SA-None File No. 1-0010

AIRCRAFT ACCIDENT REPORT

FLYING TIGER LINE, INC.

Douglas DC-8-63F N785FT

NAHA AIR BASE

Okinawa, Ryukyu Islands

July 27, 1970

Adopted: DECEMBER 29, 1971

NATIONAL TRANSPORTATION SAFETY BOARD
Washington, D. C. 20591

REPORT NUMBER: NTSB-AAR-72-10

TECHNICAL REPORT STANDARD TITLE PAGE

1. Report No. NTSB-AAR-72-10	2. Government Accession No.	3. Recipient's Catalog No.
4. Title and Subtitle Aircraft Accident Report Flying Tiger Line, Inc., DC-8-63F, Naha Air Base, Okinawa, Ryukyu Islands, July 27, 1970		5. Report Date December 29, 1971
		6. Performing Organization Code
7. Author(s)		8. Performing Organization Report No.
9. Performing Organization Name and Address Bureau of Aviation Safety National Transportation Safety Board Washington, D. C. 20591		10. Work Unit No.
		11. Contract or Grant No.
12. Sponsoring Agency Name and Address NATIONAL TRANSPORTATION SAFETY BOARD Washington, D. C. 20591		13. Type of Report and Period Covered Aircraft Accident Report July 27, 1970
		14. Sponsoring Agency Code
15. Supplementary Notes		

16. Abstract

While in the process of executing a precision radar GCA, Flying Tiger Lines, Inc., Flight 45, a DC-8-63F cargo aircraft, crashed about 2,200 feet short of the threshold of Runway 18 at Naha Air Base at 1136 local time, July 27, 1970. The four crewmembers and only occupants died as a result of the accident. The weather conditions at Naha were good with scattered rain showers, one of which was located in the vicinity of the GCA minimum altitude position. Bright areas of sunlight existed where cloud cover was absent. The National Transportation Safety Board determines that the probable cause of this accident was an unarrested rate of descent due to inattention of the crew to instrument altitude references while the pilot was attempting to establish outside visual contact in meteorological conditions which precluded such contact during that segment of a precision radar approach inbound from the Decision Height.

17. Key Words Descriptors: Aviation Accidents; Accident Investigations; precision radar GCA; Instrument approach; Unusual meteorological phenomenon; altitude awareness. Identifiers: Douglas DC-8-63F	18. Distribution Statement Released to Public. Unlimited Distribution.

19. Security Classification (of this report) UNCLASSIFIED	20. Security Classification (of this page) UNCLASSIFIED	21. No. of Pages 47	22. Price

NTSB Form 1765.2 (11/70)

FLYING TIGER LINE, INC.
DOUGLAS DC-8-63F, N785FT
NAHA AIR BASE
OKINAWA, RYUKYU ISLANDS
JULY 27, 1970

TABLE OF CONTENTS

File No. 1-0010

NATIONAL TRANSPORTATION SAFETY BOARD
Washington, D.C. 20591
AIRCRAFT ACCIDENT REPORT

Adopted: December 29, 1971

FLYING TIGER LINE, INC.
DOUGLAS DC-8-63F, N785FT
NAHA AIR BASE
OKINAWA, RYUKYU ISLANDS
JULY 27, 1970

SYNOPSIS

Flying Tiger Line, Inc., Flight 45, a Douglas DC-8-63F, N785FT, on a cargo operation, crashed into the water off the approach end of Runway 18 at Naha Air Base, Okinawa, Ryukyu Islands, at approximately 1136 local time, July 27, 1970. The four crewmembers, the only occupants of the aircraft, died as a result of the accident. The aircraft was destroyed.

The flight was making a precision radar approach to Runway 18 at Naha when, at a point approximately 1 mile short of the touchdown point, the aircraft's rate of descent increased and the flight descended below the glidepath. While the radar controller was warning the crew that they were too low, the aircraft struck the water approximately 2,200 feet short of the threshold lights for Runway 18.

The weather at the Naha Air Base, 8 minutes prior to the accident, was reported to be: ceiling 1,500 feet, visibility 7 miles in light rain showers, winds variable at 5 knots, towering cumulus overhead and in all quadrants, altimeter setting 29.84 inches, visibility to the north 1 mile. Scattered stratus clouds were reported at 1,000 feet and broken cumulus clouds at 1,500 feet.

A weather observation taken about 4 minutes after the accident was: ceiling 1,500 feet, visibility 10 miles in light rain showers, wind 360° at 8 knots, altimeter 29.83 inches, visibility to the north 1.5 miles. Scattered cumulonimbus and broken cumulus clouds were reported at 1,500 feet. Cumulonimbus were reported northwest-northeast of the station and stationary towering cumulus were existent in all quadrants.

Ground witnesses reported that just north of the approach end of Runway 18, there was a heavy rain shower from which the aircraft emerged at very low altitude just before it struck the water.

The National Transportation Safety Board determines that the probable cause of this accident was an unarrested rate of descent due to inattention of the crew to instrument altitude references while the pilot was attempting to establish outside visual contact in meteorological conditions which precluded such contact during that segment of a precision radar approach inbound from the Decision Height.

As a result of a number of instrument approach accidents that occurred in 1968 and early 1969, the National Transportation Safety Board made a number of recommendations regarding altitude awareness to the Administrator of the Federal Aviation Administration (FAA). The Safety Board believes that the Administrator should again reemphasize those altitude awareness recommendations to air carrier flight-supervisory and pilot personnel. Additionally, the Safety Board recommends that: (1) company flight operating procedures be amended to eliminate any uncertainties in

crew coordination and altitude callout procedures during instrument approaches, and (2) the FAA issue excerpts of information contained in this report to stress to flightcrews the need for continuous surveillance of flight instruments when they are operating in meteorological conditions similar to those discussed in this report.

1. INVESTIGATION

1.1 History of the Flight

Flying Tiger Line, Inc., Flight 45, a Douglas DC-8-63, N785FT, was a regularly scheduled international cargo flight from Los Angeles, California, to Da Nang Air Base, Republic of Viet Nam, with scheduled intermediate stops at San Francisco, California; Seattle, Washington; Cold Bay, Alaska; Tokyo, Japan; Naha Air Base, Okinawa; Hong Kong; and Cam-Ranh Bay, Republic of Viet Nam.

Flight 45 departed Los Angeles at 2053[1] on July 25, 1970, and, after en route stops at San Francisco, Seattle, and Cold Bay, arrived at Tokyo at 2244, July 26, 1970. No significant aircraft discrepancies were reported.

The flightcrew involved in the accident arrived in Tokyo on Flight 43 at 2032, July 26, 1970, after a flight of 6.2 hours from Cold Bay, Alaska. They checked into their hotel in Tokyo at 2124 on July 26 and were called at 0630 the next morning to prepare for departure on Flight 45. The crew was picked up at the hotel at 0730 and transported to Tokyo International Airport, where they arrived about 0810. The scheduled departure time for Flight 45 was 0740 but due to crew rest requirements, the departure time was rescheduled for 0900, July 27. The crew boarded the aircraft about 0830, and after additional delay awaiting a ground power unit, the flight departed the ramp at 0923 and took off at 0929 on an Instrument Flight Rules (IFR) flight plan for Naha Air Base, Okinawa. The flight to Naha was estimated at 2 hours and 3 minutes. Fuel aboard was computed at 3 hours 47 minutes.

Flight 45 proceeded without reported difficulty to Okinawa, and was cleared for an en route descent to an altitude of 1,000 feet mean sea level (m.s.l.) to make a precision radar approach to Runway 18 at Naha. The final approach controller established radar contact with the aircraft 18 miles northwest of the airport at 1129. Flight 45 was then advised that there was construction equipment on the left side of the runway at the approach end and on the right side of the runway at the 3,000 feet remaining marker.

The approach was continued and, at 1131, the flight was advised "... have reduced visibility on final ... tower just advised approach lights and strobe lights are on ...." About 1132, the captain mentioned a rain shower which was regarded by someone in the cockpit to have been over the field. At 1132:46, a new altimeter setting of 29.84 inches was given to the crew and acknowledged. The Cockpit Voice Recorder (CVR) transcription indicates that the landing checklist, including full flaps, setting of radio altimeters, gear down and locked, and spoilers armed, was completed at 1133:49.

At slightly less than 5 miles from touchdown, the crew was instructed to begin the descent onto glidepath and was cleared to land. The approach continued, with various heading changes and, at 1134:53, the crew was advised that they were slightly below the glidepath, 3 miles from touchdown. Additional vectors were provided and, at 1135:07, a sound, similar to the blowing of rain removal air, began; this sound continued at a steady level to the end of the CVR recording.

At 1135:14, 2 miles from touchdown, the crew was again advised "... dropping slightly below glidepath ... you have a 10 knot tailwind." At 1135:34, the controller advised the crew that they were on glidepath.

At 1135:37, the controller advised the flight, "One mile from touchdown, slightly left of course, turn left heading one eight five -- turn left heading one eight two." At 1135:42, an

[1] All times are local times, based on the 24 hour clock unless otherwise specified.

unidentified person in the cockpit said, "hundred feet." At 1135:43, the controller said "At minimum altitude, going well below glidepath, too low . . ." and at 1135:46, the recording of his voice ended. At 1135:44, during the above transmission an unidentified person in the cockpit said, "seventy feet" and, at 1135:44.5, he said, "It's fifty feet." The last comment was ended at 1135:45.5 by an electrical interruption to the recorder, and all recording stopped at 1135:46.

Ground witnesses reported that the aircraft broke out of heavy rain and low clouds at an estimated altitude of 75 to 100 feet. Several witnesses thought the aircraft was too low to make a safe landing.

The aircraft struck the water approximately 2,200 feet short of the runway threshold lights. The water in the accident area varied in depth from 6 to 70 feet.

The accident occurred in daylight at sea level elevation. The location was latitude 26° 13' N., longitude 127° 39' E.

1.2 Injuries to Persons

Injuries	Crew	Passengers	Others
Fatal	4	0	0
Nonfatal	0	0	0
None	0	0	

1.3 Damage to Aircraft

The aircraft was destroyed by impact.

1.4 Other Damage

None.

1.5 Crew Information

The flightcrew was properly certificated and had completed the flight and ground training programs required by existing regulations. (See Appendix B for detailed information.)

1.6 Aircraft Information

The aircraft was properly certificated. Maximum allowable takeoff weight was 349,500 pounds. Due to landing weight restrictions of 270,000 pounds at Naha, the maximum takeoff weight for this flight was computed at 302,950 pounds.

The forward center of gravity (c.g.) limit was 13 percent mean aerodynamic chord (MAC) and the aft limit was 32 percent. The takeoff c.g. was computed at 26.2 percent MAC and was expected to have been 24 percent MAC at landing.

The aircraft had been maintained in accordance with existing regulations and there were no pertinent airworthiness or maintenance directives outstanding. There was no evidence of a cargo shift before impact. (See Appendix C for detailed aircraft information.)

1.7 Meteorological Information

The crew was provided with a weather information folder by the company flight operations agent. The folder contained the 300- and 500-millibar prognostic charts, the tropopause height and wind shear chart, the terminal forecast sheet, and a significant weather chart.

The forecast for Naha Air Base for the period 0800 to 2100, July 27, 1970, was: wind 120° at 8 knots, visibility 6 miles, cloud coverage 3/8 cumulus at 1,500 feet and 2/8 cirrus at 25,000 feet, altimeter 29.77 inches, rain showers in the vicinity. Intermittent conditions were forecast for the period 0800 to 1300 of: wind 130° at 15 knots, visibility 3 miles in rain showers, cloud coverage 6/8 cumulus at 1,500 feet, cumulonimbus in vicinity.

Pertinent surface weather observations at Naha on July 27, 1970, at the times indicated were:

1128 — Wind variable at 5 knots, visibility 7 miles in light rain showers, 1/8 stratus at 1,000 feet, 5/8 cumulus at 1,500 feet, altimeter 29.83

inches. Ceiling 1,500 feet, towering cumulus overhead and all quadrants, visibility north 1 mile.

1134 -- Special -- Runway condition reading (RCR), 16.2[2]

1140 -- Wind 360° at 8 knots, visibility 10 miles in light rain showers, 2/8 cumulonimbus at 1,500 feet, 4/8 cumulus at 1,500 feet, temperature 28°C., dew point 27°C., altimeter 29.83 inches, ceiling at 1,500 feet, cumulonimbus northwest through northeast, stationary towering cumulus all quadrants, visibility north 1.5 miles.

A U. S. Air Force C-130 completed a ground-controlled approach (GCA) to Runway 18 at Naha several minutes before Flight 45 commenced its approach. The C-130 pilot subsequently reported that during his approach there was a heavy rain shower, approximately 1 mile in diameter, extending 1/8 to 1/4 of a mile west of the extended centerline of Runway 18, and immediately north of the approach end of the runway in the vicinity of the GCA minimum altitude position. He estimated that visibility was less than a mile in the rain shower but said that no turbulence was encountered in the shower.

Ground witnesses also reported that at the time of the crash, a heavy rain shower existed immediately north of the approach end of Runway 18. One described the shower as having a "wall-of-water" appearance in contrast to the surrounding light or nonprecipitation areas.

The local controller in Naha Tower stated that due to the prevailing northerly surface winds at speeds up to 10 knots, a change to Runway 36 was planned after the landing of Flight 45.

The entire flight from Tokyo to Naha was conducted in daylight conditions. The light conditions at Naha at the time of the accident were those associated with a broken cumulus cloud cover, clear areas of bright noonday sunshine, and a dark area north of the field where the rain shower was located.

A total rainfall of 0.14 inches was recorded at Naha Air Base on July 27, 1970. It was not known how much rain fell within a pertinent time frame of about 10 minutes before to 10 minutes after the accident.

1.8 Aids to Navigation

The only available means of conducting an instrument approach to Runway 18 at Naha was the use of precision approach radar. The equipment used to provide service to Flight 45 was a U. S. Air Force operated MPN-13 GCA unit mounted on a turntable. Ten minutes was required to rotate the unit and realign it for use on the reciprocal runway. An Instrument Landing System (ILS) was installed on Runway 36. However, the ILS was inoperative due to construction on the airfield and this information had been published in Notices to Airmen.

Naha precision approach radar (PAR) minima as specified in the instrument approach chart for the Flying Tiger Line, Inc., were 300 feet and 3/4 mile visibility for all turbo jet aircraft. U. S. Air Force PAR minima were 200 feet and 1/2-mile visibility, and published as such in Department of Defense flight planning publications

U. S. Air Force GCA procedures provide that there shall be displayed on the PAR elevation scope a "lower safe limit" line and that this line shall originate at the beginning of the runway and extend outward along the final approach course at an elevation angle 0.5° below the glidepath angle. These procedures further provide that when a target is within 3 miles of touchdown, if its lower edge touches the lower safe limit line, immediate action shall be initiated by the controller to issue missed-approach instructions.

The Naha GCA final controller stated that precipitation echoes were displayed on the PAR

---

[2]RCR 16 means a wet runway condition with braking considered as fair.

scope between 1 and 2 miles from touchdown at the time of the accident, but that they did not interfere with the target depiction of Flight 45. He also stated that, at a point inboard of 1 mile from touchdown, the target deviated abruptly from the glidepath and appeared to dive almost straight down.

FAA made a special flight check of the Naha ground-controlled approach radar unit about 3 hours after the accident. It was reported that the unit had not been moved or adjusted after the accident. It was found to be operating within prescribed tolerances.

1.9 Communications

No problems were reported with communications during the approach.

1.10 Aerodrome and Ground Facilities

Naha Air Base is located at latitude 26° 12′ N. and longitude 127° 39′ E., with a published airport elevation of 14 feet m.s.l. The single white concrete runway, designated 18-36, is 8,000 feet long and 150 feet wide. There is an overrun area 1,000 feet long on each end. About one-half of the overrun located on the approach end of Runway 18 is constructed of asphalt and the other half is of white concrete. The soil area surrounding the approach end of Runway 18 consists of crushed, impacted coral, almost white in color. Imbedded in the overrun and projecting into the water about 500 feet at the north end of the runway is a Short Approach Light System (SALS) with Sequence Flashing Lights (SFL). The SALS is 1,500 feet long. Runway lighting is provided by a High-Intensity Runway Lighting (HIRL) system.

The approach lights had been turned to the step 4 position before Flight 45 commenced its approach. This position provides about 80 percent of the maximum intensity. The runway lights had been set at step 5, the maximum brightness setting. The sequence flashing lights had been activated.

1.11 Flight Recorders

(a) Cockpit Voice Recorder

A United Control Model V-557 serial No. 2274, cockpit voice recorder (CVR), was recovered from the partially submerged wreckage. The CVR received no damage as a result of the accident. Pertinent portions of the transcription appear in Appendix D. The captain was identified by Flying Tiger Line, Inc., personnel as the person making the radio transmissions from the aircraft.

(b) Flight Data Recorder

N785FT was equipped with a UCDD Model F-542B, serial No. 2813, flight data recorder (FDR). The recorder sustained moderate crushing damage to the lower, rear portion of the case, and light mechanical damage to the frontal portion. The pitot and static pressure lines had broken at the attach fittings but the fittings remained secure. The armored front door was open but intact. The foil magazine was undamaged: all recorder parameters were clear, active and readable.

A recorder readout was produced encompassing the final 3 minutes of flight and the results were plotted on a data graph. The altitude information was based on the local altimeter setting of 29.83 inches of mercury to convert pressure altitude to altitude above m.s.l. No other corrections were made to any parameter. Accuracy tolerances for the flight recorder at this altitude are: pressure altitude ± 100 feet, indicated airspeed ± 10 knots, magnetic heading ± 20°, vertical acceleration ± 0.2g and ± 1 percent in 8 hours. Measurements made at various points throughout the flight established that the flight data recorder was operating in accordance with the current calibration, and there were no apparent malfunctions or noted abnormalities in the recorded data.

(c) Correlation of Cockpit Voice and Flight Data Recorder information (See Appendix G for Flight Profile)

The following information was obtained from a corre ion of the CVR and FDR at various positions along the flightpath from the point of entrance onto the glide slope until impact. Positions are listed in chronological sequence of aircraft corrected mean sea level altitude in feet, corrected airspeeds in knots, and magnetic headings in degrees:

At 1134:12.5, 93 seconds from impact, the aircraft was 5 miles from touchdown and a few seconds later was instructed to begin descent. At that time, the FDR traces show the aircraft at an altitude of 975 feet, airspeed 151 knots, and heading 183°.

At 1134:35, 70.5 seconds from impact, the controller informed Flight 45 that it was 4 miles from touchdown. The aircraft was then at a corrected altitude of 900 feet, airspeed 154 knots, and heading 185°.

At 1134:53, 52.5 seconds from impact, the aircraft was 3 miles from touchdown at an altitude of 650 feet, airspeed 153 knots, heading 182°.

At 1135:07, 38.5 seconds from impact, the CVR began recording the sound of the operation of the pneumatic rain removal system. This sound continued at a steady level to the end of the recording.

At 1135:14, 31.5 seconds from impact, the aircraft was 2 miles from touchdown at an altitude of 400 feet, airspeed 154 knots, heading 179°.

At 1135:28.5, 17 seconds from impact, the FDR traces show the beginning of an uninterrupted rate of descent after the aircraft had maintained an altitude of approximately 325 feet for the preceding 7 seconds. The altitude was then 315 feet, airspeed 154 knots, heading 180°.

At 1135:34, 11.5 seconds from impact, the controller informed the flight that it was on glidepath. Its altitude at that time was 250 feet, airspeed 148 knots, heading 182°.

At 1135:36 9.5 seconds prior to impact, the aircraft was 1 mile from touchdown at an altitude of 200 feet, airspeed 149 knots, heading 183°.

At 1135:42. 3.5 seconds from impact, an unidentified person in the cockpit said, "Hundred feet." The aircraft was then at about 100 feet, airspeed and heading of 146 knots and 183°, respectively.

At 1135:43, 2.5 seconds from impact, the controller called "At minimum altitude. . . ." The FDR traces show the aircraft at an altitude of 75 feet, airspeed of 144 knots, heading 182°.

At 1135:44, 1.5 seconds from impact, the unidentified person said, "Seventy feet." Aircraft altitude, airspeed, and heading at that time were about 50 feet, 144 knots and 181°, respectively.

At 1135:44.5, 1 second from impact, the unidentified person said, "It's fifty feet." Correlation shows the aircraft at an altitude of 25 feet, airspeed 145 knots, heading 180°.

Impact occurred at 1135:45.5. The correlation shows the aircraft at an altitude of zero feet, airspeed 144 knots, heading 180°.

The initial rate of descent onto the glidepath stabilized at about 950 feet per minute (f.p.m.). At slightly more than 3 miles, the rate of descent decreased to about 750 f.p.m. At the point where the CVR began recording a sound similar to the blowing of rain removal air the rate of descent increased to about 940 f.p.m. and continued at that rate until the level-off maneuver began about 8 seconds later.

Following the 7-second period of nearly level flight, the aircraft began to descend at an ever increasing rate during the final 17 seconds of flight; the rate of descent averaged about 1150 f.p.m. during those seconds.

1.12 Wreckage

The main wreckage of N785FT was located in the water from approximately 1,500 feet to 1,900 feet north of the threshold of Runway 18. (For details see Wreckage Distribution, Appendix E.) The wreckage scatter was confined to an area 700 feet long by 300 feet wide and was distributed generally in line with the runway centerline extended. The water depth in that area varied from 6 to 70 feet.

The fuselage was broken into three major sections. Both wings had separated from the fuselage and the four engines were separated from the wings. The landing gears were detached from their respective attachment points. Of the recovered wreckage the nose gear and No. 2 engine were found farthest north of the approach end of Runway 18.

The upper fuselage section from Fuselage Station (FS) 131 to FS 280 was complete, including all cockpit windows, crew entry door, and main cargo door. One cockpit window was broken during recovery operations. All instrument panels, pedestal, control wheels, rudder pedals and radio racks were intact. Portions of several sets of eyeglasses were recovered from the section.

Approximately 90 percent of the wreckage was recovered or accounted for. All structural separations and fractures appeared typical of those caused by overloads.

The captain's and first officer's instrument panels were recovered intact. Readings of all instruments and positions of all switches were recorded. Pertinent readings were as follows:

1. Captain's Flight Instrument Panel

   a. Airspeed Indicator
      Indicated Airspeed .... 0 knots
      Reference Index .... 143 knots
      Reference Bug .... 149 knots

   b. Altimeter
      Pressure Setting 29.85
      Reference Bug .... 850 feet
      Reference Bug .... 200 feet
      Indicated Altitude .... 380 feet

   c. Radio Altimeter
      Indicated Altitude .... minus 15 feet
      Reference Bug .... 200 feet

2. First Officer's Flight Instrument Panel

   a. Airspeed Indicator
      Indicated Airspeed .... 0 knots
      Reference Index .... 140 knots
      Reference Bug .... 150 knots

   b. Altimeter
      Pressure Setting .... 29.87 inches
      Indicated Altitude .... minus 30 feet

c. Radio Altimeter
   Indicated
   Altitude .... plus 10 feet
   Reference Bug .... 300 feet

3. The altitude reminder dial located on the glare shield panel was set at 310 feet.

All four engines were recovered from the water and were examined. A spectrographic analysis was conducted of oil samples taken from each engine. There was no evidence of engine or associated systems failure or malfunction.

1.13 Fire

There was no fire before or after impact.

1.14 Survival Aspects

This was a survivable accident. All four crewmembers were found in the upper fuselage section (FS 131-280) which included the cockpit areas of the aircraft. This section came to rest inverted and, for the most part, under water. The captain was found strapped in his seat by his seatbelt. The shoulder harness showed no evidence of having been used. The other crewmembers had either moved or had been moved to various locations within the section.

A witness, who was fishing near the point where the aircraft struck the water, was one of the first to arrive at the cockpit section. He stated that upon his arrival there were two survivors whom he later identified by photographs as the first and second officers. These two officers subsequently died from drowning, the navigator died from asphyxiation, and the captain from traumatic head injuries.

Persons who arrived on the scene several minutes after the accident spoke with the first officer. He had access to a small hole torn in the underside of the fuselage and could talk to the would-be rescuers. One witness stated that in response to queries as to what had caused the accident, the first officer said, "Everything was okay until we hit."

Efforts by rescuers to cut through the fuselage with hand tools were unsuccessful. The person in charge of the rescue operations ruled out the use of power tools and cutting torches due to his fear of igniting the aviation kerosene that covered the water in the accident area.

Attempts by divers to get into the cockpit through the submerged fuselage break were unsuccessful because the passage was blocked by cargo and wreckage. Attempts made to raise the submerged section with flotation bladders were also unsuccessful. As the incoming tide increased the water depth, an LCM-8[3] was moved in to lift the section out of the water by use of its power ramp. Nylon ropes looped about the section proved inadequate, as they merely stretched when tension was applied. Quarter-inch steel cables were used with success, but in spite of the interim efforts of rescuers to keep the survivors alive with snorkel breathing apparatus, they died before they could be removed from the wreckage.

Means of exit which should have been available in the cockpit section were the two sliding windows and the cockpit entry door. Neither of the sliding windows could be moved until after the cockpit section had been removed from the water and debris had been cleared from the sliding tracks. The entry door was blocked by the cargo net ring which had been forced forward just enough to prevent the door from opening.

1.15 Tests and Research

The pressure altimeter and the airspeed indicator from both the captain's and the first officer's instrument panels were examined in a laboratory. Additionally, both the altitude and airspeed modules of the air data computer[4] were examined.

---

[3] Landing craft, medium

[4] Air data computer. A high precision, analog computer used to provide air data parameters required for the navigation and control of aircraft. The computer utilizes input pressure from the aircraft pitot system and the total temperature for the derivation of the required air data

Both pressure altimeters had been subjected to overpressure from water immersion. Additionally, both units were severely corroded due to the galvanic action associated with immersion of dissimilar metals in salt water. However, no indications of prior malfunctions were discovered in either instrument. Both airspeed indicators sustained similar corrosive effects. No indications of prior malfunctions were discovered.

The altitude sensing module of the air data computer disclosed a reading of about 600 feet, uncorrected for station barometric pressure existent at the time of the accident. When the appropriate correction factor was applied, the reading became zero feet.

The air data computer revealed that the airspeed was between 140 and 150 knots at the time of the accident.

A test flight was conducted using a similar Flying Tiger Line, Inc., DC-8-63F, to determine frequency levels of the sounds of engine compressor rotation at various rotational speeds. These sounds along with those associated with operation of the pneumatic rain removal system, were recorded on a CVR from which frequency spectrographs were made. From comparison of these spectrographs with those made from the accident CVR, it was determined that during the last 22 seconds of flight, N_1 compressor rotation rate was 60 percent r.p.m., and the sounds identified in the CVR transcription as having been caused by either heavy rain or by operation of the pneumatic rain removal system, were determined to have been caused by the latter.

A special study was conducted by Safety Board personnel into problems of visual acuity, refraction or distortion caused by water on the windshield, pneumatic rain removal system, and rain repellent systems.

The aircraft was equipped with a Rainbow[5] rain repellent system, produced by the Boeing Aircraft Company. The operational characteristics of the system were studied in collaboration with Boeing Aircraft Company and various users of the system. It was found that rain repellent was used only in heavy rain under normal circumstances; that it was effective; and that its use was unlikely to cause distortion or refraction. In this instance, it could not be determined whether the rain repellent system had been used.

DC-8-63F aircraft also use a pneumatic air rain removal system to prevent accumulation of water on the windshield by utilizing selected engine compressor bleed air and routing this air over the windshield to blow the water therefrom. Since the temperature of this air is quite high, use of the system is recommended only when required for visibility purposes. The amount of air provided is a direct function of engine r.p.m., and system efficiency deteriorates at lower power settings. As noted above, spectrographic analysis of engine compressor rotational sounds on the CVR established that N_1 compressor speed was stabilized at 60 percent r.p.m. during the last 22 seconds of flight.

The special study indicated that at 60 percent r.p.m. of N_1, it was considered possible that some rain could have existed on the windshield during that period of time and that refraction or distortion could have resulted.

The Boeing Aircraft Company conducted research into the problems of visual disorientation associated with peculiarities of the atmospheric conditions existent at Naha at the time of the accident. The results of this research and the hypothesis developed are summarized in Appendix F.

Tests were performed with a Douglas DC-8-63F simulator using a 2½° glide slope. Winds and control forces were varied to observe the effect on aircraft parameters. The test input which most nearly resembled the flight-path of Flight 45 occurred under the following conditions: (1) A tailwind was abruptly removed at approximately 2 miles from touchdown at about 450 feet elevation and (2) minimum control forces were applied.

---

[5]Trade name of a chemical that was sprayed onto the windshield to prevent water from adhering to and collecting on the windshield surface.

1.16 Pertinent Information

The Company Operations Manual specified the IFR minima for the pilots. Part C, Airport Authorization and Limitations of the approved Operations Specifications, Sections 23, 25, and 30, were applicable to the Naha approach. Section 23c established basic IFR approach minima of 350 feet and 1 mile for PAR approaches. These were reduced by Section 25c for listed airports of destination and established standard PAR minima of 250 feet and three-fourths mile. Naha Air Base was listed in that section as an airport of destination. However, Section 25c also provided for a reduction of the latter minima to 200 feet and one-half mile (or RVR of 2,000 feet when operative touchdown zone and centerline lights were available) when the approach was to be made to a U. S. airport and such minima were authorized in the applicable approach procedures and to those foreign airports listed in Section 30. Naha was not listed in Section 30 as a foreign airport where the reduced minima authorized by Section 25c were applicable. The captain of Flight 45 had been certified by an FAA inspector as qualified to fly to U S minima of 200 feet and 1/2-mile for ILS approaches only.

In this instance, the approach chart used by Flying Tiger Line (FTL) for a PAR approach to Runway 18 at Naha Air Base specified minima of 300 feet and 3/4-mile for turbojet aircraft.

The Operations Manual, Section 4 (Flight Operating Procedures), stated that:

> "Standard FTL instrument approach procedures are specified in the Jeppesen Manual and the Flight Information Publications (FLIP) of the Department of Defense." Also, section 4 stated "when instrument approach procedures have been established for an airport, the instrument approach methods, procedures and minima specified shall be strictly adhered to."
>
> "The procedures set forth in this section are predicated on the Pilot (Captain) flying the aircraft and the First Officer monitoring the approach. If the situation is reversed and the First Officer is actually flying the aircraft most of the procedures still apply except that the Pilot-in-Command is responsible for all decisions such as continuing or abandoning the approach, taking over the control of the aircraft if necessary, etc."

The company personnel, who listened to the voices of the crew-members on the CVR tape and identified the captain as the one making the radio transmissions, stated that it was normal procedure for the pilot unoccupied with flying the aircraft to make the radio transmissions. Also, company personnel established that it was a normally accepted procedure for the captain to make the "500 feet" and "100 feet" above minimums calls and the "at Minimums" call when the first officer was flying the aircraft on an instrument approach. Neither of the aforementioned calls was made.

The Operations Manual specifies first officers' duties to be accomplished during the approach, in part, as follows:

> ". . . when the aircraft is 500 feet above the authorized IFR landing minimum, the First Officer shall call out. 500 feet above minimum altitude; when 100 feet above IFR landing minimum, the First Officer shall call out. 100 feet above minimum altitude; upon reaching minimum altitude he shall call out Minimum altitude, field in sight; or if applicable, field not in sight. During the approach he shall observe conditions outside the aircraft and advise the Captain when the runway has been sighted or the time to execute a missed-approach has occurred."

The manual authorized the first officer to take off and land the aircraft from the right seat, subject to the discretion of the captain. However, the manual made no provision for an exchange of duties when the first officer was flying the aircraft on an instrument approach.

According to Federal Aviation Regulation (FAR) 91.117, when an instrument approach is executed, the pilot may not operate the aircraft below the prescribed minimum descent altitude or continue an approach below decision height unless -

(1) The aircraft is in a position from which a normal approach to the runway of intended landing can be made; and

(2) The approach threshold of that runway, or approach lights or other markings identifiable with the approach end of that runway, are clearly visible to the pilot.

The regulation further provides that, if, upon arrival at the missed-approach point or decision height (DH) or at any time thereafter, any of these requirements are not met, the pilot shall immediately execute the appropriate missed-approach procedure.

2. ANALYSIS AND CONCLUSIONS

2.1 Analysis

The flight departed from Tokyo at 0929 and proceeded uneventfully to the last segment of the final approach into Naha.

Two hours after takeoff, following an en route descent to 1,000 feet m.s.l., Naha Control established radar contact with the aircraft. At the time radar contact was established (1129) the flight was 18 miles northwest of the airport and was apparently operating in visual meteorological conditions, as they had been during virtually the entire flight from Tokyo. The crew was aware that the rain shower they observed in the vicinity of the airfield was local in nature. In addition, they were aware that either they would be making a downwind landing or they would have to obtain an amended clearance if they chose to land into the wind. However, the crew made no effort to circumnavigate the rain shower, by requesting a clearance to land into the wind.

At 1129, the controller advised that there was construction equipment on the left side of the runway at the approach end and on the right side of the runway at the 3,000 feet remaining marker.

Two minutes later, at 1131, the controller advised further: ". . .have reduced visibility on final . . . tower just advised approach lights and strobe lights are on . . . ."

Cockpit conversations reflect the crew's displeasure with the location of reduced visibility due to shower activity. Thus following 2 hours of relative inactivity, the crew was faced with the necessity of executing an instrument approach with the attendant requirements for precise rapid responses to control instructions and environmental cues.

The FDR readout shows that a descent was established on the glidepath at a rate of about 950 f.p.m. at a point slightly less than 5 miles from the runway. The descent rate was reduced to 750 f.p.m. about 3 miles from the runway.

The crew activated the pneumatic rain removal system about 7 seconds prior to the final controller's "two miles . . ." transmission. At this time, the rate of descent increased to about 950 f.p.m. and continued at that rate until commencement of a level off about 10 seconds later. Completion of the level-off maneuver required about 4 seconds at 325 feet m.s.l. or about this crew's decision height. The airspeed increased from 153 knots to 163 knots during the descent within the rain shower.

During the level flight at 325 feet, the power was reduced to an N1 compressor speed of approximately 60 percent r.p.m. and the airspeed, thereupon, was reduced to 154 knots. This speed remained constant during the last 22 seconds of flight (5 seconds of level flight followed by 17 seconds of descent) at an average rate of 1,150 feet per minute.

Simulator studies were conducted by the Board to examine the last portion of the approach. These studies showed that if the 15 knots tailwind ceased for 10 seconds when the aircraft passed through about 400 feet it would result in a flight recorder trace similar to the one obtained from the accident. Additionally, the reduction in power to an N_1 compressor speed of 60 percent is a natural result of observing an airspeed 10 knots higher than desired.

Witnesses varied in their evaluation of the initial impact attitude of the aircraft. One witness stated that the aircraft struck the water in a noseup attitude, whereas other witnesses described the aircraft striking the water in a nosedown attitude. This variance in witness observations can be reconciled by the difference in visual angles, distance from the impact area, and the reduced visibility caused by the rain shower in the area of the accident.

The crew adhered closely to heading and altitude instructions until level off upon reaching Flying Tiger minimums (300 feet). Thereafter, however, the aircraft descended through the Decision Height and contacted the water. Accordingly, the investigation was directed toward determining what factors may have led to this unwarranted descent.

The Safety Board has considered and ruled out the following as possible mechanisms of causation:

(1) In-flight failure, malfunction, or abnormality that would have caused or contributed to an unwarranted rate of descent.

(2) An unauthorized person in the cockpit.

(3) Pilot fatigue.

(4) In-flight pilot incapacitation.

The crewmembers were all performing their duties and conversing in normal tones until just before the accident occurred.

It was determined from the CVR that the first officer flew the final approach to Naha while the captain handled the communications and maintained external reference.

As the aircraft progressed into the rain shower, the crew probably lost external visual reference completely, due to the intensity of the rain. However, since the flight was nearing approach minimums and they expected to break out of the shower momentarily, the captain undoubtedly devoted his attention to locating the approach lights.

During the 7-second period of level flight at 325 feet m.s.l. the aircraft passed through the most intense portion of the shower and emerged into an area of increased light intensity. The backlighted light rain could well have caused visual disorientation effects associated with an illuminated high intensity "Ganzfield" phenomenon (a homogeneous visual field of similar brightness in which no differentiating objects can be seen). The glare not only would preclude reference to outside objects but also would limit reference to cockpit instruments. During this period the final approach controller advised the crew that they were "on glidepath" and had a 10 knot tailwind. The "on glidepath" transmission undoubtedly reassured the crew regarding their altitude and position.

About 8 seconds after this "on glidepath" portion of the controller's transmission, an unidentified person in the cockpit (probably the second officer) called out "hundred feet." At that point the flight recorder indicated an altitude of 85 feet m.s.l. There was no evidence that this call alarmed the captain or the first officer, even though the radar altimeters would have indicated the altitude. The amber warning lights associated with these radar altimeters would have been lit also, since the captain's reference "bug" was set at 200 feet m.s.l. and the first officer's was set at 300 feet m.s.l.

One second after the "hundred feet" call the controller advised the flight: "at minimum altitude, going well below glidepath, too low . . ." The CVR recording of the controller's instructions ended at that point. While the final approach controller was making that transmission, the unidentified person in the cockpit was calling, "Seventy feet" and "It's fifty feet." If the latter calls alarmed the captain and/or the first officer, it was too late to refocus on the instruments, interpret them, and effect a recovery from the relatively high rate of descent that existed during the last few seconds of flight.

During the period from 1134:14 (5 miles from touchdown) to 1135:37 (1 mile from touchdown and 8.5 seconds prior to impact), the controller gave the flight six heading changes. The first officer was required to concentrate on making directional changes which may have precluded an effective overall surveillance of other instruments, particularly the altimeter. Thus, he may have been relying on the controller to provide altitude information.

There was no evidence that either the "500 feet above minimums" or "100 feet above minimums" call, required by company directives, was made. One possible explanation for the lack of those calls is that the flight was in visual conditions at both times, and consequently, the pilots may not have regarded the calls necessary. Another explanation could be the lack of explicit written company directives as to crew duties when the first officer is flying the aircraft on an instrument approach. Also, there was an evident lack of a clear understanding between the pilots as to what the DH should be. The first officer determined correctly that the DH was 300 feet (314 feet m.s.l.) as his radio altimeter bug was found set at 300 feet; he had leveled the aircraft at about 325 m.s.l. for a period of 7 seconds; and the altitude reminder dial was found set at 310 feet. The captain apparently had a minimum altitude of 200 feet in mind. His radio and pressure altimeter bugs were found set at 200 feet, and he was certified (under certain circumstances not existing in this case) as qualified for the lower minima. Assuming that the captain intended to make the "100 feet above minimums" call, a normally accepted procedure, he could not have been expected to make the call since the aircraft did not reach the 100-foot point (314 feet m.s.l.) above his 200 feet minimums until the aircraft departed the level-off altitude of 325 feet. During the reinitiated descent, his attention probably was devoted to locating the runway.

The correlation of the CVR and FDR information showed that the aircraft started the descent approximately 1/2-mile before it reached the point where the published glidepath intercepted the 1,000-foot level and that it remained consistently below the glidepath until the level-off at about 325 feet. This condition prevailed even though the aircraft was reported by the GCA final controller to be on the glidepath. The Board examined the precision approach radar unit for various defects which could have existed and could cause the aircraft to appear to be positioned differently on the glidepath from the one observed by the controller. The results of this examination were inconclusive as to the type of defect that could have caused a below-glidepath condition, since any such defect would show up on the radarscope and alert the controller to a problem with the equipment. Additionally, training procedures include alerting the controller to any abnormal radarscope presentation.

The Board recognizes that under certain conditions water drops have an effect on the radarscope presentation in heavy concentrations of water. Under these conditions the radar controller may have difficulty in observing the target presentation. However, in the case of Flight 45, the final controller stated that he observed precipitation echoes on the PAR scope between 1 and 2 miles from touchdown but that these echoes did not interfere with the depiction of the aircraft target.

The final approach controller was several seconds late in transmitting target elevation (altitude) display information relating to the declaration of minimum altitude. That transmission was made when the aircraft was at an actual altitude of about 85 feet m.s.l., as shown on the flight recorder, instead of when the aircraft was at the U. S. Air Force PAR minimum altitude of 214 feet m.s.l.

The Board believes the final approach controller devoted continuing attention to the azimuth displays as evidenced by the numerous heading changes given. This continuing attention to the azimuth display might have limited the attention that he could devote to elevation observation. This situation combined with the increased rate of descent of the aircraft during the last 8 to 10 seconds of flight, could have contributed significantly to the delay in transmission of altitude information. The controller's call, placing the aircraft at minimum altitude and too low to complete a safe approach, was not broadcast in sufficient time to alert the pilot to his dangerously low position. Additionally, the sound of the rain removal equipment might have interfered with the flightcrew's reception of the controller's calls. Thus, under the circumstances the warning effects associated with the controller's minimum altitude call were negated and the first officer's impression that everything was "OK" until they hit is quite understandable.

Another factor which compounded the crew's problems during the final descent was that the rain removal system was not operating at total capacity in removing the water from the windshield. The reduction in capacity was due to low engine r.p.m. during the last 22 seconds of flight. Thus, the accumulation of raindrops, with associated problems of refraction or distortion and possible depressed horizon, limited the crew's efforts to see the runway during the most critical portion of the approach. Subsequent to the level-off, the crew probably expected to break out or to obtain visual contact with the runway lights momentarily. The power reduction, the position in the rain shower and short approach light system could have contributed to a delay in their obtaining visual contact during which time they got into an unperceived high rate of descent from which there was no recovery.

The Board considered the possibility that erroneous barometric altitude information misled the crew during passage through the rain shower on final approach. Information concerning pressure and wind changes that occur in thunderstorms in the middle western portion of the United States was reviewed in an effort to associate the changes with those that existed at Naha at the time of the accident. However, there is nothing in the FDR trace to suggest that conditions similar to those observed in midwestern thunderstorms existed in the rain shower. Consideration was given to the possibility that Flight 45 might have encountered severe up or down drafts during passage through the rain shower, but the FDR trace shows no indication of such an occurrence.

Furthermore, the U. S. Air Force C-130 pilot who had completed an approach shortly before Flight 45 began its approach, did not encounter severe conditions within the rain shower.

The Board is mindful of the rapid and marked surface pressure variations which usually occur in a particular sequence characterized by:

(1) Falling pressure as the storm approaches;

(2) An abrupt rise in pressure associated with rain showers as the storm moves overhead; and,

(3) A gradual return to normal pressure as the storm moves on and the rain ceases.

Thus, atmospheric pressure within an area of heavy precipitation as at Okinawa would be slightly higher than the pressure in the surrounding environment.

Flying towards a zone of higher pressure, at a particular flight level, and with a constant altimeter setting, causes the altimeter to read too low. The indicated altitude is lower than the actual altitude. Accordingly, as in the case of Flight 45, the error, if any, would have been on the safe side.

In view of the above, the Board finds no evidence to indicate that atmospheric pressure fluctuations were involved in the causal area of this accident.

A pressure difference of approximately 33 inches of mercury would be required between the ambient air pressure and the static system pressure to obtain a 300-foot altimeter error. The airspeed indicator would read concomitantly about 23 knots in error (high in this case).

The possibility was considered that water ingestion in the static pressure system ports might have caused altimetry errors which led the pilots to believe they were approaching decision height when in fact they had descended through it. Tests conducted on static systems of other aircraft have shown that both altimeter and airspeed indicators experience noticeable excursions when water is being ingested. Therefore, a 200 altimeter error due to water ingestion should have been obvious to the crew.

The alternate static port is the source of static system pressure for the flight recorder. The normal source, located aft of the alternate source, provides pressure for operation of the primary instruments. During calibration and certification tests both rain and icing conditions were experienced. The static pressure difference between the normal and alternate systems in the aircraft configuration here being examined is 17 feet of altitude and 1 knot of airspeed. This is within the tolerance of pressure instrument operation.

Finally, there is no basis for a determination that the altitude callouts on the final few seconds on the CVR transcript are calls reflecting barometric altitudes above approach minimums. The fact that the calls were made by someone other than the captain or first officer, and in a manner different from that specified in company directives, would suggest that the callouts were based probably on altitudes indicated on the radio altimeter rather than on a barometric altimeter.

All flight crewmembers were FAA certificated airmen ranging in age from the late forties to the late fifties. The FAA medical record for each crewmember contains a limitation that he must wear corrective lenses while he is exercising the privileges of his certificate.

The Board reviewed the medical records with special regard for the corrective glasses requirement. This review indicates that the condition of the eyes of all crewmembers was compatible with their ages. Thus, each crewmember should have had the capability of distinguishing contrasts.

Both empty eyeglass cases and cases containing broken lenses were found scattered throughout the cockpit area but none were identifiable. The post-mortem medical examination of the crewmembers showed no evidence that eyeglasses were being worn at impact. It cannot be stated unequivocally, however, that eyeglasses were not being worn.

The CVR/FDR correlation showed that the aircraft had a 10 to 15 knot tailwind on final approach until it reached DH. This condition caused a higher than normal rate of descent (rate of descent on glide slope varies directly with groundspeed). This also would have caused the pilots to carry less than normal engine power in order to stay on the glide slope. Simulator tests were conducted in an attempt to duplicate the flight data recorder trace. These tests showed that the altitude and airspeed traces on a simulated DC-8-63, configured the same as the accident aircraft, under similar pressure temperature conditions, are most closely duplicated by: removing the 15-knot tailwind at about 450 feet; leaving it out for 10 seconds and then reinserting it; applying minimal control forces; and, reducing power to 60 percent N_1 r.p.m. at 22 seconds prior to impact. The increase in indicated airspeed and leveling of the aircraft as depicted on the FDR could have been caused by this change of wind direction and velocity. The combination of wind change, application of minimal control forces, and reduction of power is the most plausible explanation for the high rate of descent prior to impact.

2.2 Conclusions

(a) Findings

1. The crew was trained, certificated, and qualified in accordance with existing regulations.

2. The aircraft was certificated in accordance with existing Federal Aviation Regulations and had been maintained in accordance with existing FAA and Flying Tiger Line, Inc., directives.

3. The aircraft was airworthy and there was no evidence of mechanical failure.

4. Flying Tiger Line, Inc., dispatch procedures were in accordance with applicable regulations.

5. The aircraft weight and balance were within limits.

6. Flying Tiger Line, Inc., precision approach radar minimums for Naha Air Base were 300 feet and 3/4-mile visibility.

7. The approach was flown to DH in accordance with the final controller's instructions.

8. The first officer flew the approach to DH from the right seat.

9. There was a heavy rain shower in the vicinity, approximately 1 mile in diameter, at minimum descent altitude. The area surrounding the rain shower was brightly lighted by midday sunlight.

10. A 10 to 15 knot tailwind from 120° existed on the final approach.

11. The efficiency of the pneumatic air rain removal system was reduced by low power setting during the final portion of the approach.

12. The required approach altitude calls were not made.

13. The flight operating procedures in the Operations Manual were not specific with regard to altitude callouts by the captain and first officer, when the latter was flying the aircraft on an instrument approach.

14. The captain's radio altimeter reference bug was set improperly at 200 feet, the first officer's was set correctly at 300 feet, and the altitude reminder dial was set at 310 feet.

15. The aircraft leveled at about 325 feet m.s.l., and power was reduced. Power was never increased thereafter.

16. Correlation of the CVR and FDR information showed that someone in the cockpit called out "Hundred feet" at the same time the aircraft was at 100 feet m.s.l.

17. No action was taken by either pilot when this call was made.

18. The final approach controller advised the crew that they were at minimums (200 feet) 1-second after the "hundred feet" call in the cockpit.

19. The aircraft was seen emerging from the rain shower 75 to 100 feet above the water.

20. The aircraft contacted the water 2.5 seconds after the beginning of the "at minimums" call by the final approach controller.

21. The final approach simulation showed that the FDR traces could be approximated by:

(1) programming the known pressure and temperature conditions;

(2) assuming a 15 knot tailwind and removing the tailwind at 450 feet for 10 seconds; and then reinserting it;

(3) Reducing the power to 60 percent N_1 when an increase in airspeed and level off was noted, and then applying only a minimum amount of control force.

22. Meteorological conditions created a veiling glare and a visual field of similar brightness.

23. No evidence of malfunction of the static system instruments was found.

24. There was no evidence of the existence of meteorological conditions severe enough to cause the altimeter to read in error.

25. The accident was survivable; however, the captain was not wearing his shoulder harness and died as a result of injuries.

26. The aircraft was destroyed by impact and there was no fire.

27. Of the four crewmembers on board one died as a result of injuries, one from asphyxiation and two from drowning.

(b) Probable Cause

The National Transportation Safety Board determines that the probable cause of this accident was an unarrested rate of descent due to inattention of the crew to instrument altitude references while the pilot was attempting to establish outside visual contact in meteorological conditions which precluded such contact during that segment of a precision radar approach inbound from the Decision Height.

3. RECOMMENDATIONS

During the latter part of 1968 and the early part of 1969, a rash of serious aircraft accidents occurred during the instrument approach phase of flight. As a result of those accidents, the National Transportation Safety Board, by letter dated January 17, 1969, made a number of recommendations to the Administrator of the Federal Aviation Administration. Among others, it recommended that the Administrator emphasize the importance of altitude awareness during instrument approaches through strict attention to instrument indications, crew coordination, and altitude callout procedures. Due to the nature of this accident and attendant similarities, the Safety Board recommends that:

(1) The Federal Aviation Administration reemphasize to air carrier flight-supervisory and pilot personnel the pertinent altitude awareness recommendations set forth in the above-mentioned letter. (See Appendix H.)

(2) The Federal Aviation Administration issue an Advisory Circular incorporating excerpts of this report, including the findings, stressing to all instrument and airline transport rated pilots the need for continuous surveillance of flight instruments when operating in instrument meteorological conditions.

(3) The Federal Aviation Administration determine that the Operations Manuals of all air carriers, commercial operators, and air taxi operators are explicit, particularly with regard to altitude callouts when the copilot is flying the airplane during an instrument approach.

(4) Flying Tiger Line, Inc., amend its flight operations procedures to set forth specifically the responsibilities and duties, particularly with regard to altitude callouts, of both captain and first officer when the latter is flying the aircraft on an instrument approach.

BY THE NATIONAL TRANSPORTATION SAFETY BOARD:

/s/ JOHN H. REED
Chairman

/s/ OSCAR M. LAUREL
Member

/s/ LOUIS M. THAYER
Member

/s/ ISABEL A. BURGESS
Member

FRANCIS H. McADAMS, Member, filed the attached dissent.

December 29, 1971.

Aircraft Accident Report—Flying Tiger Line, Inc., Douglas DC-8-63F, N785FT, Naha Air Base, Okinawa, Ryukyu Islands, July 27, 1970

McADAMS, Member, Concurring and Dissenting:

Although the final decision with respect to the safe operation of an aircraft rests with the pilot; a precision radar approach, nevertheless, is a coordinated and cooperative effort between the GCA controller and the pilot. As such, the controller is an integral part of the entire landing procedure and must, therefore, bear some responsibility for its proper and safe operation. For this reason, the Board perhaps should have cited the handling of the approach by the controller as a contributing factor, since the transmissions from the controller to the aircraft were neither timely nor accurate.

The only available means of conducting an instrument approach to runway 18 at Naha is by precision approach radar. Under such circumstances it is incumbent upon the GCA controller to transmit current and accurate information to the flight including, *inter alia*, the initial descent instruction, glidepath and course information, distance from touchdown, minimum altitude callout, and a position report over the approach lights and over the landing threshold. Finally, the U.S. Air Force procedures require that when a target is within 3 miles from touchdown if the lower edge touches the lower-safe-limit line the controller must immediately issue missed-approach instructions.

At airports where precision approach radar is the sole means of making an approach it is relied upon by the pilot to the same or greater degree as is a fully operative instrument landing system. When an ILS system malfunctions, the crew is immediately alerted by an automatic warning device; however, if the GCA controller's instructions are inaccurate or delayed, a situation comparable to the malfunctioning of an ILS system, the pilot has no such alerting device. Therefore, the GCA controller has a substantial and continuing responsibility for the safe conduct of the approach and landing by issuing timely and accurate instructions. The controller is the fail-safe factor in the loop. It is true that the final decision in any approach—whether to continue or execute a missed approach—rests with the pilot; however, in marginal weather, during the execution of a precision radar approach, pilots have to rely upon the accuracy of GCA instructions to a substantial degree.

However, in this case the transmissions to the aircraft with respect to altitude were delayed and inaccurate from the time the aircraft was first advised to begin its descent 1/2 mile before it reached the published glidepath. From that point onward, according to the flight recorder, the aircraft was below the glidepath until it leveled off at approximately 325 feet. Notwithstanding this fact, the controller consistently advised that the aircraft was on glidepath or only slightly below. Most significantly, the controller was late in advising that the aircraft had reached minimum altitude.

If the crew had been properly monitoring the altimeters they should have been aware of the aircraft's altitude during the approach. However, after they left MDA the approach would be visually executed. In view of the possibility of the Ganzfield phenomena of visual glare, which could have affected not only outside visibility but also their ability to read the cockpit instruments, the crew were probably concentrating upon maintaining contact with the runway environment and relying more upon the GCA altitude transmissions than the altimeters, particularly following the controller's callout of minimum altitude. The GCA callout of minimum altitude was transmitted 5 to 6 seconds after the aircraft descended through the minimum altitude and was at an actual altitude of 75 feet rather than 214 feet. Under the existing meteorological conditions the pilot could have reasonably relied upon the radar altitude advice and been mislead as to the actual altitude. With the aircraft at an altitude of 75 feet and descending at an increased rate because of the wind decay (a 10-15 knot tailwind had been removed) the crew had little or no time to take corrective action before it contacted the water.

The final critical transmission from GCA was also inaccurate and too late. When the aircraft's target touched the lower-safe-limit line at an altitude of approximately 125 feet, the GCA controller was required to issue missed-approach instructions. However, such instructions were not issued until the aircraft had made actual contact with the water. The last transmission from the GCA controller at 1135:46 was "too low for safe approach. Climb immediately one thousand, if runway not in sight maintain runway heading." Unfortunately, the accident had already occurred.

Based upon the foregoing, it would appear that there was a lack of altitude awareness not only by the crew but also by the GCA controller, so that, in effect, there was a failure of the entire system.

Additionally, there should have been a more definitive discussion by the Board with respect to the survivability aspects of the accident. This was a survivable accident, yet three crewmembers died as a result of drowning. The surviving crewmembers were trapped in the inverted cockpit and at least one remained alive for 2-1/2 hours. Perhaps this could not have been avoided, but, nevertheless, the rescue operation was apparently inadequate and poorly organized. None of the rescuers was familiar with the aircraft, particularly with the location of the various exits and the operation of the cockpit entry door which was initially blocked but subsequently pried open when it was too late. No attempt was made to use power cutting tools because of the fear of igniting the kerosene; however, there is a question as to whether the kerosene at the existing temperature would have ignited if power tools had been used. Because of the substantial commercial traffic at Naha the Board should recommend to the U.S. Air Force and all commercial operators that a coordinated rescue disaster plan be established.

FRANCIS H. McADAMS, Member

January 20, 1972

INVESTIGATION AND HEARING

1. Investigation

The Board received notification of the accident at approximately 0030 e.d.t., July 27, 1970, from the Federal Aviation Administration. An investigation team was dispatched immediately to the scene of the accident. Working groups were established to conduct the factfinding processes in the areas of: Operations, Air Traffic Control, Weather, Structures, Systems, Powerplants, Witnesses, and Human Factors.

Participants in the investigation included representatives of Federal Aviation Administration, Douglas Aircraft Company, Pratt & Whitney Division, United Aircraft Corporation, Air Line Pilots Association, U.S. Air Force and The Flying Tiger Lines, Inc.

2. Public Hearing

A public hearing was not held in connection with the investigation of this accident.

3. Preliminary Reports

A preliminary report on this accident was issued September 30, 1970.

CREW INFORMATION

Captain Cleo Monte Treft was 57 years of age. He held Airline Transportation Pilot Certificate No. 79301-41, for airplane multi-engine land, ratings in C-46, CL-44, L-1049H, DC-4, and DC-8 aircraft, commercial privilege in airplane single-engine land and a helicopter rating.

Captain Treft had a first-class medical certificate issued July 16, 1970, with a limitation that he wear corrective lenses for near and distant vision when flying. He initially qualified in the DC-8 on July 21, 1968, and had received his la t instrument proficiency check on February 2, 1970, qualifying for minima of 200 feet and one-half mile visibility. His last captain line check was satisfactorily taken on Marcy 15, 1970.

The following additional pilot data was compiled from Flying Tiger Lines, Inc., records:

Total flying time	12,488.1 hours
Total DC-8-63 flying time as captain	1,381.8 hours
Total flying time, DC-8-63, last 12 months	726.0 hours
Total flying time, DC-8-63, last 90 days	256.4 hours
Total flying time, DC-8-63, last 30 days	81.0 hours
Instrument time, last 90 days	5.0 hours

Captain Treft had been on duty 11:09 hours of the 24-hour period preceding the accident and had a rest period of 12:51 hours during that 24-hour period. He had not flown into Naha Air Base during the 90 day period preceding the accident.

First Officer Robert Emmett Foley was 59 years of age. He held Airline Transport Pilot Certificate No. 38590, airplane multiengine land ratings in DC-4, Lockheed 18, L1049H, C-46 and CL-44, commercial privilege in airplane single-engine land along with a Flight Instructors Certificate No. 38590-CFI.

First Officer Foley had a first-class medical certificate issued January 15, 1970, with a limitation that he wear corrective glasses for near vision when flying. He initially qualified in the DC-8 on December 30, 1968, and received his last instrument proficiency check in the simulator on February 20, 1970. His last first officer proficiency check was successfully completed April 3, 1969.

The following additional pilot data was compiled from Flying Tiger Line , Inc., records.

Total flying time	12,206.0 hours
Total DC-8-63, flying time as first officer	1,157.1 hours
Total flying time, DC-8-63, last 12 months	726.0 hours

Preceding page blank

Total flying time, DC-8-63, last 90 days .... 256.4 hours

Total flying time, DC-8-63, last 30 days .... 81.0 hours

Total instrument time, last 90 days .... 11.5 hours

First Officer Foley had flown into Naha Air Base twice in the 90 day period preceding the accident. There were no indications that he had flown any precision radar approaches on his last instrument proficiency check.

First Officer Foley had been on duty 11:09 hours of the 24-hour period preceding the accident and had a rest period of 12:51 hours during the 24-hour period.

Second Officer William Albert George was 48 years of age. He held Flight Engineer Certificate No. 1360179 with ratings for reciprocal engine, turbopropeller and turbojet powered aircraft.

Second Officer George held a second-class medical certificate issued May 25, 1970, with a limitation that he must wear glasses when flying. He initially qualified in the DC-8 on February 13, 1969, and had successfully passed his last proficiency flight check in the DC-8-63 on February 13, 1969, and a second officer proficiency flight check in the simulator on January 6, 1970.

The following additional flight data was compiled from Flying Tiger Lines, Inc., records:

Total flying time .... 8,988.3 hours

Total DC-8-63, flying time .... 813.5 hours

Total DC-8-63, flying time last 90 days .... 211.4 hours

Total DC-8-63, flying time last 30 days .... 45.2 hours

Navigator Walter Marshall Roberts was 46 years of age. He held Flight Navigator Certificate No. 1701527 and possessed a second-class medical certificate issued May 13, 1970, with a limitation that he wear corrective glasses when flying. He initially qualified in the DC-8, August 23, 1968, and successfully passed his last proficiency check July 26, 1970.

The following additional flight data was compiled from the Flying Tiger Lines, Inc., records:

Total flying time .... 2,484.6 hours

Total DC-8-63 flying time .... 1,314.2 hours

Total DC-8-63 flying time, last 12 months .... 879.6 hours

Total DC-8-63 flying time, last 90 days .... 203.6 hours

Total DC-8-63 flying time, last 30 days .... 74.6 hours

Navigator Roberts had been on duty 11:09 hours of the 24-hour period preceding the accident and had a rest period of 12:51 hours during the 24-hour period.

APPENDIX C

AIRCRAFT INFORMATION

The DC-8-63F, registration No. N785FT, serial No. 46005, was manufactured November 9, 1968, and was purchased by Flying Tiger Lines, Inc., on November 19, 1968. It had accumulated a total of 9.2 hours at that time. The airworthiness certificate was issued by the FAA on November 20, 1968. At the time of the accident, N785FT had accumulated 6047.2 hours since new.

The aircraft was powered by four Pratt & Whitney, Model JT3D-7 turbojet engines, each rated at 19,000 pounds takeoff thrust. At the time of the accident the engines had been in operation the following number of hours and cycles.

No. 1 Position	S/N 671136	5273.8 hours	2020 cycles
No. 2 Position	S/N 671074	3507.6 hours	1518 cycles
No. 3 Position	S/N 671039	4468.0 hours	1883 cycles
No. 4 Position	S/N 671045	4119.6 hours	1510 cycles

At the time of the accident, N785FT was configured "Condition C-6" for cargo operation. The last reweight was accomplished on October 29, 1968, at which time the following data was recorded.

Configuration	Condition-6
Aircraft	Cargo
Crew Seats	7 forward
Maximum Gross Weight	353,000 pounds
Maximum Taxi Weight	358,000 pounds
Maximum Zero Fuel Weight	261,000 pounds
Maximum Landing Weight	275,000 pounds
Empty Weight	142,142 pounds
Basic Reference Number (Aft Datum Line)	397.0 inches

The last service check was performed on July 9, 1970, at the company's Los Angeles, California, maintenance base. Aircraft total time was recorded as 5870.2 hours.

The last daily check was performed on July 23, 1970, at the Los Angeles facility. A[illegible] total time was recorded as 6008.2 hours.

The last trip check was performed on July 25, 1970, at the Los Angeles maintenance facility. Aircraft total time was recorded as 6032.0 hours.

The last ground service check and the maintenance release were accomplished at the company maintenance base at Tokyo, Japan, on July 27, 1970. Aircraft total time was recorded as 6045.1 hours.

On June 6, 1969, N785FT was involved in a minor incident at Detroit, Michigan. During the landing roll, at about 80 knots, the aircraft went off the right side of the runway and came to rest in a dirt area adjacent to the runway. Minor damage occurred to the aircraft.

APPENDIX D

NATIONAL TRANSPORTATION SAFETY BOARD
Washington, D. C. 20591

TRANSCRIPT OF COCKPIT VOICE RECORDER,
FLYING TIGER LINE, INC., DOUGLAS DC-8-63F, N785FT,
NAHA AIR BASE, OKINAWA, RYUKYU ISLANDS, JULY 27, 1970

LEGEND

CAM	-	Cockpit area microphone channel
RDO	-	Radio transmissions
GCA	-	Radio transmissions by Naha AB Radar Controllers
FT785	-	Radio transmissions from aircraft made by the Captain
-1	-	Voice identified as that of Captain
-2	-	Voice identified as that of First Officer
-3	-	Voice identified as that of Flight Engineer
-4	-	Voice identified as that of Navigator
-?	-	Voice unidentified
-#	-	Nonpertinent word or phrase
-*	-	Nonpertinent radio transmissions
UNINTEL	-	Unintelligible conversation
( )	-	Words enclosed parentheses are not clearly heard or understood. The words shown represent the best presently achievable interpretation of recorded speech.

The times shown are Okinawan Local Times, based on the 24-hour clock.

CONTENT

RDO Transmissions Time		CAM Channel/Crew Conversation Time	
1129:27 - FT785 :	Naha GCA Tiger seven eight five level at -ah- one thousand.		
1129:31 - GCA :	Flying Tiger seven eight five Naha GCA, hear you loud and clear, ident.		
1129:38 - GCA :	Flying Tiger seven eight five radar contact one eight miles northwest of airport altimeter two niner eight three, perform landing check.		
1129:46 - FT785 :	-ah- Roger.		
1129:54 - GCA :	Flying Tiger seven eight five -ah- construction equipment left side of runway at approach end, also equipment right side of runway at three thousand foot remaining marker.		
1130:06 - FT785 :	Understand.		
1130:08 - GCA :	Flying Tiger seven eight five turn left heading one zero zero		
		1130:14 - ? :	Yeah, you're right –
		- ? :	Hell, hell yes.
		:	Unintelligible
		1130:24 - ? :	(You can't out guess 'em)

CONTENT

RDO Transmissions Time		CAM Channel/Crew Conversation Time	
1130:28 - GCA :	Flying Tiger seven eight five if no transmission received for five seconds on final approach, attempt contact tower one one eight point UNINTEL if VFR.		
1130:36 - FT785:	-ah- Roger.		
		1130:53 - 2 :	It's raining over there.
		- 1 :	Yeah, oh yeah that showers around here.
		1130:57 - 1 :	One over here and one (down) here.
		- ? :	(if they turn GCA around then they're pretty)
		- ? :	(turn on the rain removal)
		- ? :	Yeah
		1131:09 - 1 :	According to that (O-KEE Beacon)
		- ? :	UNINTEL
1131:13 - GCA :	Flying Tiger seven eight five turn right one five zero maintain one thousand, dog leg to final.		
1131:20 - FT785:	One fifty.		
		1131:27 - 2 :	Check list

30

CONTENT

RDO Transmissions Time		CAM Channel/Crew Conversation Time	
		1131:29 - 3 :	(Hydraulic) pumps?
		1131:30 - 1 :	On
		1131:32 - 3 :	Flaps and slots
		1131:34 - 1 :	Well, we got -ah-
		- ? :	Twenty-three so far
		- 1 :	Twenty-three and the lights are out
		- 3 :	(you're on the line)
		1131:40 - 1 :	Come on you mothers.
		- ? :	UNINTEL
		1131:44 - 1 :	Three green
		1131:45 - ? :	Okay
1131:46 - GCA :	Flying Tiger seven eight five		
1131:48 :	be advised - ah have reduced visibility on final - ah tower just advised approach lights and strobe lights are on - - - turn right heading on one eight zero.		
1131:59 - FT785 :	Ah, Roger	1132:04 - 1 :	Ok go ahead with the - ah.

CONTENT

RDO Transmissions Time		CAM Channel/Crew Conversation Time	
		1132:06 - 3 :	Gear
1132:07 - GCA :	* * * (transmission to Departure Aircraft) * * *		
		- 1 :	Three green
		- 3 :	Ignition override
		1132:10 - 1 :	On
		1132:13 - 3 :	Radio altimeters
		1132:14 - 1 :	(I gotta) set
		- ? :	Rog.
		1132:20 - 3 :	And spoilers
		1132:23 - :	(chick sound)
		- 1 :	(they're armed)
		- 3 :	(the hydro quantity)
		- ? :	(UNINTEL) pressure is
		1132:26 - 1 :	Normal and (full) UNINTEL
1132:27 - GCA :	Flying Tiger seven eight five (Film) four eight [illegible] one six.		Sound of trim horn

CONTENT

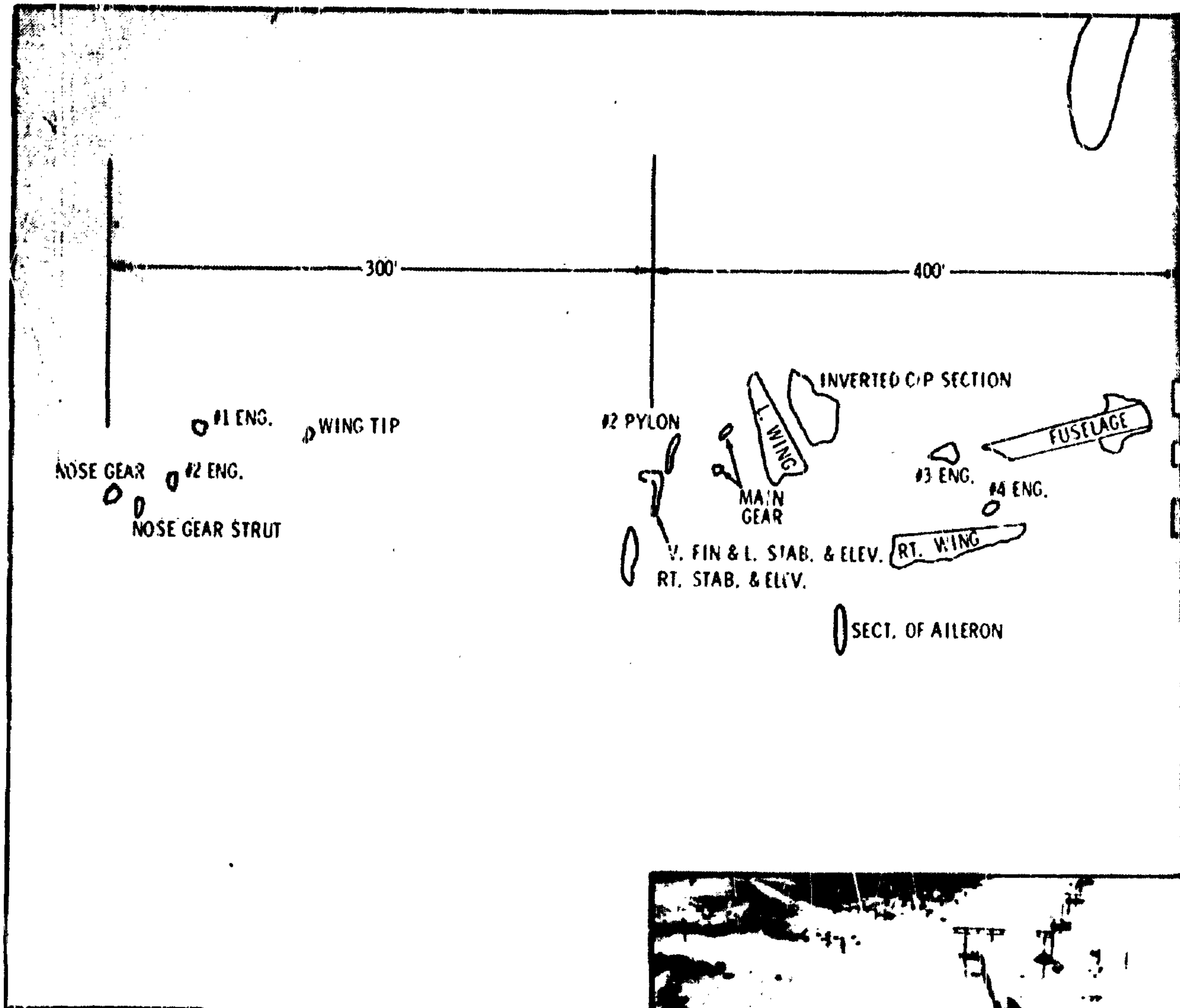
RDO Transmissions Time		CAM Channel/Crew Conversation Time	
1132:32 - FT785 :	-ah- Roger	1132:40 - 1 :	Rain shower
		1132:42 - ? :	Right over the # field
1132:46 - GCA :	Flying Tiger seven eight five, Film four eight, new altimeter two niner eight four.		
1132:51 - FT785 :	Eight four		
1132:56 - GCA :	Flying Tiger seven eight five. NAHA GCA final controller how do you hear?	1132:52 - 2 :	We had that before
- FT785 :	Loud and clear.		
1133:01 - GCA :	Roger loud and clear also here radar contact eight and one half miles from touchdown on final approach do not acknowledge further transmissions - - - turn right one eight three left of course - - - -	1133:20 - 1 :	Ah ya might as well get (yourself set)
1133:13	eight miles from touchdown heading one eight three - - - turn right heading one eight five well left of course - - - -	- 2 :	OK
		- ? :	(I wanta get,) UNINTEL
		- :	(you oughta get)
		1133:27 - ? :	(be my, yeah that's alright get 'em all down)
	- - - heading is one eight five,	- 1 :	Thirty (five)

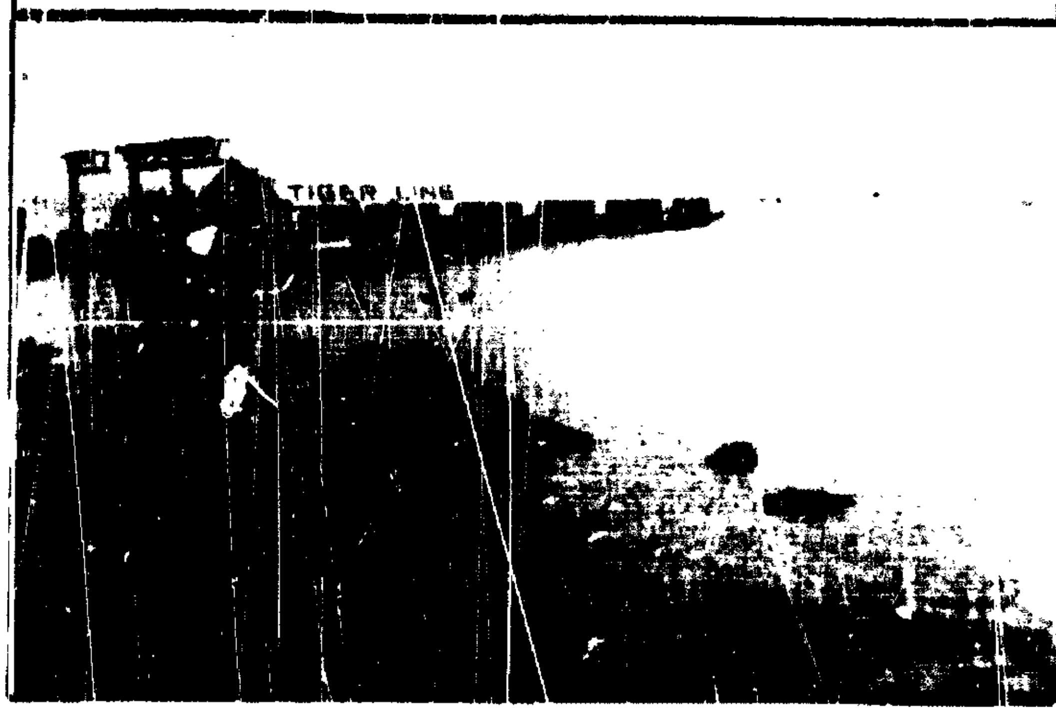
CONTENT

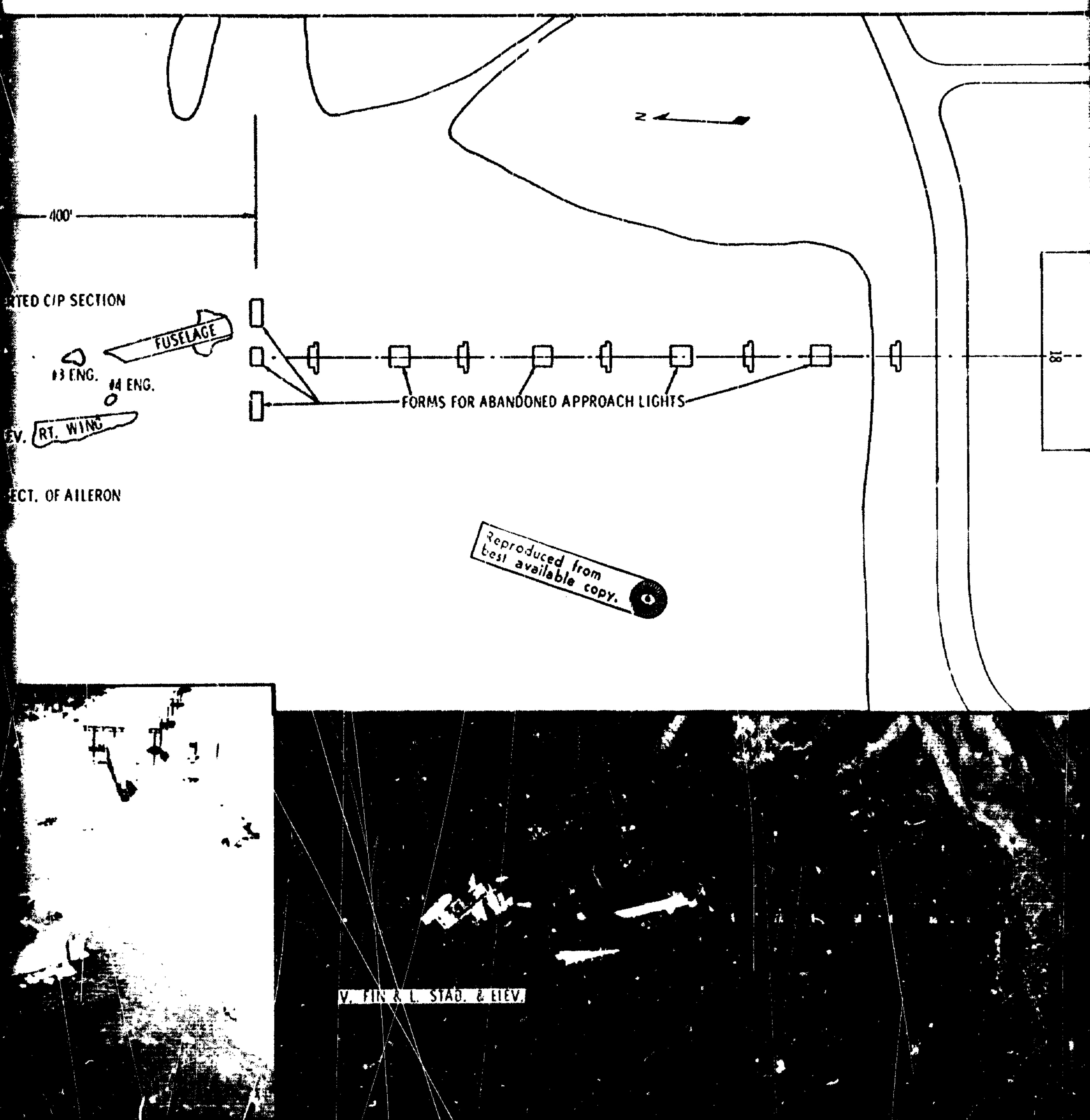
RDO Transmissions Time		CAM Channel/Crew Conversation Time	
1133:33	seven miles from touchdown - - - heading one eight five correcting to the on course - - - slightly left of course heading one eight five.	1133:37 - 1 :	Full coming down
		1133:47 - ? :	UNINTEL (standby the air controller)
		1133:49 - 2 :	Yeah (it's coming)
1133:51	Six miles from touchdown, slightly left of course, then turn left heading one eight three - - - heading is one eight three, slightly left of course correcting slowing to the on course - - - approach glide path wheels should be down heading one eight three - - -		
1134:14	Five miles from touchdown - - - wind zero two zero degrees at one zero, you're cleared to land - - - turn right heading one eight five maintaining slightly left of course, begin descent - - -	1134:18 - ? :	(your)
1134:35	- - - four miles from touchdown heading one eight five, turn left heading one eight three - - - on glide path, turn left heading one eight zero - - - on glide path going slightly right of course turn left heading one seven eight		chick sound audible
1134:53	- - - three miles from touchdown dropping slightly below glide path. - - - heading is one seven eight on glide path now, slightly right of course, correcting to the on course - - - heading one seven eight turn right one eight zero,		

CONTENT

RDO Transmissions Time		CAM Channel/Crew Conversation Time	
		1135:07	Sound similar to windshield air or heavy rain begins.
1135:14	two miles from touchdown - - - on course turn right heading one eight three, dropping slightly below glide path, heading one eight five - - - ya have a ten knot tail		
			(noise continues at steady level)
1135:34	wind on glide path, turn right heading one eight seven		
1135:37	one mile from touchdown slightly left of course turn left heading one eight five - - - turn left heading one eight two,		
		1135:42 - ? :	hundred feet
1135:43	at minimum altitude going well below glide path, too low/1135:46		
		1135:44 - ? :	seventy feet
		1135:44.5 ? :	It's fifty feet/1135:45.5
		1135:45.5	Sound of electrical interruption to recorder
		1135:46	End of recording.

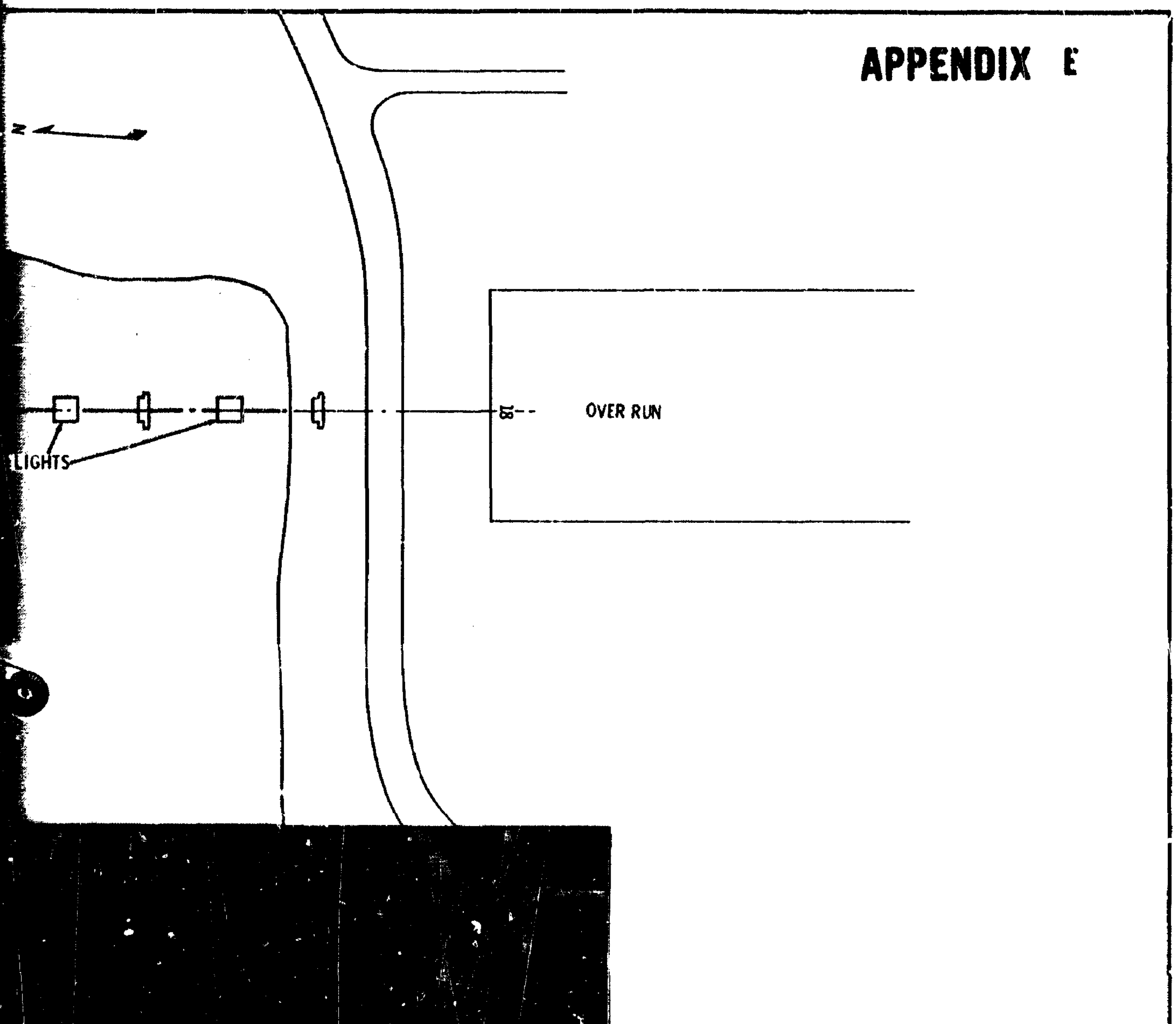

300'
400'
INVERTED C/P SECTION
#1 ENG.
WING TIP
#2 PYLON
L. WING
FUSELAGE
NOSE GEAR
#2 ENG.
MAIN GEAR
#3 ENG.
#4 ENG.
NOSE GEAR STRUT
V. FIN & L. STAB. & ELEV.
RT. WING
RT. STAB. & ELEV.
SECT. OF AILERON


TIGER LINE



400'
RTED C/P SECTION
FUSELAGE
#3 ENG.
#4 ENG.
EV.
RT. WING
ECT. OF AILERON
FORMS FOR ABANDONED APPROACH LIGHTS
18
V. FIN & L. STAB. & ELEV.

APPENDIX E



NATIONAL TRANSPORTATION SAFETY BOARD
DEPARTMENT OF TRANSPORTATION
Washington, D.C.

WRECKAGE DISTRIBUTION CHART
FLYING TIGER LINE, INC.
DC-8-63F, N 785 FT
NAHA, OKINAWA
July 27, 1970

NATIONAL TRANSPORTATION SAFETY BOARD
Washington, D.C. 20591

Veiling Glare Hypothesis, Dr. Conrad L. Kraft, The Boeing Company

To illustrate this hypothesis and other phenomena, reference is directed to the attached diagram.

From the description of the weather conditions at Naha on July 27, 1970, the average illuminance of the sky on a hazy day, at noon, at position A in the diagram would have been about 5,000 millilamberts (ml)[1]. As it would have back-lighted the light rain area B, a veiling glare would have been produced by illumination of the rain particles from some 40° off the line of sight, which was along the aircraft flightpath. Assuming that transmissivity was .05 miles and the light rain area was 1,200 feet deep, then the brightness of the near rain drops was about 1,000 ml. The runway at C, however, was in an area of general overcast and would have had a brightness of 22.8 ml,[2]. The black skid marks on the runway might have reflected a lower value, say 10 percent of this illuminance. Then, if the black marks covering the end of the runway might be considered the object of highest contrast against the light colored soil around the end of the runway, the visual contrast ratio would have been

$$\frac{22.8 - (0.10 \times 22.8)}{22.8} \times 100 = 90\%$$

Ninety percent contrast at 22.8 ml. would have been sufficient for the end of runway to be seen, but between the pilot's eyes and the runway was the 1,200 feet veil of back-lighted rain of an estimated 1,000 ml. brightness. Insertion of this factor into the contrast formula produces a contrast ratio of about 2 percent:

$$\frac{(1022.8 - 1002.28)}{1022.8} \times 100 = 2\%$$

It would have been possible for the pilots to see the very low contrast target but it would have been very difficult. Moreover, other factors became relevant.

The 1,200 feet of back-lighted rain would have given the pilots a meteorological optical range of only 660 to 1,320 feet, similar to moderate to thick fog.[3]

On emerging from the heavy rain shower the pilots have entered the area of relatively high brightness between them and the runway, after having been in an area of about 11 ml. to 110 ml. brightness for some 30 seconds or more. Some dark adaptation would therefore have

[1]Morgan, C. T.; Chapinis, A.; Cook, S. E.: Lund, N. W.; Human Engineering Guide to Equipment Design, P. 64, 1963; McGraw Hill Book Company. For a reference to millilamberts and other photometric measures. see Judd, D. B., Basic Correlates of the Visual Stimulus, Handbook of Experimental Psychology, Edited by S. S. Stevens, 1960, John Wiley & Sons, Inc., New York, New York.

[2]Blackwell, R.; Light and Vision, Section 2, Illuminating Society Lighting Handbook, page 2.27, Edited by I. E. Kaufman, 1966, I.E.S. Society New York, N. Y.

[3]Blackwell, supra note 2, at 2.27.

begun but in 30 seconds it would have been minimal. However, under the circumstances, exterior visual references on which to fixate or accommodate would have been nonexistent on transference of vision from inside to outside the cockpit. Although men of the pilots' ages, wearing near vision corrective lenses, would have had to accommodate by only one diopter at most, recent data indicates that this would require from 6 to 8 seconds.[4] With the lack of anything outside the cockpit on which to focus the eyes, incomplete focusing would result. This along with the sudden appearance of the relatively high brightness of the back-lighted rain would have effectively presented the pilots with an illuminated Ganzfield.[5]

Unlike total darkness wherein one does not expect to see things, the lighted Ganzfield often makes the individual conscious of both the severe visual disorientation present and the uncertainty as to where he is looking. In this instance, such a condition would have produced a very serious problem for pilots hurriedly attempting to locate a single object – the runway. It has been shown that under similar experimental conditions, observers took as long as 20 seconds to locate an object six times larger than a runway threshold.[6]

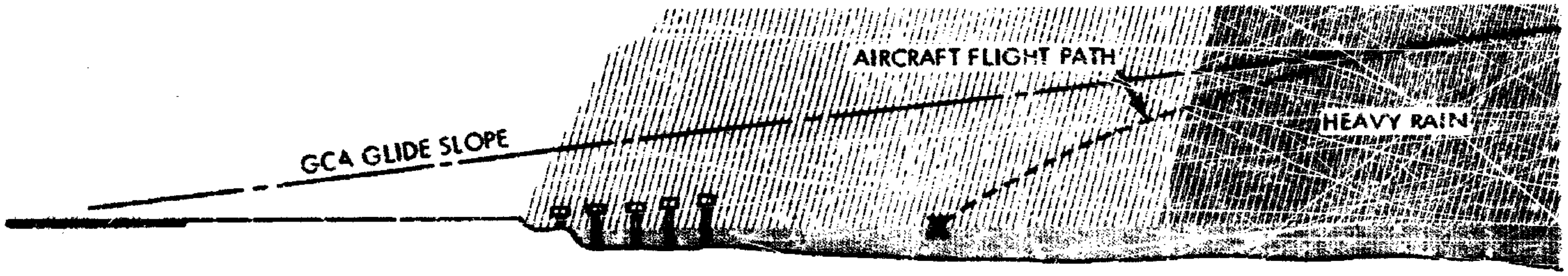
Consequently, under the meteorological conditions present at the time of the accident, the pilots may have been faced with a series of phenomena, any one of which, by itself, would not have precluded visual acquisition of the runway. However, when combined together as (1) the veiling glare, (2) restricted optical range, (3) incomplete visual accommodation, and (4) the sudden appearance of a back-lighted, high intensity Ganzfield with its possible disorientation effects, it would appear that acquisition may have been effectively denied.

---

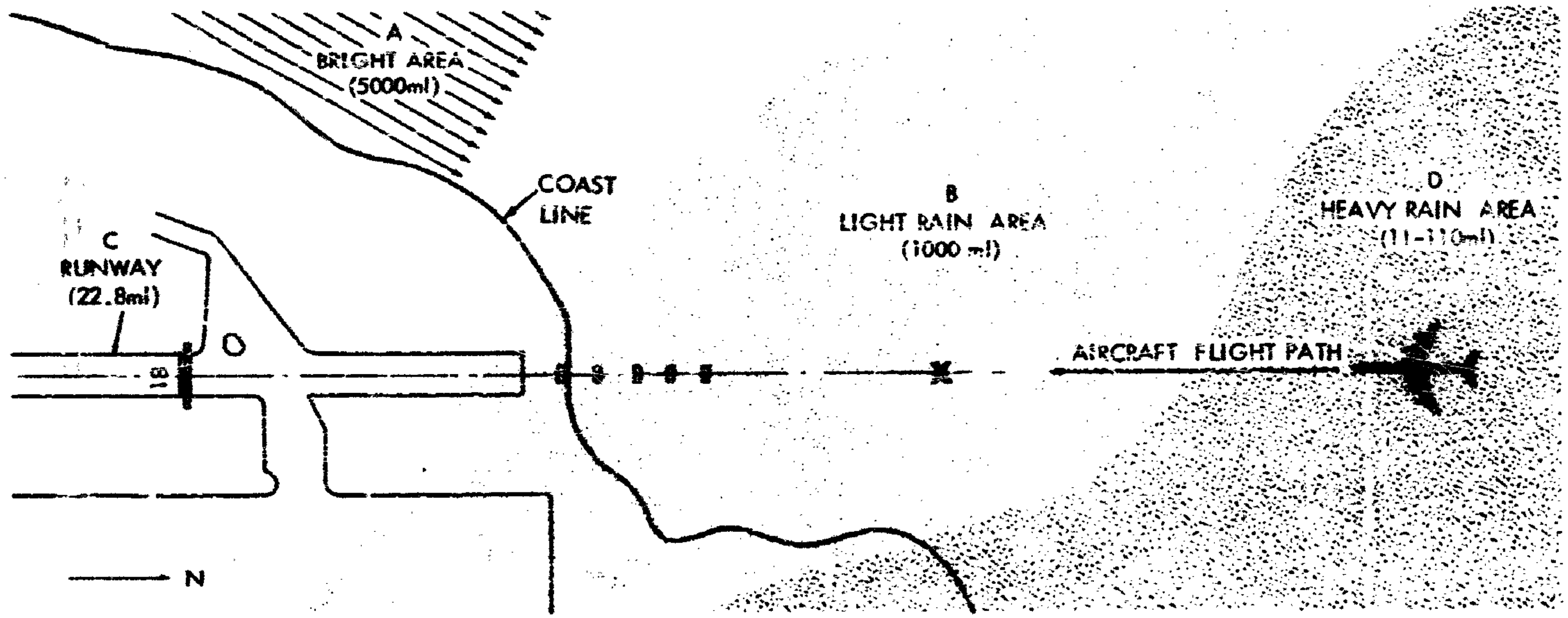
[4] Elworth, C. L. and Larry, C., Measurement of Near to Far Visual Refocusing Time. The Boeing Company, 1970. (In Press.)

[5] An Illuminated Ganzfield is described as a homogenous visual field of similar brightness in which no differentiating objects can be seen. Miller, J. W. and Hall, R. J. "The Problems of Motion Perception and Orientation in the Ganzfield," Visual Problems in the Armed Forces, M. A. Whitcomb, Editor, National Academy of Sciences, N. R. C. Washington, D. C. 1961.

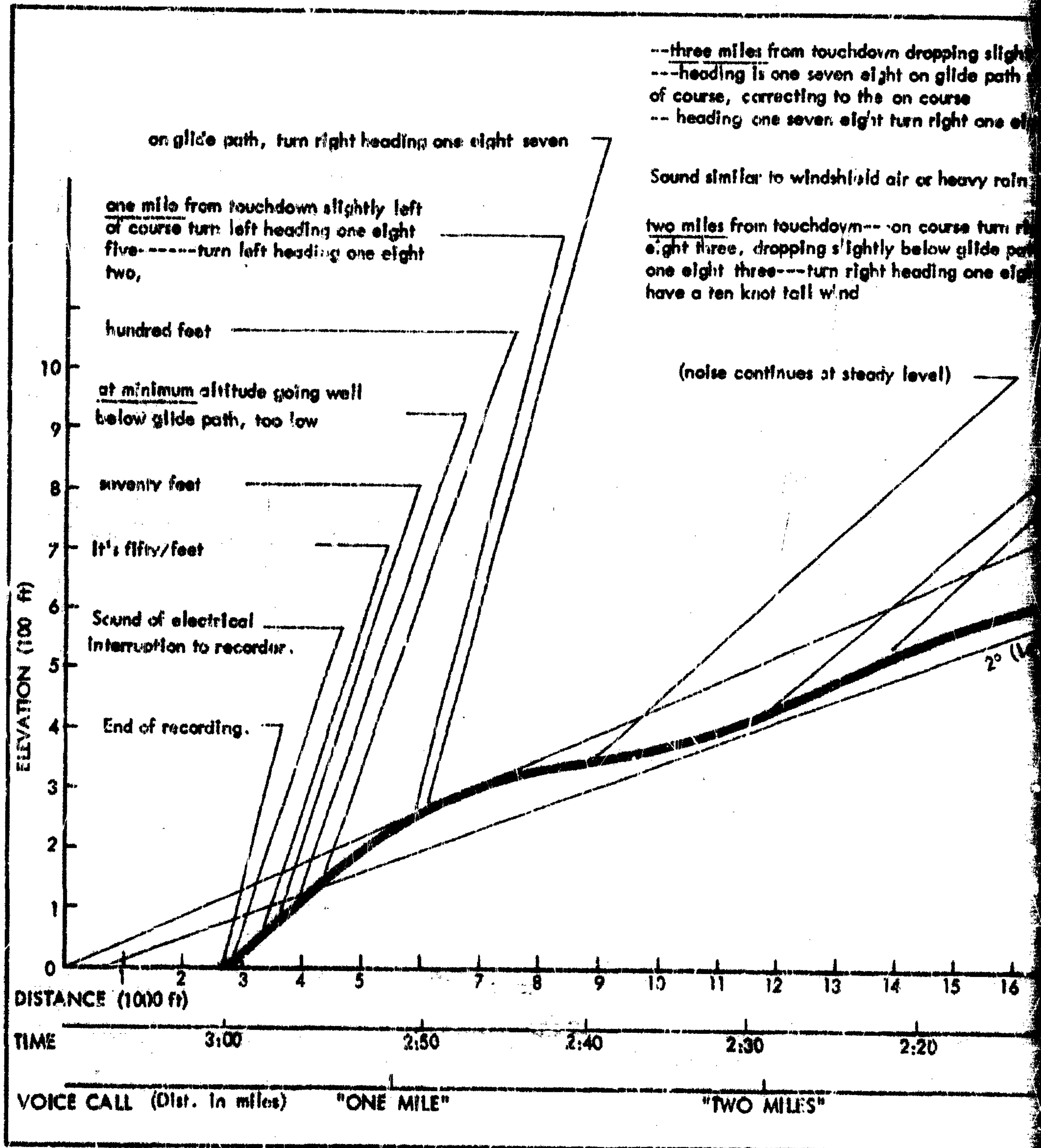
[6] Miller, J. W. and Ludvigh, "Time Required for Detection of Static and Moving Objects as a Function of Size in Homogenous and Partially-Structured Visual Fields," U. S. Navy School of Aviation Medicine. 1959, No. 15, Project NM 10-99, Pensacola, Florida.

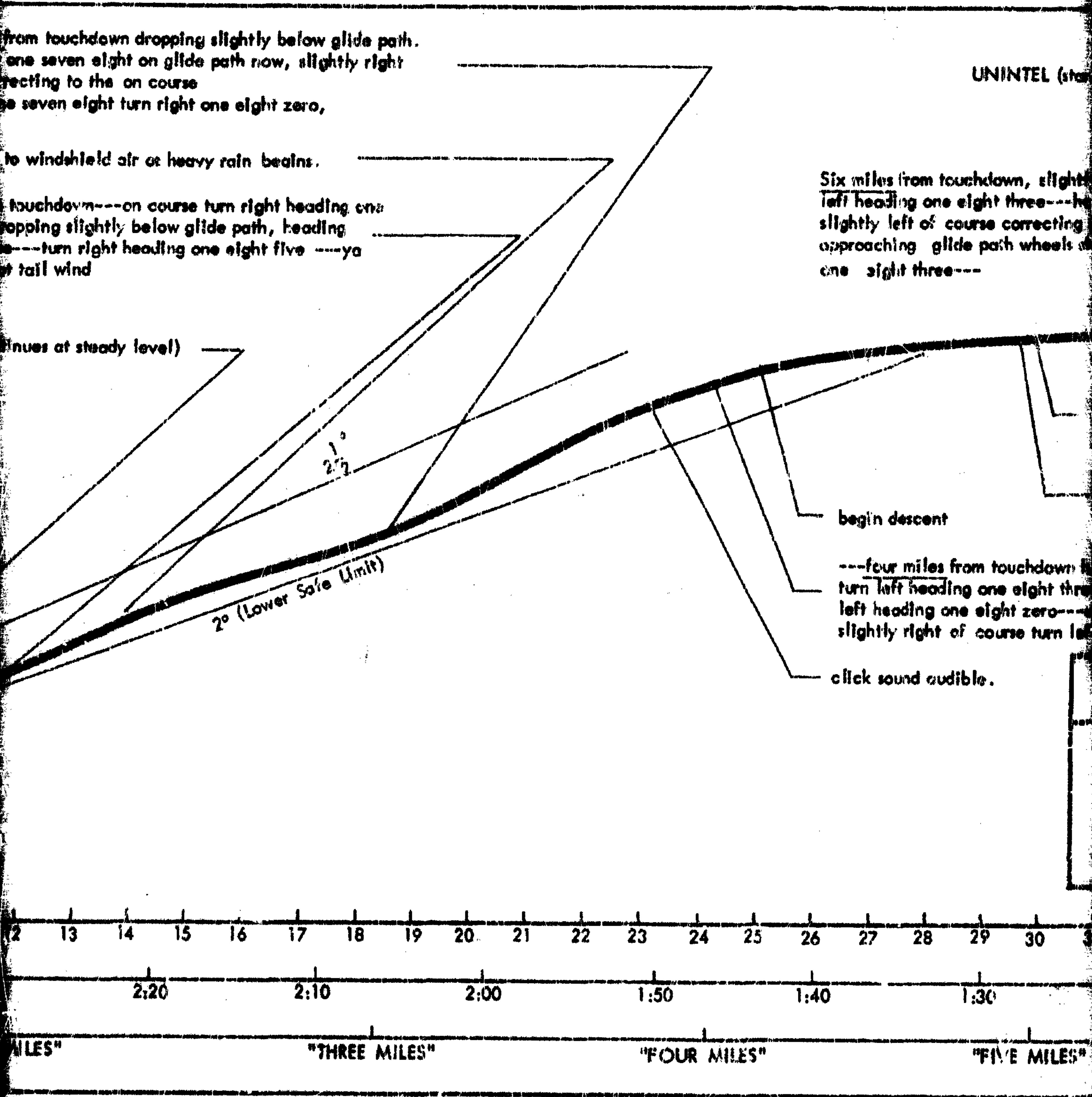


ELEVATION VIEW



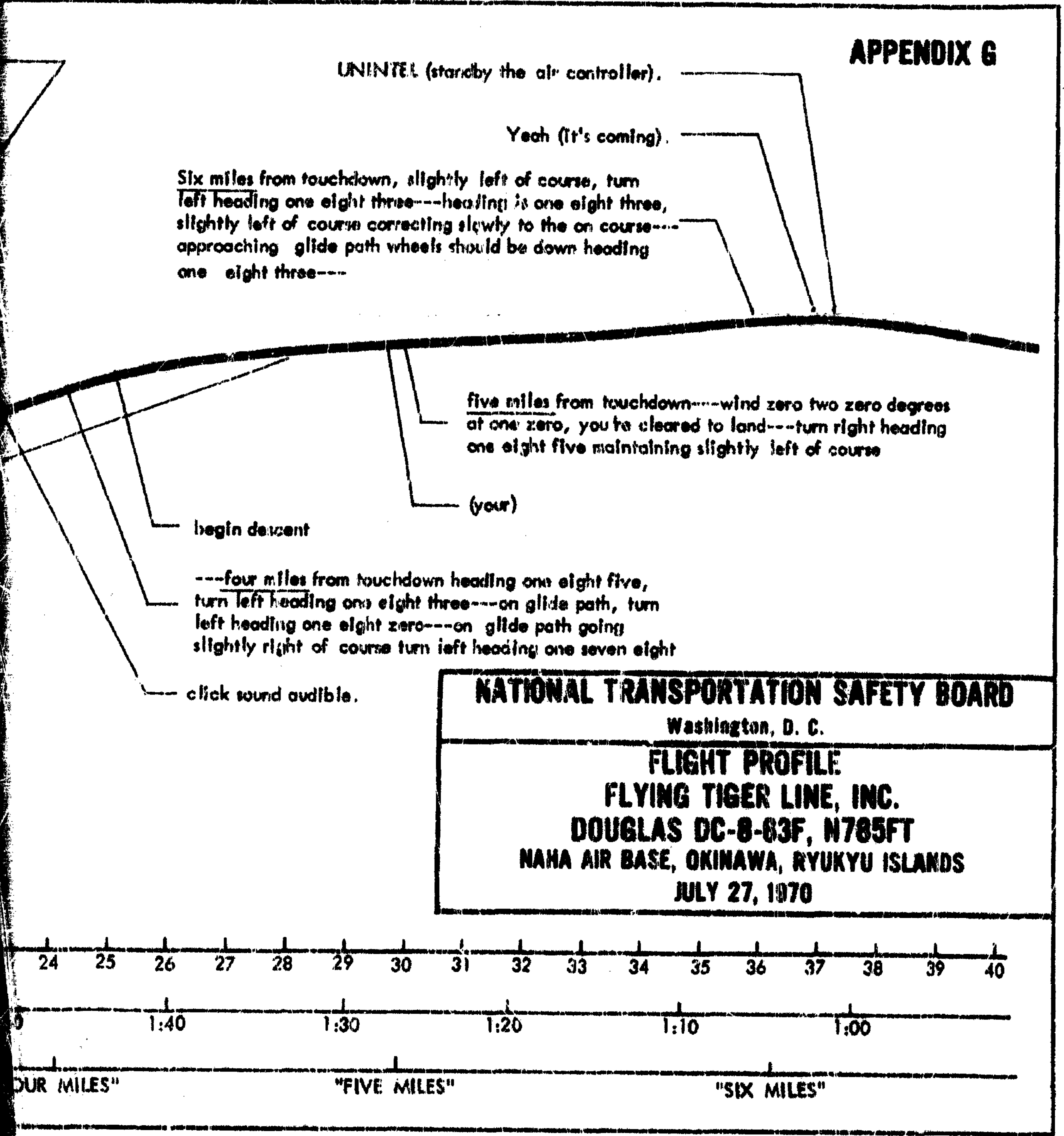
PLAN VIEW


--three miles from touchdown dropping sligh
---heading is one seven eight on glide path
of course, correcting to the on course
-- heading one seven eight turn right one ei
on glide path, turn right heading one eight seven
Sound similar to windshield air or heavy rain
one mile from touchdown slightly left of course turn left heading one eight five--------turn left heading one eight two,
two miles from touchdown---on course turn ri
eight three, dropping slightly below glide pa
one eight three---turn right heading one eig
have a ten knot tail wind
hundred feet
(noise continues at steady level)
at minimum altitude going well below glide path, too low
seventy feet
It's fifty/feet
Sound of electrical interruption to recorder.
End of recording.
ELEVATION (100 ft)
DISTANCE (1000 ft)
TIME
3:00
2:50
2:40
2:30
2:20
VOICE CALL (Dist. in miles)
"ONE MILE"
"TWO MILES"



from touchdown dropping slightly below glide path.
one seven eight on glide path now, slightly right
recting to the on course
e seven eight turn right one eight zero,
to windshield air as heavy rain begins.
touchdown---on course turn right heading one
ropping slightly below glide path, heading
e---turn right heading one eight five ---ya
t tail wind
inues at steady level)
UNINTEL (sta
Six miles from touchdown, slight
left heading one eight three---h
slightly left of course correcting
approaching glide path wheels
one eight three---
1°
2½
2° (Lower Safe Limit)
begin descent
---four miles from touchdown
turn left heading one eight thr
left heading one eight zero---
slightly right of course turn le
click sound audible.
12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 30
2:20 2:10 2:00 1:50 1:40 1:30
ILES"
"THREE MILES"
"FOUR MILES"
"FIVE MILES"

APPENDIX G



NATIONAL TRANSPORTATION SAFETY BOARD
Washington, D. C.

FLIGHT PROFILE
FLYING TIGER LINE, INC.
DOUGLAS DC-8-63F, N785FT
NAHA AIR BASE, OKINAWA, RYUKYU ISLANDS
JULY 27, 1970

NATIONAL TRANSPORTATION SAFETY BOARD
DEPARTMENT OF TRANSPORTATION
WASHINGTON, D.C.

January 17, 1969

Mr. David D. Thomas
Acting Administrator
Federal Aviation Administration
Department of Transportation
Washington, D.C. 20590

C
O
P
Y

Dear Mr. Thomas:

Accidents which occur during the approach and landing phase of flight continue to be among the most numerous. They are again highlighted by some of the events of the past month that have aroused nationwide interest in air safety. Most approach and landing accidents have been attributed to improper operational procedures, techniques, distractions, and flight management. In many cases vertical/horizontal wind shear, forms of turbulence, and altimetry difficulties were, or could have been contributing factors. The phenomenon of breaking out into visual flight conditions and subsequently becoming involved in patches of fog, haze, rain, blowing snow and snow showers and other visibility obscuring forms of precipitation seems to be fairly common occurrence. The sensory illusion problem associated with night approaches over unlighted terrain or water is another likely factor about which more is being learned daily.

Other related factors are the handling characteristics of our transport type aircraft in day-to-day operations, the absence or outage of glide slope facilities, cockpit procedures, possible effects of snow or rain on dual static port systems as they could affect altimetry accuracy, and altitude awareness. These are all factors which may exist singularly or in combination. The inability to detect or obtain positive evidence, particularly such evidence as ice accretion or moisture which becomes lost in wreckage, makes it difficult, if not impossible, in many cases to reach conclusions based upon substantial evidence. It is clear that had all ground and airborne navigational systems been operating accurately *and* had the flight crews been piloting with meticulous reference to properly indicating flight instruments, these accidents would not have occurred.

In this light, and with the number and frequency of approach and landing phase accidents under similar weather and operating environments, we believe that certain immediate accident prevention measures need to be taken. We believe that preliminary to the successful completion of our investigations into the factors and causes of the recent rash of accidents, renewed attention to, and emphasis on, recognized good practices will tend to reduce the possibilities of future accidents.

Pilots, operators and the regulatory agencies should renew emphasis on—and improve wherever possible—cockpit procedures, crew discipline, and flight management. It is recommended that both the air carrier industry and the FAA review policies, procedures, practices, and training toward increasing crew efficiency and reducing distractions and nonessential crew functions during the approach and landing phase of the flight. It is specifically recommended that crew functions not directly related to the approach and landing, be reduced or eliminated, especially during the last 1000 feet of descent. Accomplishment of the in-range and landing check lists as far as possible in advance of the last 1,000-foot descent will allow for more intense and perhaps more accurate cross checking and monitoring of the descent through these critical altitudes.

It is also recommended that during the final approach one pilot maintain continuous vigilance of flight instruments--inside the cockpit--until positive visual reference is established.

In order to induce a renewed altitude awareness during approaches where less than full precision facilities exist, it is recommended that there be a requirement that during the last 1000' of final approach the pilot *not* flying call out altitudes in 100-foot decrements above airport elevation (in addition to airspeed and rate-of-descent). To further enhance altitude awareness within the cockpit, it is recommended that there be a requirement to report indicated altitude to Air Traffic Control at various points in the approach procedure such as the outbound procedure turn and at the outer marker position.

Consistent with and in support of the concept inherent in your Notice of Proposed Rulemaking No. 67-53, the Board urges the aviation community to consider expediting development and installation of audible and visible altitude warning devices and the implementation of procedures for their use. Additional improvements, although desirable now, are attainable only through continued research and development.

The reassessment of altimetry systems with particular regard to their susceptibility to insidious interference by forms of precipitation needs to be the subject of attention by the highest level of aeronautical research facilities and personnel. Toward this end, we are meeting with members of your staff, the National Aeronautics and Space Administration and various segments of the aviation community to initiate an assessment of possible failure modes and effects within the static system.

The possibility of development of additional altitude warning systems--external to the aircraft--needs to be explored by the aviation community. One such possibility would be a high intensity visual warning red light beam--projected up along and slightly below the desired approach glide slope--to warn of flight below the desired path.

Likewise, development is needed in the fields of radio/radar, and inertial altimetry and CRT/microwave pictorial display approach aids as possible improved replacement of the barometric altimetry system in the near future.

Modified use of existing approach radar should be further studied with regard to its adaptability as a surveillance--accident prevention--tool for nonprecision instrument approach.

During the time that we press for answers as to the causes of a number of these recent accidents, the Board urges increased surveillance, more frequent and more rigorous inspection and maintenance of altimetry systems by both the air carrier operators and the FAA: and urges also that the FAA reexamine certification requirements and procedures to determine if there is a possibility of a single failure mode of nominally dual systems which, when combined with an already existent passive failure or inadequate cockpit procedures, can invalidate dual failure protection features.

Whereas these problems have been highlighted by air carrier accidents, they should not be construed as being unique to air carrier aviation. The Safety Board considers that they are applicable to all forms of air transportation.

We know that your Administration, as well as other responsible segments of the aviation community, have been working extensively in all of these areas.

We appreciate your continuing emphasis on the safety of air carrier operations as evidenced by recent communications with your inspectors and airline management.

Your views regarding the implementation of our suggestions will be welcome.

Sincerely yours,

/s/ Joseph J. O'Connell, Jr.
Chairman

DEPARTMENT OF TRANSPORTATION
FEDERAL AVIATION ADMINISTRATION

WASHINGTON, D.C. 20590

C
O
P
Y

OFFICE OF
THE ADMINISTRATOR

Feb. 6, 1969

Honorable Joseph J. O'Connell, Jr.
Chairman, National Transportation Safety Board
Department of Transportation
Washington, D. C. 20591

Dear Mr. Chairman:

I have your letter of January 17, 1969, which contained suggestions and recommendations for the prevention of accidents during the approach and landing phase of flight.

My letter of January 28, 1969, commented on a number of the items covered in your January 17 letter. Therefore, I will not repeat them here, except to reiterate that our immediate concern and followup actions are directed to the areas of adherence to established procedures, altitude awareness, winter operating procedures, and cockpit discipline and vigilance.

Our comments concerning the matters discussed in your letter are as follows:

1. Reduce distractions and non-essential crew functions during approach and landing. Instructions to our inspectors require them to review on a continuing basis cockpit check lists and procedures to assure that minimum checking will be done during the more critical periods of flight such as departures, approaches, and landings.

2. Use of in-range and landing check lists. We believe the airlines require all cockpit check procedures, particularly the in-range check list, to be completed well before the last 1,000 feet of descent. However, we will request our inspectors to doublecheck and take action where warranted.

3. Cockpit vigilance. The instructions to our inspectors referred to in item 1 above also require them to assure that cockpit check procedures are arranged so that the pilot flying devotes full attention to flight instruments. As stated in my letter of January 28, 1969, crew vigilance and cockpit discipline is one of the areas stressed in my wire to the airline presidents.

Preceding page blank

4. Altitude awareness. Over two and one-half (2½) years ago, instructions were issued to our inspectors to be sure the airlines emphasized in training and included in company manuals altitude awareness procedures to be used during climbs, descents, and instrument approaches. This is one of the areas on which we asked our inspectors to place emphasis during the accelerated inspections mentioned in my January 28 letter.

   Your letter recommended that during the last 1,000 feet of the final approach the pilot not flying be required to call out altitudes in 100 foot increments. The altitude awareness procedures that we have asked the carriers to adopt require the pilot not flying to call out, during the final 1,000 feet of the approach, 500 feet above field elevation, 100 feet above minimums, and minimums. We believe this procedure is preferable, since it served to keep cockpit conversation to a minimum and at the same time, assures pilot altitude awareness. This procedure also reduces pilot workload.

5. Pilot reports to ATC of altitudes during instrument approaches. Adoption of this suggestion would significantly increase frequency congestion and increase crew and controller workload. We believe our efforts in the areas of pilot training and education will prove to be the most beneficial course of action.

6. Altitude alerting devices. I appreciate your support of the rule which became effective on September 28, 1968, which will require by February 28, 1971, both visual and aural altitude alerting signals to warn pilots of jet aircraft when approaching selected altitudes during climbs, descents, and instrument approaches.

7. Altimetry systems. With respect to your suggestion that an assessment be made of possible failure modes of altimeter static systems, we plan to participate with NASA and the aviation industry to assist in such a program. Development and testing to validate such improvements will be required. At this time, we know of no practical replacement for the barometric altimeter.

8. Additional altitude warning systems. Your suggestion concerning visual glide path warning would not provide complete information concerning the optimum glide path as does the Visual Approach Slope Indicator (VASI) systems which are installed at many runways throughout the country. We plan to continue to install these systems in accordance with current criteria within the limits of funds appropriated for this purpose.

9. Development to replace barometric altimeter systems. The use of inertial altimetry could be investigated, but must be considered as a long range R&D program. CRT/microwave pictorial display (radar mapping) has been evaluated by the military as an additional approach aid monitor. The FAA as yet does not have detailed information, since this equipment, until recently, was classified. However, we plan to obtain additional information and will look into the matter further.

10. Modified use of existing approach radar. I would appreciate receiving from you additional details on the modified use you had in mind, so that we can more properly evaluate and respond to your suggestion.

11. Inspection and maintenance of altimeter systems. On January 29, 1969, representatives of our Flight Standards Service met with ATA's Engineering and Maintenance Advisory Committee to review and discuss altimetry problems. The airlines are monitoring the operation of these systems and reviewing their maintenance procedures. ATA advised us at this meeting that few troubles are being experienced or reported by the flight crews. This is confirmed by our analysis of the MRR reports. Nevertheless, ATA has agreed to reactivate its Altimetry and Static System Maintenance Subcommittee to further explore this area and intends to review and update material previously published on this subject.

12. Certification of altimeter systems. On August 16, 1968, we issued a Notice of Proposed Rule Making proposing revisions to Part 25 of the Federal Aviation Regulations to require in systems design means to assure continued safe operation following any single failure or combination of failures not shown to be extremely improbable. Industry comments are now being reviewed and analyzed.

Your interest in these problems is appreciated and I can assure you we will continue to press for solutions to them.

Sincerely,

D. D. Thomas

D. D. Thomas
Acting Administrator

GPO 925-889