

U. S. DEPARTMENT OF COMMERCE
WASHINGTON

REPORT

AIRCRAFT NC-15065 ACCIDENT INVESTIGATION

August 27, 1937

TO

THE HONORABLE
THE SECRETARY OF COMMERCE
WASHINGTON, D. C.

An accident involving an aircraft of American registry, designated as NC-15065, occurred in the vicinity of Coco Solo, Canal Zone, on August 2, 1937.

On August 4, 1937, by an order, pursuant to the Air Commerce Act of 1926, as amended, J. M. Johnson, Assistant Secretary of Commerce, designated his assistant Miller Foster; Ed L. Yuravich, Chief Airline Inspector, (Foreign), Bureau of Air Commerce and Roy B. Keeley, Airline Inspector, Bureau of Air Commerce, as a Board to investigate this accident and to hold public hearings at such places and at such times as should be deemed practical. The Board was directed by the above mentioned order to do everything reasonable and necessary to obtain all available information relating to the facts, conditions and circumstances pertaining to the cause or causes of this accident and thereafter to make a report thereof as promptly as possible to the Secretary of Commerce.

The order of the Assistant Secretary of Commerce designated as technical advisers to the Board the following:

Brigadier General George H. Brett,
Wing Commander Air Corps, U. S. Army,
Albrook Field, Quarry Heights, Canal Zone

Commander E. L. Gunther, Commanding
Officer, Fleet Air Base, U. S. Navy,
Coco Solo, Canal Zone

Jerome C. Annis, Airline Maintenance
Inspector, Department of Commerce, stationed
at Miami, Florida

Your Board desires to express its sincere appreciation of the fine and splendid cooperation given by its technical advisers. Their council and assistance were of great help to the Board in the discharge of its duties.

Upon receipt of the order above referred to, the Board and one of its technical advisers, Jerome C. Annis, proceeded from the United States to Coco Solo, Canal Zone, arriving there on the early morning of Sunday, August 8th. Contacts were made immediately with technical advisers General Brett and Commander Gunther, through the assistance of First Lieutenant Frederic H. Smith, Jr., Air Corps, stationed in the Canal Zone and who had been previously detailed by direction of the President to act as aircraft and engine inspector for the Department of Commerce in the Canal Zone, in addition to his other duties. During the afternoon of August 8th the Board was in conference with its technical advisers and Lieutenant Smith.

On Monday, August 9th, the Board made necessary arrangements for starting the public hearing and by use of a Navy plane, furnished through the courtesy of Commander Gunther, flew over the Canal Zone and traversed a portion of the last part of the route flown by the NC-15065 before the accident in question.

On Tuesday, August 10th, at 8 o'clock A.M., the public hearing was opened in the Headquarters Building, France Field, Coco Solo, Canal Zone, and, with the exception of Sunday, August 15th, continued each day thereafter through Wednesday, August 18th, at which time the hearing at Coco Solo was adjourned with the understanding that if necessary or advisable it would be continued elsewhere. Technical advisers to the Board and Lieutenant Smith were present during the entire period of the hearing.

On the night of August 18, the Board and technical adviser Annis sailed from the Canal Zone for the United States, arriving in Washington August 24th, 1937.

The transcribed record of the public hearing, submitted herewith, embraces some 400 pages and there follows a summary of pertinent facts:

The aircraft involved in this accident, designed for take offs and landings both on water and land, is technically designated as S-43, NC-15065 and is sometimes referred to in the transcribed record as P-33, meaning Panagra aircraft No. 33. On May 25, 1936, it was delivered to Pan American Grace Airways, Inc., (referred to in the record as Panagra), by its manufacturer, the Sikorsky Manufacturing Company, and was put in operation on June 20, 1936.

Pan American Grace Airways, Inc., was incorporated under the laws of the State of Delaware in February, 1929, its principal reason for existence as stated by its Vice President and Operation Manager is to operate in foreign territory a U. S. Air Mail line, designated as "Foreign Air Mail Contract No. 9." This contract calls for airmail service from Cristobal, Canal Zone, down the west coast of South America to various points in Colombia, Ecuador, Peru, Chile, Bolivia, Argentina and across to Montevideo, Uruguay on the east coast of South America.

One-half of the capital stock of Panagra is owned by W. R. Grace & Company and the other half is owned by Pan American Airways, Inc., referred to in the transcribed record as Panair.

Panair and Panagra are separate Corporations. However, it may be borne in mind that Cristobal is not only the northern terminal of Panagra's northern division but also the southern terminal for Panair in operations of that Company both from Miami, Florida, and Brownsville, Texas. Maintenance service for Panair planes reaching Cristobal is performed by Panair at France Field, Coco Solo, (a couple of miles from Cristobal) and Panair's maintenance organization there services aircraft of Panagra landing at Cristobal. The expense of this service is borne in the original instance by Panair and then Panagra reimburses Panair for work required by Panagra.

In addition to its mail service, Panagra operates a passenger service with various stops from Cristobal to Montevideo, Uruguay, over a route some 4568 miles in distance. For certain purposes, including that of flying scheduled operations, this route is divided by Panagra into three divisions; northern, central, southern. The northern division comprises the operations between Cristobal, Talara, Peru; the central from Talara to Arica, Chile, on the west coast of America, and from Arequipa, Peru, to Villazon, Bolivia, on a diagonal operation.

while the southern division includes all remaining operations of Panagra in Chile, Argentina and Uruguay.

On August 2nd, 1937, NC-15065 was being used in the operation of the northern division and thus the inquiry of the board was directed more particularly to that division.

This aircraft, piloted by Captain Stephen Dunn and First Officer J. G. Gray, departed Cristobal, Canal Zone at 11:40 A.M. August 1. It was to have departed Cristobal at 4:30 A.M. but was delayed because the south bound mail was not ready for transportation. The scheduled flight of August 1 called for Guayaquil as the southern terminal of the flight but due to the delay in leaving Cristobal on August 1 an over-night stop was made at Cali. The plane, piloted by Captain Dunn and First Office J. G. Gray, departed Cali, Colombia, South America, at 6:15 A.M. on August 2, 1937, for Guayaquil with 8 passengers and Purser Evans. At 7:50 A.M. August 2, the plane landed at Tumaco and departed for Guayaquil at 8:05 A.M., landing at Guayaquil at 10:15 A.M.

At Guayaquil there was a substitution of first officer (co-pilot) and purser personnel; L. A. Bickford replacing First Officer J. G. Gray and J. H. Diez-Canseco replacing Purser Evans.

The same plane, piloted by Captain Stephen Dunn and First Officer L. A. Bickford then departed Guayaquil 11:05 A. M. on its return flight to Cristobal with eleven passengers and Purser J. H. Diez-Canseco. At 1:15 P.M. a landing was made at Tumaco and a departure for Cali was made at 1:25 P.M. with eleven passengers. At 3:10 P.M. a landing was made at Cali and a departure from Cali was made at 3:40 P.M. with the following named passengers: Thomas Wakely, Garnett Q. Caldwell, Rex Martin, Amy Levering, Jessie Mary Levering, James Walker Levering, Oscar F. Miller, Ernest W. Woods, Percy Wallace Kumble, Samuel W. Oliver, and Isidor Sousa. (Mr. Martin had boarded the plane at Guayaquil and Mr. Caldwell at Lima.) Records submitted by Panagra show the gross weight of the aircraft as it took off from Cali to be 19,487 pounds. The licensed gross weight permitted for this aircraft was 19,500 pounds. This aircraft was due to have arrived Cristobal C.Z., 7:10 P.M. this same date, without intermediate stops between Cali and Cristobal. On August 2nd the sun-set hour at Cristobal was 6:42 P.M. Darkness came at 7 P.M. and there was no moon,

The scheduled flying for Captain Dunn on this date would have been eleven hours and ten minutes and up to the last radio report transmitted at 7:38 P.M. he had been flying 11 hours and 38 minutes.

Prior to clearing Cali Captain Dunn had the following weather reports which had been forwarded to Cali by the Navy radio station at Cristobal:

Balboa 12:45 and 1:00 P.M. Observations: These two reports indicated sky conditions at Balboa (Albrook Field) were a high broken overcast with a lower broken overcast at 3000 to 3500 feet, visibility was unlimited and winds were changing from north to west with a velocity of 3 to 8 miles per hour. Temperature was 87 to 88 degrees with a rise in barometric pressure from 29.86 to 2

Cristobal 1:05 P.M. Observations: This report indicated sky conditions were practically overcast with a lower broken overcast at 2000 feet, visibility was unlimited and the wind was northwest 8 miles per hour. Temperature was 84 with a barometer of 29.91.

Cape Mala 2:30 P.M. Observation: This report indicated sky conditions at Cape Mala were high broken overcast with lower scattered clouds at 2500 feet, visibility was 15 miles, wind was from the south at 3 miles per hour. Temperature was 86 with a barometer of 29.72.

Darien 2:20 P.M. Observation: This report indicated conditions at Darien were a high broken overcast with a lower broken overcast at 4000 feet, visibility was 10 miles. Wind was from the northwest at 3 miles per hour. No temperature or barometer was given.

Following are all of the radio messages transmitted to or received from NC-15065 during its flight from Cali to the scene of the accident near Cristobal:

- 3:40 P.M. Dunn advised Cristobal (Navy radio) that he was departing Cali at 3:40 P.M. with eleven passengers.
- 4:00 P.M. Dunn advised Cristobal that he was circling over Cali at 8000 feet.
- 4:11 P.M. Cristobal sent to Dunn the Darien 3:30 P.M. weather: This observation indicated conditions at Darien were still overcast. However, breaks had increased one tenth per cent since the last weather report of 2:30 P.M. Other conditions remained the same.
- 4:12 P.M. Cristobal sent to Dunn the Cape Mala 3:30 P.M. weather: This observation indicated conditions at Cape Mala were the same as given in the 2:30 P.M. report with the exception that the barometer had dropped from 29.72 to 29.70.
- 4:30 P.M. Dunn advised Cristobal that he was flying at an altitude of 13,000 feet on a course of 325 degrees with cloudy conditions and a light rain.
- 4:57 P.M. Cristobal sent to Dunn the Cape Mala 4:30 P.M. weather: This observation indicated conditions at Cape Mala were the same as previously given Captain Dunn at 4:12 P.M. with the exception that the wind had changed to southeast.
- 4:59 P.M. Cristobal sent to Dunn the Darien 4:30 P.M. weather: This observation indicated conditions at Darien, located about 18 miles southeast of Cristobal, were slightly worse than the previous 2:30 and 3:30 P.M. reports in that cloudiness had increased from four to seven tenths and the lower clouds had lowered from four thousand to fifteen hundred feet and rain clouds were reported south and to the northwest.
- 5:00 P.M. Dunn advised Cristobal that he was flying abeam Solano Point at 13,000 feet and conditions were cloudy.
- 5:15 P.M. Cristobal sent to Dunn the Cristobal 5:15 P.M. weather. This observation indicated conditions at Cristobal had changed considerably in that heavy rain was reported with a solid overcast with a ceiling of 1500 feet and one mile visibility. Wind had dropped from eight to five miles per hour and was from the same direction as indicated in previous reports. Temperature had decreased 2 degrees and the barometer had dropped from 29.91 to 29.87. Remarks on this report indicated a rain squall was moving over France Field from the northwest.
- 5:30 P.M. Dunn advised Cristobal that he was flying abeam Cape Marzo at 13,000 feet and conditions were cloudy.
- 6:00 P.M. Dunn advised Cristobal that he was approaching San Jose Island at 12,000 feet and conditions were cloudy; also estimated his arrival Cristobal at 7:00 P.M.
- 6:01 P.M. Cristobal transmitted to Dunn the Darien 5:30 P.M. weather. This observation indicated there had been little change at Darien with the exception that the lower broken clouds had raised from 1500 feet to 15,000 feet and thunder and rain were noted east and north.

- 6:04 P.M. Cristobal transmitted to Dunn the Cape Mala 5:30 P.M. weather. 1. observation report indicated the weather at Cape Mala had improved materially within the last hour. This report showed practically clear and unlimited conditions with a one point rise in the barometer at Cape Mala.
- 6:10 P.M. Cristobal sent Dunn the Cristobal 6:00 P.M. weather. This observation indicated an overcast condition which was the same as 5:15 P.M. except that no rain was reported and ceilings had increased from 1500 to 2500 feet and visibility was one mile to seven to unlimited. Blue holes were reported to the west and northwest.
- 6:13 P.M. Cristobal sent Dunn the Balboa 6:10 P.M. weather. This report indicated conditions at Balboa had changed considerably since the last Balboa weather forwarded Dunn at 1:00 P.M. Sky conditions had changed from broken overcast with a 3000 foot ceiling to a solid overcast with a 450 foot ceiling. Visibility had decreased from unlimited to a variable of from one mile to unlimited. Barometer had dropped 2 points, Thunder and rain reported in the vicinity.
- 6:30 P.M. Dunn advised Cristobal and Lima he was approaching Balboa at 5000 feet and conditions were undercast.
- 6:38 P.M. Cristobal sent Dunn the Cristobal 6:30 P.M. weather. Dunn advised Cristobal that Cape Mala weather not desired as he was too busy. 6:30 P.M. Cristobal weather indicated some improvement over the last report as ceiling had increased from 1000 feet to 2500 feet.
- 6:52 P.M. Dunn requested that Cristobal ask Balboa if they could hear his motors.
- 6:54 P.M. Cristobal advised Dunn to use more power as a squall was moving in over France Field, at Coco Solo.
- 6:57 P.M. Cristobal sent Dunn the Darien 6:30 P.M. weather. (Darien is 18 miles southeast of Cristobal). This report indicated conditions at Darien had become considerably worse since the 4:30 P.M. observation in that it was raining and the sky had changed from broken to solid overcast with a 1000 foot ceiling and visibility was reduced from ten miles to $\frac{1}{4}$ of a mile. Sky was reported clearing to the northwest and heavy rain south. (It is believed that Dunn was in the vicinity of Darien at this time.)
- 6:58 P.M. Cristobal called Dunn but no answer.
- 6:59 P.M. Cristobal advised Dunn, in answer to his 6:54 P.M. message, that Balboa could not hear his motors account too much thunder.
- 7:00 P.M. Dunn called Cristobal, but stopped and said "Wait," without finishing transmission. Although ordinarily given at this time, no position report was given Cristobal by Dunn.
- 7:03 P.M. Dunn requested wind at Cristobal.
- 7:04 P.M. Cristobal advised Dunn France Field wind was north 5, field was clear with shallow pools of water on runways.
- 7:06 to 7:15 P.M. Cristobal called plane but received no answer. (Very possible Bickford was using plane's directional radio endeavoring to locate France Field.)
- 7:17 P.M. Dunn requested Cristobal give him ceiling at France Field.
- 7:17 P.M. Cristobal advised Dunn ceiling at France Field was 500 to 1000 feet.
- 7:21 P.M. Cristobal advised Dunn ceiling to southeast of France Field was 5000 feet and to north of the field it was 5000 feet with moderate rain and surface wind was north 8.
- 7:26 P.M. Dunn apparently started to give Cristobal his position report but stopped and said "Wait."
- 7:29 P.M. Cristobal advised Dunn ceiling to the north of France Field was 5000 feet.

- 6:30 P.M. Cristobal advised Dunn ceiling to the north and northwest of France Field was 2000 feet with moderate rain.
- 7:32 P.M. Dunn advised Cristobal that he was "standing by waiting for an opening to get down."
- 7:37 P.M. Dunn advised Cristobal that he was spiralling down over water and believed that he was over the east coast.
- 7:38 P.M. Dunn again transmitted to Cristobal that he was spiralling down over water and believed that he was over the east coast.

The Cristobal radio station continued to call Dunn at frequent intervals for the remainder of the night but received no answer. Therefore, it is reasonable to believe NC-15065 crashed immediately after the 7:38 P.M. report was transmitted, advising Cristobal that they were spiralling down over water believed to be the east coast. Wreckage from the plane was found in waters off the east coast, at a point approximately 15 miles west of Cristobal at about 11 o'clock A.M. on the morning of August 3. The drift of the current in the general direction where the wreckage was found was about $1\frac{1}{2}$ miles per hour to slightly north of east so that the probabilities are that the plane struck the water about 20 miles slightly south of west from the point where the drifting wreckage was found, or about 35 miles west of Cristobal in the Caribbean Sea and about 10 miles from the nearest shore line. The Caribbean side of the Isthmus is generally referred to as the East Coast.

From a study of this radio log every indication is that the flight of NC-15065 proceeded normally from Cali to San Jose Island (approximately 80 miles southeast of Cristobal) at which point Dunn started to descend to a lower altitude preparatory to landing at France Field, Cristobal. At this same point he estimated his time of arrival at France Field as being 7:00 P.M. which would have put him in ten minutes ahead of schedule time. This would indicate that Dunn up to his arrival at San Jose Island was not experiencing any unusual conditions nor did he anticipate any trouble or delay in arriving at France Field.

The 6:30 P.M. position report shows that Dunn knew his position definitely. However, his request at 6:52 P.M. to have Balboa check his position by listening for his motors indicates that at that time he was flying either over-top or on instruments and did not know positively his position with reference to Balboa.

Messages from 6:30 P.M. until the last message sent by Dunn at 7:38 P.M. indicate that Dunn was flying for the greater portion of this period over-top or on instruments and his position relative to France Field was not always positively known to himself.

Although it appears from the radio messages sent by Capt. Dunn that his position from the time he was over San Jose Island was not always positively known to himself, after detailed study the Board is of the belief that Capt. Dunn was just about where he thought he was on the flight from the region of San Jose Island till the time of the crash. Some interesting observations may be made in connection with the above statement. Interpretation of weather reports, as well as the testimony of eye witnesses, established the fact that two storms were moving over the Canal Zone between the period 6:30 to 7:30 P.M. August 2. One of these storms at about 6:30 P.M. was moving in on Balboa from the east and it actually rained hard on Albrook Field at Balboa from 6:30 to around 7:30 P.M. The testimony convinces us that Capt. Dunn was approaching close to Balboa at about 6:30 P.M. The natural thing for him to do was what we believe he did; that is, bear to his left (west) of his normal course across the Isthmus

in order to avoid the storm. Then there was another storm on the Cristobal side of the Isthmus which the Division Meteorologist for Panair estimated to have centered on Lake Catun at about 6:45 P.M. moving in an east, southeast direction passing a bit to the south and east of France Field. This storm was between Capt. Dunn and France Field and would naturally cause Capt. Dunn to bear still further to the left (west) of his normal course. On his way across the Isthmus, the weather at Darien, a point on Capt. Dunn's normal route, was getting worse but weather reports radioed to him indicated that the weather was clearing to the northwest of Darien. Under these circumstances, we feel certain from the record that Dunn decided to go out over the Caribbean Sea (to the northwest of Darien) in order to get down through the overcast rather than run the risk of coming down through the overcast over the Isthmus with its hazardous hills, radio towers, etc. In this connection the Board is of the opinion that his judgment was excellent.

It may be noted here that the record shows tropical squalls with severe rain and low clouds form in the Canal Zone and vicinity with great suddenness.

The above is a brief running account of the flight of this plane from the time it took off from Cali on the morning of August 2, 1937, and until the time of the crash some time shortly after 7:38 P.M. August 2nd. In connection therewith, comment is made on the following:

- A. Pilot History.
- B. Aircraft History (NC-15065).
- C. Airways Facilities - Panagra Northern Division.
- D. Weather Services - Panagra Northern Division.
- E. Operation Policies and Procedure - Panagra Northern Division.
- F. Floating Wreckage of NC-15065.

A. Pilot History.

(1) Captain Stephen Dunn

Captain Dunn was 35 years of age at the time of his death on August 2, 1937. Born in 1902, he went to sea in 1918 and joined the Navy in January, 1919. In August, 1920, he was transferred to the Naval Air Station in Pensacola, Florida, completing his pilot's course in the Pensacola Air Station August 15, 1922. In 1930 he was honorably discharged as a Chief Aviation Pilot, having received a medal of good conduct from the Navy and commendatory letter from the Secretary of the Navy. Captain Dunn left the Navy to accept commercial employment and operated a large flying boat between Miami and Havana.

The commercial line for which he operated, was purchased by Panair in September 1930, and Capt. Dunn was employed by Panagra on September 11, 1930. He assigned to the Northern Division and was continuously employed till the time of his death. In December, 1934, he was appointed as Chief Pilot of the Northern Division. In 1936, Capt. Dunn had a two months vacation, returning for duty Panagra during the month of August, 1936. His flying time for each of the 12 months preceding his death was as follows: 1936 - August, 46 hours; September 64 hours; October, 41 hours; November, 94 hours; December, 121 hours; 1937 - January, 78 hours; February, 62 hours; March, 60 hours; April, 117 hours; May 47 hours; June, 100 hours; July, 80 hours; August, 14 hours, 55 minutes.

The minutes for August are estimated as the exact time of the crash is known.

1936:

August - 84 hours;
October - 58 hours;
December - 139 hours;

September - 54 hours;
November - 105 hours;

1937:

January - 86 hours;
March - 94 hours;
May - 73 hours;
July - 66 hours;

February - 46 hours;
April - 91 hours;
June - 87 hours;
August - 7 hours, 55 min.

Mr. Bickford held Department of Commerce Transport License No. 23586 and co-pilot rating, Department of Commerce Engine Mechanics License No. 12653 and Federal Communications Commission Radio License T-3-653. He had never received formal instrument or night flying instruction from Panagra.

Other Panagra pilots gave Mr. Bickford a good rating as a co-pilot.

B. Aircraft History (NC-15065)

Delivery was accepted at the Sikorsky factory on May 25, 1936, and after approximately 10 hours of test flying the aircraft was flown to Miami, Florida. After a lay-over of several days at Miami the aircraft proceeded to Cristobal, C. Z., with an overnight stop at Barranquilla, Colombia. After arrival of the aircraft at Cristobal on June 7, 1936, Chief Pilot Stephen Dunn of the Panagra northern division, was given a flight test in the craft so as to become familiarized with the operation of the aircraft and its accessories.

During the period of June 7 to 9, 1936, the aircraft made a round trip between Cristobal and Guayaquil. At Balboa on one of the trips the aircraft suffered an accident on landing due to the failure of the locking device of the landing gear in the down or extended position resulting in damage to the upper half of the left landing gear, the left pontoon, left pontoon struts and fairing. Temporary repairs were made and the aircraft ferried to Lima for final repairs and inspection.

On June 10, 1936, the aircraft was ferried over the regular route to Lima for the purpose of familiarizing the personnel along the route with the aircraft and for routine check and final repairs caused by the accident on June 9. On June 20, 1936, the aircraft was placed in regular scheduled operation out of Lima for Cristobal.

Reports indicate difficulties with leaky auxiliary gas tanks.

The aircraft operated normally until September 24, 1936, when it was noted to be right wing heavy. All reports from that date indicate the wing heaviness to have been corrected.

Pilot report of November 19, 1936, shows that bad gasoline fumes were present in the cabin caused by a broken gas line which caused considerable loss of gas while in flight. Repairs were made at Guayaquil.

During period from December, 1936, to March, 1937, several reports indicated malfunction of various flight and engine instruments and automatic pilot. Also the change of several carburetors was required. Other than routine discrepancies the operation of the aircraft was normal.

gasoline flow failure. Inasmuch as the gasoline system was identical to NC-15065 which was in the accident under investigation, the members of the Board made a personal investigation of this situation.

It was found that in the revision of the gasoline system the float valves installed in the main tanks for the purpose of closing off the lines against suction of air when empty, had been removed, and that the two outboard tank lines had been joined together with a lead in to a header tank located under the wing, in the rear section of the engine nacelle cowling. The two inboard tanks had been likewise connected so as to feed into a header tank located in a like position in the left engine nacelle rear cowling. From the header tanks the lines lead into a selector valve which is actuated from the pilots' cockpit.

The two auxiliary tanks are individual units with valves located directly beneath each tank. These valves are actuated by individual handles, one located behind the pilot's seat and one behind the co-pilot's seat. These handles operate cables attached to the valve arms which pull the valves open and the closing of these valves depends on the tension of an elastic shock-cord bungee. The lines from the auxiliary tanks lead into the main line between the engines and the main selector valve.

Investigation disclosed two facts: first, that the closing of these valves by the elastic bungees was not positive, resulting in the gasoline from the auxiliary tanks seeping into the main lines even when the control handle was turned to the "off" position, thus leaving the pilot short of fuel in the auxiliary tanks in the event he was flying close on the main tanks and depending on the auxiliary for reserve. Second, on depletion of gas from the auxiliary tanks the fuel pumps suck air through the auxiliary tanks and lines cutting off the flow of gas from the main tanks, and resulting in stoppage of the engines. When the handles are turned to the "off" position, there may be a partial, instead of an entire closing of these valves due to the malfunctioning of the impositive bungee system in relation to the specific gasoline system shown by the testimony to have been installed in NC-15065 at the time of the accident. If the gas in the reserve tanks is entirely depleted there will be engine stoppage due to the sucking of air instead of gas from the reserve (auxiliary) tanks, thus cutting off the flow of gas from the inboard and outboard tanks.

C. Airways Facilities - Panagra Northern Division.

The facilities at Guayaquil consist of airport and seaplane landing base, meteorological station, radio communication station, and radio direction finding station.

The next scheduled stop to the north is Tumaco, a distance of 382 miles. The intermediate facilities comprise the following:

- Salinos: landing facilities for sea or land.
- Ahorcados: airport.
- Manla Bay: airport.
- Esmeraldas: seaplane landing.
- Mira Delta: airport.

Tumaco facilities consist of airport and seaplane base, meteorological station, radio communication station, and radio direction finding station.

From Tumaco to Cali, a distance of 189 miles, there are the following intermediate landing facilities:

Mohogual: airport.

Guapi: seaplane landing.

Cali: airport, radio communication and direction finding station and meteorological station.

From Cali to Cristobal, a distance of 472 miles, there are the following facilities:

Buenaventura: seaplane base, meteorological station, radio communication station, and direction finder station.

Catago: airport, radio communication station, and meteorological station.

Quibdo: seaplane landing.

Port Utrica: seaplane landing.

Bay Solano: seaplane landing.

Cape Mago: seaplane landing.

Pinas Point: seaplane landing and airport.

Cape Mala: (due west of Pinas Point) radio and meteorological station.

La Palma: seaplane landing.

Trapuche in the Perlas Islands: seaplane landing.

Balboa, Albrook Field, U. S. Army: boundary lights installed, no beacon, Panair seaplane landing base, meteorological station and radio station.

Camboa: airport and various other emergency landing areas both for land and water in the Gatun Lake area.

At Cristobal: France Field, U. S. Army, boundary lights installed, no beacon, seaplane landing base, meteorological station, radio communication station, direction finder station under construction by Panair.

In addition to the above mentioned facilities, the aircraft is equipped with a radio direction finder, with electrostatic shielded loop, from which bearings are taken from the plane on the following points, in addition to Panagra's own station: the Cristobal Marine Beacon, Cape Mala, Toro Point Marine Beacon, and the Naval Radio Stations at Balboa and Gatun. Cape Mala and Toro Point operate on fixed schedule from the even hour to 10 past and from 30 to 40 after the hour, but Balboa and Gatun stations operate intermittently and not on a fixed schedule.

In addition to the direction finder the aircraft was equipped with a transmitter of 20-Watt output, all communication being by code, and tuned radio frequency regenerative receiver. Ground station transmitters owned by Panagra vary from 40 Watts to 100 Watts output, with frequencies of 33-52-97 meters and 1638 kcs. for homing purposes. Army and Navy operated stations in the Canal Zone are of practically unlimited power.

The above mentioned radio facilities, while in most cases owned by Panagra, are operated by the governments of the countries in which they are located, as no radio can be operated by other than government agency.

In addition to the aids and facilities mentioned heretofore, aircraft operating into Cristobal or Balboa at night with limited ceiling, may by request

obtain the use of powerful search lights, operated by the U. S. Army at various points in the Canal Zone area. Albrook Field at Balboa and France Field at Cristobal are equipped with boundary lights but no beacon. The Naval field at Coco Solo is in process of being lighted at the present time.

D. Weather Services, Panagra Northern Division.

The weather information services on the Guayaquil-Cristobal Division are composed mainly of observations made by Panagra personnel at terminal points, and augmented by a number of intermediate weather stations operated by Panagra or for whose services Panagra has completed arrangements to furnish reports when requested. Reports from terminals and from such intermediate points along the route believed necessary are collected by radio prior to the plane's departure. After the plane is enroute additional reports are furnished the plane by either Panagra or United States Navy radio station or available upon request.

Air aloft and forecast services, available only in the Canal Zone, are those compiled by the Navy personnel at the Fleet Air Base, Coco Solo, C. Z. Panagra does not utilize the above weather information during regular operations.

In the instance of Captain Dunn's flight from Cali to Cristobal on August 2, 1937, weather reports were furnished prior to his takeoff from Cali from the following points in the Canal Zone: Cristobal, Dairen, Balboa, and Cape Mala. After his takeoff and up to the time of the last radio contact at 7:38 P.M., almost hourly and in some instances more frequently, weather observations were made at the above-named stations and radioed to Captain Dunn.

E. Operation Policies and Procedure.

All operations between Cristobal, C. Z., and Guayaquil, Ecuador, a distance of 1043 miles, is under the direct supervision of the Northern Divisional Superintendent and a Chief Pilot, headquartered at Cristobal. These in turn are under the supervision of the Vice President in charge of operations headquartered at Lima, Peru.

The Divisional Superintendent supervises all flying activities on this Division and serves as a first pilot for an average of 30 to 40 hours per month. Captain Stephen Dunn was Chief Pilot on this division and had, in addition to his regular duties as a line pilot, the responsibility of checking and instructing all piloting personnel and assisting the Divisional Superintendent in the promulgation of flying regulations, policies, etc.

The responsibility of loading the plane within the prescribed limits, dispatch and flight enroute is pretty much centered in the Captain of the particular aircraft scheduled. Flying and equipment operating policies are outlined in operations manuals. However, takeoff and landing procedures are outlined in a form too brief to be specific for practical operation. Testimony indicates a great many of the policies were carried out as the result of mutual understanding between supervising personnel and pilots.

There appeared to be a lack of specific procedure in the training and checking of pilot personnel, particularly instrument flight checks involving unusual maneuvers and assimilating adverse weather landings.

Minimum fuel supply requirements are outlined in the company's operations manual and in the instance of the Cali-Cristobal flight stipulates a minimum of 380 gallons. This amount should provide a reserve of at least one hour under normal cruising power. Instructions to pilots in the use of the S-43, modified Panagra fuel system could create a real hazard in view of the faulty emergency shut-off valves of the auxiliary tanks.

F. Floating Wreckage of NC-15065.

On August 3, 1937, at about 11 o'clock A. M., Navy planes sighted floating wreckage of NC-15065 at a point previously mentioned. This wreckage was distributed over an area of 15 to 20 square miles. Part of the left wing was afloat but in effort to recover it the wing sank.

Many other portions of the wreckage were recovered by the Navy and brought ashore. The Board examined these with particular attention to the several ones which bore evidence of slight burns or scorches. One of these was the balsa wood support of the auxiliary gasoline tank. Another was a small piece of broken balsa wood which originally was a part of the flooring enclosed between layers of thick material and metal. Another was a small piece of balsa wood which had been a part of a fairing strip in the cabin superstructure. One of the emergency ration container covers was slightly burned. A cover still on an unopened life preserver bore evidence of burns over about one-fifth of its surface. The life preserver inside was not burned or scorched. The Board understands that before its arrival at Cristobal some floating mail with evidences of scorches had been turned over to the Post Office Department.

Other portions of recovered wreckage including one rubber life boat, 9 seat cushions and 5 pillows, bore no evidence of burns or scorches. Some of these were made of or covered with cream colored cloth material.

Portions of two chairs with seat belts, still buckled, fastened to one side, were among the wreckage.

In view of the burns or scorches on recovered portions of the wreckage and the history of the aircraft, the Board gave serious and exhaustive study to the probability of NC-15065 having a fire while in flight. Our study completely negatives any such theory. The parts that were found slightly burned were situated at considerable distances from each other in the plane. Therefore, while the ship was in flight, only a very considerable fire that would occupy nearly the whole ship could have burned them. The slightly burned portions were all of comparatively low kindling point. Many other portions of equally low kindling point, located in the ship right in the proximity of the scorched portions, showed absolutely no evidence of burns or scorches. Further, if the ship had caught fire in the air it is not likely that passengers would have left their seat belts buckled across their bodies.

Our study also causes the Board to definitely eliminate pilot error as a cause or contributing cause of this accident. We think a proper definition of pilot error is the failure of a pilot to do that which a pilot of high skill and prudence would do under the circumstances, or the doing of that which a pilot of high skill and prudence would not do under the circumstances.

The Board is conclusively of the opinion that the accident was caused by the NC-15065 striking the water while moving at less than 90 miles

per hour, tearing the ship to pieces, causing the death of all aboard and that a fire resulted from the impact with the water. The Board is convinced that at the time of the collision the plane had a minimum of 80 gallons of gas which would have burned on the water a sufficient length of time to cause all burns or scorches found on any recovered wreckage.

The specific contributing cause of this aircraft colliding with the water is beyond the knowledge of man. However, there must have been a specific contributing cause or causes, and the Board is of the opinion that the most probable contributing cause is one of the following and in the order named:

1. Failure of one or both engines due to faulty gasoline system, occurring during the spiralling down mentioned in the pilot's last radio message.
2. The encountering of a sudden severe rain, as altitude was being lost by the plane in the spiralling descent, resulting in the blanking out of all visual contact.

Your Board recommends that the Department of Commerce use every endeavor to process to the best possible advantage the information obtained as a result of the investigation of this accident, associating and considering it in connection with previous accidents and translating and applying the conclusions derived therefrom to any possible improvement in planes, equipment and aids to air navigation, thereby obtaining the maximum benefits to safety in air commerce.

Respectfully submitted,

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