FOR IMMEDIATE RELEASE

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DEPARTMENT OF COMMERCE
BUREAU OF AIR COMMERCE
Washington

# REPORT OF THE INVESTIGATING BOARD

Statement of probable cause concerning an accident which occurred to an aircraft of Pan American Airways Company near Pago Pago, Tutuila, Samoa, on January 11, 1938.

To the Secretary of Commerce:

On January 11, 1938, at approximately 7:40 p. m. Greenwich Civil Time (8:40 a. m. Pago Pago local civil time) in the vicinity of Latitude 14°08'20" S and Longitude 170°51'00" W, which is approximately 12.5 nautical miles NW of Pago Pago, Tutuila, American Samoa, and 10.5 nautical miles from Fagasa Bay, an airplane of United States registry, while being flown in scheduled foreign operation, carrying mail and express, met with an accident resulting in death to all on board and the complete destruction of the aircraft. No authority had been requested or granted for the carrying of passengers on this route; hence, none were aboard. The crew consisted of the Captain, First Officer, Junior Flight Officer, Navigating Officer, Radio Officer, Flight Engineer and Assistant Flight Engineer.

The Captain, Edwin C. Musick, held a Federal Transport Pilot's license, Class 3-B Land and Sea. His last physical examination, as required by the Department of Commerce and taken on December 9, 1937, showed him to be in good physical condition for flying, with a preceding physical examination, taken on November 1, 1937, in conformity with Company regulations for all flight personnel, which also showed him to be in satisfactory physical condition. Captain Musick's record indicated that he had a total of 13,200 hours flying experience, 2,320 hours of which had been in trans-Pacific operations. His total flying experience with the Sikorsky S-42-B type seaplane in trans-oceanic operations

was 502 hours.

First Officer Cecil G. Sellers held a Federal Transport Pilot's license Class 3-B Sea. His last physical examination, as required by the Department of Commerce, was taken on October 15, 1937, and showed him to be in satisfactory physical condition. His record showed that he had a total of over 8,000 hours flying experience, 464 of which had been in trans-Pacific operations.

Junior Flight Officer Paul S. Brunk held a Federal Transport Pilot's license. His last physical examination, as required by the Department of Commerce, was taken on July 13, 1937, with a subsequent physical examination taken on November 29, 1937, in conformity with Company regulations for all flight personnel, both of which showed him to be in satisfactory physical condition. Pilot Brunk's record showed that he had a total of 1,922 hours flying experience, 125 hours of which had been in trans-Pacific operations.

Navigating Officer Frederick J. MacLean's last physical examination, in conformity with Company regulations for all flight personnel, was taken on October 4, 1937, and showed him to be in satisfactory physical condition. He had been employed by the operator in its Eastern Division as Navigation Instructor from November 6, 1935, to May 1, 1937, when he was transferred to the Pacific Division. His record showed that he had a total of 524 hours flying experience in trans-Pacific operations, as a navigator.

Radio Officer Thomas J. Findley held a Radiotelegraph License Extra First Class with endorsement for Radiotelephone Operator First Class and had a total of 765 hours of flying time as a Radio Officer in trans-Pacific service.

Flight Engineer John W. Stickrod held an Airplane Mechanic's license. His total flying time in NC-16734, as an engineer officer, amounted to approximately 650 hours.

Assistant Flight Engineer John A. Brooks held an Airplane and Engine Mechanic's license. He was assigned as a Chief Mechanic to the Pacific Division when it was first organized in March, 1935, and had since served continuously in that capacity. He had just been transferred to flight duty and was making this trip to New Zealand as Assistant Flight Engineer preparatory to undertaking independent duty as a Flight Engineer.

The aircraft, a Sikorsky, model S-42-B flying boat was owned and operated by the Pan American Airways Company, whose principal place of business is 135 East 42nd Street, New York. It was delivered to the operator by the manufacturer at Bridgeport, Connecticut, in November 1936, and was last certificated as airworthy on November 5, 1937. It bore Federal license number NC-16734. On December 22, 1937, the Department of Commerce granted authority to the operator to utilize this airplane for the carriage of mail and goods in scheduled service between Honolulu. T. H., and Auckland, New Zealand, at a maximum gross weight of 44,000 pounds. The specified conditions included a mandatory provision for the jettisoning (dumping) of sufficient fuel to reduce the gross weight to 41,000 pounds for landing with three or four engines operating and to 36,600 pounds in the event of a landing with less than three engines operating. Between December 23, 1937, and January 3, 1938, the airplane completed a scheduled flight from Honolulu, T. H., to Auckland, New Zealand, and return via Kingman Reef and Pago Pago, at the conclusion of which it had a total flying time of 838 hours and 33 minutes.

The trip on which the accident occurred was known as No. A-5, scheduled from Honolulu, T. H., to Auckland, New Zealand, with overnight stops at Kingman Reef and Pago Pago. Departure from Honolulu was made on January 9, 1938, the flight arriving at Kingman Reef on that date. On January 10, 1938, the trip was continued from Kingman Reef to Pago Pago on schedule. Departure from the dock at Pago Pago, Samoa, was made at 5:32 a.m. local time, January 11, 1938, and the airplane actually rose from the water five minutes later. Sunset at

Auckland, the destination, was at 4:12 p. m., Auckland local civil time, thus giving 14 hours and 42 minutes of daylight for the flight. The flight time analysis indicated that in standard cruising, at a density altitude of 9,000 feet, the flight would take 12.8 hours. There were 2,300 gallons of gasoline on board, 1,150 of which were in the wing tanks and the balance in the hull tanks. This amount of gasoline was calculated to provide a cruising endurance of 18.0 hours with the conditions stated above. The airplane carried a total of 751 pounds of cargo and was loaded to a gross weight of 41,936 pounds at the time of take-off.

The maintenance attention given the airplane was determined by routine servicing procedures at stated intervals, Flight Engineer's reports and the results of detailed inspections by designated ground personnel. Prior to its last departure from Honolulu, T. H., NC-16734 had been ashore at the United States Navy Fleet Air Base in Pearl Harbor, T. H., where maintenance facilities had been made available to the operator. While ashore, the airplane was inspected and routine service procedures known as "Intermediate Airplane Service" and "Long Engine Service" were carried out. The former principally required cleaning and inspection of specific parts of the airplane. The latter called for inspection of cowling, changing of oil, recording of cylinder compression pressure, changing of spark plugs and general inspection of the engine controls and installation. The "Shore Run-up Report" and the ensuing test flight showed satisfactory operation. During the overnight stops at Kingman Reef and Pago Pago, the maintenance activity was, in principle, similar to that described above. Both airports followed service forms known as "Overnight Airplane Service" and "Overnight Engine Service". The former required inspection of vital parts and the addition of fuel, oil, water and auxiliary fluids. The latter required a detailed inspection of the engines, their controls and their installations. No significant abnormalities were reported by the Flight Engineer or

detected by the respective Airport Chief Mechanics. The total flight time on the airplane at the time of departure from Pago Pago was 833 hours and 51 minutes. Total engine times were as follows: No. 1 engine, 409 hours and 58 minutes; No. 2, 393 hours and 39 minutes; No. 3, 381 hours and 25 minutes; No. 4, 405 hours and 20 minutes. All of the engines were new at the time of their installation in this airplane and had not reached the total operating time of 450 hours, at which time a major overhaul is required by Company regulations.

The trip forecast, on the basis of which the airplane was dispatched, was as follows:

| | Zone 8 Lat.15°to 20° S | Zone 9 Lat.20°to 25° S | Zone 10 Lat.25°to 30° S | Zone 11 Lat.30°S to Auckland |
|---|---|---|---|---|
| Weather Conditions | Scattered Clouds | Partly Cloudy | Partly Showers | Partly Showers |
| Visibility | Good | Good | Good | Good |
| Ceiling | 3,000 ft. | 2,500 ft. | 2,500 ft. | 2,000 ft. |
| Cloud tops | 4,000 ft. | 4,500 ft. | 5,000 ft. | 4,000 ft. |
| Sea conditions | Moderate | Moderate | Moderate | Smooth |
| Wind at 4,000 ft. | ESE 12 | SE 12 | S 8 | SE 8 |
| Wind at 7,800 ft. | ESE 12 | ESE 15 | SSE 8 | SE 8 |
| Wind at 11,500 ft. | SE 14 | ESE 16 | SE 10 | ESE 8 |

Remarks: No frontal activity on course Stop Mariposa 24° S 177° E 2100 G.C.T.

The foregoing forecast was issued by the Company Meteorologist, whose headquarters are at Auckland, New Zealand.

Local weather at Pago Pago at 4:30 a. m. Pago Pago local civil time, was:

| | | |
|---|---|---|
| Weather conditions | - | Clear |
| Visibility | - | Not reported because of darkness and the absence of lights outside the harbor. |
| Amount of clouds | - | 1/10 |
| Height of lower clouds | - | 2,500 feet |
| Weather for past hour | - | Clear |
| Wind | - | Calm |
| Barometer | - | 29.79 |
| Temperature | - | 79°F |
| Water conditions | - | Smooth |
| Remarks | - | Few cumulo to east of harbor |

Radio facilities at Pago Pago consisted of a Company station, KABS, which was remote from the seaplane base, and a United States Navy station, NPU, close to the base. A radiotelephone circuit was established between these two stations. The airplane was equipped with two independent transmitters, one of which was used for communicating on the aeronautical frequencies and the other for the international calling frequency of 500 kilocycles.

Radio communication was maintained throughout the flight. All communications were of a routine nature until 6:37 a. m. Pago Pago local civil time, at which time the following message was received from the airplane NC-16734:

13 KHAUL VX 8
NC34 11 1938 1708
PANOP
PGO
OIL LEAK NR4 RETURNING
MUSICK 1737

Interpretation: Message Number 13, originating on board NC-16734 at 6:08 Pago time, addressed to Operations, Pago Pago and transmitted by NC-16734 to Pago Pago at 6:37 Pago time. It means, "We have oil leak in the right outboard engine and are returning to Pago Pago".

No explanation for delay in sending this message is reported, although it is possible that the message was held up by Captain. This has happened previously when there was some doubt as to whether or not the trouble could be cleared and aircraft could continue flight. The next few contacts were of a routine nature. At 8:23 a. m. Pago Pago time, the following message was received from airplane NC-16734:

19 KHAUL VX 25
NC34 Jan 11 1938 1920
PANOP PANMAIN
ALA PANMAIN HNL
LESLIE RAMSEY TAYLOR NUMBER FOUR ENGINE BRAKED 1708 DUE TO OIL LEAK DUMPED GAS WILL RADIO DETAILS AFTER LANDING
STICKROD 1923

Interpretation: Message filed on board NC-16734 at 8:20 Pago time, addressed to Operations and Maintenance, Alameda, and to Maintenance, Honolulu. Signed by the Engineer Officer. Transmitted by NC-16734 to

Pago at 8:23 Pago time. It means that the engine with the oil leak had been stopped at 6:08 a. m. and that some gasoline had subsequently been dumped.

This was followed by a message to NC-16734 giving landing conditions at Pago Pago at 8:26 a. m., Pago time.

All subsequent communications with airplane NC-16734 are given by the Company Operator at Pago Pago as follows:

"At 1927 (8:27 Pago time) this is the last communication logged and although it is logged as 1927, this communication was merely conversation between FY (Findley - Radio Officer on NC-16734) and myself and actually lasted until 1935 or 1937 (8:35 or 8:37 Pago time). KHAUL (NC-16734) said Captain Musick wanted Airport Manager to send out REM (returning account of mechanical trouble) to SOPAC(all South Pacific stations) advising 24-hour delay; told him Airport Manager did not want to send out the SOPAC (all South Pacific stations) until the plane was on the water; he said "okay". I asked him if he was coming home, as it was now very near the time he said they were going to land. His signals were exceedingly loud so felt he was very close to Pago Pago and as he had not asked for any further QLC (landing conditions) since the first request at the time they turned back, felt he would be wanting present QLC (landing conditions). He said no, they were not coming home. I started to ask him what they were going to do when he broke me to say they were going to dump gas and couldn't use the radio during the dumping. (This was a precautionary measure) - QRX (stand by) which I did. I sent a CTI (city message) to KNBF (PAA radio Honolulu) at 1934 (8:34 Pago time) and at 2007 (9:07 Pago time) approximately 30 minutes from last QSO (contact), called KHAUL (NC-16734) making a string of V's for him. He did not answer so assumed he was still unable to use the radio, although the length of time was apparently quite long."

The history of the flight, as reconstructed from the foregoing and other available information, including the statements of eye witnesses, is as follows:

The airplane left the water of Pago Pago Harbor enroute to Auckland, New Zealand, in a normal take-off at 5:37 a. m., having been properly dispatched and with favorable weather forecast for the trip. Its gross weight at this time was 41,936 pounds which is approximately 2,000 pounds less than the maximum weight authorized for take-off. Of this weight, 6,900 pounds was represented by the 1,150 gallons of gasoline in the wing tanks, all of which were equipped with dump valves. This provided for the contingency of failure of two or more engines, as specified in the operating limitations. The 1,150 gallons of fuel in the hull tanks could also have been dumped, although more

slowly as they would have had to be pumped first to a wing tank. At 6:08 a. m., 31 minutes after take-off, the right outboard engine developed an oil leak and was braked, the flight proceeding thereafter on three engines. About five minutes later, the Captain proceeded to turn back. Whether fuel was dumped from the tanks supplying the inoperative engine at this time or not, is not definitely known but such procedure would be expected as it would lighten the ship for three-engine flight. The Flight Engineer's message of 8:23 could be interpreted to mean that this was done. At 6:56 a. m., one hour and 19 minutes after the take-off, the airplane reported over Pago Pago and was seen at that location. At this time, the amount of fuel consumed, even if none had been dumped, would have brought the gross weight down to about 40,628 pounds, which is 372 pounds below the maximum authorized landing weight with three engines operating.

It is necessary at this point to describe the harbor in order to explain the probable reason that a landing was not made immediately. Pago Pago harbor is a boot-shaped water area and, with the exception of a narrow entrance to the sea on the southeast side, is surrounded by hills rising rather abruptly from the water's edge to a height of 800 to 1700 feet. The toe-to-heel (west to east) portion of this harbor is used for seaplane operation and provides a landing and take-off area of approximately two miles in length by an average width of approximately one-quarter mile. In approaching for a landing with an aircraft of the S-42-B type, it is necessary to fly over the 800-foot ridge from the west as closely as practicable and at a minimum air speed, then descend rather abruptly to assure landing within the area. Even under favorable operating conditions this rate of descent is considerably in excess of that usually employed during normal landings with this type of aircraft. Because of these limitations, it was advisable for NC-16734 to substantially reduce its gross weight before attempting a landing. Captain Musick, therefore, decided to dump

fuel. He advised the ground station to that effect at 7:42 and proceeded immediately to do so. The amount dumped is not known but that particular operation was completed by 7:59, at which time radio communication was resumed.

At 7:59, the airplane was over Apia, a harbor point on an island approximately 70 miles to the west and north of Tutuila (on which Pago Pago is situated). It is apparent that this point was visited for the purpose of surveying its possibilities as an alternate airport to Pago Pago. Captain Musick had intended doing this upon his return from Auckland and probably decided to take the opportunity which presented itself while he was lightening the airplane preparatory to landing at Pago Pago.

At 8:35 the airplane was back in the vicinity of Tutuila near Fagasa Bay on the north shore of the island and the crew was preparing to jettison a further supply of fuel. The last radio contact between the airplane and the ground was made at this time.

Shortly after 8:35, the airplane was seen by one native witness throughout the following described maneuver, parts of which are substantiated by other witnesses. It flew westward just off-shore across the mouth of Fagasa Bay, continuing in a wide circle to the northward away from land. During this time fuel was being dumped from both wings. When at a point somewhere between 5 and 10 miles to the northwest of the witness and proceeding directly away from her, it appeared to descend rather abruptly to the water, still dumping fuel. What appeared to her to be its landing was accompanied by a flash of fire, followed by a considerable quantity of black smoke and later by a detonation, after which the wings of the airplane appeared to be visible for an appreciable interval before sinking from sight. At or near the spot indicated by this testimony, a Navy airplane sighted an oil slick and some small debris later that day.

The following morning at daybreak, a Navy surface vessel picked up what wreckage could be found afloat and was of sufficient size to present evidence

of possible significance. The items and bits of wreckage salvaged were few in number, there being no structural or metal parts among them except for a piece of strut fairing at the load water line of about 5 inches by 8 inches. It is significant that practically all of the items picked up, i. e., bits of flooring, partitioning, books and papers, the navigator's drift target tray, and interior side wall parts, were apparently from the interior of the cabin adjacent to the hull fuel tanks. A further important point is that the parts which are known or believed to have been in the compartment to the rear of the tanks are considerably burned, while those from the compartments forward of the tanks show evidence of heat but not of exposure to flame. The drift target tray, which was resting on the floor in the rearward compartment, appeared to have been wetted on its exterior with gasoline which then burned. The only part thus far recovered which is known to have been remote from the immediate vicinity of the hull tanks was an arm rest from the pilot's seat.

The NC-16734 had eight gasoline tanks in the wings, four of 170 gallon capacity and four of 140 gallon capacity, approximately. Each tank contained a dump valve. One large and one small tank together constituted the fuel supply for a given engine, entirely independent of the tanks associated with the other engines. The two dump valves in a given pair of tanks were operated by a single handle in the cockpit so that dumping of one tank independently of the other was not possible. The valves were opened by cable tension and closed by a spring mechanism forming part of the dump valve assembly. They had last been tested for free opening and tight closing in Manila in the period between September 27 and October 2, 1937. They were satisfactory at that time and there had been no reports of leaks since then.

Neither the cause nor the extent of the oil leak which caused the airplane to return to Pago Pago is known. There is nothing in the general history of

this airplane or its type to indicate a characteristic of oil leaks in the vicinity of the engine. Certain other airplanes of this type had in the past experienced failures of the propeller governor high pressure oil line. NC-16734, operating at different cruising RPM than most other airplanes of the type, had not experienced this trouble. During the last service period in Hawaii, it was found that "both studs were found broken off at front of (oil) sump" on No. 4 engine. These were drilled out and 5/16" bolts installed. Although a conceivable cause of future oil leaks, the failure described and the remedy used appear to be in the category of minor repairs and of corresponding significance. It is not believed that the oil leak was symptomatic of a primary engine failure because there was no indication of this in the Flight Engineer's radio report. It is concluded, therefore, that the reason for stopping the engine was to prevent further depletion of the engine oil supply.

With reference to the last few moments preceding the accident, it is believed that the details are indeterminable and must remain largely conjectural. It is almost a certainty, however, that the dumping of fuel was associated with the cause of the accident because of the nature of the last observed events and because any other conclusion would involve coincidences which are believed improbable.

Two alternatives in the sequence of events are apparent. Either the airplane was incapacitated by fire and explosion in the hull during level flight while dumping fuel, or some emergency arose at that time which dictated an immediate landing at sea, during the course of which fire and explosion occurred in the hull. That an explosion occurred is evident from the testimony of the witness and from the general nature and appearance of the recovered parts and from the fact that a piece of plywood flooring had been driven edgewise through the bottom of the navigator's drift target tray. The possibility of a fire which would not be almost instantly followed by an explosion is

difficult to concede.

One fact which tends to a belief that a landing had been started and at least almost completed is the absence of general wreckage such as one would expect to find in the event of uncontrolled impact with the water from high altitude. It is possible, however, that there was general wreckage which, being mostly metal, held together sufficiently to sink completely.

Careful analysis was made, without positive result, looking to the precise cause of ignition of the combustible mixture. No doubt every precaution was observed by the crew to prevent fire. The causes of gasoline fires on the ground in other industries have been numerous, however, and some electrical connection or static charge may have been responsible in this case. It is further conceivable that fire in the air may have been caused by the engine exhaust igniting the dumped gasoline. Such fire might enter the wings through their ventilating holes and follow through to the interior of the hull. A fire following this path could get under the hull tanks and do enough damage there to get under the floor of the navigator's compartment in which location it is almost certain an explosion occurred.

If an emergency dictated an immediate landing, such emergency might conceivably be one of two things, viz: either loss of further engine power, due to unintentional dumping of too much fuel, or, a fire which eventually got out of control and destroyed the airplane by explosion on or near the water. The possibility of the crew having been overcome by gasoline vapor is rejected on the grounds that adequate cabin ventilation was possible by opening the forward windows.

As to the inadvertent dumping of too much fuel, this does not coincide with the known thoroughness and capability of the Captain and the Flight Engineer. The only tenable possibility in this connection is a stuck dump valve

control which would have emptied the two tanks feeding one of the operating engines. If this is the case, however, it is necessary to look to a separate cause for the fire. The most probable cause here again would be the engine exhaust and since this series of events is possible, it must be retained as an alternative.

It is the opinion of the Investigating Board that the probable cause of this accident was fire and explosion associated with the dumping of fuel, the precise cause of ignition being undeterminable.

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Briefed from the original report prepared by E. L. Yuravich, Chief, Airline Inspection Section (Foreign) and Richard C. Gazley, Chief, Safety and Planning Division.

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