

FILE NO. 1-0001

AIRCRAFT ACCIDENT REPORT

PAN AMERICAN WORLD AIRWAYS, INC.

BOEING 707-321B, N454PA

PAGO PAGO, AMERICAN SAMOA

JANUARY 30, 1974

ADOPTED: NOVEMBER 8, 1974

NATIONAL TRANSPORTATION SAFETY BOARD

Washington, D.C. 20591

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SYNOPSIS

About 2341, American Samoa standard time, on January 30, 1974, Pan American World Airways Flight 806, crashed 3,865 feet short of runway 5 at Pago Pago International Airport. The flight was making an ILS approach at night. Of the 101 persons aboard the aircraft, only 5 survived the accident. One survivor died of injuries 9 days after the accident. The aircraft was destroyed by impact and fire.

The National Transportation Safety Board determines that the probable cause of the accident was the failure of the pilot to correct an excessive rate of descent after the aircraft had passed decision height. The flightcrew did not monitor adequately the flight instruments after they had transitioned to the visual portion of an ILS approach. The flightcrew did not detect the increased rate of descent. Lack of crew coordination resulted in inadequate altitude callouts, inadequate instrument cross-checks by the pilot not flying the aircraft, and inadequate procedural monitoring by other flight crewmembers. Visual illusions produced by the environment may have caused the crew to perceive incorrectly their altitude above the ground and their distance to the airport. VASI was available and operating but apparently was not used by the crew to monitor the approach.

I. INVESTIGATION

1.1 History of the Flight

On January 30, 1974, Pan American World Airways, Inc., Flight 806, a Boeing 707-321B, N454PA, operated as a scheduled international passenger flight from Auckland, New Zealand, to Los Angeles, California. En route stops included Pago Pago, American Samoa, and Honolulu, Hawaii.

Flight 806 departed Auckland at 2014 1/ with 91 passengers and 10 crewmembers on board. It was cleared to Pago Pago on an instrument flight rules (IFR) flight plan.

At 2311:55, Flight 806 contacted Pago Pago Approach Control and reported its position 160 miles south of the Pago Pago airport. Approach

1/ All times herein are American Samoa standard, based on the 24-hour clock.

control responded, "Clipper eight zero six, roger, and Pago weather, estimated ceiling one thousand six hundred broken, four thousand broken, the visibility-correction, one thousand overcast. The visibility one zero, light rain shower, temperature seven eight, wind three five zero degrees, one five, and altimeter's two nine eight five."

At 2313:04, Pago Pago Approach Control cleared the flight to the Pago Pago VORTAC. Flight 806 reported leaving flight level (FL) 330 at 2316:58 and leaving FL-200 at 2324:40. Pago Pago Approach Control cleared the flight at 2324:49: ". . . Clipper eight zero six, you're cleared for the ILS DME runway five approach 2/ via the two zero mile arc south-south-west. Report the arc, and leaving five thousand." At 2330:51, the flight requested the direction and velocity of the Pago Pago winds and was told that they were 360° variable from 020° at 10 to 15 knots.

At 2334:56, the flight reported out of 5,500 feet 3/ and that they had intercepted the 226° radial of the Pago Pago VOR. The approach controller responded, "Eight oh six, right. Understand inbound on the localizer. Report about three out. No other reported traffic. Winds zero one zero degrees at one five gusting two zero."

At 2338:50, Approach Control said, "Clipper eight oh six, appears that we've had power failure at the airport." The copilot replied, "Eight oh six, we're still getting your VOR, the ILS and the lights are showing." At 2339:05, Approach Control asked, "See the runway lights?" The flight responded, "That's Charlie." The approach controller then said, ". . . we have a bad rain shower here. I can't see them from my position here." At 2339:29, the copilot said, "We're five DME now and they still look bright." Approach Control replied, "'kay, no other reported traffic. The wind is zero three zero degrees at two zero, gusting two five. Advise clear of the runway." At 2339:41, the flight replied, "Eight zero six, wilco." This was the last radio transmission from the flight.

According to the cockpit voice recorder (CVR), the last 59 seconds of the flight were routine. The captain asked the first officer about visual reference with the runway, and the first officer answered that the runway was visible. Windshield wipers were turned on and the flaps were set at the 50° position, which completed the checklists for landing.

At 2340:22.5, the first officer stated, "You're a little high." Four seconds later, a sound similar to electric stabilizer trim actuation could be heard on the CVR.

2/ ILS DME Runway 5 approach - an approach to runway 5 on Pago Pago airport, using the instrument landing system and the distance measuring equipment of the VORTAC as aids.

3/ All altitudes are expressed as mean sea level unless otherwise indicated.

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From 2340:29.5 to 2340:34, the radio altimeter warning tone sounded twice. At 2340:33.5, the first officer interrupted the second warning tone with, "You're at minimums."

At 2340:35, the first officer reported, "Field in sight". Seconds later, the first officer stated, "Turn to your right", followed by "Hundred and forty knots." This was the last transmission recorded on the CVR. There had been no comments made by either the flight engineer or the pilot who occupied the jumpseat (as to abnormalities in airspeed, altitude, or rate of descent indications).

At 2340:42, the aircraft crashed into trees at an elevation of 113 feet and about 3,865 feet short of the runway threshold. The first impact with the ground was about 236 feet farther along the crash path.

The aircraft continued through the jungle vegetation, struck a 3-foot-high lava rock wall, and stopped about 3,090 feet from the runway threshold. The aircraft was destroyed by impact and the subsequent fire.

The accident occurred during the hours of darkness at 14° 20' 55" S. latitude and 170° 43' 55" W. longitude. There were no ground witnesses to the accident.

1.2 Injuries to Persons

<u>Injuries</u>	<u>Crew</u>	<u>Passengers</u>	<u>Others</u>
Fatal	10	86	0
Nonfatal*	0	5	0
None	0	0	0

Of the 101 occupants of the aircraft, 9 passengers and 1 crewmember survived the crash and fire. One passenger died the next day; the crewmember and three passengers died 3 days after the accident.

1.3 Damage to Aircraft

The aircraft was destroyed.

1.4 Other Damage

The middle marker (MM) was destroyed.

* One passenger died of his injuries 9 days after the accident. 14 CFR 430, section 430.2, defines fatalities attributable to an accident as those occurring within 7 days after the accident.

1.5 Crew Information

The four crewmembers were certificated to serve as crewmembers on this flight. (See Appendix B.)

The captain occupied the left seat and flew the aircraft from Auckland. The third officer acted as copilot because the first officer had laryngitis. The first officer occupied a jumpseat.

The captain had been off flying status from September 5, 1973, to January 15, 1974, for medical reasons. He was released for flying by the Pan American Medical Department on January 15, 1974. Captain Petersen underwent voluntary simulator training on January 16, 1974, and the following comments were made by the training captain who monitored the period:

" . . . we covered heavy gross weight takeoff, departure procedures-engine fire-holding, fuel dumping, steep turns, stall series (clean-T.O. - Ldg) and approaches particularly ILS approaches. By the end of the period Captain Petersen was doing very good work including 3 engine FLT. Director ILS approaches to CAT II minima."

His "A" Phase check was completed January 18, 1974, with the notations that he exhibited a good knowledge of systems and procedures and that the simulator work was "very well done throughout." In order to re-qualify in the B707 Captain Petersen made three takeoffs and landings on January 19, 1974. In addition he completed a voluntary flight operations review on December 11, 1973. This approach to Pago Pago was the first instrument approach the captain had flown in IMC since his return to flying status.

Prior to 1974, Captain Petersen's experience at Pago Pago International Airport was limited to one landing, in May 1972. Before the pattern (trip) he flew starting January 22, 1974, he saw the Pan American movie presentation of Pago Pago Airport to familiarize himself with the airport. This is required by Pan American policy and Part 121.447 of the FAR's. He flew into Pago Pago Airport on the second leg of his pattern January 23, 1974, but available information indicated the first officer accomplished the landing.

Captain Petersen had flown 38:34 hours during the period from January 19, 1974, to the accident. This represents his total flight time for the past 60 days. From January until December 1973, he had recorded 323:48 hours of night flying.

The captain accomplished his last line check August 2, 1973, and the comment "good trip" was noted. He completed the normal "B" Phase check June 29, 1973. This phase consisted of simulator and aircraft training periods. After completion of the simulator period the following comment

was made: "All work well done. Good oral quiz. Smooth pilot. Repeated 3 eng. FD. ILS due out of limits at DH and GA. Second very good." The comments for the aircraft period the following day were: "Repeated 1 eng. inop. F/D app. to correct A/S control technique & G/S bracketing." Captain Petersen was observed by FAA Air Carrier Inspectors during proficiency checks on June 29, 1973, and June 29, 1972.

1.6 Aircraft Information

The aircraft was certificated, equipped, and maintained in accordance with FAA requirements. (See Appendix C.)

1.7 Meteorological Information

The terminal forecast for Pago Pago International Airport, issued by the National Weather Service Forecast Office at Honolulu, Hawaii, at 1700, on January 30, 1974, valid for 24 hours beginning at 1900 was:

Wind - 020°, 15-26 kn., visibility - more than 5 nmi, 2/8 (scattered) cumulus at 2,000 feet, 6/8 (broken) altocumulus at 8,000 feet, 6/8 cirrostratus at 25,000 feet. 1900 to 0700: temporary conditions-- visibility - 3 miles, 6/8 cumulus at 1,500 feet, 8/8 (overcast) altocumulus at 7,000 feet, 8/8 cirrostratus at 25,000 feet.

The official surface weather observations at Pago Pago International Airport near the time of the accident were as follows:

2258 - estimated ceiling - 1,600 feet broken, 4,000 broken, 11,000 feet overcast, visibility - 10 miles, light rain showers, temperature - 78°F., dew point - 70°F., wind - 320°, 15 kn, altimeter setting - 29.85 in.

2339 - Special, estimated ceiling - 1,600 feet broken, 4,000 feet broken, 11,000 feet overcast, visibility - 1 mile, heavy rain showers, wind - 040°, 22 kn, altimeter setting - 29.85 in.

2345 - Special, estimated ceiling - 1,700 feet broken, 4,000 feet overcast, visibility - ½ mile, heavy rain showers, wind - 020°, 13 kn, gusts - 35 kn, altimeter setting - 29.86 in.

The 2258 weather observation was the last received by the flight. The 2339 special observation was not received by approach control in time to be transmitted to the flight.

According to the third officer, the flight had encountered rain, but not heavy rain, before the crash.

Survivors stated that lights on the ground were clearly visible and that there was little or no rain before the crash. They stated

that there was heavy rain after the accident. The accident occurred in darkness, below clouds, and in rain.

1.8 Aids to Navigation

A full ILS serves runway 5 at Pago Pago. A nondirectional beacon and MM are located 1.7 and 0.5 nmi, respectively, from the runway threshold. The ILS glide slope is installed at a descent angle of 3° 15', and is not usable below 138 feet because of the effects of the irregular terrain on signal reliability. The ILS localizer is offset to the right and crosses the extended runway centerline 3,000 feet from the runway threshold. Postaccident flight and ground checks of the ILS system, including the use of a Radio Theodelite, showed no indication of a system malfunction.

1.9 Communications

No communications difficulties were reported between the flightcrew and the air traffic controllers.

1.10 Aerodrome and Ground Facilities

The Pago Pago International Airport is located on the south-central coast of the Island of Tutuila, American Samoa. Runway 5 is 9,000 feet long and 150 feet wide. The runway is paved with asphalt, and the elevation at the touchdown zone is 30 feet.

The airport is equipped with high intensity runway lights, a medium intensity approach light system, runway alignment indicator lights, and a visual approach slope indicator (VASI).

According to written statements and testimony at the public hearing, the runway and approach lights were set at step 3 and 10 percent illumination, respectively, as required for nighttime operations, and the VASI lights were illuminated. The first officer, according to the CVR, had the runway lights in sight from about 8 miles on the approach. He stated in his postaccident interview that he did not remember seeing the VASI lights.

The airport has no control tower. Flightcrews rely on advisories from the Pago Pago Combined Approach Control International Station (CAPIS). The CAPIS is located about 2,000 feet northwest of the runway.

The approach to Pago Pago International Airport is conducted over water until 3.25 miles from the runway threshold. About 1.7 nmi from the runway threshold, the approach path crosses over Logotala Hill, which has an elevation of 399 feet. The terrain under the approach path slopes downhill from Logotala Hill to the runway. The terrain of the approach path is characterized by small, rolling hills. The area is sparsely inhabited and covered with trees and jungle vegetation.

1.11 Flight Recorders

The aircraft was equipped with a Fairchild Model A-100 cockpit voice recorder (CVR), serial No. 1752. The recorder received severe fire and heat damage, but there was no evidence of mechanical damage. The internal electrical, electronic, and nonstainless steel components were either melted or severely distorted because of heat. The steel housing which surrounded the tape was not damaged, except for exterior heat damage. A normal readout of the tape was obtained.

The aircraft was also equipped with a Lockheed Aircraft Service Company Model 109-C flight data recorder (FDR), serial No. 838. The FDR was found intact and undamaged. There was no evidence of exposure to heat or fire. The aluminum foil recording medium was not damaged, and all recorded parameters were legible. There was no evidence of recorder malfunction or recording abnormalities.

The FDR was located in the fuselage, aft of the rear pressure bulkhead. The CVR was located forward of the pressure bulkhead in lavatory "E".

Data taken from the FDR and the CVR were combined into one profile and compared to the 3.25° glide slope at Pago Pago. (See Appendix E.)

1.12 Wreckage

The aircraft came to rest about 3,900 feet from the approach end of runway 5 at Pago Pago International Airport, American Samoa. The wreckage path was about 775 feet long and about 150 feet wide.

The aircraft first contacted trees 25 feet above the ground and 3,865 feet short of the threshold of runway 5. The ground elevation at this point is 88 feet.

The first visible signs of ground contact were located at a point 3,629 feet from the runway threshold. Pieces of forward nose fuselage structure were found embedded in the rocks. Radome material was recovered from the same area.

The aircraft cut a swath through the trees, jungle vegetation, and a 3-foot-high lava rock wall before stopping. The downward angle of the swath through the trees and jungle vegetation was about 3.5°. The swath path was somewhat left of the runway centerline and slightly lower on the right side at initial impact with the trees. During the last part of the ground slide, the aircraft's right wing hit and destroyed the MM transmitter located 3,090 feet from the runway threshold.

There was progressive destruction of the aircraft during its travel through the vegetation, and as it slid over the ground. The landing gear,

the outer wing panels, the outboard ailerons, parts of the main and fillet wing flaps, all four engines, and the No. 3 pylon separated from the aircraft. The lower fuselage structure from the nose to just forward of the rear pressure bulkhead was severely damaged. A portion of the center section keel beam was found at the lava rock wall.

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The fuselage, including the empennage, the left wing outboard to about W.S. 733, and the right wing outboard to W.S. 820, came to rest over a shallow gully and partially on a service road to the MM site.

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Fire was evident during the last 350 feet of the wreckage pattern. The aircraft fuselage from the aft pressure bulkhead forward through the cockpit area was gutted by fire. From the wing trailing edge forward, the top of the fuselage and the fuselage sidewalls were consumed down to a point about 4 feet above the window line. The passenger cabin floor and contents were consumed from the aft pressure bulkhead forward to the cockpit.

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The cockpit area was extensively damaged by fire. Many of the instruments and instrument panels were melted, and no valid information was obtained from them.

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Both wings and all fuel tanks which remained with the aircraft were burned and melted. The upper skin was melted on the Nos. 1, 2, and 3 main fuel tanks and both stub sections of the center wing tanks. The No. 4 main wing tank had ruptured and was damaged extensively by fire. The reserve tanks separated from the wings and were not damaged by fire. There was no evidence of fire or explosion at the wing tip tank vents.

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There was no evidence of in-flight structural failure, fire, or explosion. All structural fractures were typical of those caused by overload.

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Examination of the wing flaps and landing gear components revealed that the flaps were extended to a setting of 50° and that the landing gears were extended at the time of impact.

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Most of the aircraft systems were destroyed. The spoilers were in the retracted position. The speed brake handle in the cockpit was in the full forward position (down) and locked. The recovered wing leading edge device actuators were in the fully extended position.

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The empennage was basically intact on the aft fuselage structure. Fire damage was evident on the lower surfaces of the right horizontal stabilizer and elevator. The elevators, elevator tabs, rudder, and rudder tab were in place and movable. The elevator tabs were in neutral, the rudder tab was deflected about 4 in. to the left, and the rudder was in neutral. The rudder tab setting corresponded to the setting on the cockpit trim wheel.

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The interior of the rear fuselage aft of the rear pressure bulkhead was not damaged by fire. The flight control cables were in place and intact. The horizontal stabilizer actuator was in place, intact, and positioned at three units aircraft nose up. There was no evidence of malfunction of the aircraft flight control system before impact.

All four engines separated from their pylons and the No. 3 pylon had separated from the wing. The turbine thrust reversers were separated from engines Nos. 3 and 4. The turbine thrust reverser buckets of the No. 1 engine were closed, and the translating sleeve was missing. Portions of the fan reversers remained on each engine and were in the stowed position.

The first and second stage fan blades on the four engines were broken off at the blade platforms. The third stage rotor blades on the four engines were bent opposite the direction of engine rotation. Various amounts of finely chopped, fibrous residue were found in the bleed air passages of each of the engines.

1.13 Medical and Pathological Information

Post-mortem examination of the crewmembers disclosed no evidence of incapacitating disease.

Except for the third officer, who occupied the copilot seat, all fatally injured persons died of smoke inhalation, massive first-, second- and third-degree burns, and complications from those massive burns.

Toxicological examinations of the casualties revealed, in each case, significant levels of carbon monoxide and hydrogen cyanide. These gases are normal byproducts of aircraft fires.

The third officer, who survived the crash but later died of his injuries, received traumatic leg and arm injuries and severe burns.

1.14 Fire

A small fire truck, manned by two firemen, was parked next to the runway--a standard practice when aircraft are scheduled to land at Pago Pago.

At 2343, the fire station received the first alarm. Response was delayed because of confusion as to whether a house or an aircraft was involved in the reported fire. Response to the accident scene was further delayed by heavy rain and two chain gates across the access road from the airport to the accident scene.

Access to the fire was limited to a one-lane road, and only one piece of firefighting equipment at a time could approach and fight the

fire. The fire department's activities were limited to extinguishing the fire. No rescue activities could be carried out until after the fire was under control.

1.15 Survival Aspects

This was a survivable accident.

Passengers who survived the accident said that the impact forces were slightly more severe than a normal landing. No damage to the cabin interior was reported. Large fires were seen outside the right side of the aircraft. One person opened an overwing exit on the right side of the aircraft; flames came in through the exit, and he closed it. Other survivors opened the left overwing exits, and all the survivors except the copilot escaped through those exits. The copilot was assisted in his escape by two other cockpit crewmembers and left the aircraft through a hole in the cockpit wall.

The surviving passengers reported that some passengers rushed toward the front and rear of the cabin before the aircraft stopped. The survivors did not hear instructions regarding escape from the aircraft after the accident. Most of the survivors suffered burns and other injuries after they escaped from the cabin.

Postaccident investigation revealed that the forward and the rear entry doors were not opened or used for escape. The forward door was opened about 2 to 3 inches, but the aft door was closed.

The forward galley service door could not be identified in the wreckage. The rear galley service door was found in place and locked.

1.16 Tests and Research

At the request of the Safety Board, the General Electric Company made a sound spectro-analysis of the engine sounds on the CVR tape. This analysis, along with a copy of the FDR readout, was then furnished to the Boeing Company. The Boeing Company conducted an energy analysis to determine the thrust level required during the approach.

The energy analysis indicated that the four aircraft engines were operating during the last 3 minutes of the approach. The analysis further indicated that there was sufficient thrust available to offset an increase in drag caused by heavy rain.

1.17 Other Information

1.17.1 Restricted Cargo

The aircraft was carrying restricted cargo. The cargo, listed as article No. 727 by the International Air Transport Association (IATA)

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Restricted Articles Regulation, was Ethyl Methyl Ketone Peroxide (MEK Peroxide). IATA regulations specify the maximum quantity that may be packed in any one outside container is $\frac{1}{2}$ kilogram (one pound) or $\frac{1}{2}$ litre (one pint). Compatible plastic tubes of not over 5cc (1/6 fluid ounce) capacity each, packed with sufficient noncombustible cushioning and absorbent material which will not react with the contents and which will prevent breakage or leakage shall be packed in fiberboard containers up to a maximum net quantity of $\frac{1}{2}$ kilogram or $\frac{1}{2}$ litre. No more than 24 of these containers should be packed into 1 container, providing the net quantity does not exceed 1 kilogram (2 pounds), or 1 litre per container.

The MEK peroxide was diluted to 59.8 percent peroxide with hydroquinone. This inhibitor increased the flashpoint from 125° F to 180° F, in addition to inhibiting it chemically. The cargo consisted of 200 20-cc bottles, with 50 bottles per 1 gallon tin. The bottles were placed in plastic bags and then in the tins. Perlite was placed beneath, around, and above the bags. The tins were sealed. The four tins were then placed in a fiberboard carton. The weight of the MEK peroxide in the carton was 4 kilograms.

The shipper, who was responsible for identifying the material as hazardous, believed that the flashpoint of the material was the only criterion for classifying material as hazardous. Consequently, the freight forwarder and the carrier were not advised that the material was hazardous. Further, since the flight dispatch papers did not identify the material, the flightcrew was unaware of the nature of the cargo.

1.17.2 Company Procedures

The following procedures are extracted from the Pan American Flight Operations Manual:

"Conducting the Approach and Landing

Regardless of the type of approach, the aircraft should be on final approach in the landing configuration with the Landing Checklist complete, in IMC, not lower than 1,000 feet AFE or, VMC, not lower than 500 feet AFE. At this point, the aircraft should be stabilized on the glidepath, on Vprog, with the proper sink rate and trimmed for zero control forces.

During any approach, the pilot not flying is to call-out the sink-rate when it exceeds 800 FPM.

"ILS Approach Call-Outs

During an ILS approach, the pilot not flying is to make the following call-outs:

1. Outer Marker

Outer marker, altitude checks, instruments cross-checked.

2. 500 feet AFE

500 feet, instruments cross-checked.

3. 100 feet above DH (Decision Height)

100 feet above decision height and the airspeed.

4. At DH

At decision height call out 'Decision Height,' followed by 'visual contact' or 'no contact' as appropriate.

"Approach Duties

The flight engineer will in addition to his regular duties:

Monitor communications
Cross-check flight instruments.
Be aware of correct altimeter setting and altitude.
Be alert for missed approach.
Watch for visual cues approaching DH/MDA.

The Second/Third Officer will:

Monitor communications.
Cross-check instruments.
Use approach charts to monitor approach.
Confirm correct facilities tuned and identified.
Be aware of correct altimeter setting and cross-check altitude. Watch for visual cues approaching DH/MDA.

"Determining DH/MDA - Approaches Other Than Category II

The DH or MDA for any approaches other than a Category II ILS is determined by reference to the barometric altitude.

"Limiting Descent Rates Below 2,000 Feet

The maximum descent rate recommended below 2,000 feet above ground level (AGL) is 1,000 FPM."

In addition to the above-listed procedures, the flight operations manual and the aircraft operating manual prescribed specific duties to be performed by various cockpit crewmembers throughout the approach. The

pilot not flying was to call out 100 feet above minimums, but this call was not made. The pilot not flying did call "minimums" at the decision height. He also called "field in sight" and then called the airspeed. These calls were specified by the manual. The pilot not flying had a primary responsibility (the flight engineer and third pilot had a second responsibility) to call any rate of descent exceeding 800 feet per minute or any deviation from a normal approach. No calls regarding rate of descent or other deviation from a normal approach were recorded on the CVR. The pilot not flying was required to call out deviations of more than 5 knots from the selected target speed for the approach -- in this case 150 kn. The pilot not flying called the airspeed when a 10-kn. deviation was observed. Instrument cross-checks and altitude awareness were the responsibility of all the flight crewmembers throughout the approach. Finally, all flight crewmembers were charged to insure that the sink rate at 100 feet above field elevation did not exceed 800 feet per minute "regardless of conditions."

1.17.3 Airport Qualification Program - Pan American

Pan American World Airways uses a movie to augment their Airport Qualification Program. The movie about the Pago Pago Airport emphasizes the ILS/DME procedure. The movie and narrative are descriptive; however, because of recent physical changes in the airport, and a change in the reported elevation of Logotala Hill, the portions of the movie which related to these items are outdated. The approach is accurately described. The narrative also states, when operating VFR, "Due to terrain, when landing on runway 5, maintain 1,000 feet and disregard VASI until crossing Lima Oscar Gold NDB. At this point, VASI will indicate high."

2. ANALYSIS AND CONCLUSIONS

2.1 Analysis

The aircraft was certificated, equipped, and maintained according to requirements and regulations. The gross weight and c.g. were within prescribed limits during takeoff at Auckland and the approach to Pago Pago.

Based on the investigation, the third officer's statement, and the performance analysis, the Safety Board concludes that the aircraft powerplants, airframe, electrical and pitot/static instruments, flight controls, and hydraulic and electrical systems were not factors in this accident.

Although the ethyl methyl ketone peroxide was improperly packaged, there is no evidence to indicate that it contributed to the cause of the accident or to the death of the passengers and crew.

Survivability

This was a survivable accident. The cabin remained intact; the crash forces were within human tolerances; and occupant restraint was maintained throughout the accident. The only traumatic injuries were those to the copilot. The survival problems stemmed from postcrash factors.

Three major postcrash survival problems were: (1) The cabin crew did not open the primary emergency exits, (2) the passenger reactions to the crash, and (3) passenger inattentiveness to the pretakeoff briefing and the passenger information pamphlet.

It could not be determined why the primary emergency exits were not opened on the left side of the aircraft. The fire outside the aircraft on the right side or the press of passengers may explain why the doors on the right side were not opened.

The doors on the left side of the aircraft may have been damaged during the crash. In this event, the flight attendants would be expected to redirect the passengers to other exits. The surviving passengers were all seated near the middle of the aircraft and did not hear instructions given by flight attendants after the crash. Since none of the flight attendants received traumatic injuries in the crash, it is possible that they were overcome by smoke or that they tried to open the exits and did not redirect passengers to alternate exits.

It is also possible that the passengers crowded against the doors, and for that reason, the flight attendants were unable to open the exits.

It is unlikely that all of the passengers could have escaped from the aircraft through the left overwing exits. However, it is possible that there would have been more survivors had the passengers acted according to preflight instructions and proceeded to the nearest exit, instead of moving toward the main exits through which they had originally entered.

All the survivors reported that they listened to the pretakeoff briefing and read the passenger information pamphlet. These actions prepared them for the evacuation by stressing the location of the nearest exit and the procedures to be followed in an emergency. The movement of most of the passengers, including many of the passengers in the overwing area of the aircraft, to the front and rear exits indicates that they either did not absorb the pretakeoff briefing or they reacted to the emergency without thinking.

Flightcrew Qualification and Training

The approach was not stabilized, and the aircraft struck the ground short of the runway. This cannot be attributed to a problem with the air-

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craft or its systems. Therefore, the Safety Board evaluated the operational and human-factor aspects of the approach, including flightcrew's training and qualifications, and the effects of illusions during landing approaches at night.

The flight crewmembers were certificated and qualified in accordance with company and FAA regulations.

The captain was off flying status from September 5, 1973, to January 15, 1974, because of a health problem. When he returned to flight status, he completed the required flight and simulator training, which included three takeoffs and three landings for requalification in the 707 series aircraft. These three landings were accomplished in VMC. The captain made three additional approaches and landings since this training; however, these landings were also accomplished in VMC. Therefore, the accident approach was the captain's first instrument approach, in actual IMC in 132 days. The probability is that his instrument proficiency was not at its best under these circumstances.

The Approach

The CVR readout and the interview with the third officer established that the runway was in sight when the aircraft was about 8 miles from the threshold. The runway remained in sight during the entire approach. There is no indication that any of the navigational aids or the aircraft instruments were faulty.

The captain, who was flying, did not intercept the glide slope smoothly. According to the approach plate he could have descended to 2,500 feet after being cleared for the approach, and then intercepted the glide slope at the 7-mile DME Gateway, at about 2,180 feet. The FDR shows that the aircraft leveled off at 5,000 feet for 1 minute before descending through the glide slope. At the 6-mile DME fix, the aircraft was about 260 feet below the glide slope. The aircraft then leveled off at about 1,750 feet.

At 2338:53, the aircraft reintercepted the glide slope at 1,725 feet and followed a flightpath that was roughly 100 feet above the glide slope until about 2340:19.5 when the first officer said, "Now you have the runway."

During the time that the captain was using the glide slope for vertical guidance, the rate of descent was about 690 fpm which is less than the recommended no-wind rate of descent of about 750 fpm for this glide slope.

Indicated airspeed remained fairly constant, at 160 kns from the time the aircraft descended through 2,000 feet until it approached 1,400 feet. At that time, large excursions in airspeed from 160 to 188 kns are

indicated on the FDR, which continues until 30 seconds before impact. The CVR tape revealed numerous power changes during the same time period. The approach checklist was completed in a timely manner, and the landing checklist was completed at 2340:06, at an altitude of 817 feet. Pan American policy recommends that the checklist be completed before reaching 1,000 feet above ground. However, completion of the checklist is at the captain's prerogative, and in this case, the timing did not appear to hamper the cockpit workload. The approach profile did not change when the last checklist item, "flaps 50⁰," was accomplished.

The captain was flying by reference to his instruments, and he remained on instruments, with the first officer primarily "heads up" until about 2340:13.

About 700 feet, or 23 seconds, before impact, the captain apparently went visual to complete the landing. Within 3 seconds after the captain went visual, the first officer said, "You're a little high." Four seconds later, the CVR recorded a sound similar to the electric stabilizer trim actuator. A major change in the approach profile was recorded. The rate of descent increased from a 690 fpm average to 1,470 fpm and continued at the latter rate until impact.

The captain probably did not refer to the instrument panel to monitor the ILS presentation, the vertical speed indicator, or the barometric altimeter after he went visual. These flight instruments would have indicated that the aircraft was below the glide slope and was descending too rapidly to complete the landing safely.

The evidence confirms that the VASI installed on Runway 5 was illuminated and operating satisfactorily at the time of this approach. Under the existing visibility conditions, the VASI would have been visible to the flightcrew at the same time that the runway lights came into view. At this point in the approach, with the aircraft above the glide path, the crew would have seen the VASI as 2 white light bars; an indication that they were above the desired glidepath. As the aircraft descended through and then below the glidepath, the light bar indications would have changed from white-white to white-red, then to red-red. The latter light bar configuration would have indicated a significant deviation below the glidepath and would have caused the crew to make an immediate and positive response to arrest the descent rate and attain a proper light bar indication (red-white).

Although the first officer stated that he did not remember seeing the VASI lights at any time during the approach, the Board concludes that that VASI was on and operating and should have been used by the crew.

In this instance, proper monitoring of the VASI lights would have provided positive visual indications to the crew that the aircraft was descending below the glidepath.

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Visual Illusions

Of the many factors that can lead to visual illusions, there are several that could have caused the cockpit crewmembers to believe that they were higher than normal during the final approach to Pago Pago. These include haloing and runway foreshortening. What effects these false perceptions may have had in the accident are difficult to determine. However, the possibility that visual illusions influenced the crew cannot be dismissed completely, because of the third officer's statement that "just prior to impact everything looked normal."

Numerous studies conducted on the effects of the visual illusion phenomenon have established they contribute to disorientation and faulty horizontal distance judgments by flightcrews.

Rain can affect the pilot's perception of distance to the approach and runway lights by the diffusion of their glow (haloing) and thus cause the lights to appear less intense. This would lead the pilot to conclude that the lights were farther away than they actually were. On occasion, rain causes lights to appear larger (but not brighter) and the pilot believes he is closer than he actually is. In either case, the pilot would be prompted to descend to an altitude comparable to the perceived runway elevation.

Another illusion, runway foreshortening, could have had an effect on the crew. The heavy rain pattern, which was moving slowly down the runway toward the approach end, would have caused the physical dimensions of the runway to appear to decrease, thereby leading the pilots to believe that they were high on the approach.

Regardless of the illusions present when the descent rate was increased, pilot technique, cockpit discipline, and crew coordination were disregarded when the captain allowed the aircraft to depart from an established, normal rate of descent.

Fire and Rescue

Fire and rescue personnel reported that they took 14 minutes to reach the crash site and to begin extinguishing the fire. The response of the fire department was hampered by the weather, obstacles across the response route, and the uncertainty of whether the fire was from an aircraft or a house.

It is doubtful that any of the occupants remaining in the aircraft were still alive when the fire and rescue personnel arrived at the scene.

Fire and Rescue Activities at the Scene

The fire and rescue personnel experienced considerable difficulty in fighting the fire. The greatest problem was the limited access to the

wreckage. The one-lane road precluded more than one vehicle from fighting the fire at a time. All approaches to the fire had to be made from the front of the aircraft; therefore total coverage of the fire was not possible. Had all fire vehicles been able to approach the fire simultaneously, fire damage to the aircraft may not have been so extensive.

2.2 Conclusions

(a) Findings

1. The captain had been off flying status for 132 days before the start of Flight 806.
2. There was no evidence of preimpact structural failure, fire, or flight control or powerplant malfunction.
3. All components of the ILS to runway 5 were operated properly.
4. The crew was not specifically told that the visibility was rapidly decreasing at the airport although the fact was alluded to by the controller.
5. The runway was in sight during the last 2 minutes 50 seconds of the flight.
6. When the captain went "heads up," he apparently flew the aircraft using visual cues only and made no further reference to the instrument panel.
7. The required altitude awareness callouts and vertical rate of descent callouts were not made.
8. At no time before initial impact did the crew indicate any awareness that they were too low or that any aspects of the approach were out of the ordinary.
9. The approach environment may have caused the crewmembers to experience visual illusions and to perceive the aircraft's altitude to be higher than the actual altitude.
10. The captain's instrument scan proficiency probably was degraded because of his lengthy absence from flying.
11. The impact was survivable. Relatively minor crash forces were involved, occupant restraint was adequate, and the occupiable area of the aircraft was not compromised.
12. The injuries sustained by the fatally injured passengers as well as the surviving passengers were a direct result of the postcrash fire.

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13. Only the copilot sustained traumatic injuries in the accident.
14. Only the left overwing exits were used in evacuating the aircraft.
15. All surviving passengers reported that they listened to the pretakeoff briefings and that they reviewed the passenger information pamphlets.
16. Fire and rescue response time was delayed by rain, barriers across the response route, terrain, and confusion as to what was burning.
17. Restrictions in the approach to the fire hampered fire-fighting effectiveness.

(b) Probable Cause

The National Transportation Safety Board determines that the probable cause of the accident was the failure of the pilot to correct an excessive rate of descent after the aircraft had passed decision height. The flightcrew did not monitor adequately the flight instruments after they had transitioned to the visual portion of an ILS approach. The flightcrew did not detect the increased rate of descent. Lack of crew coordination resulted in inadequate altitude callouts, inadequate instrument cross-checks by the pilot not flying the aircraft, and inadequate procedural monitoring by other flight crewmembers. Visual illusions produced by the environment may have caused the crew to perceive incorrectly their altitude above the ground and their distance to the airport. VASI was available and operating but apparently was not used by the crew to monitor the approach.

BY THE NATIONAL TRANSPORTATION SAFETY BOARD

/s/ JOHN H. REED
Chairman

/s/ FRANCIS H. McADAMS
Member

/s/ LOUIS M. THAYER
Member

/s/ ISABEL A. BURGESS
Member

/s/ WILLIAM R. HALEY
Member

November 8, 1974

APPENDIX A

INVESTIGATION AND HEARING

1. Investigation

The Safety Board was notified of the accident at about 0825 on January 31, 1974. The investigation team went immediately to the scene. Working groups were established for operations, witnesses, weather, human factors, structures, maintenance records, powerplants, systems, flight data recorder, and cockpit voice recorder.

Participants in the on-scene investigation included representatives of the Federal Aviation Administration, Pan American World Airways, Inc., Air Line Pilots Association, Flight Engineers International Association, The Boeing Company, Pratt & Whitney Aircraft Division of United Aircraft Corporation, and the Government of American Samoa.

2. Public Hearing

A 3-day public hearing was held at the Princess Kaiulani Hotel, Honolulu, Hawaii, beginning March 19, 1974. Parties represented at the hearing were: The Federal Aviation Administration, Pan American World Airways, Inc., Air Line Pilots Association, and the Flight Engineers International Association.

APPENDIX B

CREW INFORMATION

Captain Leroy A. Petersen

Captain Leroy A. Petersen, 52, was employed by Pan American World Airways, Inc., March 3, 1951. He received his initial B707 training as a Reserve Copilot/Navigator November 1, 1960. He was upgraded to Master Copilot on the B707 on July 2, 1965, and to B707 captain November 10, 1967. Captain Petersen had 17,414 flight hours, of which 7,414 hours were in the B707.

Captain Petersen held Airline Transport Pilot certificate No. 7191-41, issued July 2, 1965. He was type rated in the Douglas DC-4, Boeing 337, 707/720. He possessed radio certificate No. 12-500880 and navigator certificate No. 1225367, issued September 5, 1951. His first-class physical was taken August 9, 1973, with no limitations.

First Officer Richard V. Gaines

First Officer (F/O) Richard V. Gaines, 37, was employed by Pan American World Airways, Inc., August 7, 1964. His initial B707 Reserve Copilot/Navigator training was completed October 20, 1964, and he was upgraded to Master Copilot on June 15, 1967. He had 5,107 flight hours, all in the B707. In the past 60 days he had flown 127:14 hours and 56:44 in the past 30 days.

F/O Gaines held Airline Transport Pilot certificate No. 1578652 dated July 14, 1967, with type ratings in the Boeing 707/720. He held radio certificate No. P-3-12-17992 issued June 23, 1969, and navigator certificate No. 1623158, dated February 16, 1965. His first class medical examination was taken November 21, 1973, with no waivers noted.

F/O Gaines completed his "A" Phase training January 18, 1974. The simulator and aircraft portions of "B" Phase training were completed July 21 and 22, 1973. In addition, he completed voluntary simulator training July 1, 1973. Mr. Gaines was observed by an FAA inspector March 20, 1973, during an en route inspection. Numerous routing Copilot Trip reports were reviewed from his file, and no adverse comments were noted.

F/O Gaines had flown into Pago Pago twelve times in the year preceding the accident.

Third Officer James S. Phillips

Third Officer James S. Phillips, 43, was employed by Pan American World Airways, Inc., April 25, 1966. His initial B-707 training as a

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Reserve Copilot/Navigator was completed January 3, 1967. He had 5,208 flight hours, including 4,706 hours in the B707. In the past 60 days, he had flown 119:07 hours, and in the last 30 days he had flown 56:07 hours. Between July and December 1973, he recorded 199:38 hours of night flying.

Mr. Phillips held Commercial Pilot rating No. 1498280 issued May 16, 1961, a radio certificate issued May 23, 1966, and navigator certificate No. 1729148, issued November 21, 1966. His first class medical examination was taken February 5, 1973, with no waivers noted.

Mr. Phillips completed "A" Phase of training November 14, 1973. The following comments were noted by the training captain: "'A' Phase complete. Good work. Should rate in six hours." The "B" Phase simulator training was accomplished May 7, 1973, and the aircraft period completed the following day. After the aircraft period, the training captain commented: "All areas at a good level of RCO proficiency Ok for line ldg." This aircraft period was observed by an FAA inspector.

Mr. Phillips had flown into Pago Pago Airport seven times in the past 7 months. Since October 11, 1973, he had made seven takeoffs and nine landings.

Flight Engineer Gerry W. Green

Flight Engineer (F/E) Gerry W. Green, 37, was employed by Pan American World Airways, Inc., April 24, 1967. He received his initial Reserve Copilot/Navigator B707 training October 20, 1967, and his initial B707 Flight Engineer Qualifications July 2, 1973. He had 2,399 flight hours of which 1,444 hours were in the B707. In the past 60 days he had flown 82:15 hours, and in the past 30 days he had flown 63:13 hours.

F/E Green held Commercial Pilot rating No. 1497654 issued March 27, 1963. His radio certificate was issued October 4, 1966, and his navigator certificate No. 1771733 was dated July 14, 1967. He held Flight Engineer certificate No. 2077773, dated March 11, 1971. His second class medical examination was taken August 3, 1973, with no waivers.

F/E Green completed his "A" Phase training December 7, 1973. His last flight engineer line check was completed July 2, 1973, and his FAA B707 qualification check was June 20, 1973.

All four flightcrew members had identical itineraries during the 24 hours preceding the accident. They had been of duty about 19:14 hours before reporting to the airport in New Zealand 1 hour before takeoff. Their total flight time for the 24-hour period was 3:46 hours. Interviews with Pan American operations personnel at Auckland, New Zealand, indicated the crew appeared normal and alert during the preflight preparation.

Flight Attendants

	<u>Date of Birth</u>	<u>Date of Hire</u>	<u>Initial Training</u>	<u>Last Recurrent Training</u>	
Elizabeth Givens	9-28-43	7-1-66	7-14-66	6-20-73	op 20
Gorda Rupp	9-12-39	3-18-66	3-30-66	1-17-73	
Gloria Olson	6-4-48	2-14-72	3-6-72	3-2-73	pe
Patricia Reilly	7-22-48	5-8-72	5-30-72	3-28-73	be
Kinuko Seko	3-19-45	5-1-69	5-14-69	9-7-73	ac
Yvonne Cotte	4-10-50	2-19-73	3-6-73	3-6-73	ho
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APPENDIX C

AIRCRAFT INFORMATION

Aircraft N454PA, a Boeing 707-321B, serial No. 19376, was owned and operated by Pan American World Airways, Inc. It was manufactured December 20, 1967, and delivered to Pan American on that date.

The last major inspection, an aircraft inspection/refurbishment was performed April 22, 1973, in Miami, Florida. A maintenance "B" check had been accomplished January 24, 1974, and a maintenance "A" check had been accomplished at Auckland airport just before takeoff January 30, 1974.

Before the takeoff from Auckland, the aircraft had accumulated 21,625 hours flight time.

The weight and balance manifest for this flight indicated that the aircraft had been within its weight and balance limitations both at take-off and at the time of the accident.

There were 117,000 pounds of jet A-1 fuel aboard the aircraft upon departure from Auckland. The planned fuel burn-off for the flight to Pago Pago was 48,500 pounds. The estimated gross weight, fuel remaining and center of gravity at the time of the accident were 245,400 pounds, 68,500 pounds, and 26.2 percent, respectively. The aircraft was carrying 37,900 pounds of stored fuel to be used on a later leg of the trip.

According to company records, all airworthiness directives were complied with.

ENGINES

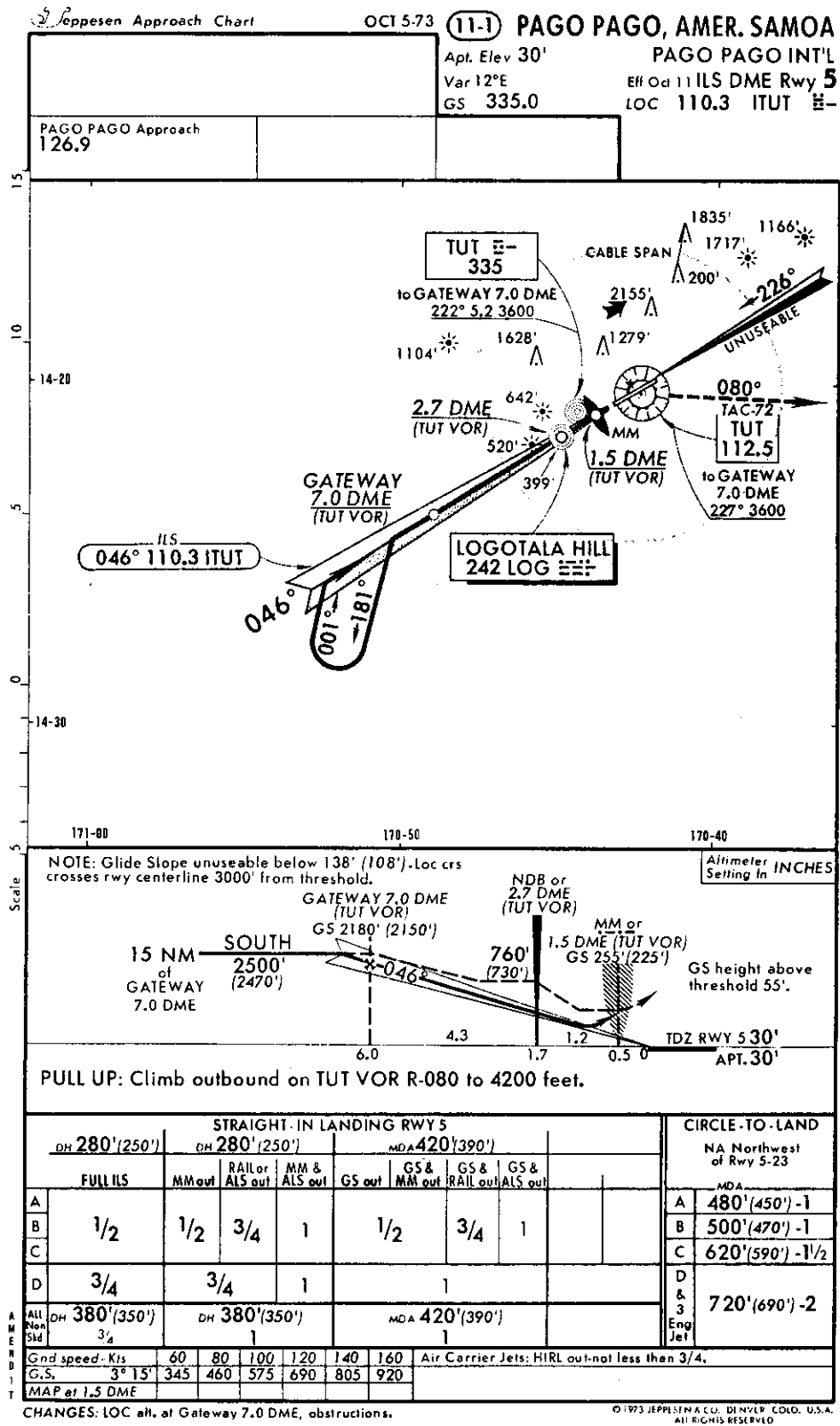
	<u>Date Installed</u>	<u>TSO Hours</u>	<u>Flight Cycles</u>	<u>Hours Since Installed</u>
No. 1 Engine S/N P645165	2/22/72	14,814	8,461	14,814
No. 2 Engine S/N P668165	4/11/73	18,769	6,181	18,769
No. 3 Engine S/N 695684	4/19/73	9,370	7,373	22,744
No. 4 Engine S/N 645961	12/19/73	20,527	6,478	20,527

Company records indicate that N454PA had been maintained in accordance with company procedures and with FAA requirements.

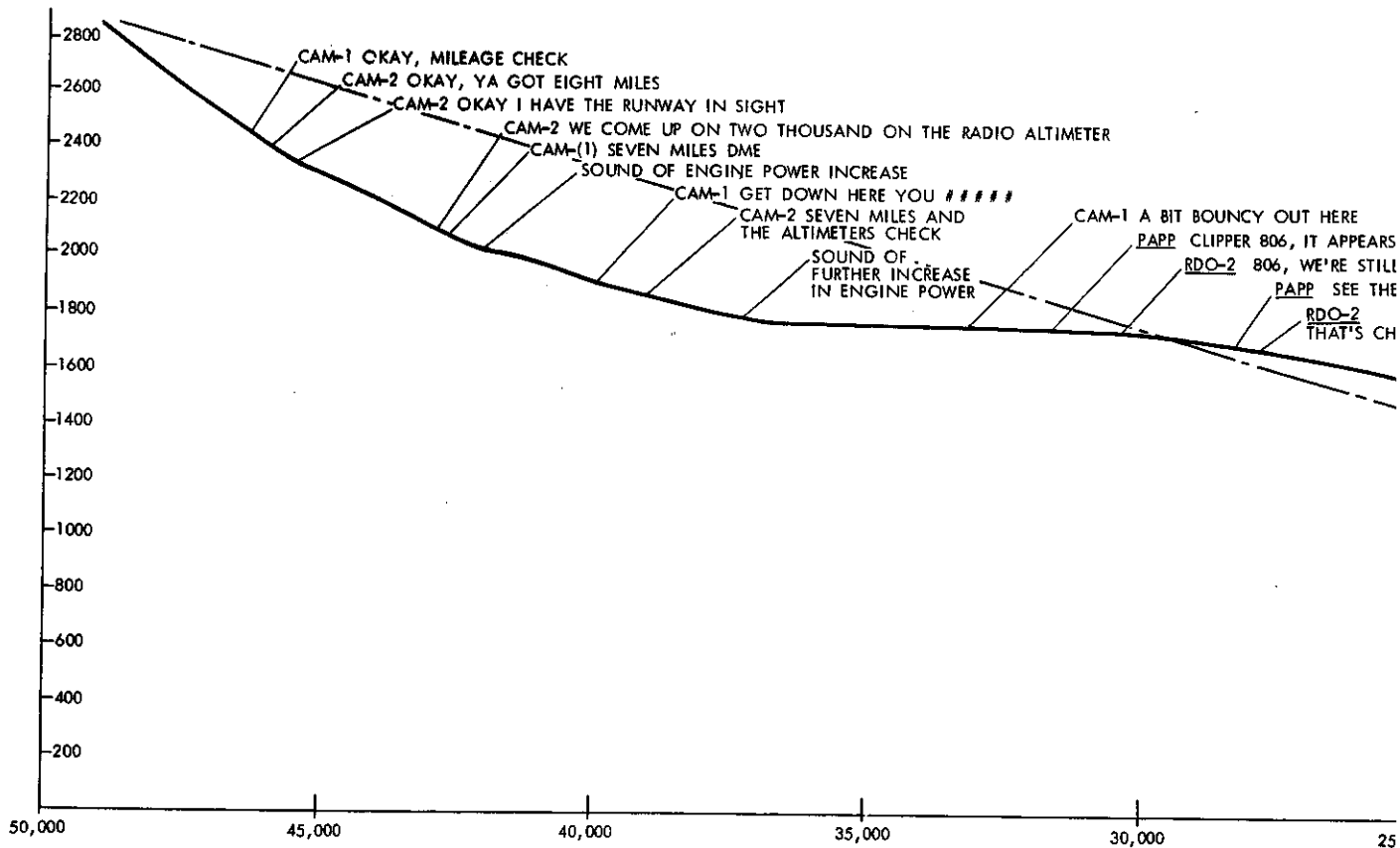
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training

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17-73
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28-73
7-73
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APPENDIX D



"ILLUSTRATION ONLY - NOT TO BE USED FOR NAVIGATIONAL PURPOSES"

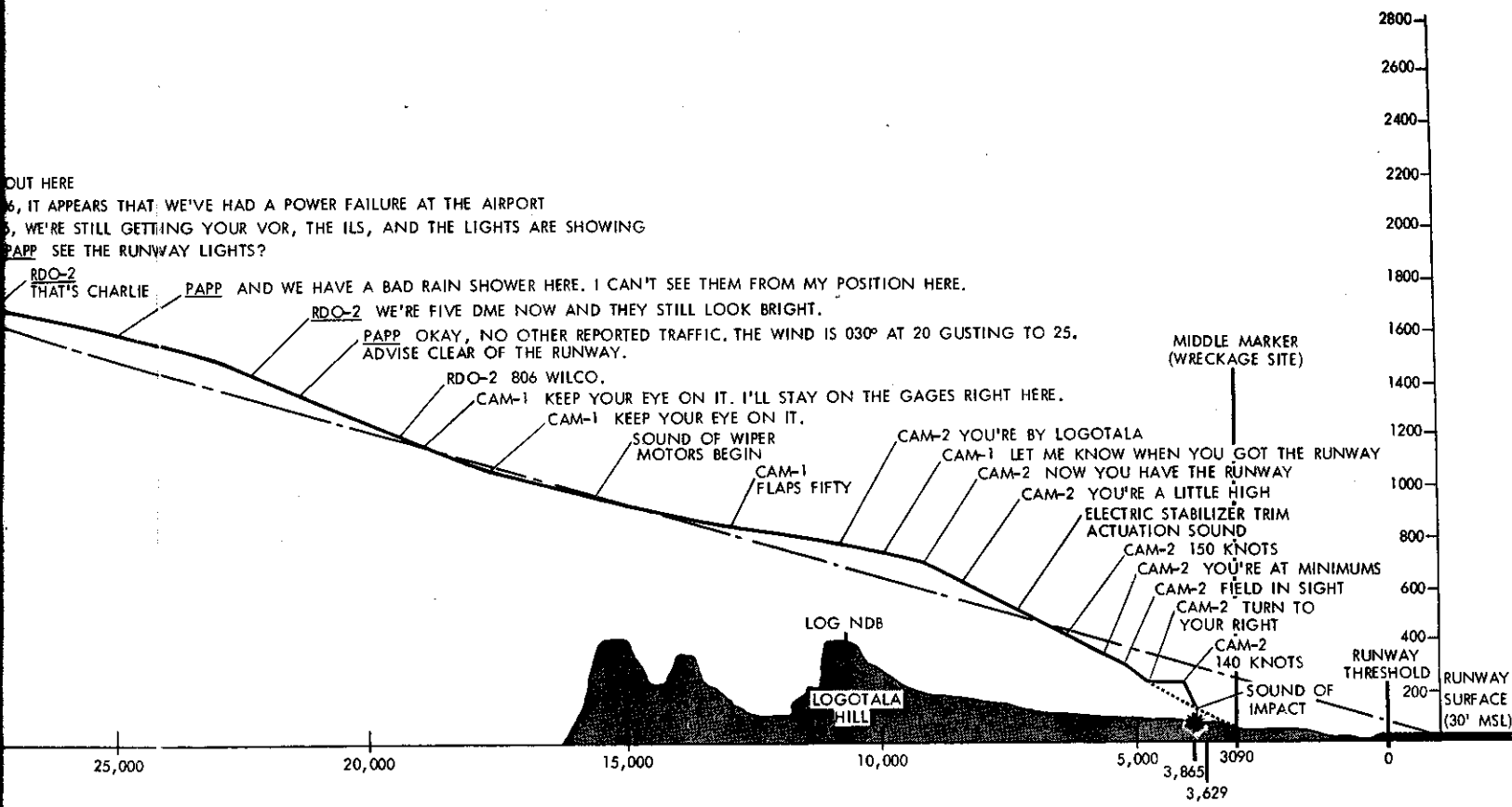


---GLIDE SLOPE
—DESCENT PROFILE
.....PROJECTED ACTUAL FLIGHT PATH
* AIRCRAFT INITIAL CONTACT WITH TREES 25 FEET ABOVE GROUND LEVEL

CAM-1 CAPTAIN
CAM-2 FIRST OFFICER
PAPP PAGO PAGO APPROACH CONTROLLER
RDO-2 FIRST OFFICER TRANSMITTING TO PAGO PAGO APPROACH CONTROLLER

NOTE: GLIDE PATH INTERCEPTS RUNWAY 975 FEET BEYOND RUNWAY THRESHOLD

APPENDIX E



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NATIONAL TRANSPORTATION SAFETY BOARD
 WASHINGTON, D.C.

COMPARISON OF DESCENT PROFILE AND 3.25° GLIDE SLOPE
PAN AMERICAN WORLD AIRWAYS, INC.
B-707-321B(A), N454PA
PAGO PAGO, AMERICAN SAMOA
JANUARY 31, 1974