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Aircraft Accident Report - ?an American World Airways, Inc., Boeing 707-3215, N454A, Pago Pago, American Samoa, January 30, 1974

National Transportation Safety Board, Washington, D.C.

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16. Abstract
About 2341, American Samoa standard time, on January 30, 1974, Pan American World Airways Flight 806 crashed 3,365 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 flightcrew's late recognition and failure to correct in a timely manner an excessive descent rate which developed as a result of the aircraft's penetratiun through destabilizing wind changes. The winds consisted of horizontal and vertical components produced by a heavy rainstorm and influenced by uneven terrain close to the aircraft's approach path. The captain's recognition was hampered by restricted visibility, the illusory effects of a "blackhole" approach, inadequate monitoring of flight instruments, and the failure of the crew to call out descent rate during the last 15 seconds of flight.

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ILS approach. visual illusions, crew coordination, altitude callouts, crew discipline, VASI, survivable accident, fire, restricted articles, airport qualifications, recent experience.
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FOREWORD

On November 8, 1974, the National Transportation Safety Board adopted and subsequently issued report No. NTSB-AAR-74-15. This report contained the facts, circumstances, and conclusions that were known at that time concerning the accident described herein.

On May 6, 1976, the Air Line Pilots Association petitioned the Safety Board to reconsider the probable cause in accordance with the Board's Procedural Regulation 49 CFN 831.36.

As a result of the petition, the Safety Board reopened the accident investigation because of knowledge gained through other accidents after the original investigation. The aircraft's flight data recorder data, the cockpit voice recorder data, and the aircraft's engineering performance data were reevaluated extensively to determine more conclusively the effect of the existing environmental conditions on the pilots' ability to stabilize the aircraft's approach profile.

The following report reflects the findings of the National Transportation Safety Board's reinvestigation. This report supercedes and replaces NTSB AAR-74-15.

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NATIONAL TRANSPORTATION SAFETY BOARD
WASHINGTON, D.C. 20594

Adopted: October 6, 1977

PAN AMERICAN WORLD AIRWAYS, INC.
BOEING 707-3218, N454PA
PAGO PAGO, AMERICAN SAMOA
JANUARY 30, 1974

SYNOPSIS

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

The National Transportation Snfety Board determines that the probable cause of the accident was the flightcrew's late recognition and failure to correct in a timely manner an excessive descent rate which developed as a result of the aircraft's penetration through destabilizing wind changes. The winds consisted of horizontal and vertical components produced by a heavy rainstorm and influenced by uneven terrain close to the aircraft's approach path. The captain's recognition was hampered by restricted visibility, the illusory effects of a "blackhole" approach, inadequate monitoring of flight instruments, and the failure of the crew to call out descent rate during the last 15 seconds of flight.

1. FACTUAL INFORMATION

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 306 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 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-southwest. Report the arc, and leaving five thousnnd." 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."

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

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 mean sea level unless otherwise indicated.

At 2338:50, approach control said, "Clipper eight oh six, appears that we've had power failure at the airport." The first officer 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 had rain shower here. I cnn't see them from my position here." At 2339:29, the first officer 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), conversation in the cockpit for the last 59 seconds of the flight was 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, whish completed the checklists for landing. The first officer stated during his postaccident interview that the only thing he had not accomplished whtch he should have was to change the No. 2 navigational receiver selector switch from the VOX frequency to the ILS frequency at the final approach fix.

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 un the CVR.

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 communication recorded on the CVR. There had bern 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. The first officer stated in his postaccident interview that he did not remember seeing the VASI lights.

At 2340:42, the aircraft crashed into trees at an elevation of 113 feet, and about 3,865 feet short of the runvay 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 3,096 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. Thrre were no ground witnesses to the accident.

1.2 Injuries to Persons

Injuries	Crew	Passengers	Others
Fatal	10	86	0
Nonfatal 4/	0	5	0
None	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.

1.5 Personnel 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 Flight Director ILS approaches to CAT II minima."

The captain's "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 requalify in the B-707, he made three takeoffs and landings on January 19, 1974. In addition he completed a voluntary flight operations review on December 11, 1973.

4/ One passenger died of his injuries 9 days after the accident. 49 CFR section 830.2, defines fatalities attributable to an accident as those occurring within 7 days after the accident.

This approach to Pago Pago was the first instrument approach the captain had flown in instrument meteorological conditions (IMC) since his return to flying status.

Before 1974, the captain's experience at Pngo Pago International Airport was limited to one landing — in May 1972. Before this trip, Which began on January 22, 1974, he saw the Pan American movie on Pago Pago Airport to familiarize himself with the airport. Pan American policy and 14 CFR 121.447 required the movie. lie flew into Pago Pago Airport on the second leg of this trip on January 23, 1974, but; available Information indicated the first officer landed the aircraft.

The captain had flown 38:34 hours from January 19, 1374, until the accident--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 on August 2, 1973, and the comment "good trip" was noted. He completed the normal "B" Phase check June 29, 1973, which 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 and G/S bracketing." He 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.)

There were 117,000 pounds of jet A-1 fuel aboard the atrcraft upon departure from Auckland. The planned fuel burnoff for the flight to Pago Pago was 48,000 pounds. The estimated gross weight, the fuel remaining, and the center of gravity at the time of the accident were 245,400 pounds, 68,500 pounds, and 26.2 percent, respectively.

1.7 Meteorological Information

The terminal forecast for Pago Pago International Airport, issued by the National Weather Service Forecast Office at Honnlulu, Hawaii, at 1700 on January 30, 1974, and valiu 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 tine 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 shovers, temperature - 78°F., dewpoint - 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 - 1/2 mile, heavy rain showers, wind - 020°, 13 kn, gusts - 35 kn, altimeter netting - 29.86 in.

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

Several persons, who were waiting at. the airport terminal for Flight 806, stated that ic was raining heavily when they saw the glow near the approach end cf runway 5 which later proved to be the burning aircraft. At least one of these persons stated that he watched the storm as it moved across the airport toward the approach end of runvay 5.

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. lhe accident occurred in darknesc, below clouds, and in rain.

1.8 Aids to Navigation

A full ILS serves runway 5 at Pago Pago. h nondirectional beacon and IM 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. The decision height for the approach was 280 ft.; 250 ft. above field elevation. Postaccident flight and ground checks of the ILS system, which included the use of a radio theodolite, showed no indication of a system malfunction or out of tolerance condition.

Although the ILS approach procedure requires that DME be used to establish the final approach fix (FAF), the DME is not available on the ILS frequency. Thus, the flightcrew is required to monitor the VOR frequency on at least one radio receiver until passage of the 7 nmi DME fix (FAF) position.

1.9 Communications

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

1.10 Aerodrome Information

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). The VASI is a two-bar configuration located on the left side of runway 5. The bars are located 750 ft. and 1,500 ft., respectively, from the approach end of the runway.

According to written statements and testimony at the public hearing. the runway lights 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.

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

A Fairchild model A-100 cockpit voice recorder (CVR), serial No. 1752, was installed in the aircraft forward of the rear pressure bulkhead in lavatory E. Although the recorder case was severely damaged by fire and heat, the tape was intact and a normal readout was obtained.

The tape was subjected to a sound spectroanalpsis, which was conducted by the General Electric Company, to determine the predominant frequencies of recorded. engine sounds. These frequencies were compared with the known engine soucd characteristics to determine engine thrust values as a function of time.

The aircraft was also equipped with a Lockheed Aircraft Service Company model 109C flight data recorder (FDR), serial No. 838. This unlt, which was installed in the fuselage aft of the rear pressure bulkhead, was found intact and undamaged. There was no evidence of exposure to heat or fire. The aluminum foil recording medium was examined and all recorded parameters (altitude, airspeed, heading, vertical acceleration, and VHF radio transmission times) were legible. The values of these parameters were determined as a function of time for the final 6.5 minutes of the flight.

The FDR time base was correlated with the CVR time by a comparison of the common recording of VHF radio transmissions. The comparison showed that an initial vertical acceleration peak, 3 seconds before the recordings ceased, coincided closely with the first sound of impact.

Although there was no evidence of recorder malfunction or recorder abnormalities, a comparison of recorded altitude at the time of impact with the elevation of trees which were struck showed a difference of about 70 feet, the recorded value was high. Also, a comparison of the recorded airspeed values at the times of the first officer's airspeed callouts disclosed a difference of 9 knots; again, the FDR values were high.

The FDR airspeed measurement, when corrected to agree with the CVR airspeed ieferences, shows that the aircraft was indicating ahout 160 knots when at an altitude of 1,100 feet about. 1 minute before impact. The airspeed increased to a maximum of about 175 knots before decreasing to about 140 knots at impact. The sound spectroanalysis for rhrust values showed that thrust varied between about 17.000 pounds and 13.800 pounds during the last minute of flight. Thrust was increasing at impact.

1.12 Wreckage and Impact Information

The aircraft came to rest about 3.090 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 86 feet.

The first visible signs of ground contact were located 3,629 feet from the runway threshold. Pieces of forward nose fuselage structure were found embedded in 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.

The fuselage, including the empennage, the left wing outboard to about wing station (WS) 733, and the right wing outboard to WS 820, came to rest over a shallow gulley and partially on a service road to the MM site.

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.

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.

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. There was no evidence of fire or explosion at the wing tip tank vents.

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

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.

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.

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 tahs were in neutral, the rudder tab was deflected about 4 in. to the left, and the rudder was in neutral. The rudder tab setting rcrrraponded to the setting on the cockpit trim wheel.

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 vas 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 tho direction of engine rotation. Various amounts of finely chopped, fiberous 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 byproducto of aircraft fires.

The third officer, who survived the crash bur later died of his injuries, received traumatic leg and ann 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 arc 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 involver! 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 io 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 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 accidect 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 first officer escaped through those exits. The first officer was assisted in his escape by two other cockpit crewmembers and left the aircraft through a hole in the ccckpit wall.

The surviving passengers reported that some passengers rushed toward the front and rear of the cabin before the aircraft sropped. The survivors did not hear instructions regarding escape from the aircraft after the eccident. 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

Flight Recorder Data - Airplane Performance Data Analysis

The measured values of the flight data recorder parameters were analyzed along with the thrust values determined froa the General Electric Company's spectrographic study of the cockpit voice recorder tape and the nanufacturcr's data on airplane performance. Tht purpose of this analysis was to determine the magnitude of the winds along the flightpath and tu construct a flight profile which would relate the airplane's position during the final minute with the ILS glide slope and the corresponding VASI indication.

(a) Determination of winds encountered -- The aircraft's performance capability for a given set of conditions (including weight, configuration, thrust, airspeed, and altitude) is described by a specific plot of vertical speeds versus longitudinal accelerations. When tho values for the airplane's rate of altitude change and rate of airspeed change at a given instant were not compatible with the calculated theoretical performance capability, the differences were attributed to external forces on the airplane which were produced by changes in the vertical and horizontal components of the wind.

Although the total effect of the wind could be determined by these analyses, the exact combinations of vertical and horizontal wind components which the aircraft encountered could not be determined precisely.

The data showed that the winds encountered by the aircraft were characterized as follows:

> From about 58 seconds before Impact to 51 seconds, very little wind effect; from 51 seconds to 47 seconds, an increasing headwind about: 5 kn/sec., or an updraft of over 4,000 fpm, or some combination of increasing headwind and updraft; from 47 seconds to 39 seconds. a decreasing headwind about 1 kn/sec., or a downdraft of about 1,000 fpm, or some combination of decreasing hesdvind and downdraft; from 39 seconds to 27 seconds, an increasing headwind varying between ahout 1.5 kn/sec. aad 3.5 knlsec. or an updraft varying between about 1,200 fpm and 3,000 fpm, or some combination of increasing headwird and updraft; from 27 seconds to 4 seconds, little wind effect ranging from .3 kn/sec. increasing headwind to .6 kn/sec decreasing headwind, or from 300 fpm updraft to 450 fpm downdraft, or some combination of headwind change and vertical wind change; final 4 seconds (from 125 feet above to ground), a decreasing headwind of about 2 kn/sec., or a downdraft of about 1,700 fpm, or a combination of decreasing headwind and downdraft.

The thrust uhich would have been required for the aircraft to have achieved level flight with a constant indicated airspeed was also calculated for each of the envircnmental conditions encountered. The thrust required for all conditions except that encountered during the final 4 seconds was less than the thrust available with takeoff power applied (nominally about 57,000 pounds). When encountering the calculated wind change for the final 4 seconds of the flight, the thrust which would have been required to maintain unacceleratad level flight would have exceeded the thrust available at takeoff power. Under these conditions, level flight could have been maintained for a short time ai the sacrifice of airspeed. With continued exposure to these wind changes. the aircraft would, eventually, decelerate to a stall.

These wind changes, however, were calculated based on the aircraft's descent profile. If the winds during the last 4 seconds were varying as a function of altitude caused by the friction effects associated with their (the winds) clcse proximity to the terrain, they could have been significantly different than those calculate? from the descent profile. In which case, the aircraft, once level flight had been achieved, nay have encountered a more stable wind velocity. Under there conditions, the available thrust would have been sufficient to accelerate the aircraft or to climb.

The amount of altitude which the aircraft would lose during a transition from a 1,500 feet per minute descent to level flight following the pilot's initial action to arrest the descent is dependent upon several variables--initial airspeed, the rate and amount of the pilot's control input, thrust management, and wind changes. This is a dynamic problem which would probably produce a range of results if examined in simulation. Although simulation was not conducted, the question was analyzed based upon specific assumptions. These assumptions were: (1) that the maneuver was initiated at an airspeed of 148 kn; (2) that the pilot introduced a control column input to produce a load facto- of 1.5g, or activate the stick shaker whichever occurred first; (3) that the pitch rate was such that maximum pitch change was accomplished during a 3-second period; (4) that there was no significant increase in thrust until the aircraft reached level flight; and, (5) that the wind was varying only as a function of the aircraft's change of altitude.

Under the assumed conditions, the aircraft would have lost about 55 feet in completing the maneuver. The total change in pitch attitude would be from about nose level at the initiation of the maneuver to about 12^{o} nose up at the instant level flight was attained:. Thus, the rotation rate the aircraft assumed was about 4^{o}/sec, slightly higher than the 3^{o}/sec normally used in a go-around maneuver. The aircraft would lose about 7 kn of airspeed in completing the leveloff.

Assuming that, as the descent rate was arrested, the pilot lowered the nose of the aircraf. to maintain level flight, the aircraft would have an initial deceleration rate of about 1.5 kn/sec and the deceleration would continue at an increasing rate until the engines were producing higher thrust. The instantaneous application of takeoff thrust at the initiation of the leveloff maneuver, even ignoring an allowance for engine acceleration time, would have hat! no significant effect on rhe total loss of altitude.

The thrust which wculd be required to maintain position on a 3.25^{o} glide slope in no wind conditions for two configurations was also calculated. For a 40^{o} flap configuration, at 150 kns, about 20,160 pounds of thrust would be required, A 50^{o} flap configuration would require about 24.170 pounds of thrust to maintain an approach airspeed of 140 kns.

(b) Determination of <u>Plight Profile and Relationship with ILS Glide Slope and VASI Indication</u> -- The flight profile of the aircraft. that is. its altitude versus distance from the runway threshold. was determined for the last minute of flight using airspeed and altitude values from the FDR. The values were used uncorrected and corrected for the ipparent errors evident from impact site elevation and CVR callouts. The calculations were performed assuming both a 15-kn constant neadwind and a. headwind which varied between zero and 35 kns (the maximum wind speed indicated in meteorological reports) in accordance with the wind accelerations determined in the described wind analysis.

The flight profiles were compared with the corresponding positions of the ILS and VASI glide nlopcs. The ILS glide slope elevations were calculated from a 3.25° glide slope with a threshold crossing height of 55 ft and airport elevation of 30 ft. The VASI indications were determined for a system installation and alignment as described in FAA Document 6850.2, Handbook Visual Guidance Lighting Systems, October 16, 1974.

(The results for a plausible set of assumptions--using corrected FDR altitude and airspeed values and headwinds varying between zero and 35 kns--are shown in Appendix E.)

The results indicate that the aircraft was bracketing, and within 30 feet of, the glide slope with a red/white VASI indication presented from 1 minute until 40 seconds before impact. At that time, the aircraft crossed the glide slope centerline from iow tc high. The aircraft continued to diverge above the glide slope while airspeed increased ahout 10 kns until, about 20 seconds before impact, it reached a glide slope deviation of 55 it (one-dot displacement on raw data display). The VASI would have presented a' pink/white indication during that period. About 16 seconds before impact, the aircraft began to rapidly converge with the glide slope. The aircraft crossed the glide slope from high to low between 11 and 12 seconds before impnct and continued to diverge below the glide slope until impact. The VASI presentation would have changed rapidly going from pink/white to red/white about 12 seconds before impact, to red/pink ahout 8 seconds, and to red/red about 6 seconds before inpact. The glide slope raw dzta would have shown a full scale deviation for the final 6 seconds.

1.17 Additional Informntion

None

1.17.1 Use of Flight Director in Windshear Conditions

An engineering flight simulator was used to observe pilot and aircraft performan-e during passage through windshear environments as pan of the investigation of another accident. 5/ During the simulation, some pilots noted that the sinulator would continue to descent to impact the ground while below glide slope, even though the flight director

5/ Eastern Air Lines, Inc., B-727, Jamaica, New York, June 24, 1975 (NTSB-AAR-76-8).

steering commands were nulled. This was noted when passing through programmed winds which consisted of rapid changes in both the horizontal and vertical speeds. Following that same accident, simulated windshear encounters were conducted at the NASA Ames Research Center. During those tests, the pitch attitude required to stop the descent rate often exceeded the flight director pitch command limits when the encountered wind caused a rapid and extreme speed decay, or after a large glide slope error was allowed to develop as a result of slow pilot response to initial commands, or after a flight director step gain decrease was initiated at MM passage.

1.17.2 Restricted Cargo

The aircraft was carrying restricted cargo. The cargo, listed as article No. 727 by the International Air Transport Association (IATA) 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 1/2 kilogram (1 pound) or 1/2 litre (1 pint). Compatible plastic tubes of not over 5cc (1/6 fluid once) 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 1/2 kilogram or 1/2 litre. No more than 24 of these containers should be packed into one container'. providing the net quanti-v does not exceed 1 kilogram (2 pounds), or 1 litre per container.

The MEK peroxide was diluted to 50.8 percent peroxide with hydroquinone. This inhibitor increased the flahhpoint from 125° F to 180° F, in addition tu inhibiting it chemically. The cargo consisted of 200 20cc bottles, with 50 bottles per 1 gallon tin. "he 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 Iour 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, :he 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.

1.17.3 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 approacn 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 instruments.
Be aware of correct altimeter setting and aititude.
Re 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 end cross-check altitude. Watch for vlsual cups 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 Eeet above ground level (AGL) **is** 1,000 FPN."

1.17.4 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 were outdated. The approach **was** accurately described. The narrative also stated. 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."

I.. 1s New Investigation Techniques

None

2. ANALYSIS

General

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

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

Based on the investigation, the third officer's statement, and the performance analysis, the Safety Board concludes that the aircraft's 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.

The Approach

The CVR readout and the interview with the first officer established that the runway was in sight when the aircraft was about 8 nmi from the runway threshold. The runway probably remained in sight during most of the approach.

The first officer commented five times during the approach, after the aircraft was within 7.5 nmi of the runway threshold, that he had the runway or the runway lights in sight. There was no indication that any of the navigational aids or the aircraft instruments were faulty.

The aircraft descended about 500 ft. below the published minimum glide slope intercept altitude of 2,500 ft. before the glide slope intercept point was roached. This placed the aircraft 180 ft. below the final approach fix altitude of 2,180 ft. These altitudes are confirmed by a CVR comment, "Two thousand", made abcut 1.5 seconds before the FAF callout. The Safety Board was unable to determine the reason for this deviation from approach procedures.

At FAF passage, the 7 nmi DME fix, the first officer's navigational receiver selector switch should have been changed from the VOR position to the ILS position; however, this vas not accomplished. If the change had been made, as good practice would dictate, the first officer could have monitored the approach more efficiently and his navigational display would have been ready for crosscheck by the captain or crossover in case of the failure of the captain's instruments.

As the aircraft approached the glide slope, it continued through and above it as the captain started hia descent. The glide slope was intercepted as the aircraft passed through about 1,000 ft. The airspeed during this time varied a few knots above and below 160 kn.

From this point on during the approach, FDR information shared that the aircraft flightpath waa not compatible with the aircraft performance which would be expected in stable air. The differences can be attributed to external forces acting upon the aircraft, such as wind changes or rain drag. Analysis has shown that a maximum density rain could produce an increase in drag forces which would equate to a –600 fpm change in descent rate; however. statements by the first officer and the surviving passengers refute any claim that the aircraft encountered such a heavy rain before impact. Therefore. the difference between expected and recorded aircraft performance was more likely caused by the winds.

An analysis was conducted to determine the wind changes needed to produce the recorded aircraft performance. The flight recorder data as recorded and corrected for an assumed 9–knot airspeed error. as indicated by the first officer's airspeed callouts, were used in the analysis. The differences produced by the 9–knot error were not considered to be significant in the analyzed wind.

This analysis indicated that the aircraft encountered gusty wind conditions with a predominantly increasing headwind and/or an updraft about 50 seconds before impact. The influence of this wind condition persisted for about 25 seconds. The Safety Boiird believes that the windshear was caused by the outflowing winds from the rainstorm over the airport as they were affected by the upsloping terrain around Logotala Bill. The windshear was evident by a sharp increase in airspeed and a shallowing of the descent path. Consequently. the aircraft went above the glide slope. The airspeed at this time was still about 160 kn. The sound spectogram showed that. at this time, the thrust was reduced to apparently correct the high and fast condition.

As the aircraft passed Logotala Hill, it apparently came out of the increasing headwind or updraft, condition and the positive performance effect was lost. In fact, a wind which produced a small negative performance effect was probsbly encountered. The thrust was well below that normally needed for a stabilized approach, and. about 16 seconds before impact, the aircraft started a rapid descent. of about 1,500 fpm.

Thus, the Board concludes that the captain recognized the initial effect of the windshear condition and acted to correct the aircraft's flight profile by reducing thrust, but he did not recognize the second effect as the windshear condition changed. Consequently, the aircraft, with low thrust, responded to the changing wind by developing a high descent rate. The captain had at least 12 seconds in which he could have taken action to arrest the descent in time to prevent the accident. During that time, tht total thrust available exceeded that required to maintain constant airspeed in level flight. That the necessary pitch attitude and thrust changes were not applied can only indicate that the flightcrew was not aware of the high descent rate and the impending crash.

Evidence indicated that, when the sink rate increased, the captain may have been looking outside the aircraft and, therefore, was not flying by reference to the flight instruments. At the time the sink rate increased to about 1,500 fpm, the aircraft was over an area devoid of lights (known as a "blackhole"), a heavy tropical rainstorm was over the airport and moving toward the approach end of the runway, and the first officer had called the runway in eight.

The circumstances of several other accidents which have been investigated by the Board have indicated that the transition from instrument flight to visual reference for vertical guidance is the most critical portion of the approach, particularly if the transition is initiated prematurely. Dynamic changes to the aircraft'n flight profile are apt to go unrecognized. In tbia accident, the heavy rainshower ahead of the aircraft probably caused visual cues to diminish to the extent that the increased sink rate would have been extremely difficult. if not impossible, to recognize. An a result of previous studies, the Safety Board has endorsed strongly the installation of VASI as a visual aid to vertical guidance and even more so. the optimization of instrument approach procedures which would prevent the premature transition to visual reference by the pilot controlling the aircraft.

VASI was available and operating during this approach, however, there was no way to determine with certainty that the crew could have seen VAST continually during the approach because of the heavy rainstorm that was moving across the airport. As the heavy rain associated with the storm moved toward the aircraft's approach path from the opposite end of runway 5, the rain most likely would have obscured, progressively. each pair of runway edge lights. This obscuration would have progressed until the VASI disappeared from the flightcrew's sight. At this point, the approach could still have been continued because the approach lights, the runway end identifier lights, and up to 750 ft. of runvay edge lights could have been visible to the flightcrew. The fact that some lights were visible to them is verified by the repeated callouts to that effect made by the first officer during the approach.

The Safety Board believes it likely that the flightcrew did see and use VASI at some time during the approach, particularly after the first officer's report that the aircraft was "...a little high." Even though the first officer could not remember seeing the VASI, the most likely reference for his statement of the aircraft's position relative to the glide slope would have been VASI, becsuce he had not changed his No. 2 navigational receiver selector switch to the ILS frequency. Therefore, ILS information was not displayed on his instruments and to obtain this information, other than visually, he would have had to look "cross-cockpit" at the captain's instruments to determine that the aircraft was high. In the last few seconds, the first officer would have had to look back into the cockpit to ascertain that the aircraft was at minimum altitude and that the airspeed was 140 kns and advised the captain. It is possible that he would not have seen the below glide slope indications on the VASI under these circumstances.

Even had the captain been observing VASI as the aircraft descended below glidepath, his attention to the Indications and his reaction to an unsafe red/red signal would have had to be rapid and decisive in order to prevent impact.

The analysis of the VASI indications, based on the flight profile derived from flight recorder data, showed that, at the time of the first officer's callout, the captain, assuming that the VASI was visible to him, would have seen an above glide slope indication on the VASI. This was about the same time the high rate of descent started. Without reference to his flight instruments or a call from one of the other crewmembers in reference to the increased rate of descent, the captain would have had no reason to apply power at this time. If he continued to watch the VASI, he would have seen an "on glide slope" indication, then a "slightly low on the glide slope" indication; still no visual indication alerted him to the need for a power application. By the time that the VASI would have changed to an unsafe, low indication, the aircraft was already descending about 1,500 fpm. The captain may have seen the unsafe indication because power was applied shortly before the first impact is heard on the cockpit voice recorder. This whole sequence of change in VASI indications would have taken place in 15 seconds or less, with the "below glide slope" and then the "unsafe" indications occurring in the last 8 seconds or less.

The flight profile analysis showed that the aircraft was about 178 feet above the trees when the red/red VASI should have been seen by the crew. At that time the aircraft was descending at 25 feet/second. Thus, allowing 1 second for the captain to introduce a control movement after recognizing the necessity to do so, the aircraft would then have lost about 80 feet of altitude before the descent was arrested. This assumes a very positive leveloff maneuver where the aircraft is rotated at 4°/sec. to a 1.5g load factor. Therefore, the captain would have had to recognize and start responding to the situation within about 2.5 seconds of the red/red VASI presentation in order to limit the total altitude loss to 133 feet and to miss the trees with about 35 feet of margin. Slower recognition time or a less positive leveloff maneuver would have resulted in impact with the trees. The Safety Board believes that 2.5 seconds is marginal for the perception of the change in VASI indications and the initiation of appropriate response. by the captain.

Performance analysis showed also that the aircraft could not maintain flight without further loss of airspeed after the leveloff even with maximum thrust if the decreasing headwind condition encountered within 120 feet of the trees persisted. However, the Board believes it likely that the windshear encountered by the accident aircraft as it approached the ground was a result of the wind variation with altitude common when in close proximity to the terrain. If so, the aircraft's performance would not be degraded once level flight was achieved. Accelerated level flight or a climb should have been achievable after thrust attainment.

The Safety Board considered another factor which could have added to or have supported the captain's visual indications that he need not apply power to reach the runway or to arrest a high rate of descent. The heavy rainstorm which. was moving toward the aircraft could have caused a shortening of the pilot's visual segment— that distance along the surface visible to the pilot over the nose of the aircraft. This can produce the illusion that the horizon is moving lower and, as a result, is often misinterpreted as an aircraft pitch change in the nose up direction. The natural response by the pilot would be to lover the nose or to decrease, not increase, power.

While conceding that the environmental circumstances at the time of this accident were unfavorable, the Safety Board must conclude that the accident could have been avoided had the crew recognized, from all available sourcen, the onset of the high descent rate and taken timely action. The Board is, therefore, concerned about crew procedures relative to altitude awareness and required callouts. If the crew was completely aware of the aircraft's altitude, they should not have accepted a glide slope intercept altitude 500 ft. lower than the published altitude; they should not have accepted an altitude 150 ft. lower than that altitude prescribed for the FAF crossing; and the pilots-not-flying should have made altitude warning callouts. The first officer did make an altimeter check abcut 2.4 minutes before impact, but he said nothing about actual altitude. About 3 seconds alter the first officer's comment, the captain made an unintelligible comment which nay have been a recognition of the aircraft's lower-than-prescribed altitude because, 5 seconds later, the sound of a power increase could be heard on the CVR.

The CVR tape contained a few other unintelligible comments that may have been altitude or warning callouts. However, if these comments were altitude or warning callouts, it is difficult. to understand why they went unheeded by the captain.

Perhaps even more important than altitude awareness in this accident was awareness of increasing sink rate. Pan American procedures required that the pilot not flying the aircraft call out sink rate when it exceeded 800 fpm and recommended that the sink rate below 2,000 ft. should not exceed 1,000 fpm. An analysis of the approach to Pago Pago showed thnt the 3.25° glide slope would require a descent rate. slightly less than 800 fpm with an indicated airspeed of 135 kns in zero wind conditions. In this case, 135 kns was the reference speed (V_{ref}) for the approach. Using the company procedure of adding only half the steady wind velocity to V_{ref}, the required descent rate would be less than that rate required for zero wind since the groundspeed would be affected by the total value of the steady wind velocity. Any additional speed margin to compensate for wind gust velocity would have had the effect of increasing the groundspeed and thereby Increasing the required descent rate; however, cuch rates would still be less than 1,000 fpm even with a 35-knot gust margin.

The captain of Flight 806 was attempting to maintain an approach speed of 150 kno. If the anticipated headwind dissipated to zero, the descent rate required to maintain position on the glide slope would have been 880 fpm, still less than the 1,000 fpm maximum. Nevertheless, according to procedures, a callout should have been made whicn may have alerted the captain that the actual winds differed from those reported.

The FDR data showed that the aircraft's rate of descent increased about 1.500 fpm at least 15 seconds before impact. Again, there were no callouts and the evidence indicated that the captain did not recognize or react to this increased sink rate in a timely manner. The Safety Board believes that, had he done so as a result of a callout by one of the nonflying crewmembers, the accident could have peen avoided.

The Safety Board also believes that flight instruments are more reliable indicators than the senses of the pilots, especially during that portion of the approach when the aircraft is close to the ground and when the visual cues are aparse or diminishing. In undocumented windshear encounter tests conducted at NASA, it was determined that the flight director steering commands ere adequate except when the windshear resulted in very rapid speed decay, when initial steering commands were not followed by tne pilot, or after the flight director gain-change was initiated at MM passage. Therefore, to manage such conditions the flight director must be used in combination with other flight instruments such as the raw data indications.

In the final 15 seconds of this approach, the rate of descent must have averaged considerably more than the 1,000 fpm recommended maximum and the raw data glide slope needle must have shown that the aircraft passed through, then below, the glide slope. The glide slope was noted unusable below 138 ft., but the aircraft departed the glidepath well above that altitude. Any indication that the aircraft was below the glide slope at an altitude lower than 300 ft. should have been treated with suspicion, the note about glide slope unusability notwithstanding, especially if the VASI was not in sight or was obscured.

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 first officer. 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 hy stressing the location of the nearest: exit and the procedures to be followed in an emergency. The movement of mast of the passengers. including many of the passengers in the overwing area of the aircraft, to the front and rear exits indicates that ti-cy either did not comprehend the pretakeoff briefing or they reacted to the emergency without thinking.

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 r e s personnel arrived at the scene.

The fire and rescue personnel experienced considerable difficulty in fighting the fire. Tne greatest problem was the limited access to the wreckage. The one-lane road precluded more than one vehicle from fighting the fire at a, tine. All approaches to the fire had to be made from the front of the aircraft: therefore, total coverage of the fire vas not possible. Had all fire vehicles been able to approach the fire simultaneously, fire damage to the aircraft may not have been so extensive.

3. CONCLUSIONS

3.1 Findings

1. There vas no evidence of preimpact structural failure, fire, or flight control or powerplant malfunction.

2. Flight 806 was conducting an ILS/DME approach to runway 5 at Pago Pago International Airport; the captain vas flying the aircraft: the third officer was perfuming first officer duties and was qualified to do 60.

3. All components of the ILS and visual guidance lighting systems were operating properly.

4. When Flight 806 was approximately 3 nmi from the airport, it encountered an increasing headwind and updraft which caused the aircraft to gain airspeed and deviate above the glide slope.

5. The wind condition was associated with a heavy rain shower which was moving down the runway toward the approach end.

6. The pilot observed the airspeed and glide slope deviations caused by the initial windshear encounter and responded by reducing thrust.

7. When Flight 806 was approximately 1.25 nmi from the airport, the positive performance. effect of the windshear diminished and the airplane. because of the reduced thrust, began descending at a rate of 1,500 fpm.

8. The 1,500-fpm descent rate was not corrected for 15 seconds until just before impact, although power was increased during the last 4 seconds.

9. The flightcrew had at least some of the runway lights in sight during the last 2 minutes 50 seconds of the flight.

10. The flightcrew probably did not recognize the development of the increasing descent rate and the deviation below glide slope because of their reliance on visual referenceb: although VASI was available and operating, the lights may have been obscured by rain.

11. A visual assessment of vertical guidance would have been difficult because of an absence of visual cues and the "blackhole" approach phenomena.

12. Although the first officer monitored and called cut airspeeds and minimum altitude during the final seconds of the flight, there were no rate of descent callouts by any of the nonflying crew although the descent rate exceeded the 1,000 fpm recommended maximum for at least 15 seconds.

13. The No. 2 nav receiver was tuned to the VOR frequency to provide DME information and the first officer had not switched to display the ILS information on his instruments; consequently, the glide slope raw data and flight director steering commands were displayed only on the captein's instrument panel.

14. The impact was survivable. Relatively minor crash forces were involved, occupant restraint was adequate, and the occupiable area of the aircraft was not compromised.

15. The injuries sustained by the fatally injured passengers as well as the surviving passengers were a direct result of the postcraah fire.

16. All surviving passengers reported that they listened to the pretakeoff briefings and that they reviewed the passenger information pamphlets.

17. Fire and rescue response time was delayed by rain. barriers across the response route, terrain, and confusion over what was burning.

18. Restrictions in the approach to the fire hampered fire-fighting effectiveness.

3.2 Probable Cause

The National Transportation Safety Board determines that the probable cause of the accident was the flightcrew's late recognition and failure to correct in a timely manner an excessive descent rate which developed as a result of the aircraft's penetration through destabilizing wind changes. The winds consisted of horizontal and vertical components produced by a heavy rainstorm and influenced by uneven terrain close to the aircraft's approach path. The captain's recognition was hampered by restricted visibility, the illusory effcces of a "blackhole" approach, inadequate monitoring of flight instruments, and the failure of the crew to call out descent rate during the last 15 deconds of flight.

4. SAFETY RECOMMENDATIONS

As a result of its investigation of this accident, the National Transportation Safely Board has recommended that the Federal Aviation Administration:

"Amend 14 CFR 121.439 to require that a check airman (1) observe a pilot as he performs the three takeoffs and three landings specified for recent experience, and (2) certify that the pilot is qualified and proficient to return to his assigned status. In addition, the check airman should require a pilot to perform any maneuvers necessary to certify performance." A-74-104

"Require Air Carrier Operations Inspectors to review and evaluate airport and route qualification programs to insure that all information is up to date, that company procedures are consistent with the published FAA procedures, and that obsolete procedural material is not included." A-74-118

"Amend 14 CFR 139.55(b)([illegible]) to prescribe minimum levels of medical service provisions similar to those provided for in Advisory Circular 150/5210.2 to insure that mass casualties resulting from an aircraft accident can be adequately handled and satisfactorily treated." (A-75-1)

For FAA's responses to these recommendations see Appendix F.

BY THE NATIONAL TRANSPORTATION SAFETY BOARD

/s/ FRANCIS H. McADAMS
Member

/s/ PHILIP A. HOGUE
Member

/s/ WILLIAM R. HALEY
Member

KAY BAILEY, Acting Chairman, filed the following dissent:

I disagree with the probable cause in the majority decision. I think windshear should be stated as a major factor in the cause of the accident. The probable cause should read:

> The National Transportation Safety Board determines thai the probable cause of the accident was the aircraft's penetration through destabilizing wind changes and the flightcrew's late recognition and failure to correct in a timely manner the resulting excessive descent rate. The winds consisted of horizontal and vertical components proauced by a heavy rainstorm and influenced by uneven terrain close to the aircraft's approach path. The captain's recognition was hampered by restricted visibility, the illusory effects of a "blackhole" approach, inadequate monitoring of flight instruments, and the failure of rhe crew to call out descent rate during the last 15 seconds of flight.

I believe we should look at the whole picture when determining probable cause. Our vision becomes too narrow when we adhere to the "last possible chance to prevent the accident" as the only probable cause. In this case, the complete reasoning should begin with the fact that there was a windshear and then state the lack of proper reaction under the circumstances.

/s/ KAY BAILEY
Acting Chairman

October 6, 1977

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 far 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 6 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, Honclulu. 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.

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APPENDIX B

Personnel 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 cn the 11107 on July 2, 1965, and to B707 captain November 10, 1967. Captain Petersen had 17,414 flight hours, of which 7,416 hours were In the B707.

Captain Petersen held Airline Transport Pilot Certificate No. 7191-41, issued July 2, 1965. He was type rated in ?he Douglas DC4, Boeing 337, 707/720. He possessed radio certificate No. 12507880 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 Fan American World Airways, Inc., August 7, 1964. His initial B707 Reserve Copilot/Navigator training was completed October 20, 15\64, and he was upgraded to Master Copilot on June 15, 1967. He had 5,107 flight-hours. all in the B707. In the cast 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 tnken 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 Ccpilot 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.

APPENDIX B

Third Officer Jam-s S. Phillips

Third Officer James S. Phillips, 43, was employed by Pan American World Airways, Inc., April 25, 1966. His initial B707 training as a Reserve Copilot/Navigator waa 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" Phose of training November 14, 1973. The following comments were noted by the training captain: "'A' Phase complete. Goo? work. Should rate in six hours." The "B" Phase simulator training was accmplished May 7, 1973, and the aircraft period completed the following day. After :he aircraft period. the training captain commented: " All areas at a good level of RCO proficiency Ok for line ldg." This sircraft period was observed by an FAA inspector.

Mr. Phillips had flown into Pago Pago Airport seven times in the paet 7 months. Since Cctober 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 2,299 flight hours of which 1,444 hours were in the B707. In the past 60 days he Lad 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.

APPENDIX B

All four flightcrew members had identical itineraries during the 24 hours preceding the accident. They had been off 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

	Date of Birth	Date of Hire	Initial Training	Last Recurrent Training
Elizabeth Givens	9-28-13	7-1-66	7-14-66	6-20-73
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
Patricia Reilly	7-22-48	5-8-72	5-30-72	3-28-73
Kinuko Seko	3-19-45	5-1-69	5-14-69	9-7-73
Yvonne Cotte	4-10-50	2-19-73	3-6-73	3-6-73

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, end delivered to Pan American on that date.

The last rajor 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 ha3 been accmplished at Auckland airport just before tnkroff 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 sircraft had been within ita weight and balance limitations both at takeoff and at the time of the accident.

There were 117,000 pounds of jet A-I fuel aboard the aircraft upon departure from Auckland. The plnnned 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, end 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.

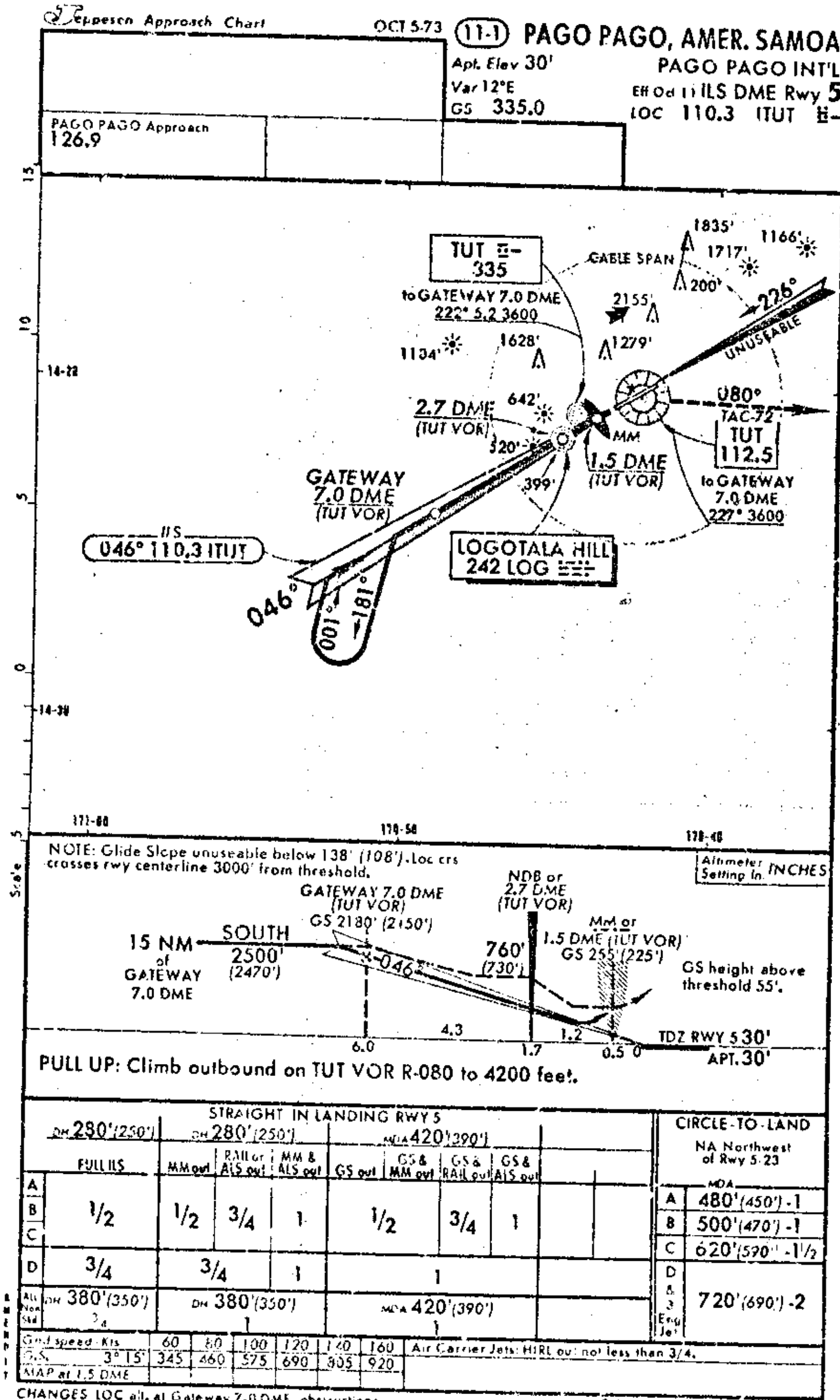
APPENDIX C

ENGINES

	Date Installed	TSO Hours	Flight Cycles	Hours Since Installed
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.

APPENDIX D



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

Appendix E
Flight Profile - Relationship with Glideslope & V.A.S.I.

Time before impact seconds	Indicated airspeed knots	Assumed wind vel. kn.	Calculated ground speed feet/sec	Distance to runway threshold feet	Altitude [illegible] feet	GLIDESLOPE Elevation feet	GLIDESLOPE Deviation feet	GLIDESLOPE Deviation dots	VISUAL APPROACH SLOPE INDICATOR High bar elevation white	High bar elevation pink	Low bar elevation pink	Low bar elevation red	Indication
60	154.3	1.3	263.3	18024	1135	1108	+27	+.20	1213	1128	1007	925	pink/white
59	158.3	1.3	270.2	17757	1115	1093	+22	+.17	1197	1113	993	913	
58	160.7	1.2	274.5	17485	1095	1078	+17	+.13	1180	1098	979	900	↑
57	160.1	1.0	273.8	17210	1076	1062	+14	+.11	1163	1082	964	885	red/white
56	160.0	0.8	273.9	16937	1056	1047	+9	+.08	1147	1067	950	873	
55	160.0	0.6	274.3	16662	1036	1031	+5	+.04	1130	1051	937	860	
54	158.7	0.4	272.4	16389	1017	1016	+1	——	1113	1036	921	847	
53	158.2	0.2	271.8	16117	997	1000	−3	−.03	1098	1020	907	834	
52	158.5	0.0	272.7	15845	978	985	−7	−.06	1080	1005	893	821	
51	158.8	0.2	273.5	15572	959	969	−10	−.09	1063	989	879	808	
50	161.4	3.2	272.3	15299	939	954	−15	−.13	1046	974	864	795	
49	162.3	8.1	265.6	15030	920	938	−18	−.17	1030	958	850	782	
48	167.4	13.0	266.1	14764	901	923	−22	−.21	1014	943	836	769	
47	175.2	17.9	271.2	14495	881	908	−27	−.26	997	928	822	756	
46	171.2	16.7	266.4	14227	865	893	−28	−.27	981	913	808	743	
45	169.4	15.5	265.3	13961	853	878	−25	−.24	965	898	794	730	
44	165.5	14.4	260.4	13698	842	863	−21	−.21	948	883	780	718	
43	161.1	13.2	254.9	13440	831	848	−17	−.18	933	868	767	705	
42	156.7	12.0	249.3	13188	820	834	−14	−.14	917	854	754	693	
41	155.0	10.8	248.4	12939	810	820	−10	−.10	902	840	741	681	
40	155.0	9.6	250.5	12690	801	806	−5	−.05	887	825	727	669	
39	151.7	8.4	246.8	12441	791	791	——	——	872	811	714	657	
38	154.4	8.1	252.0	12192	781	777	+4	+.04	856	797	701	645	
37	156.7	9.1	254.2	11935	770	763	+7	+.08	841	783	688	633	
36	156.7	10.5	251.0	11686	759	749	+10	+.12	826	768	675	621	
35	159.8	12.0	254.7	11432	748	734	+14	+.17	810	754	662	609	
34	158.0	13.4	249.2	11180	737	720	+17	+.21	794	740	648	597	
33	158.9	14.9	248.2	10932	726	706	+20	+.25	779	726	635	585	↓
32	157.4	16.4	243.1	10686	715	692	+23	+.30	764	712	622	573	pink/white
31	156.8	19.4	240.5	10444	705	678	+27	+.35	749	698	610	561	
30	161.1	22.8	238.7	10204	694	664	+30	+.40	735	684	597	550	
29	162.7	26.2	235.7	9967	684	651	+33	+.46	720	671	585	538	
28	164.0	29.5	232.4	9733	673	[illegible]	+35	+.50	706	658	572	527	
27	167.3	32.9	232.3	9501	663	625	+38	+.56	692	644	560	516	
26	165.6	34.0	227.5	9271	653	611	+42	+.62	678	631	548	505	
25	165.7	34.1	227.5	9043	642	598	+44	+.66	664	618	536	494	
24	162.8	34.2	222.4	8813	632	586	+46	+.72	650	606	524	483	
23	160.4	34.4	217.9	8598	622	573	+49	+.78	637	593	513	473	
22	158.0	34.5	213.6	8383	611	561	+50	+.82	623	581	502	462	
21	156.2	34.6	210.3	8171	601	549	+52	+.88	610	569	491	452	
20	157.6	34.7	212.6	7959	590	537	+53	+.92	597	557	480	442	
19	157.0	34.8	211.4	7747	580	525	+55	+.98	584	545	468	432	
18	155.9	34.9	209.3	7537	567	513	+54	+.99	572	533	457	422	
17	155.2	35.0	208.1	7328	554	501	+53	+.99	559	521	446	412	
16	154.7	35.0	207.1	7121	540	489	+51	+.98	546	509	436	402	
15	154.1	34.4	207.1	6913	521	478	+43	+.86	533	497	425	392	
14	150.7	33.9	202.0	6709	497	466	+31	+.64	521	486	414	382	
13	149.3	33.3	200.7	6508	474	455	+19	+.41	509	474	403	372	
12	148.4	32.8	199.9	6307	450	443	+7	+.15	496	463	393	363	↓
11	149.5	32.2	202.3	6106	427	432	−5	−.11	484	452	382	353	red/white
10	147.8	31.7	200.8	5905	407	420	−17	−.40	472	440	372	343	
9	146.4	31.1	199.4	5704	380	409	−29	−.70	460	429	361	334	↓
8	147.4	30.6	201.9	5504	351	396	−47	−1.16	447	417	351	324	
7	148.0	30.0	204.0	5301	322	386	−64	−1.66	435	406	340	314	red/pink
6	148.0	29.5	204.8	5096	294	374	−80	full scale	422	394	329	304	↓
5	148.0	28.9	205.8	4891	265	363	−98	full scale	410	383	319	295	red/red
4	148.0	28.1	207.2	4685	236	351	−115	full scale	397	371	308	285	
3	143.5	25.9	203.2	4479	207	339	−132	full scale	385	359	297	275	
2	141.3	23.6	203.3	4276	178	328	−150	full scale	372	348	287	265	
1	140.3	21.3	205.4	4072	149	316	−167	full scale	360	336	276	255	
impact	140.0	19.3	208.3	3865	116	304	−188	full scale	347	324	265	245	↓

See text (Section 1.16) for assumptions used to derive this chart.

APPENDIX F

DEPARTMENT OF TRANSPORTATION
FEDERU AVIATION ADMINISTRATION

WASHINGTON, D.C. 20590

OFFICE OF THE ADMINISTRATOR

Notation 1365

December 18, 1974

Honorable John H. Reed, Chairman
National Transportation Safety Board
Department of Transportation
Washington. D. C. 20591

Dear Mr. Chairman:

I have reviewed Safety Recommendation A-74-104 concerning the Board's investigation of the Pan American World Airways' (PAWA) Flight 806, B-707 accident near Pago Pago international Airport on January 31.

As you state in your letter. Captain Peterson, after being off night status for some four months. did in fact accomplish all of the re-qualification training for the B-707 aircraft required by Federal Aviation Regulations. In addition to simulator training under the supervision of a check airman. ground school sessions and three actual takeoffs and landings. he received 34 flying hours as pilot-in-command prior to the accident.

We very much appreciate the suggestion which you and your Board Members have made that Section 121.439 of the Federal Aviation Regulations be amended to require that a check airman supervise the three takeoffs and landings in the same manner in which. by current regulation, the simulator training is supervised. And we note that if this were to bo done, that same check airman would be Ires to require the pilot to perform my other maneuvers deemed ne: ssary or advisable.

Your recommendation is being given close and careful attention by the FAA staff and, through it, by appropriate organizations and individuals in the aviation community. I will advise you personally of my decision.

Sincerely,

Alexander P. Butterfield
Alexander P. Butterfield
Administrator

APPENDIX F

DEPARTMENT OF TRANSPORTATION
FEDERAL AVIATION ADMINISTRATION
WASHINGTON, D.C. 20590

OFFICE OF THE ADMINISTRATOR

JAN 14 1975

Honorable John H. Reed
Chairman, National Transportation Safety Board
Department of Transportation
Washington, D. C. 20591

Notation 1365C

Dear Mr. Chairman:

This is in response to your letter of December 24 regarding Safety Recommendation A-74-118.

Although airport qualification was not considered a causal factor in the accident, we will issue an Air Carrier Operations Alert to our field inspectors as soon as possible after the authorized release date to implement your recommendation.

Sincerely,

Alexander P. Butterfield

Alexander P. Butterfield
Administrator

APPENDIX F

DEPARTMENT OF TRANSPORTATION
FEDERAL AVIATION ADMINISTRATION
WASHINGTON, D.C. 20590

OFFICE OF
THE ADMINISTRATOR

JAN 27 1975

Honorable John H. Reed
Chairman, National Transportation Safety Board
Department of Transportation
Washington, D.C. 20591

Dear Mr. Chairman:

This will acknowledge receipt of your January 16 letter which transmitted Safety Recommendation A-75-1.

We are studying the recommendation and will respond as soon as our evaluation is completed.

Sincerely,

Alexander P. Butterfield
Alexander P. Butterfield
Administrator

APPENDIX F

DEPARTMENT OF TRANSPORTATION
FEDERAL AVIATION ADMINISTRATION

WASHINGTON, D.C. 20590

OFFICE OF
THE ADMINISTRATOR

February 26, 1975

Honorable John H. Reed
Chairman, National Transportation Safety Board
Department of Transportation
Washington, D. C. 20591

Notation 1365D

Dear Mr. Chairman:

This is in response to NTSB Safety Recommendation A-75-1.

We concur in your recommendation to amend Section 139.55 of Federal Aviation Regulations Part 139 to prescribe minimum levels of medical service provisions to insure that mass casualties resulting from an aircraft accident can be adequately handled and satisfactorily treated.

The Federal Aviation Administration has for some time required airports to develop, as a certification requirement, an emergency plan and has encouraged periodic testing of the plan. The Agency has also been in the process of developing more definitive requirements concerning medical services in the emergency plans.

The new requirements will expand on what an airport manager will be required to include in his emergency plan concerning medical services and will be the subject of a proposed amendment to Part 139. The additional information required will include such items as available communication systems both on and off the airport, the availability of medical facilities and services, procedures for notification and participation in a mass casualty emergency, available transportation systems, traffic control procedures, etc. In addressing each one of the required items, the levels of medical services may be established based on the total passenger capacity of the largest aircraft providing service to that airport.

A project for development of a Notice of Proposed Rule Making has been established.

Sincerely,

James E. Dow

James E. Dow
Deputy Administrator

DEPARTMENT OF TRANSPORTATION
FEDERAL AVIATION ADMINISTRATION

WASHINGTON, D.C. 20590

OFFICE OF THE ADMINISTRATOR

NOTATION 1365

MAR 12 1975

Honorable John H. Reed
Chairman, National Transportation
Safety Board
Department of Transportation
Washington, D. C. 20591

Dear Mr. Chairman:

This is in further reply to your November 21, 1974, letter on the Board's Safety Recommendation A-74-104 concerning the Pan American World Airways' B-707 accident near the Pago Pago International Airport on January 31, 1974.

Your recommendation has been carefully reviewed and I agree with the suggestion made by you and your Board members. I have, therefore, directed that a regulatory project be established to amend Section 121.439 of the Federal Aviation Regulations as you have proposed.

Sincerely,

James E. Dow

James E. Dow
Deputy Administrator