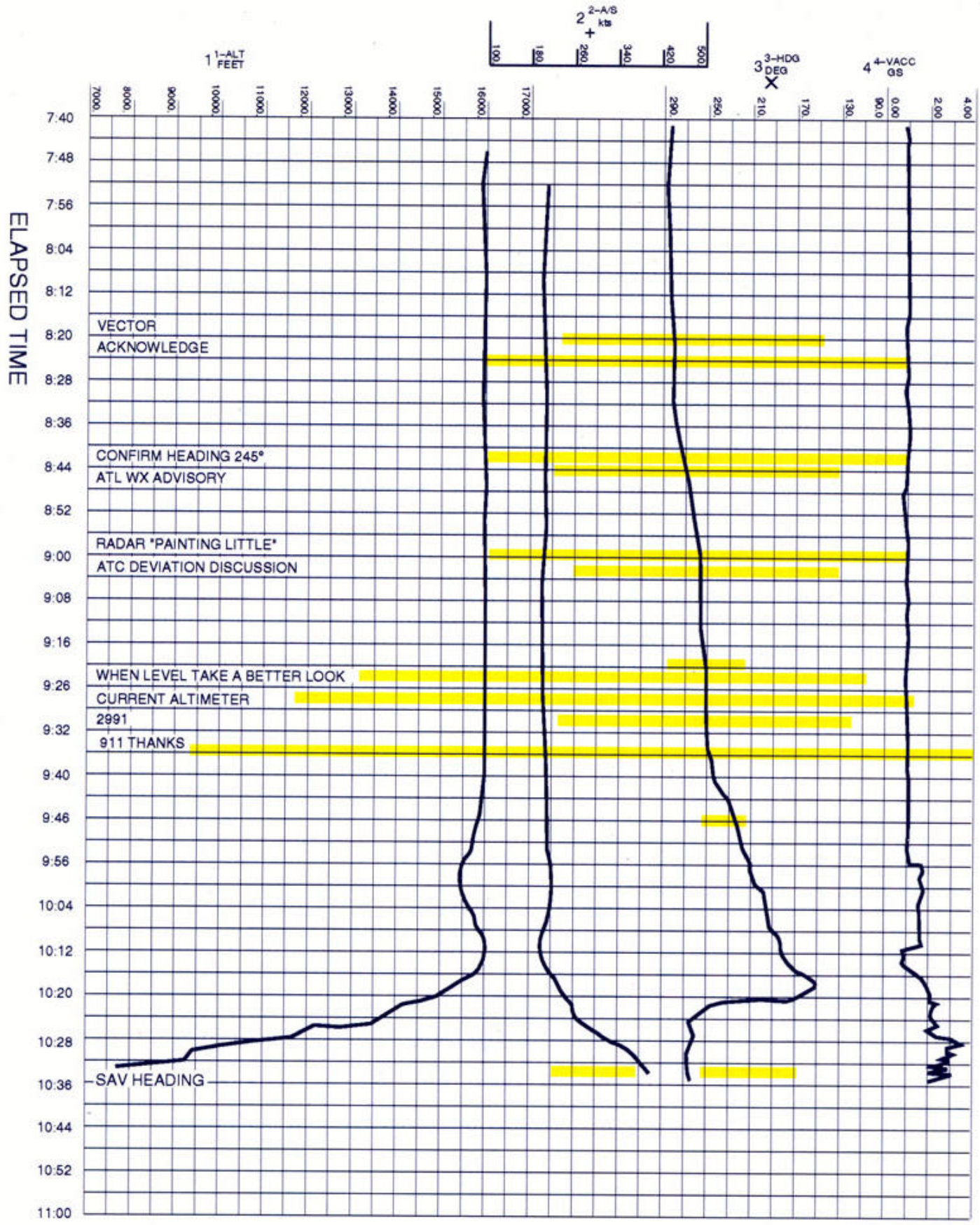
0147:51	R52	Trader four zero one turn ah thirty degrees left vectors traffic
0147:54	TDR401	Thirty degrees left Trader four zero one
0148:12	TDR401	The heading is two forty five for Trader four zero one
0148:14	R52	Trader four zero one roger I'm showing an area of weather in your twelve o'clock position and ah starts about thirty miles out extends ah a good seventy miles along your route of flight and also continues to your ten o'clock position ah between ten and twelve o'clock ah showing anything out there

0146:30	TDR401	Ah we're painting a little ah nothing much to speak of yes
0148:32	R52	Roger I did have an express jet earlier at one seven thousand he ah he deviated southeast ah he went around the south side of it ah your route of flight takes you right through the center of it right now I'm not sure if you want to try going around the ah northwest side da the right or going around the south side to the left
0148:52	TDR401	Okay once we level out here we'll take a better look
0148:56	TDR401	Ah can we get a current altimeter for Platsburg air
0148:59	R52	Trader four zero one the ah Burlington altimeter two niner nine one
0149:04	TDR401	Nine nine one thanks
0150:04	R52	Trader four zero one say heading
0150:14	R52	Trader four zero one say heading
0150:37	R52	Trader four zero one Boston Center
0150:47	R52	Trader four zero one Boston how do you hear

END OF TRANSCRIPT



NATIONAL TRANSPORTATION SAFETY BOARD
OFFICE OF RESEARCH AND ENGINEERING
WASHINGTON, D. C.



NATIONAL TRANSPORTATION SAFETY BOARD
OFFICE OF RESEARCH AND ENGINEERING
WASHINGTON, D. C.

PRINTOUT OF OUTPUT DATA

POINT NO	MIN	SEC	ALTITUDE FT	GROUND SPEED KNOTS	TRACK ANGLE DEG	VERT. VEL. FPM	FLIGHT PATH DEG	LIFT G,S	T-D GS	ANGLES ROLL DEG	ANGLES PITCH DEG	ANGLES HEADING DEG MAG	AIRSPEED TRUE KNOTS	AIRSPEED IND. KNOTS	AOA
4	47	22.10	15899.	222.1	269.88	-193.38	-0.49	1.07	-0.02	3.11	0.89	281.64	265.4	204.2	1.30
5	47	22.20	15899.	222.0	269.91	-168.31	-0.43	1.13	-0.02	3.78	0.96	281.67	265.2	204.1	1.32
6	47	24.60	15907.	221.7	270.28	128.95	0.33	1.02	0.00	0.37	1.57	281.98	264.8	203.8	1.29
7	47	31.00	15927.	220.6	270.23	195.15	0.50	0.99	0.00	-1.19	1.70	281.91	263.8	202.9	1.29
8	47	38.00	15949.	220.3	268.92	-3.64	-0.01	0.99	0.00	-3.82	1.27	280.80	263.9	202.9	1.29
9	47	39.20	15947.	219.8	268.39	-68.97	-0.18	0.99	0.00	-3.05	1.14	280.35	263.5	202.6	1.29
10	47	43.40	15937.	219.1	266.82	-117.50	-0.30	1.00	0.00	-4.19	1.03	279.03	263.2	202.4	1.29
11	47	51.10	15920.	221.5	264.83	-132.69	-0.34	1.00	0.01	-1.81	1.00	277.42	266.0	204.7	1.29
12	48	0.20	15899.	221.5	264.40	92.73	0.24	1.02	0.02	0.50	1.49	277.09	266.1	204.8	1.29
13	48	0.50	15899.	221.3	264.37	78.67	0.20	1.07	0.01	-2.00	1.47	277.06	265.9	204.7	1.30
14	48	0.90	15901.	223.9	264.44	180.44	0.46	1.13	0.00	1.12	1.69	277.16	268.5	206.7	1.31
15	48	2.60	15910.	221.4	264.01	367.39	0.94	1.03	0.00	-9.18	2.06	276.77	266.2	204.8	1.29
16	48	4.50	15921.	221.4	261.59	336.45	0.86	1.02	0.00	-11.28	1.98	274.76	266.7	205.2	1.29
17	48	4.90	15923.	219.4	261.22	336.45	0.87	1.03	0.00	-13.09	1.98	274.42	264.7	203.6	1.29
18	48	7.60	15938.	219.6	257.91	336.48	0.87	1.03	0.00	-14.15	1.97	271.68	265.5	204.2	1.29
19	48	8.90	15946.	218.7	256.10	336.49	0.87	1.03	-0.01	-12.77	1.98	270.17	264.9	203.7	1.29
20	48	11.50	15960.	216.8	252.67	336.49	0.88	1.03	-0.01	-13.61	1.98	267.33	263.4	202.5	1.30
21	48	15.00	15980.	216.9	249.14	273.16	0.71	0.98	0.00	-13.14	1.83	264.42	263.8	202.7	1.28
22	48	15.60	15983.	216.7	248.46	229.98	0.60	0.89	0.00	-27.22	1.61	263.85	263.6	202.6	1.26
23	48	16.30	15987.	216.0	246.85	-101.82	-0.27	0.90	-0.01	-25.32	0.92	262.51	263.0	202.1	1.26
24	48	16.60	15985.	219.4	246.91	-176.55	-0.45	0.82	0.00	-10.31	0.84	262.56	266.4	204.7	1.23
25	48	22.70	15949.	219.4	241.46	-404.28	-1.04	1.18	-0.02	-18.47	0.41	258.07	266.2	204.7	1.33
26	48	24.00	15942.	219.2	239.15	-94.03	-0.24	1.04	0.00	-9.07	1.08	256.19	265.9	204.5	1.30
27	48	24.40	15943.	219.9	238.69	-46.66	-0.12	1.08	-0.01	-12.09	1.18	255.81	266.6	205.0	1.30
28	48	29.10	15954.	219.2	235.54	149.60	0.39	1.01	-0.01	-5.00	1.60	253.22	265.6	204.2	1.29
29	48	34.30	15967.	218.4	233.97	147.66	0.38	1.00	0.00	-2.60	1.60	251.93	264.6	203.4	1.29
30	48	36.90	15974.	217.8	233.47	140.50	0.36	1.00	0.00	-2.14	1.59	251.52	264.0	202.9	1.29
31	48	38.30	15977.	218.4	233.75	133.76	0.35	1.00	0.02	0.18	1.57	251.74	264.7	203.4	1.29
32	48	50.90	15999.	219.2	232.53	104.90	0.27	1.00	0.02	-4.14	1.51	250.72	265.3	203.9	1.29
33	48	55.20	16007.	220.7	230.65	82.30	0.21	0.99	0.02	-5.97	1.45	249.16	266.5	204.7	1.28
34	48	59.50	16014.	221.2	227.98	-36.66	-0.09	0.95	0.00	-6.07	1.18	246.93	266.6	204.8	1.27
35	49	1.50	16018.	221.4	226.95	-278.68	-0.71	0.97	-0.01	-4.97	0.68	246.07	266.5	204.8	1.28
36	49	3.30	15995.	222.0	226.30	-585.57	-1.49	0.97	0.03	-5.36	0.03	245.50	267.0	205.2	1.27
37	49	6.50	15970.	221.8	224.86	-527.27	-1.34	1.00	0.02	-8.72	0.15	244.32	266.4	204.8	1.28
38	49	6.90	15967.	224.1	224.67	-464.78	-1.17	0.99	0.03	-10.36	0.28	244.14	268.7	206.6	1.28
39	49	9.20	15949.	224.3	221.92	-735.96	-1.85	0.98	0.02	-13.08	-0.31	241.83	268.2	206.3	1.27
40	49	10.10	15936.	228.7	221.22	-819.94	-2.03	0.99	0.03	-12.56	-0.46	241.18	272.3	209.6	1.27
41	49	13.10	15893.	230.8	218.04	-900.93	-2.20	1.09	0.02	-16.02	-0.62	238.48	273.4	210.5	1.29
42	49	14.60	15871.	231.4	215.56	-695.05	-1.70	1.21	0.07	-26.51	-0.25	236.39	273.1	210.4	1.32
43	49	15.20	15865.	231.9	213.97	-597.56	-1.46	1.37	0.05	-40.02	-0.19	235.05	272.9	210.3	1.37
44	49	15.50	15862.	233.9	212.72	-491.78	-1.19	1.38	0.03	-43.93	-0.03	233.95	274.5	211.5	1.37
45	49	16.20	15856.	233.8	208.45	-731.02	-1.77	1.37	-0.05	-52.61	-0.68	230.31	272.8	210.2	1.37
46	49	16.80	15851.	238.2	206.18	-977.79	-2.32	1.12	0.01	-48.13	-1.14	228.26	276.2	212.9	1.29
47	49	18.90	15792.	238.8	201.67	-2490.35	-5.87	1.03	0.02	-34.09	-4.06	224.30	275.4	212.5	1.27
48	49	19.30	15772.	241.6	200.94	-2590.59	-6.04	1.40	-0.12	-36.81	-4.18	223.59	278.0	214.6	1.36
49	49	20.30	15730.	241.6	196.25	-1980.93	-4.62	1.32	-0.08	-40.62	-3.05	219.54	274.9	212.3	1.35
50	49	20.50	15721.	244.4	195.77	-1677.27	-3.87	1.41	-0.07	-31.97	-2.26	219.05	277.2	214.2	1.36
51	49	23.80	15714.	244.4	187.65	-7471.67	-16.78	1.53	-0.17	-30.86	-13.97	211.60	281.8	217.8	1.38
52	49	24.10	15651.	245.7	186.71	-7294.61	-16.32	1.47	-0.17	-24.38	-13.55	210.72	281.8	218.0	1.37
53	49	24.50	15608.	249.2	185.14	-6641.72	-14.73	2.00	0.18	-27.11	-12.08	209.22	282.5	218.7	1.49
54	49	25.60	15519.	254.5	182.59	-4231.98	-9.32	1.25	0.24	-31.27	-7.41	206.90	281.3	218.1	1.31
55	49	26.00	15485.	255.1	181.76	-4485.38	-9.84	2.18	0.00	-2.61	-7.50	206.07	281.6	218.5	1.54
56	49	26.10	15476.	259.4	181.58	-4198.52	-9.07	2.22	-0.04	-6.08	-6.82	205.80	285.4	221.5	1.54
57	49	26.80	15452.	260.7	182.90	-1925.14	-4.17	2.32	0.07	1.46	-2.26	207.08	285.0	221.3	1.56
58	49	27.20	15438.	261.3	182.62	-1210.75	-2.62	1.85	0.09	-9.00	-0.97	206.83	285.0	221.4	1.45

PRINTOUT OF OUTPUT DATA

POINT NO	MIN	SEC	ALTITUDE FT	GROUND SPEED KNOTS	TRACK ANGLE DEG	VERT. VEL. FPM	FLIGHT PATH DEG	LIFT G,S	T-D GS	ANGLES ROLL DEG	ANGLES PITCH DEG	ANGLES HEADING DEG MAG	AIRSPEED TRUE KNOTS	AIRSPEED IND. KNOTS	AOA
59	49	27.60	15437.	265.7	181.78	-787.39	-1.67	1.74	0.08	-21.55	-0.23	205.98	288.7	224.3	1.41
60	49	28.70	15415.	266.5	176.97	52.61	0.11	1.80	-0.05	-34.01	1.29	201.59	286.0	222.2	1.43
61	49	29.00	15418.	267.2	175.72	335.18	0.71	1.84	-0.07	-35.45	1.84	200.43	285.8	222.1	1.44
62	49	29.40	15423.	267.4	174.02	789.05	1.67	1.97	0.02	-33.09	2.80	198.85	285.0	221.4	1.48
63	49	30.20	15433.	268.4	170.33	1834.57	3.86	1.76	0.04	-32.35	4.86	195.46	283.7	220.3	1.43
64	49	30.60	15450.	268.8	168.72	2277.10	4.78	1.82	-0.18	-25.21	5.85	193.96	283.3	219.9	1.44
65	49	31.30	15480.	269.2	166.92	3059.77	6.40	1.88	-0.05	-7.99	7.56	192.30	283.1	219.7	1.46
66	49	31.50	15488.	267.0	166.94	3436.83	7.24	1.64	-0.13	-9.68	8.31	192.41	281.4	218.3	1.41
67	49	32.10	15536.	265.5	166.62	4507.82	9.51	1.49	-0.13	-7.89	10.45	192.22	281.3	218.1	1.37
68	49	32.50	15567.	261.0	166.06	4458.59	9.56	0.97	-0.10	-18.77	10.33	191.84	276.5	214.1	1.25
69	49	33.10	15605.	260.7	164.73	3852.30	8.29	0.99	-0.11	-15.26	9.17	190.58	274.4	212.3	1.26
70	49	33.30	15618.	260.8	164.80	4054.55	8.72	0.94	0.07	-15.84	9.57	190.65	274.8	212.6	1.25
71	49	33.90	15657.	260.7	163.73	3651.11	7.86	0.86	0.01	-24.37	8.68	189.63	273.5	211.4	1.23
72	49	35.20	15754.	255.9	161.95	2977.17	6.55	0.93	-0.12	-18.41	7.51	188.12	266.8	205.8	1.26
73	49	38.10	15818.	256.0	158.07	4133.35	9.05	2.11	0.09	-12.05	10.40	184.55	265.5	204.6	1.60
74	49	38.30	15834.	254.9	158.08	4551.73	9.99	1.62	0.05	-23.24	11.09	184.61	265.1	204.3	1.46
75	49	38.90	15889.	251.3	155.44	6174.33	13.62	1.93	0.21	-25.68	14.80	182.35	262.9	202.3	1.56
76	49	39.70	15985.	252.6	153.43	5483.10	12.08	0.45	0.04	-91.83	11.91	180.24	261.3	200.8	1.13
77	49	40.70	16049.	253.7	152.45	1776.78	3.95	0.55	0.07	-163.28	2.80	179.14	256.6	196.9	1.17
78	49	41.20	16045.	255.8	152.50	-88.69	-0.20	0.53	0.11	-167.57	-1.33	179.02	258.1	198.0	1.16
79	49	42.00	16038.	257.5	152.66	-2085.57	-4.57	0.20	0.14	-109.04	-4.87	179.02	260.7	200.2	1.06
80	49	42.80	15998.	262.0	151.89	-3260.30	-7.00	0.71	0.27	-63.52	-6.42	178.00	265.7	204.1	1.20
81	49	43.90	15925.	261.9	147.83	-4592.57	-9.81	1.32	0.11	-74.86	-9.52	173.89	264.0	203.1	1.38
82	49	44.10	15910.	265.7	146.59	-4521.38	-9.53	1.35	0.19	-88.48	-9.59	172.50	266.6	205.2	1.38
83	49	44.80	15846.	273.7	142.48	-6086.72	-12.37	1.88	0.11	-109.97	-13.17	167.96	273.9	211.1	1.50
* 84	49	45.60	15762.	273.3	135.92	-9975.08	-19.80	1.66	0.16	-105.57	-21.01	161.05	279.3	215.7	1.42
* 85	49	46.10	15653.	273.3	132.91	-10906.62	-21.49	1.65	-0.03	-108.60	-23.02	157.83	280.4	216.9	1.42
* 86	49	47.10	15448.	274.6	131.57	-11632.71	-22.68	0.84	-0.40	-12.47	-22.72	156.32	283.2	219.8	1.21

* SMOOTHED VALUES ARE APPROXIMATE NEAR END POINTS

Results (to 1993)

- ATL89MA072 HS-748-2A 2 fatal
- DRG NGT CARGO OPN, CHECK CAPT (RGT SEAT) WAS EVALUATING THE 1ST OFFICER (F/O, LEFT SEAT) FOR PSBL UPGRADE TO CAPT. BFR DEPG, FLT WAS CLRD FOR RGT TURN AFTER TKOF TO 020 DEG. TKOF BGN AT 0441:11. WTR/METHANOL INJECTION WAS USED (TO 1ST PWR RDCN). AT 0441:49, LNDG GEAR WAS RETRACTED; 8 SEC LTR 1ST PWR RDCN WAS MADE, THEN A FREQ CHG WAS APPROVED. CAPT NOTED THEY SHLD CLB TO 1500' MSL (APRX 500' AGL) BFR TURNING. AT ABT 300' AGL, ACFT ENTERED OVC & BGN A STEEP RGT TURN. CVR INDCD CAPT WAS PERFORMING COCKPIT DUTIES AT THIS TIME & GIVING INFO TO F/O ABT THE DEP. FDR SHOWED ACFT RCHD MAX ALT OF 423' AGL & BGN DSCNDG. AT 0442:22, CAPT REMARKED TO F/O, "DON'T GO DOWN . . . GET UP . . . UP UP UP . . . UP, OH!" AT ABT THAT TIME, ACFT HIT IN AN OPEN FLD, BUT CONTD FLYING FOR APRX 3/4 MI. IT THEN HIT A TREE & CRASHED IN A WOODED AREA. INV REVEALED THAT DRG SVRL TRNG FLTS & 2 CHECK FLTS, THE F/O DEMONSTRATED DIFFICULTY IN PERFORMING INSTRUMENT FLT DUE TO DISORIENTATION, NARROW FOCUS OF ATTENTION, OR LACK OF INSTRUMENT SCAN (INST FIXATION), ESPECIALLY DRG HI TASK WORK LOAD.
  Probable Cause
  IMPROPER IFR PROCEDURE BY THE FIRST OFFICER (COPILOT) DURING TAKEOFF, HIS LACK OF INSTRUMENT SCAN (IMPROPER USE OF FLIGHT/NAVIGATION INSTRUMENTS), HIS FAILURE TO MAINTAIN A POSITIVE RATE OF CLIMB OR TO IDENTIFY THE RESULTANT DESCENT, AND THE CAPTAIN'S INADEQUATE SUPERVISION OF THE FLIGHT. CONTRIBUTING FACTORS WERE: DARK NIGHT, LOW CEILING, DRIZZLE, THE FIRST OFFICER'S LACK OF TOTAL EXPERIENCE IN THE TYPE OF OPERATION, AND POSSIBLE

  SPATIAL DISORIENTATION OF THE FIRST OFFICER.

Results (to 1993)

- Part 135

- CHI84FA058 C207 4 fatal
- THE PLT & 3 PASSENGERS TOOK OFF AT NIGHT ON AN OVER WATER FLT TO AN ISLAND IN LAKE ERIE TO PROVIDE HELP TO A HEART PATIENT. NO FLT PLAN WAS FILED & NO RECORD OF A WX BRIEFING WAS FOUND. REPORTEDLY, AFTER TAKEOFF, THE ACFT DISAPPEARED IN A CLOUD OR HAZE. ALSO AFTER DEPARTING, SHERIFF'S PERSONNEL RECEIVED A RADIO CALL FROM THE ACFT STATING "WE ARE IN IT." ACCORDING TO LOCAL RESIDENTS, THERE WAS PATCHY FOG IN THE AREA. WHEN THE ACFT DID NOT ARRIVE AT ITS DESTINATION, A SEARCH WAS INITIATED. THE PLANE WAS FOUND IN LAKE ERIE ALONG THE EXPECTED ROUTE OF FLT. THE ACFT WAS INTACT, EXCEPT THE ENG WAS LOOSE FROM THE FIREWALL & THERE WAS MAJOR DAMAGE TO THE RIGHT, OUTER WING PANEL. NO PREIMPACT/MECHANICAL MALFUNCTION/FAILURE WAS FOUND. ABOUT 45 MI WEST AT TOLEDO, OH, THE 2150 WX IN PART WAS: 1500 FT OVERCAST, VISIBILITY VARIABLE 1 TO 2 MI WITH FOG, TEMP 32, DEW POINT 31, WIND FROM 330 DEG AT 4 KTS.
- Probable Cause

  Preflight planning/preparation..Inadequate..Pilot in command
  VFR flight into IMC..Continued..Pilot in command
  Proper altitude..Not maintained..Pilot in command
  Clearance..Misjudged..Pilot in command

- Contributing Factors

  Light condition..Dark night
  Weather condition..Fog
  Self-induced pressure..Pilot in command

  Spatial disorientation..Pilot in command

Results (to 1993)

Part 137

- LAX88DUJ05 G164B
- DEN92LA062 AT-301

Results (to 1993)

Part 137

- LAX88DUJ05 G164B 1 minor
- DURING AN AERIAL APPLICATION FLIGHT, THE PILOT DISPENSED THE LOAD AND WAS RETURNING TO THE AIRSTRIP DUE TO AN APPROACHING THUNDERSTORM. ENROUTE, THE VISIBILITY WAS REDUCED TO NEAR ZERO FROM BLOWING DUST. THE PILOT LOST CONTROL OF THE AIRPLANE AND COLLIDED WITH THE TERRAIN. THERE WERE NO REPORTED MECHANICAL FAILURES OR MALFUNCTIONS AT THE TIME OF THE ACCIDENT.
- Probable Cause

  In-flight planning/decision..Poor..Pilot in command
  Flight into known adverse weather..Intentional..Pilot in command
- Contributing Factors

  Weather condition..Sand/dust storm
  Spatial disorientation..Pilot in command

Results (to 1993)

Part 137

- DEN92LA062 AT-301 1 fatal
- WHILE FLYING BETWEEN FIELDS ON AN AERIAL APPLICATION FLIGHT, THE AIRCRAFT IMPACTED THE GROUND IN A SHALLOW DIVE WITH POWER ON THE ENGINE. WEATHER AT THE TIME WAS 800 FEET OVERCAST SKIES AND GROUND FOG.
  Probable Cause
  THE PILOTS FAILURE TO MAINTAIN ALTITUDE DUE TO SPATIAL DISORIENTATION. FACTORS WERE: LOW OVERCAST SKIES AND GROUND FOG.

Results (to 1993)

Part 91

- 1999 Nall Report http://www.aopa.org/asf/publications/99nall.html
- In 1998, six accidents contained specific references to spatial disorientation in the sequence of events or narrative sections of their reports. This number is, however, what statisticians call a "lower bound" on the true number of accidents in which spatial disorientation was a significant factor. The conditions surrounding a number of other weather-related accidents suggest that spatial disorientation might have been contributory there as well.

Results (to 1993)

Part 91

- 1999 Nall Report http://www.aopa.org/asf/publications/99nall.html
- **A detailed analysis of accidents over a ten-year period (1987-1996) with an emphasis on spatial disorientation as a cause or significant contributory factor reveals a much higher involvement of this factor than suggested by the direct references in the 1998 reports. During this period, there was an average of almost 37.6 accidents per year, of which 33.9 were fatal. At this rate, there is one fatal spatial disorientation accident every eleven days.** Over 90 percent of all the accidents during this time in which spatial disorientation was a factor resulted in fatalities.

Results (to 1993)

Part 91

- 1999 Nall Report http://www.aopa.org/asf/publications/99nall.html
- **Typically, these accidents are suffered by noninstrument-rated pilots attempting to complete VFR flights in instrument meteorological conditions.** At least one accident in 1998, however, occurred when an experienced instrument-rated pilot in a well-equipped turbine-powered airplane became disoriented during the visual portion of a circling IFR approach. In this case, a moonless night exacerbated the weather conditions.

Conditions	Total	Fatal	Percent Fatal
All	1,679	341	20.3%
Day VMC	1,216	139	11.4%
Night VMC	75	18	24.0%
Day IMC	58	37	63.8%
Night IMC	19	13	68.4%

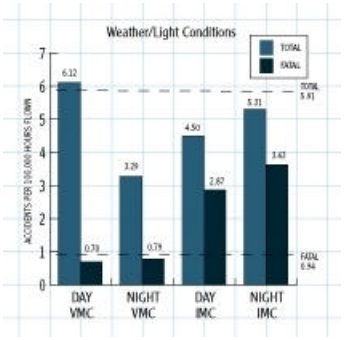
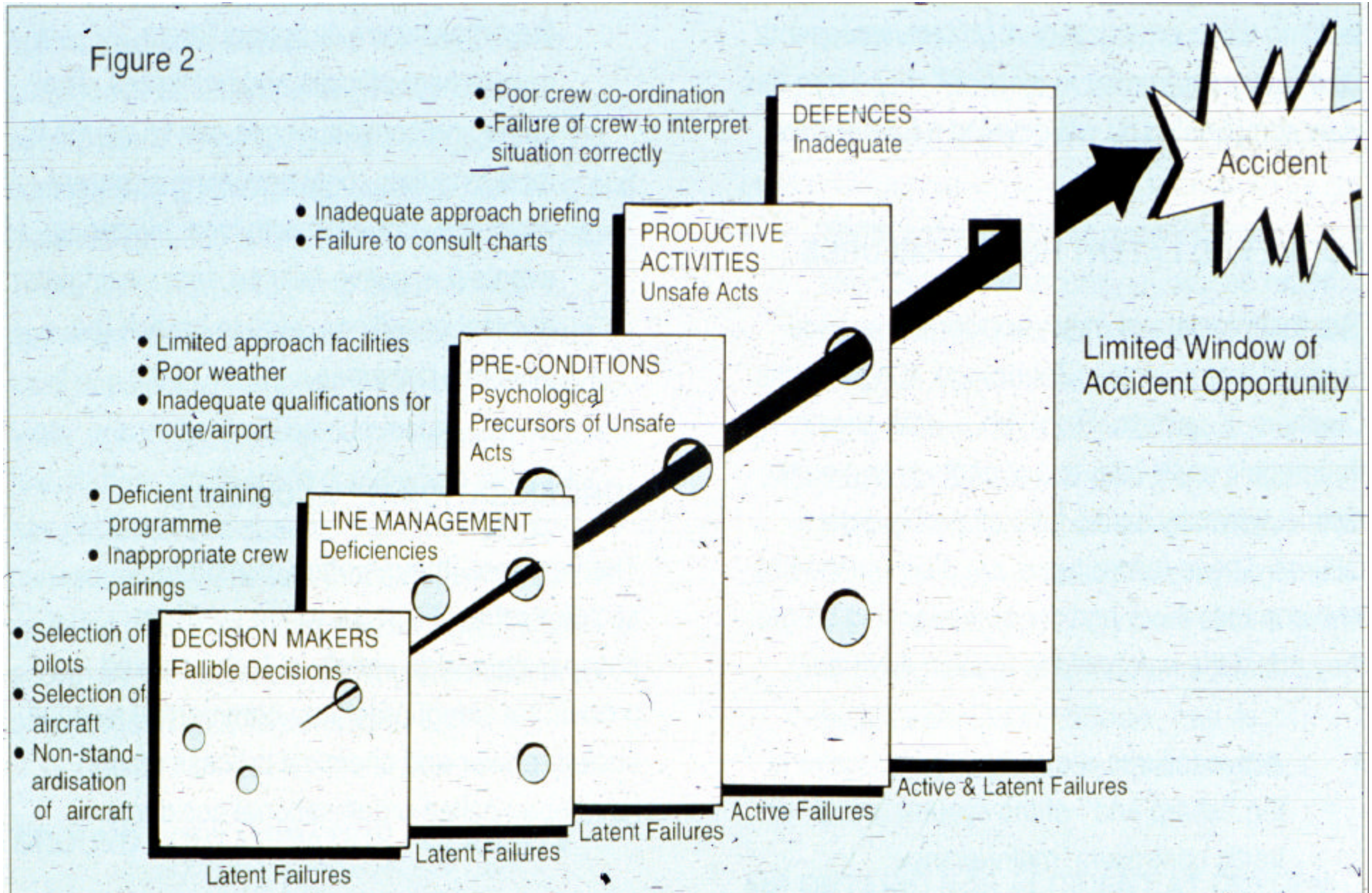
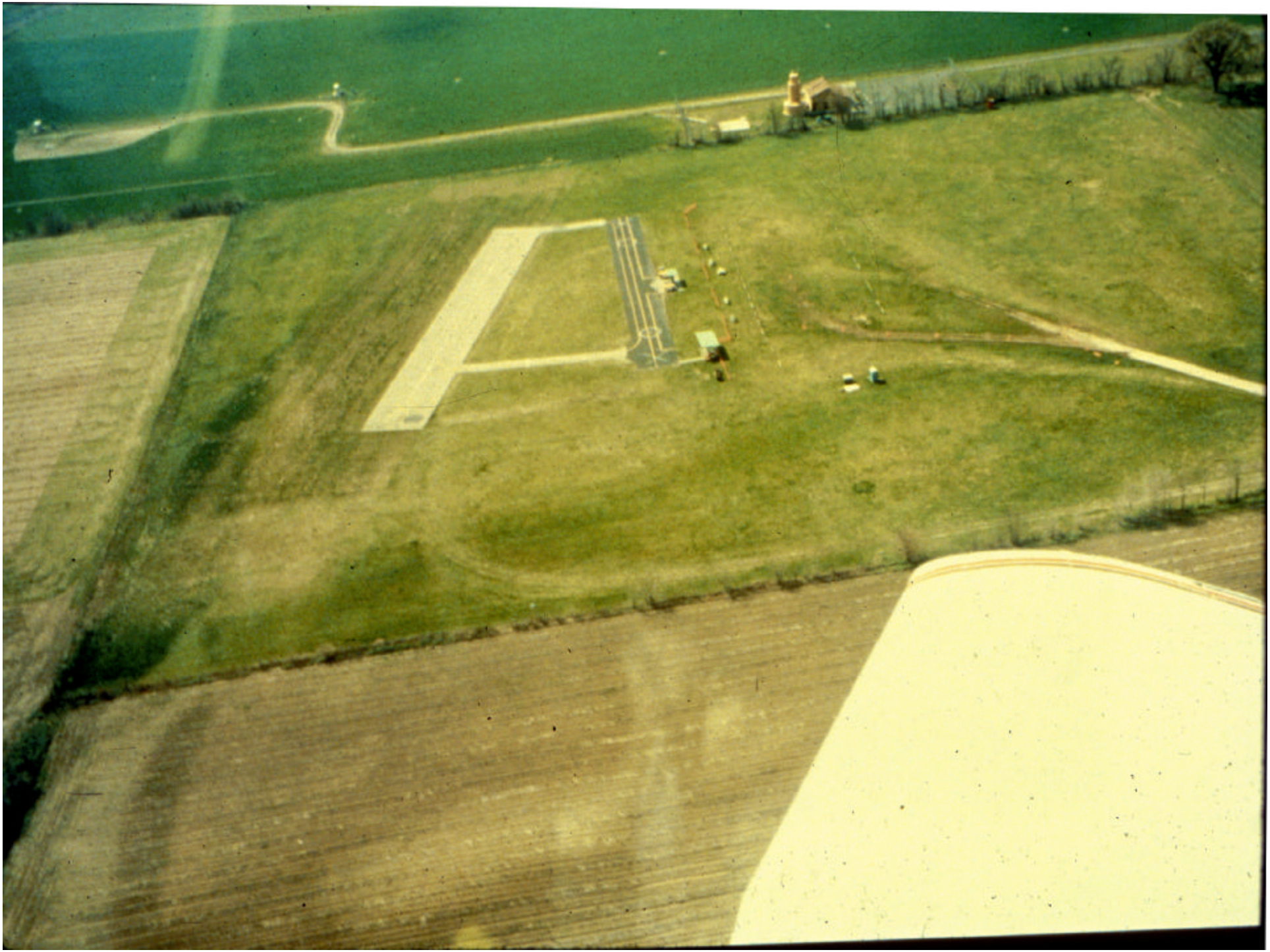


Figure 2

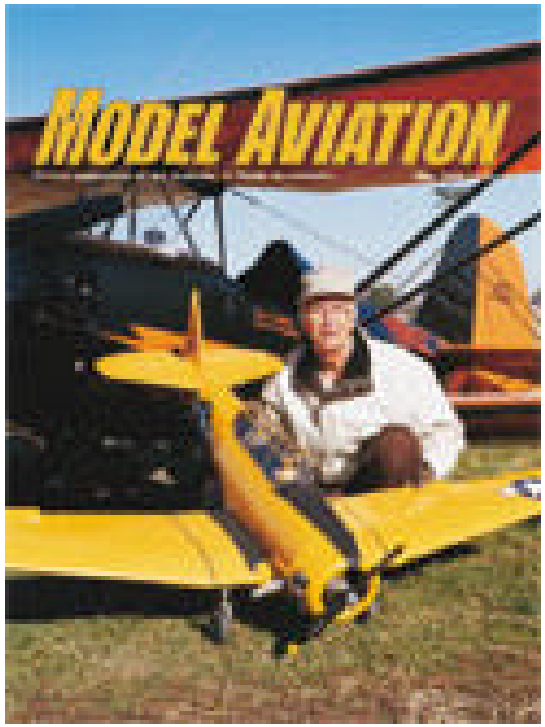


Modified Version of James Reason's Model of Accident Causation. Source: Human Error, James Reason, Cambridge University Press, 1990, page 302. Printed with permission.



Human Factors

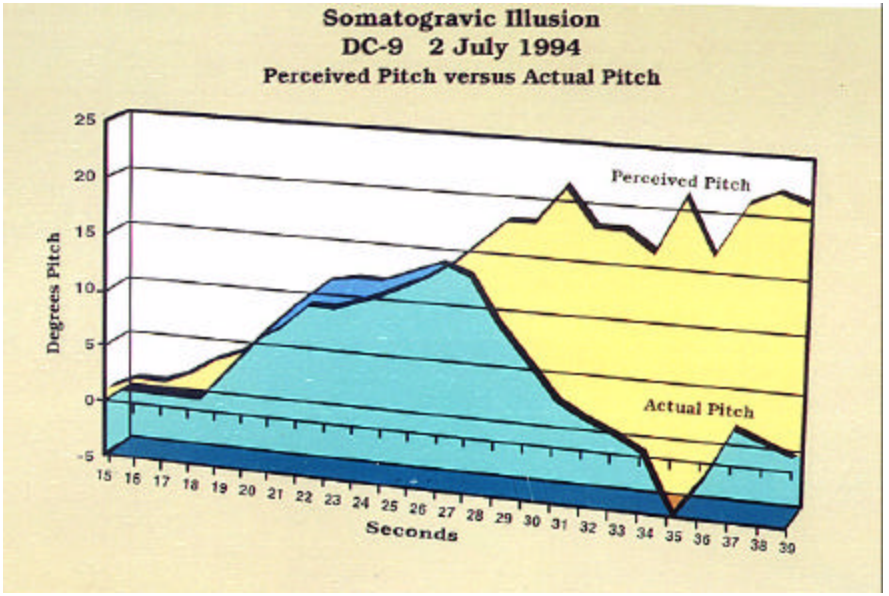
- Radio controlled aircraft runway
- Visual illusions

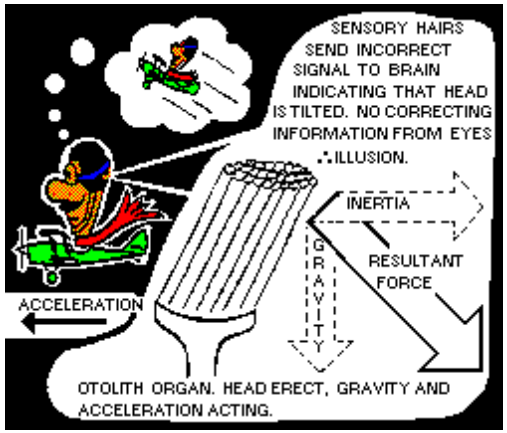


Spatial Orientation

Spatial Disorientation

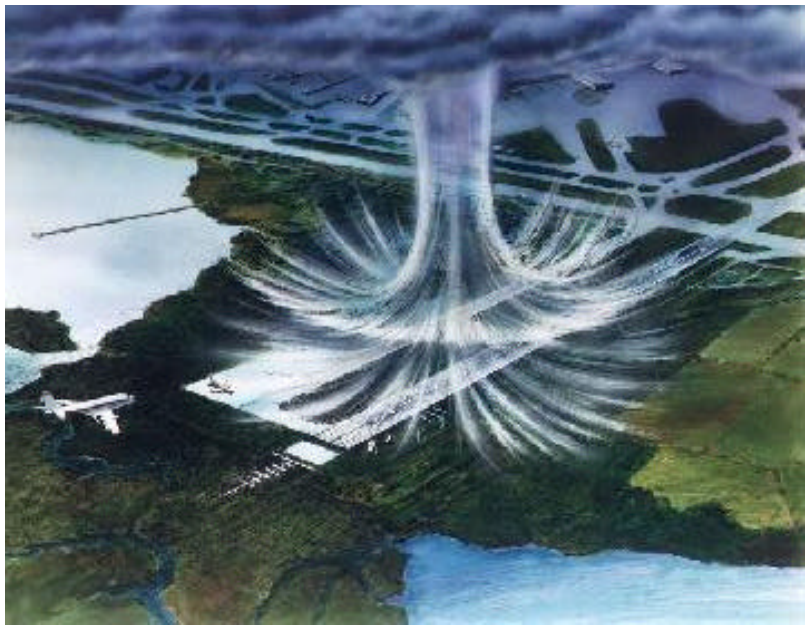
- DC-9 missed approach
- Windshear
- ATC info provided



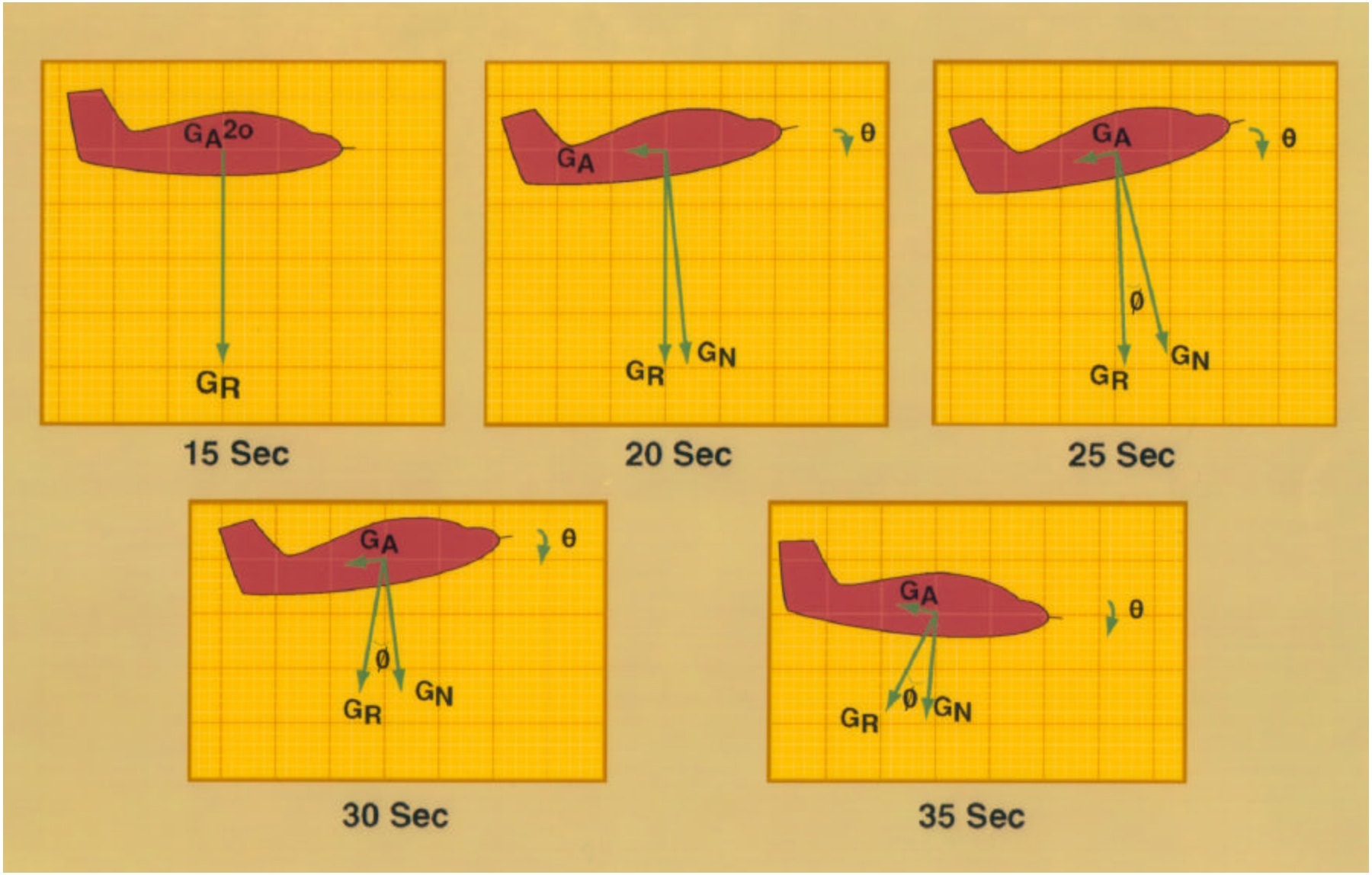


Spatial Disorientation

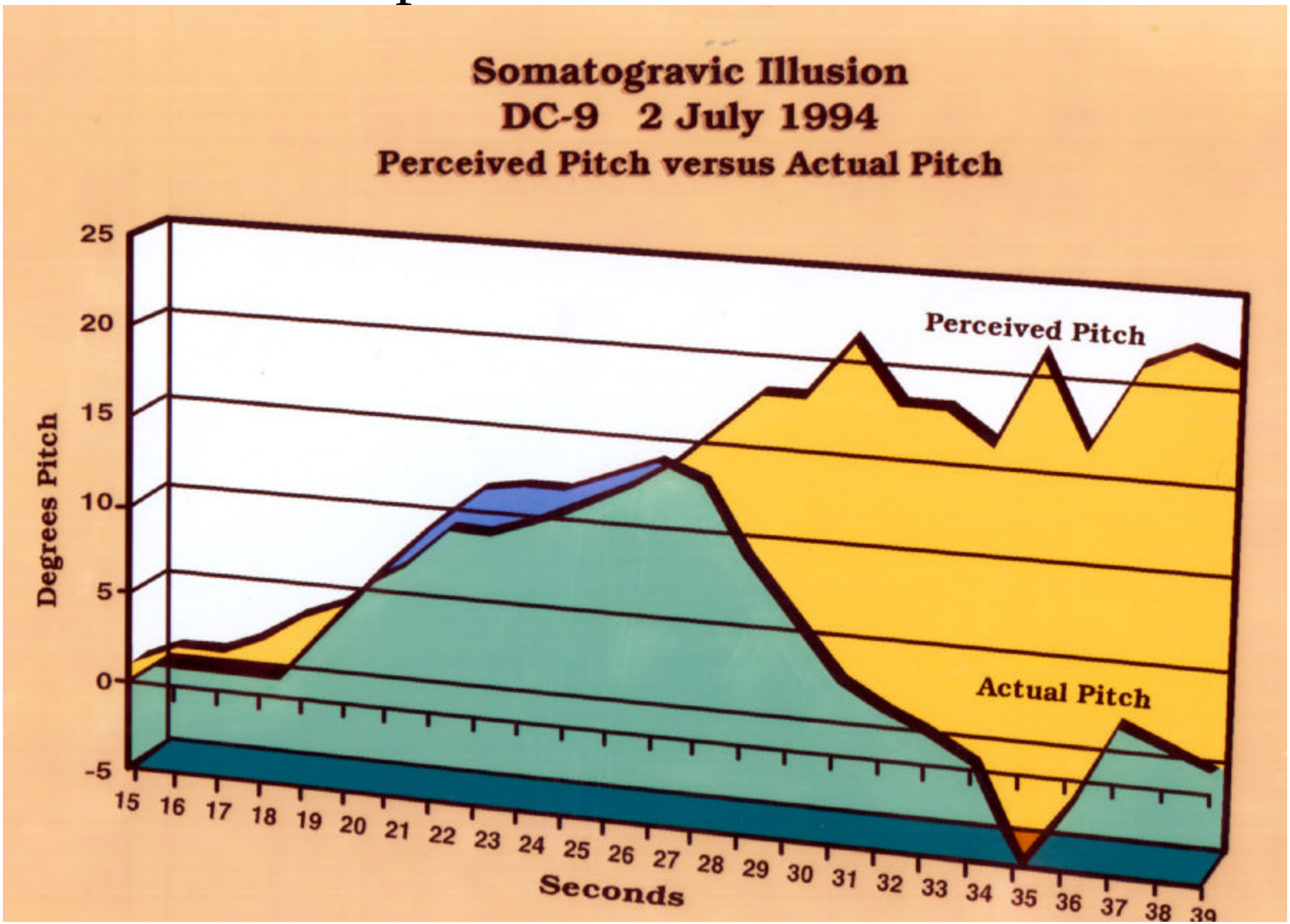
- DC-9 missed approach
- Windshear
- ATC info provided



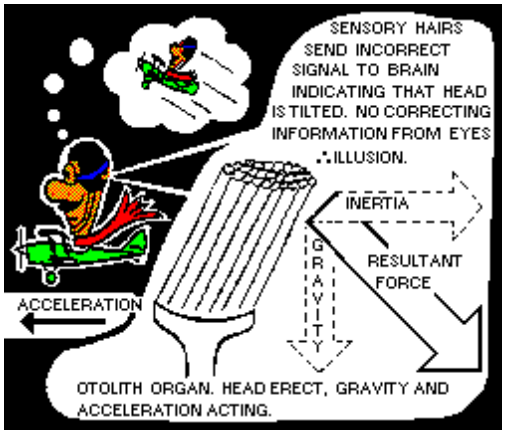
Spatial Disorientation

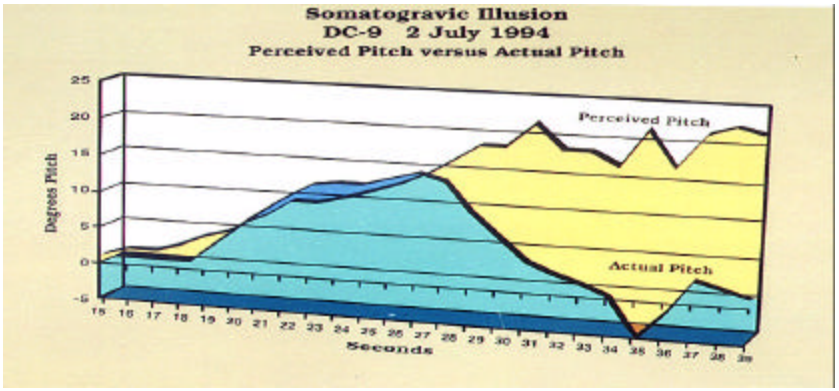


Spatial Disorientation

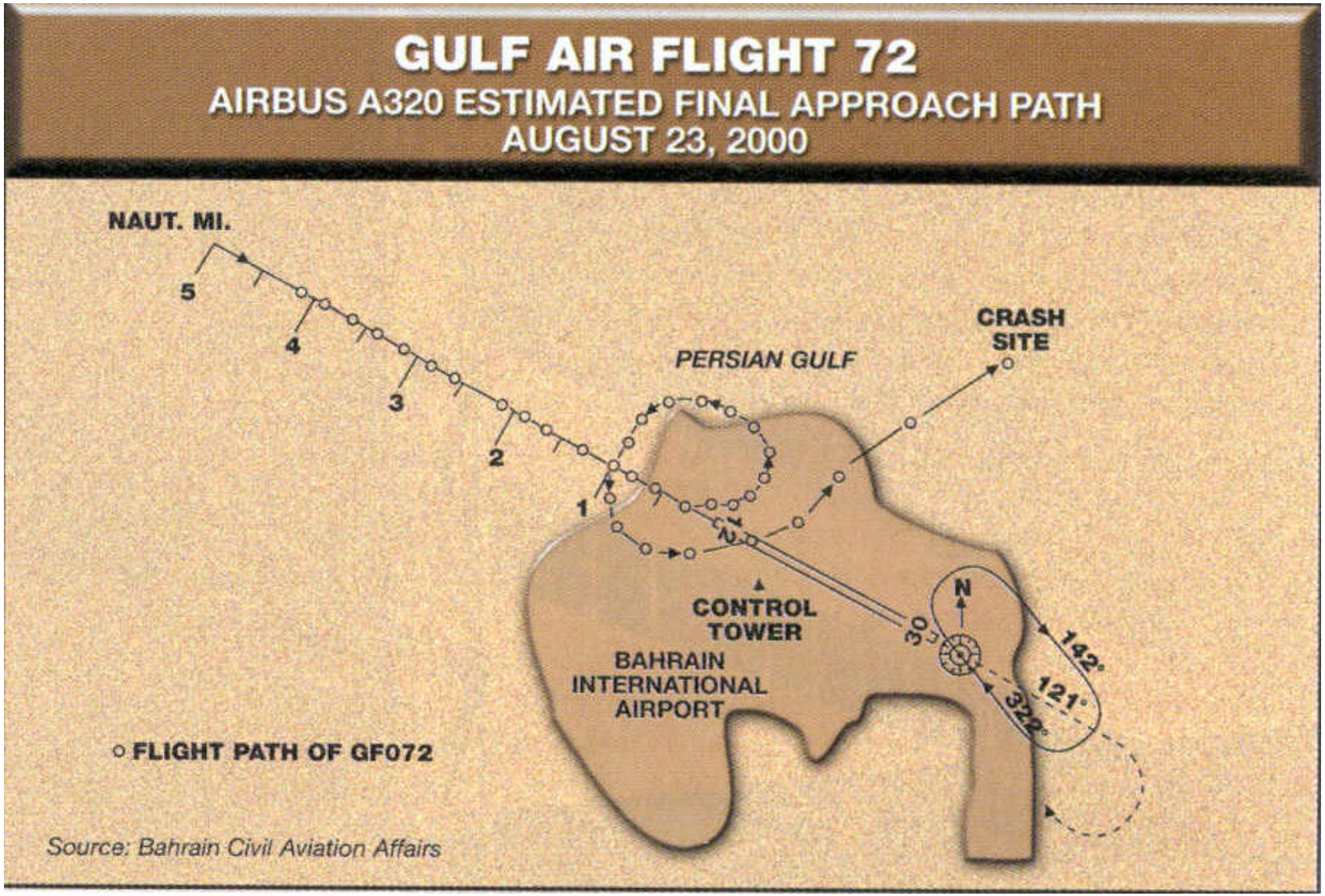


Spatial Disorientation





Most recent case



Spatial Disorientation

- Lake Victoria
- Black hole approach
- Narrow runway
- ATC warned

Emergency

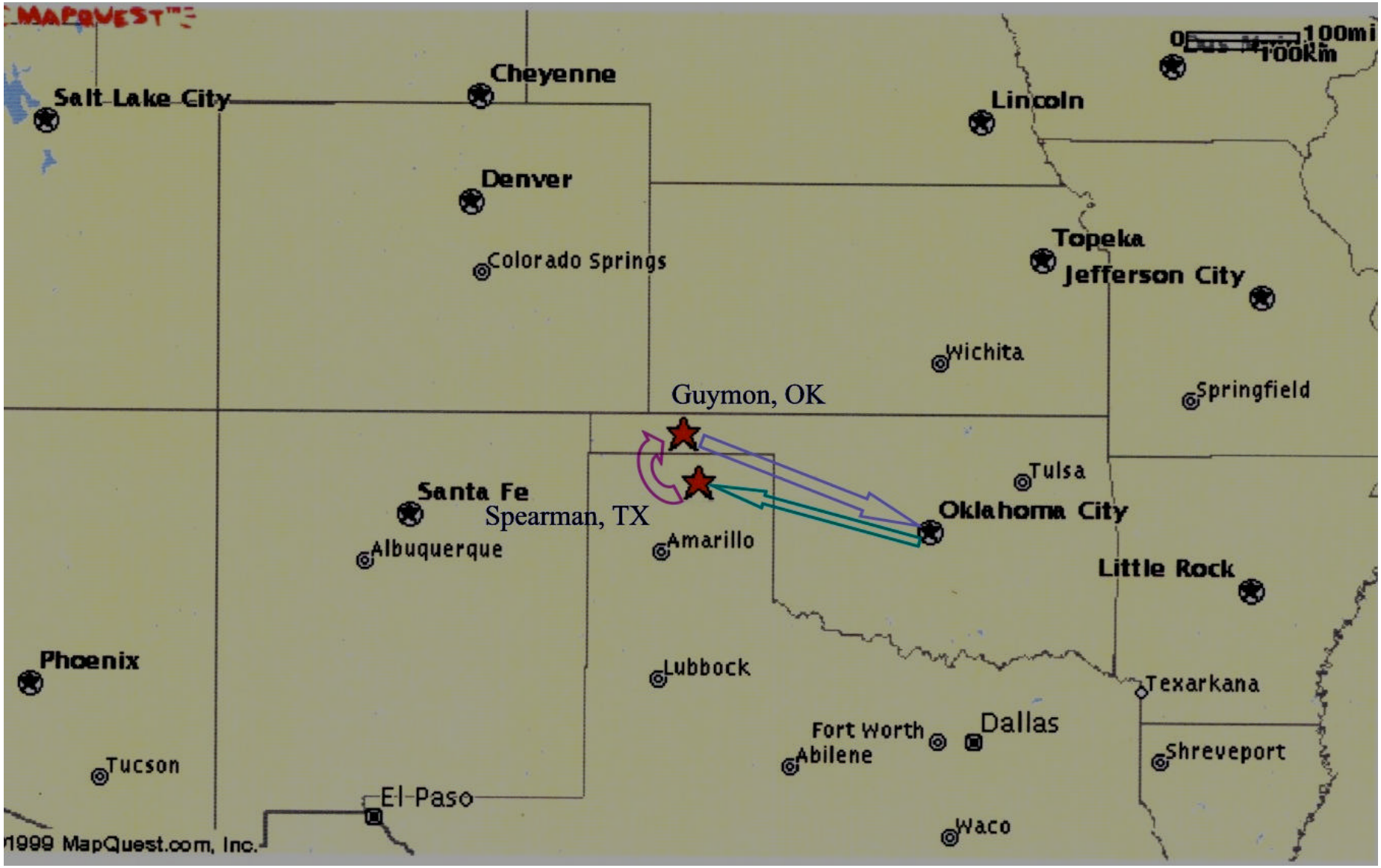
- Smoke in the cockpit


11:49:50
LT RT
2.0
1.8
1.6
1.4
1.2
1.0
EPRS
154
CAS KTS
664
ALTITUDE FT MSL
Radio Altitude 355
Pitch -3
041
LT RT
UNL
DEP
Thrust Reversers
LO
60
30
0
SPLR
Derived
RI
60
30
0
SPLR
LT RT
-30 -20 -10 0 10 20 30
Rudder Position

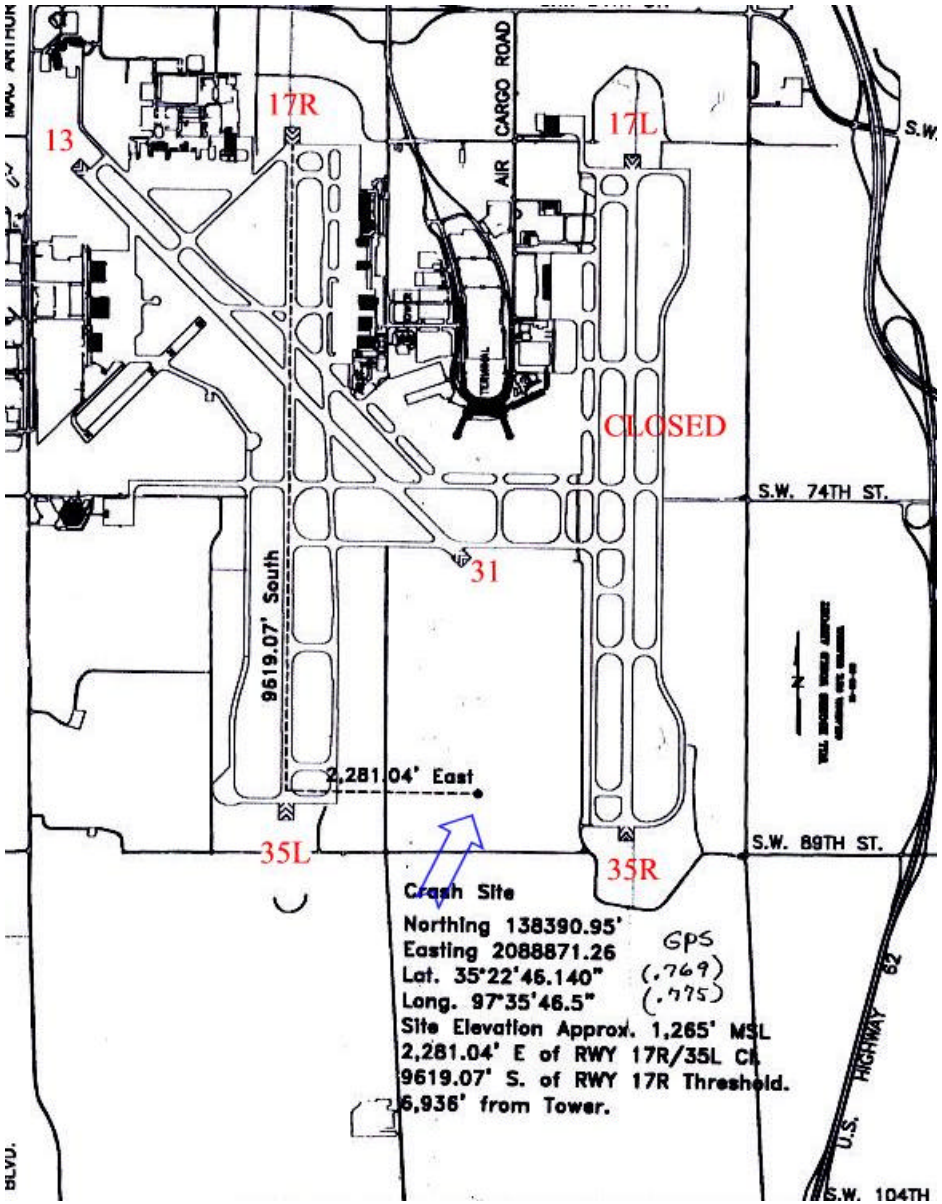
C210 N94 Will Rogers Airport

25 October 2000

C210 N94 Will Rogers Airport



C210 N94 Will Rogers Airport



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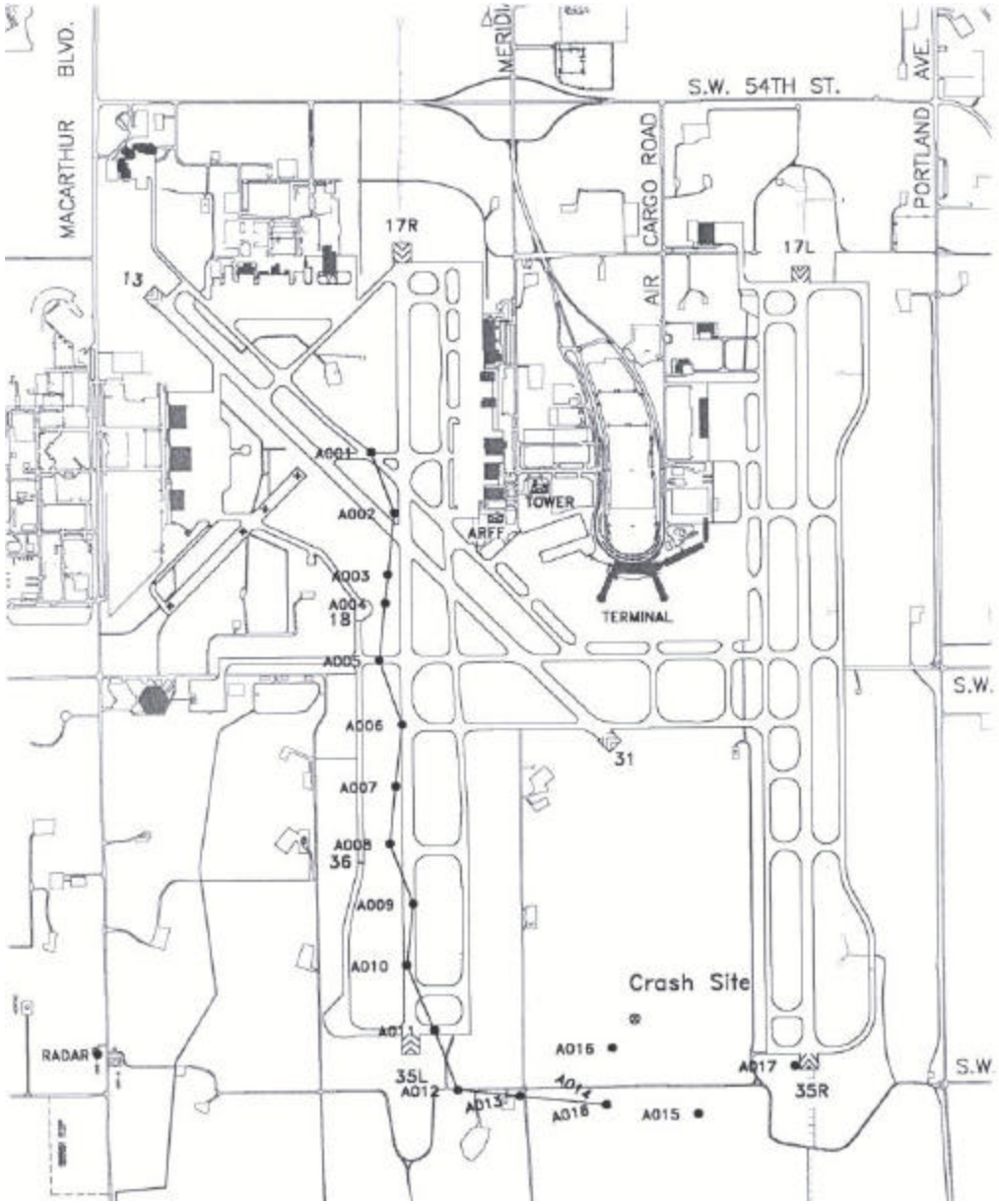
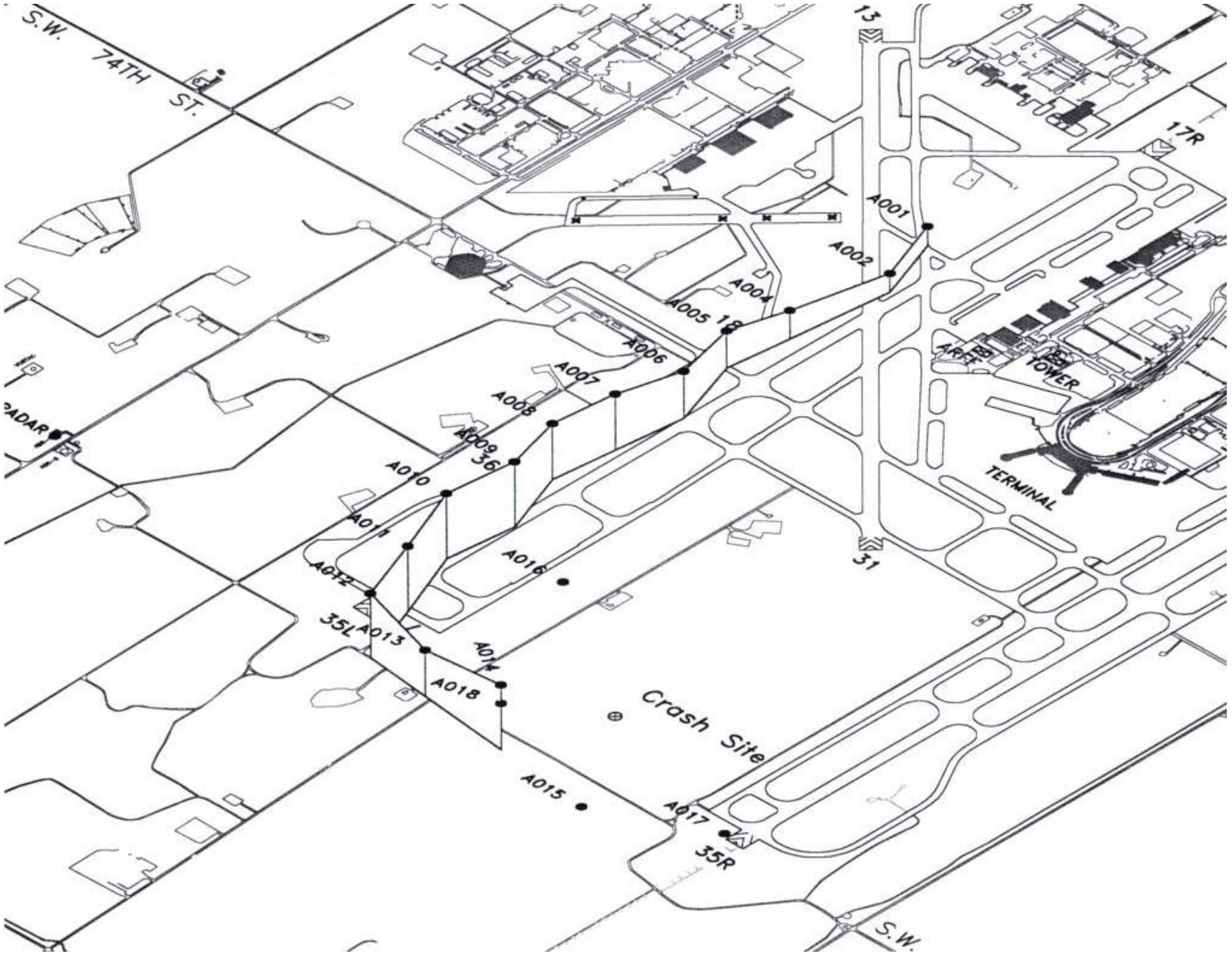


C210 N94 Will Rogers Airport



C210 N94 Will Rogers Airport

INDEX	LATITUDE	LONGITUDE
"A1"	35.235765089	97.362563249
"A2"	35.235009041	97.362221383
"A4"	35.233874098	97.362373156
"A5"	35.233157287	97.362469008
"A6"	35.232341505	97.362135174
"A7"	35.231564960	97.362239014
"A8"	35.230848156	97.362334862
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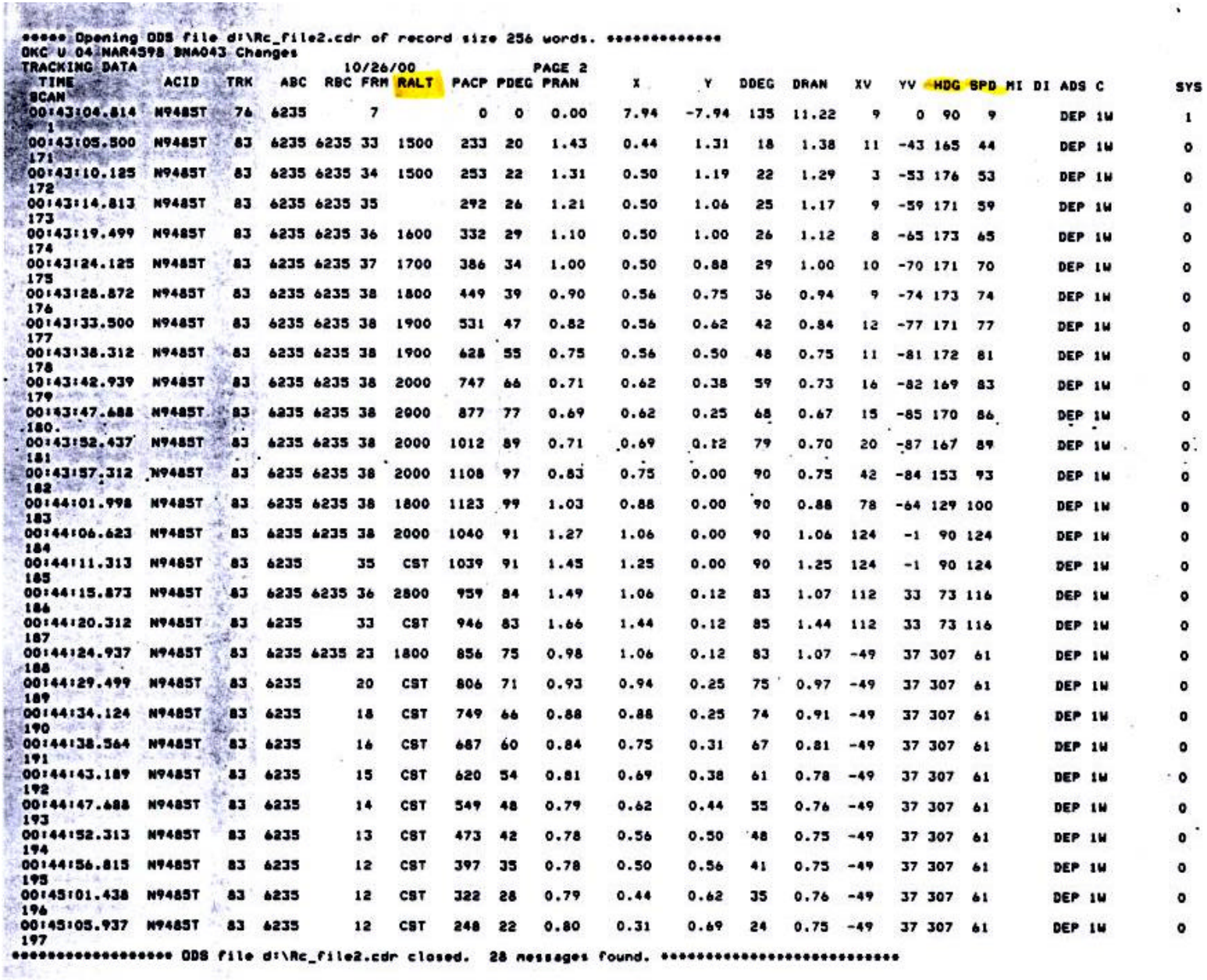
"A11"	35.224493228	97.361690170
"A12"	35.223737174	97.361348414
"A13"	35.223652111	97.360400285
"A14"	35.223534298	97.355087490
"A16"	35.224251095	97.354991575
"A18"	35.223534298	97.355087490

C210 N94 Will Rogers Airport

C210 N94 Will Rogers Airport



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***** Opening ODS file d:\Rc_file2.cdr of record size 256 words. **************
OKC U 04 MAR4598 BNA043 Changes
TRACKING DATA                    10/26/00                              PAGE 2
  TIME          ACID   TRK   ABC   RBC FRM RALT  PACP PDEG PRAN     X      Y   DDEG  DRAN   XV   YV  HDG SPD MI DI ADS C        SYS
 SCAN
00:43:04.814   N9485T   76  6235         7          0    0  0.00   7.94  -7.94  135  11.22    9    0   90   9        DEP 1W      1
  1
00:43:05.500   N9485T   83  6235  6235  33  1500   233   20  1.43   0.44   1.31   18   1.38   11  -43  165  44       DEP 1W      0
171
00:43:10.125   N9485T   83  6235  6235  34  1500   253   22  1.31   0.50   1.19   22   1.29    3  -53  176  53       DEP 1W      0
172
00:43:14.813   N9485T   83  6235  6235  35         292   26  1.21   0.50   1.06   25   1.17    9  -59  171  59       DEP 1W      0
173
00:43:19.499   N9485T   83  6235  6235  36  1600   332   29  1.10   0.50   1.00   26   1.12    8  -65  173  65       DEP 1W      0
174
00:43:24.125   N9485T   83  6235  6235  37  1700   386   34  1.00   0.50   0.88   29   1.00   10  -70  171  70       DEP 1W      0
175
00:43:28.872   N9485T   83  6235  6235  38  1800   449   39  0.90   0.56   0.75   36   0.94    9  -74  173  74       DEP 1W      0
176
00:43:33.500   N9485T   83  6235  6235  38  1900   531   47  0.82   0.56   0.62   42   0.84   12  -77  171  77       DEP 1W      0
177
00:43:38.312   N9485T   83  6235  6235  38  1900   628   55  0.75   0.56   0.50   48   0.75   11  -81  172  81       DEP 1W      0
178
00:43:42.939   N9485T   83  6235  6235  38  2000   747   66  0.71   0.62   0.38   59   0.73   16  -82  169  83       DEP 1W      0
179
00:43:47.688   N9485T   83  6235  6235  38  2000   877   77  0.69   0.62   0.25   68   0.67   15  -85  170  86       DEP 1W      0
180.
00:43:52.437   N9485T   83  6235  6235  38  2000  1012   89  0.71   0.69   0.12   79   0.70   20  -87  167  89       DEP 1W      0
181
00:43:57.312   N9485T   83  6235  6235  38  2000  1108   97  0.83   0.75   0.00   90   0.75   42  -84  153  93       DEP 1W      0
182
00:44:01.998   N9485T   83  6235  6235  38  1800  1123   99  1.03   0.88   0.00   90   0.88   78  -64  129 100       DEP 1W      0
183
00:44:06.623   N9485T   83  6235  6235  38  2000  1040   91  1.27   1.06   0.00   90   1.06  124   -1   90 124       DEP 1W      0
184
00:44:11.313   N9485T   83  6235         35   CST  1039   91  1.45   1.25   0.00   90   1.25  124   -1   90 124       DEP 1W      0
185
00:44:15.873   N9485T   83  6235  6235  36  2800   959   84  1.49   1.06   0.12   83   1.07  112   33   73 116       DEP 1W      0
186
00:44:20.312   N9485T   83  6235         33   CST   946   83  1.66   1.44   0.12   85   1.44  112   33   73 116       DEP 1W      0
187
00:44:24.937   N9485T   83  6235  6235  23  1800   856   75  0.98   1.06   0.12   83   1.07  -49   37  307  61       DEP 1W      0
188
00:44:29.499   N9485T   83  6235         20   CST   806   71  0.93   0.94   0.25   75   0.97  -49   37  307  61       DEP 1W      0
189
00:44:34.124   N9485T   83  6235         18   CST   749   66  0.88   0.88   0.25   74   0.91  -49   37  307  61       DEP 1W      0
190
00:44:38.564   N9485T   83  6235         16   CST   687   60  0.84   0.75   0.31   67   0.81  -49   37  307  61       DEP 1W      0
191
00:44:43.189   N9485T   83  6235         15   CST   620   54  0.81   0.69   0.38   61   0.78  -49   37  307  61       DEP 1W      0
192
00:44:47.688   N9485T   83  6235         14   CST   549   48  0.79   0.62   0.44   55   0.76  -49   37  307  61       DEP 1W      0
193
00:44:52.313   N9485T   83  6235         13   CST   473   42  0.78   0.56   0.50   48   0.75  -49   37  307  61       DEP 1W      0
194
00:44:56.815   N9485T   83  6235         12   CST   397   35  0.78   0.50   0.56   41   0.75  -49   37  307  61       DEP 1W      0
195
00:45:01.438   N9485T   83  6235         12   CST   322   28  0.79   0.44   0.62   35   0.76  -49   37  307  61       DEP 1W      0
196
00:45:05.937   N9485T   83  6235         12   CST   248   22  0.80   0.31   0.69   24   0.75  -49   37  307  61       DEP 1W      0
197
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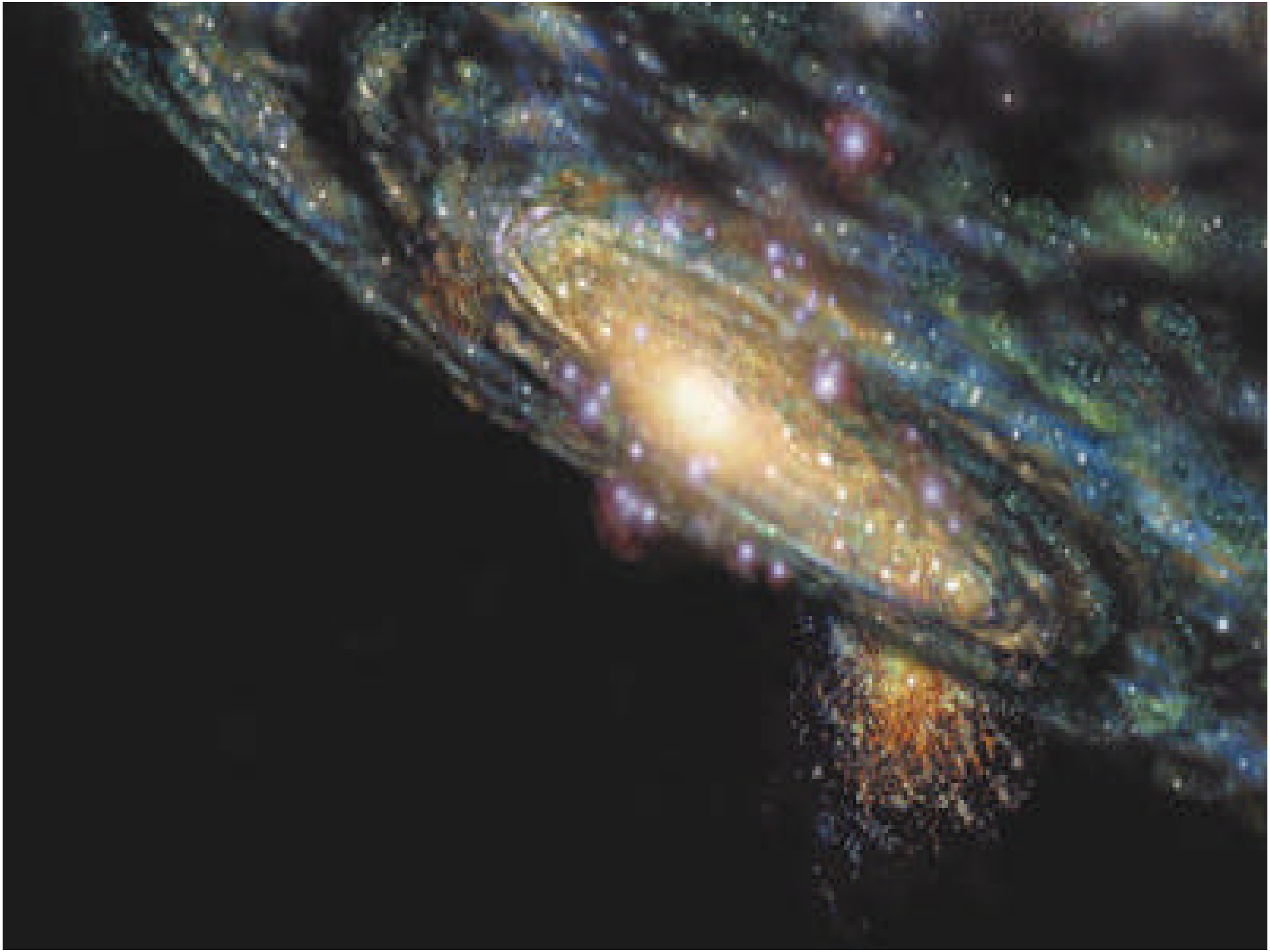
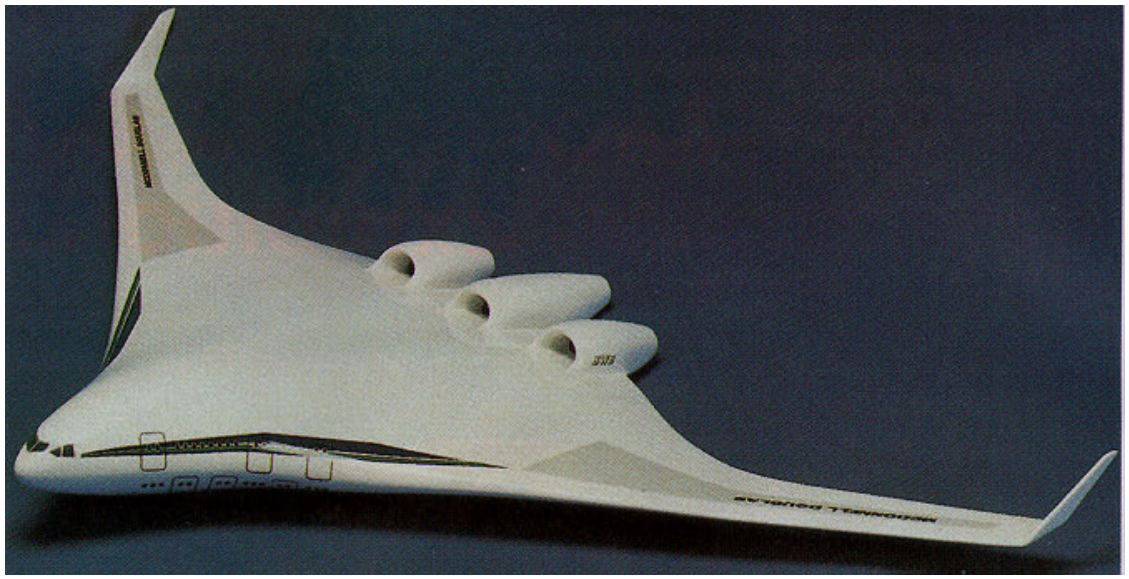
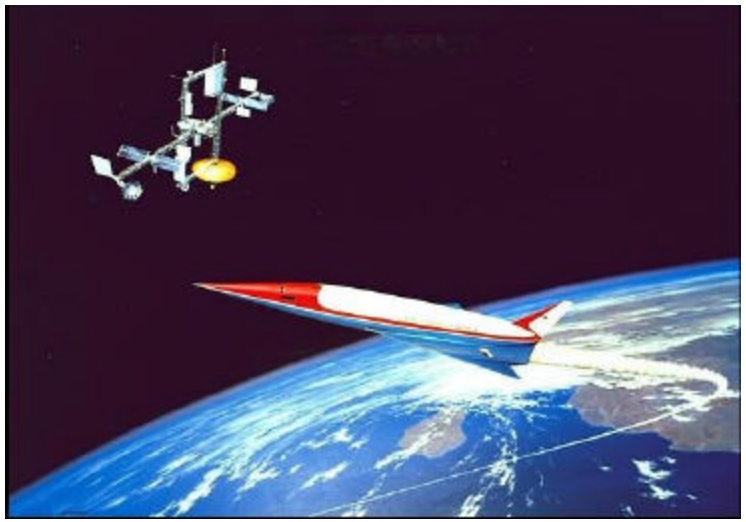
CFIT Prevention



What's Next?





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