SA-382

File No. 1-0064

CIVIL AERONAUTICS BOARD

AIRCRAFT ACCIDENT REPORT

ADOPTED: June 2, 1966 **RELEASED:** June 8, 1966

THE FLYING TIGER LINE INC.
L-1049H, N6915C,
SAN FRANCISCO INTERNATIONAL AIRPORT
SAN FRANCISCO, CALIFORNIA
DECEMBER 24, 1964

SYNOPSIS

A Flying Tiger Line Inc., L-1049H, N6915C, operating as Flight 282, crashed on Sweeney's Ridge, approximately 4.3 miles west-southwest of the San Francisco International Airport at approximately 0031:30 P.s.t. The three crewmembers were fatally injured. There were no passengers. The flight, scheduled as domestic cargo from San Francisco to John F. Kennedy International Airport, Jamaica, New York, had just departed Runway 28L at 0028. At 0031:20 the departure controller advised that they were left of course, and within seconds, ". . . the target stopped, bloomed, and disappeared from the radar scope." All attempts to contact the flight following the target disappearance were unsuccessful.

The Board determines that the probable cause of this accident was that the pilot, for undetermined reasons, deviated from departure course into an area of rising terrain where downdraft activity and turbulence affected the climb capability of the aircraft sufficiently to prevent terrain clearance.

1. INVESTIGATION

1.1 History of the Flight

The Flying Tiger Line Inc., L-1049H, N6915C, Flight 282, was a scheduled domestic cargo flight from the San Francisco International Airport (SFO), San Francisco, California, to the John F. Kennedy International Airport (JFK), Jamaica, New York. It was originally scheduled to depart at 2100 1/ 23 December, but the flight was delayed because of the non-availability of a flight engineer. An engineer obtained from Los Angeles, arrived in San Francisco at 2315, and the flight departed at 0028, 24 December.

The original flight plan was IFR: requested altitude - 11,000 feet; route of flight was San Francisco direct to Sacramento, Victor Airways to JFK; estimated time en route - 9 hours 16 minutes; fuel aboard - 11 hours 3 minutes; alternate airport - Newark, New Jersey. Gross weight of the aircraft was 142,073 pounds 2/ of which 29,000 pounds (5,000 gallons) was fuel and 41,078 pounds was cargo.

1/ All times herein are Pacific standard, based on the 24-hour clock.
2/ Maximum gross weight for takeoff from runway 28L at SFO for an L-1049H was 142,100 pounds.

At 0013 the crew contacted SFO Ground Control for taxi clearance and was cleared to runway 28L, surface wind was 210 degrees at 15 knots, gusts to 23 knots, altimeter 29.98.

At 0015, while taxiing to runway 28L, Flight 282 advised SFO Ground Control that because of a heavy load, they would like to proceed out past the Gap Radio Beacon to the Golden Gate Intersection, thence via Victor 150 to Sacramento instead of direct to Sacramento as originally filed. The request was coordinated with Oakland Air Route Traffic Control Center and approval obtained. The crew was then advised that for takeoff on runway 28L, there would be a "heavy" left cross wind from 210 degrees at 18 to 25 knots which they acknowledged.

After switching to clearance delivery frequency, the crew was asked if they would accept a Golden Gate One Departure. 3/

Flight 282 advised, "We'll do a little bit research there, stand by."

The Clearance Delivery Controller then stated: "That's OK, I'll give you the climb out Tiger Niner Fifteen 4/ cleared to Kennedy Airport via Victor one fifty Sacramento, Victor six north, flight plan route, maintain one, one thousand, climb out on the San Francisco two eight seven radial for a vector to Victor one, correction, to Golden Gate Intersection to intercept Victor one fifty."

The first officer then read back the clearance as follows: "Roger cleared to JFK Airport via Victor one five zero Sacramento, Victor six north flight planned route, maintain one one zero, climb out on San Francisco two eight seven degree radial for a vector to Golden Gate Intersection to intercept Victor one five zero."

The Clearance Delivery Controller then stated: "Roger, you can disregard the vector, climb outbound San Francisco 287-degree radial to Golden Gate Intersection, then Victor 150, and, depending on your altitude, they probably will give you a vector to intercept (Victor) 150 before you get to Golden Gate." 5/

3/ The published Golden Gate One Departure was via the San Francisco 287° radial to intercept and proceed via the Sausalito 215° and 035° radials to Richmond Intersection, then transition to Sacramento via the Sausalito 035° and Sacramento 215° radials to Sacramento. (See Attachment #3.)

4/ The Radio call sign for Flight 282.

5/ Radar vectoring could not be provided an aircraft departing runway 28 via the Golden Gate Standard Instrument Departure until the aircraft reached an altitude of 1,500 feet. This was because standard obstruction clearance from the terrain, both vertical and lateral, could not be achieved insofar as criteria, as it existed 24 December 1964, was concerned. Lateral clearance from obstructing terrain is so critical that there is no space available in which to safely vector an aircraft below 1,500 feet. (See Attachment #3.)

The crew acknowledged, "Right 287 to (Victor) 150, thanks," at 0021.

At 0027:45, the flight advised the Local Controller that they were ready for takeoff. At 0028 the flight advised: "915 rolling."

The Local Controller, who was also assuming the position of Tower Supervisor, noted the time of 0030 on his clock as the aircraft became airborne and passed the tower. An eyewitness observed the landing lights retracting as Flight 282 crossed the end of the runway. However, several witnesses along the flightpath, including some located at points just prior to the crash, saw both landing lights on. Landing lights of the L-1049H may be retracted flush with the lower wing surface and remain on until switched off.

After takeoff witnesses stated the aircraft made a slight turn to the right, then a steeper turn to the left, and then was observed returning to a wings-level attitude as it entered the clouds.

At 0030:22, the flight was advised to contact Departure Control.

At 0030:52, the crew established radio communication with the Departure Controller by asking: "Departure, Tiger nine one five, you got us-ah-over?"

The Departure Controller acknowledged with the reply at 0300:57: "Flying Tiger nine one five, San Francisco Departure Control radar contact, report leaving thousand-foot altitudes, over."

At 0031:05, the crew responded: "Roger, how do you have us tracking toward the-ah-Gap?" At this point in time, the Departure Controller switched his radar scope from the 30 to the 10-mile setting and requested the flight's altitude.

At 0031:16, the crew replied: "Nine Hundred."

At 0031:20, the Departure Controller acknowledged with the following advisory: "Nine Hundred, Roger, it shows you are going directly out on the, well, you're left of course of the San Francisco two eight seven (radial)." When the Departure Controller received no acknowledgement for this advisory, it was repeated. The Departure Controller stated: ". . . within seconds after the second transmission, the target stopped, bloomed, and disappeared from the radar scope." Repeated attempts to communicate with the flight after its disappearance from the scope were unsuccessful. At this time, 0032:30, the controller placed a time hack on the communications tape. Ground impact was computed to have occurred at approximately 0031:30. Main impact occurred 860 feet above sea level on Sweeney's Ridge, 6/ at approximately 4.3 miles on the 257° radial of the SFO TVOR.

6/ The coordinates of the impact area were 122°28'00" west longitude, 37°38'28" north latitude.

1.2 Injuries to Persons

Injuries	Crew	Passengers	Others
Fatal	3		
Non-Fatal			
None			

1.3 Damage to Aircraft

The aircraft struck the east slope of a hill and disintegrated. Portions of the aircraft were partially or completely consumed in the intense ground fire which developed.

1.4 Other Damage

The aircraft crashed on a Coast Guard Reservation. Impact damaged numerous antenna structures and fire consumed portions of the hillside foliage.

1.5 Crew Information

Captain Jabez Albert Richard, age 49, was employed by The Flying Tiger Line on December 4, 1950. He held valid airline transport pilot certificate No. 1173067 with type ratings in C-46, DC-4, L-1049H, and CL-44 aircraft. He had a total of 14,911 flying hours of which 3,942 hours were in L-1049H aircraft. He held a current first class medical certificate with the limitations: "Holder shall possess correcting glasses for near vision while exercising the privileges of this airman certificate."

The captain had arisen sometime before 1000 on the 23rd of December, and had been on duty since 2030 of that date. He had not flown in the previous 24-hour period. He was based in Newark, New Jersey, and his last departure as a crewmember from the San Francisco International Airport was on December 14, 1963, as a copilot.

Although the captain was required to have corrective lenses for near vision, no eyeglass frames, lenses, or broken lenses were found at the accident site. A slip-in eyeglass case was found at the site, labeled with an east coast optometrist's name and address. It contained no traces of broken glass. The captain was the only east coast crewmember.

First Officer Daniel White Hennessy, age 33, was employed by The Flying Tiger Line on April 24, 1955. He held valid airline transport pilot certificate No. 1280066 with type rating in DC-3, and a flight instructor rating. He had a total of 3,636 flying hours of which 1,277 hours were in L-1049H aircraft. He held a current first-class medical certificate with no limitations. First Officer Hennessy had been on duty for 4.3 hours during the previous 24-hour period of which 1.8 were flying hours.

Flight Engineer Paul M. Entz, age 37, was employed by The Flying Tiger Line on November 5, 1956. He held airframe and powerplant certificate No. 1283680, and flight engineer certificate No. 1360058. He had a total of 4,113 flying hours of which 3,811 hours were in L-1049H aircraft. He held a current first-class medical certificate with no limitations. Flight Engineer Entz had 17 hours of rest during the previous 24-hour period. He had been on duty for 7 hours but had not flown except for the deadhead flight from Los Angeles.

Blood specimens from each crewmember were subjected to toxicological examination. Results were negative for the first officer and engineer and only a small amount of blood ethanol was indicated in the captain's specimen. Since alcohol production may be associated with post-mortem changes, the concentration did not of itself constitute evidence of alcohol ingestion. There was no evidence to indicate the possible consumption of alcohol by the captain prior to the flight.

Examination of the captain's heart indicated extensive arteriosclerosis of the coronary arteries with considerable narrowing of the lumina of the vessels. However, there was no thrombus or plague hemorrhage found that would have acutely compromised the circulation within the arteries. There was also no anatomic evidence that the captain had experienced an episode of anginal pain in the few seconds preceding the crash.

Review of the medical records of all the crewmembers failed to disclose any indications of significant pre-existing disease.

1.6 Aircraft Information

There was no evidence of failure of the powerplants, systems, or structural components of the aircraft prior to initial impact.

When the aircraft taxied from the ramp, it weighed 142,073 pounds, within 27 pounds of the allowable takeoff gross weight. The c.g. limits for maximum gross weight of this aircraft are 23 to 32 percent of MAC. Flight 282 had a c.g. of 29.3 percent. The station agent certified on the flight clearance that the aircraft was loaded within limits.

1.7 Meteorological Information

Surface weather charts for the evening of December 23 and the early morning hours of December 24 indicate that San Francisco was under the influence of a cold frontal system moving onshore. At the time of the accident rain, low cloudiness, and considerable fog were shown along virtually the entire Pacific coast. The San Francisco terminal forecast issued at 2045 (Dec. 23) valid for a 12-hour period beginning at 2100 was in part as follows:

2100-0400 - 700 feet scattered clouds, ceiling 1,800 feet overcast, visibility 6 miles in light rain, occasionally ceiling 600 feet broken clouds, 1,800 feet overcast, visibility 6 miles in light rain.

The 0028 San Francisco International Airport surface weather observation in part showed the following:

Scattered clouds at 400 feet, measured 1,100 feet overcast, visibility 6 miles in light rain and fog, temperature 59°F., dewpoint 57°F, wind from 240 degrees at 22 knots, gusts to 28 knots.

The San Francisco International Airport, U. S. Weather Bureau's Daily Pilo Weather Briefing log showed the following entry for 2330 December 23: "Telephon briefing, Flying Tiger, REMARKS, passed information on terminal weather San Francisco, Kansas City, and JFK, no route weather requested."

There was little significant change in the general weather situation in the San Francisco International Airport area approximately two hours before and after the accident.

The captain of an L-1049H aircraft weighing approximately 113,000 pounds departed runway 28L at 2130, 23 December 1964. He described his departure as follows:

"At the time of departure, the surface wind was from 190 degrees at approx mately 15 knots, variable and gusty. The general weather was squally with light intermittent rain showers. . .Immediately upon breaking ground, as was anticipat a strong right drift was noted, and I immediately applied heading corrections to maintain track outbound on the ILS back course. I would estimate the average drift correction to have been approximately 10 degrees left.

Immediately upon becoming airborne, it was noted that the air was generall very unstable with light to moderate turbulence and strong downslope conditions. These strong downslope conditions were not of the brief, momentary type, but pre vailed continuously as long as we were flying on the lee side of the hills and until reaching an altitude of 2,000 to 2,500 feet m.s.l., at which time the air became more stable and a somewhat normal rate of climb was possible.

It was noted that the rate of climb was very low for the weight of the air craft, and I was required to maintain METO power and 60 percent flaps for a con siderable time in order to maintain a positive rate of climb and to gain suffici altitude to clear the hills and get through the Gap safely. Under power and cli conditions which normally would result in a rate of climb of approximately 1,000 feet per minute, our rate of climb varied from 200 to 500 feet per minute, and there were moments when the rate of climb was near zero. I do not recall at thi time exactly how long we maintained METO-power climb, but I do recall commenting to my first officer regarding the bad downslope conditions and our poor rate of climb, and expressed the opinion that we were fortunate that we had not departed at maximum gross weight. Also, due to our slow rate of climb, and the length of time that passed after takeoff before we were able to report 2,000 feet, Depar tu Control called us at least three times checking on our altitude. . .I did not detect any malfunction of any of the ground facilities or airborne equipment, prior to departure. However, I must note here that except for checking my out bound track by the ILS and the fore and aft indications on the ADF indicators, was too busy for the first several minutes after takeoff flying the aircraft, trying to maintain proper attitude and a rate of climb sufficient to clear the I had no time to give the radios any further concern."

There were five departures from San Francisco International Airport within approximately one-half hour after Flight 282 departed. Most of the captains of these flights submitted written statements, all of which indicated the winds were strong and gusty on takeoff; there were low clouds and intermittent rain; and the turbulence was light to moderate until reaching at least 1,000 feet altitude.

The meteorologist stationed at the San Francisco International Airport at the time of the accident, testified that there would have been moderate to severe turbulence in the area of Sweeney's Ridge with moderate downdrafts as one approached the ridge.

The Flying Tiger Flight Operations Agents on duty prior to the departure of Flight 282 indicated that the flight crew was provided with the 400-150 mb. significant weather prognostic chart, the winds from the 500 mb. prognostic chart, as well as terminal weather information.

1.8 Aids to Navigation

All radar and NAVAID equipment operated within prescribed tolerances when checked following the accident. The captain certified on the flight clearance that he considered conditions were satisfactory for flight in accordance with his analysis, and current Flying Tiger Line and Civil Air Regulations, including Secs. 42.303 and 42.357. 7/

1.9 Communications

All four communications frequencies utilized by ATC to communicate with Flight 282 were recorded on the same tape. Timing of these transmissions revealed an elapsed time of 4 minutes and 30 seconds from the time the crew stated: "Nine one five rolling," until the controller's time hack of 0032:30.

During the brief pause in the 0031:05 transmission following the word "toward," a background voice could be heard to say two, one-syllable words. The best determination that could be made of these words was "flaps up," but they could not be definitely associated with a specific crewmember aboard the aircraft.

During the investigation, the departure controller testified that he observed the aircraft's radar return as it departed from runway 28. However, communications were not established with departure control at this time. The aircraft was more than two miles from the end of the runway when the flight was

7/ 42.303 requires the pilot in command who had not flown over a route and into an airport within the preceding 60 days to certify to his knowledge of weather, NAVAIDS, communication procedures, types of terrain and obstruction hazards, minimum safe flight altitudes, ATC procedures, arrival and departure procedures, and familiarity with the airport and its surrounding area.

42.357 requires the pilot to have aboard the aircraft appropriate aeronautical charts and instrument approach procedures, and a flashlight in good working order.

advised, at 0030:57, that they were in radar contact. When the crew requested, "How do you have us tracking toward the -ah- Gap?", at 0031:05, the controller asked for the aircraft's altitude and, during the query, switched the scope from the 30-mile to the 10-mile range setting. Approximately 3 to 4 sweeps of the antenna occurred 8/ after which the Departure Controller oriented himself to the new scope picture, located the radar return of Flight 282, and advised the crew that they were left of the 287-degree radial. There was no acknowledgement for this advisory or subsequent transmissions.

1.10 Aerodrome and Ground Facilities

All ground functions such as refueling and loading, were completed at 2115 when the aircraft was ready for departure.

There were no unusual aerodrome or ground facility activities or conditions at San Francisco International Airport during the departure of Flight 282. The runway and taxiways were wet from the light rain and fog conditions existing at the time of takeoff.

1.11 Flight Recorders

No flight recorder was required or installed aboard this aircraft.

1.12 Wreckage

Initial impact was by the left wing tip at an elevation of 840 feet. The fuselage struck the hill at 860 feet, on a magnetic heading of 225 degrees and spilled over the top of the hill and down the west side of the slope. The wreckage was scattered in an area approximately 300 feet wide and 600 feet long. Sweeney's Ridge runs from northwest to southeast, and the top is 925 feet at the accident site.

There was no inflight separation of any flight control surface. The landing gear retracting cyclinders were found in the full retracted position. The flaps were found in the 25 percent position.

The four engines were found severely damaged by fire and impact. However, no operating failures were found during examination. The propeller governors of Nos. 1, 2, and 4 engines indicated engine r.p.m. settings of 2771, 2695, and 2847, respectively. Number 3 governor could not be checked because of fire damage.

Propeller shim plate impact markings were all found in the relatively high power with impact range of 22 to 26 degrees.

The No. 1 VOR receiver was found tuned to 111.2 mcs. the San Francisco TVOR frequency. The No. 2 VOR receiver was found tuned to 110.4 mcs. the

8/ The antenna makes approximately 13.5 revolutions per minute. This is equal to 4.5 seconds per revolution. The use of the 30-mile or 10-mile range setting is left to the controller's discretion.

Sausalito VOR frequency. The No. 1 ADF receiver was tuned to a frequency of 379 kcs. The San Francisco Airport ILS outer marker frequency is 379 kcs. The No. 2 ADF receiver was tuned to approximately 332 kcs., the San Francisco Gap Homer frequency.

The readings taken from the captain's course line indicator (Collins, Type 331A-2C) were as follows: The lubber line or magnetic heading arrow was found on 218 plus or minus 4 degrees; the VOR course selector arrow was pointing to 268 degrees. However, subsequent internal examination of the unit indicated the course selector was set at 298 plus or minus 10 degrees when the internal mechanism was damaged at impact.

The readings taken from the copilot's course line indicator which was more heavily damaged were as follows: The magnetic heading arrow was determined to be 218 degrees; the VOR course selector arrow was pointing to 028 degrees.

The ADF dual bearing indicator was heavily fire damaged. The needle pointer readings were as follows: The No. 1 pointer was reading a relative bearing of 270 to 280 degrees; No. 2 pointer was reading a relative bearing of 110 degrees. One recovered loop mechanism indicated a relative bearing of 123 degrees.

1.13 Fire

The fire that followed impact was extinguished by local firefighting apparatus.

1.14 Survival Aspects

This was a non-survivable accident.

1.15 Tests and Research

Following the accident, flights were conducted to correlate ground witnesses and traffic controller information. These flights pinpointed the probable speed and flightpath of Flight 282, and established that the initial left turn immediately after takeoff was in excess of 25 degrees of bank. Validation of times and rates of climb were also established by the flight tests.

Performance figures of the manufacturer indicate that this aircraft's rate of climb should have been in excess of 800 feet/minute from liftoff. The FTL chief pilot at SFO stated that in his experience similarly loaded L-1049H aircraft will normally climb between 400-500 feet/minute on departures from runway 28 at SFO. While no minimum rate of climb per mile was established for runway 28 departures at the time of the accident, the FAA has since specified that 250 feet/mile is the minimum acceptable. (See Attachments #2 and 4.)

A facility test was made of the San Francisco TVOR to determine what effect, if any, an aircraft taxiing in the vicinity of the TVOR antenna on the airport would have on the 287-degree radial reception by Flight 282. All known ground

and air traffic was duplicated while an aircraft flew the same flightpath as the accident aircraft. Portable TVOR receivers were also placed at several permanent locations to monitor the 287-degree radial signal. These tests revealed no appreciable effect on radial reception.

A review of previous L-1049 aircraft accidents indicates that a number of these were aircraft of the L-1049H series purchased by The Flying Tiger Line, and involved navigation errors of some type.

Subsequent to the accident a radio transfer switch assembly 9/ containing loose wire-clipping contamination was removed from a sister aircraft N6917C, as a result of extensive troubleshooting for a VOR course deviation bar discrepancy. Examination of this switch and another one removed from N6919C revealed short pieces of wire, varying from 1/16 to 1/4 inch in length within the wafer switch mechanisms. Several wire-to-switch terminals had untrimmed wire strands extending up to 1/2 inch beyond the terminal lug. A review of the last available log sheet of N6915C, the accident aircraft, revealed that the VOR system had write-ups similar to N6917C. The log of N6915C indicated that the corrective action was removal of the VOR receiver which checked out normally during the subsequent bench check.

During the FTL campaign to examine all relay switches in the fleet, two switches were found to be contaminated and four were found to have a source of contamination present. Electrical shorts caused by relay switch contamination have been known to cause navigation bearing angle errors of as great as 60 degrees.

Subsequently, the Board in a recommendation to the FAA, suggested that all operators of this type aircraft examine the switch to determine if contamination existed. On May 20, 1965, the FAA issued an Airworthiness Directive applicable to all L-1049C, E, G, and H series aircraft equipped with Lockheed Radio Transfer Switch Assembly, P/N319122, which required the disassembly and checking for wire clippings of each radio transfer switch assembly within the next 300 hours time in service. (See Attachment #5.)

2. ANALYSIS AND CONCLUSIONS

2.1 Analysis

An examination of the evidence indicates that the structure, powerplants, and system components were capable of normal operation prior to initial impact.

The medical records of all flight crewmembers failed to disclose any significant pre-existing diseases which would have disqualified any of the crewmembers from performing their duties for this flight.

9/ Lockheed Part No. 319122. A multiple gang-type circular switch that switches navigation signals and allows the captain to view on his instrument, information from the copilot's VOR system. There are three of these switches on each Lockheed 1049 aircraft. The type of switch here referred to is the deviation indicator transfer switch.

An analysis of available meteorological information indicates that, at the time of the accident, Sweeney's Ridge would have been obscured by clouds and light rain. Winds would have been from the west-southwest at 30 to 35 knots, with occasional gusts to 45 knots. This would have created moderate to severe turbulence and a marked downdraft condition in the lee of Sweeney's Ridge. Turbulence would have been encountered throughout the flightpath, increasing in intensity as the flight approached the ridge.

The ATC clearance and routing provided was in accordance with the crew's request and all ground electronic navigational aids were operating satisfactorily. The Gap homer and the Outer Marker compass locator frequencies were selected on the aircraft's ADF receivers and the loop bearing of the No. 2 ADF system validates electrical power at impact. Even assuming a malfunction of the aircraft's VOR course deviation needle, adequate guidance to a safe altitude was possible from the localizer course, the outer compass locator of the instrument landing system or the Gap low frequency homer. Also, three separate sources of heading information were available.

The phraseology "Radar Contact" is used when radar identification of an aircraft is established. This term, as presently defined, indicates that the air traffic controller has identified the aircraft on the radar display and that radar service in the form of radar separation, radar navigational guidance, or radar monitoring can be provided within the limitations of the facility. Critical obstruction clearance criteria for the Runway 28 departure at San Francisco, and limitations of the facility radar equipment, precluded radar vectoring service until the aircraft reached 1,500 feet. If the foregoing limitations were unknown to the crew, they may have believed the aircraft was under continuous radar surveillance from the time departure control reported radar contact. The crew may have disregarded their instruments believing their flight was monitored by the radar controller and, because of the turbulent weather conditons encountered, they may have concentrated their efforts on maintaining control of the aircraft. In those circumstances, the crew may have failed to detect errors in the instrument presentation to the extent that there were in fact erroneous indications portrayed.

It is possible that a contaminated switch could cause intermittent large errors in navigational information displayed on the pilot's instrument. A review of log discrepancies on a number of L-1049 aircraft presently owned and flown by The Flying Tiger Line revealed navigation errors in the VOR system that may have veen caused by contamination of the radio relay switch, even though the VOR navigation selections had been properly made.

Flight 282 made a left turn of approximately 55 degrees shortly after takeoff. The reconstructed flightpath indicates that this heading was maintained until impact. Since the relay switches in N6915C were destroyed by fire, it was impossible to determine whether contamination existed. However, the radio transmission before impact indicates the copilot's concern about the position of the aircraft. The turn after takeoff and the subsequent concern of the copilot could be attributed to a malfunctioning VOR since it is the prime navigation aid. The straight track flown after the turn indicates that the pilot was using at least some of the aircraft's navigation instruments for guidance.

Immediately after takeoff, the aircraft would have drifted to the right because of strong southwest winds. Moderate to severe turbulence would have been encountered and should have continued while the aircraft was in the lee of Sweeney's Ridge. Drift corrections would have been made to the left and high power settings were required to maintain a positive rate of climb. The aircraft was near maximum gross. It is probable that because of the gross weight condition of the aircraft, the crew may have been more concerned with flight and engine instruments than they were with navigational instruments and that, accordingly, the initial period of the flight was spent flying the aircraft, maintaining proper attitude, and a positive rate of climb. It is possible the crew became aware that they were left of course and requested from the departure controller: "How do you have us tracking towards the -ah- Gap?" At this point, 0031:05, they were considerably left of the course and 25 seconds from impact.

Under conditions of instrument flight, during a departure, if the crew was concerned with incorrect navigational readings combined with turbulence and marginal climb performance, the cumulative demands upon the pilot would be very great.

Since no reason is apparent why the left turn would not have been displayed on the instrument panel, the Board concludes that the crew apparently failed to refer to the total instrument portrayal in the cockpit.

The investigation of this accident revealed that the lateral and horizontal terrain clearance for a runway 28 departure at San Francisco could be marginal for an aircraft operating in this environment. With respect to the radar procedures utilized, radar vectoring is not provided during this instrument departure until the aircraft reaches 1,500 feet. This is because standard vertical and lateral obstruction clearance from the adjacent terrain cannot be achieved insofar as present criteria are concerned. The lateral clearance from obstructing terrain is so critical, there is no available space in which to vector an aircraft safely until it has reached an altitude of 1,500 feet.

As far as can be determined Flight 282 was initially climbing at approximately 250 feet per mile minimum rate of climb and would have undoubtedly made a safe climbout had it remained on the appropriate standard instrument departure route. However, after the aircraft left the prescribed departure route, it entered an area of rising terrain where downdraft activity and moderate to severe turbulence affected the climb capability of the aircraft sufficiently to prevent terrain clearance. The deviation to the left was not detected in time to avert impact with the hill.

2.2 Conclusions

(a) Findings

1. The crew of Flight 282 was properly certificated and there was no evidence of pre-impact incapacitation.

2. The aircraft was loaded to within the c.g. limits and was under the maximum gross takeoff weight limitation.

3. Takeoff was normal and the landing gear and landing lights were retracted after the aircraft became airborne. The landing lights were not turned off after retraction.

4. The aircraft made a slight right turn then a left turn exceeding 25 degrees of bank, rolled out and proceeded in an approximately straight line until it impacted Sweeney's Ridge.

5. The engines were functioning properly and were operating at a high rate of power at impact.

6. There were navigation instruments in the cockpit that were giving accurate heading and cross-check information at the time of the accident.

(b) Probable Cause

The Board determines that the probable cause of this accident was that the pilot, for undetermined reasons, deviated from departure course into an area of rising terrain where downdraft activity and turbulence affected the climb capability of the aircraft sufficiently to prevent terrain clearance.

BY THE CIVIL AERONAUTICS BOARD:

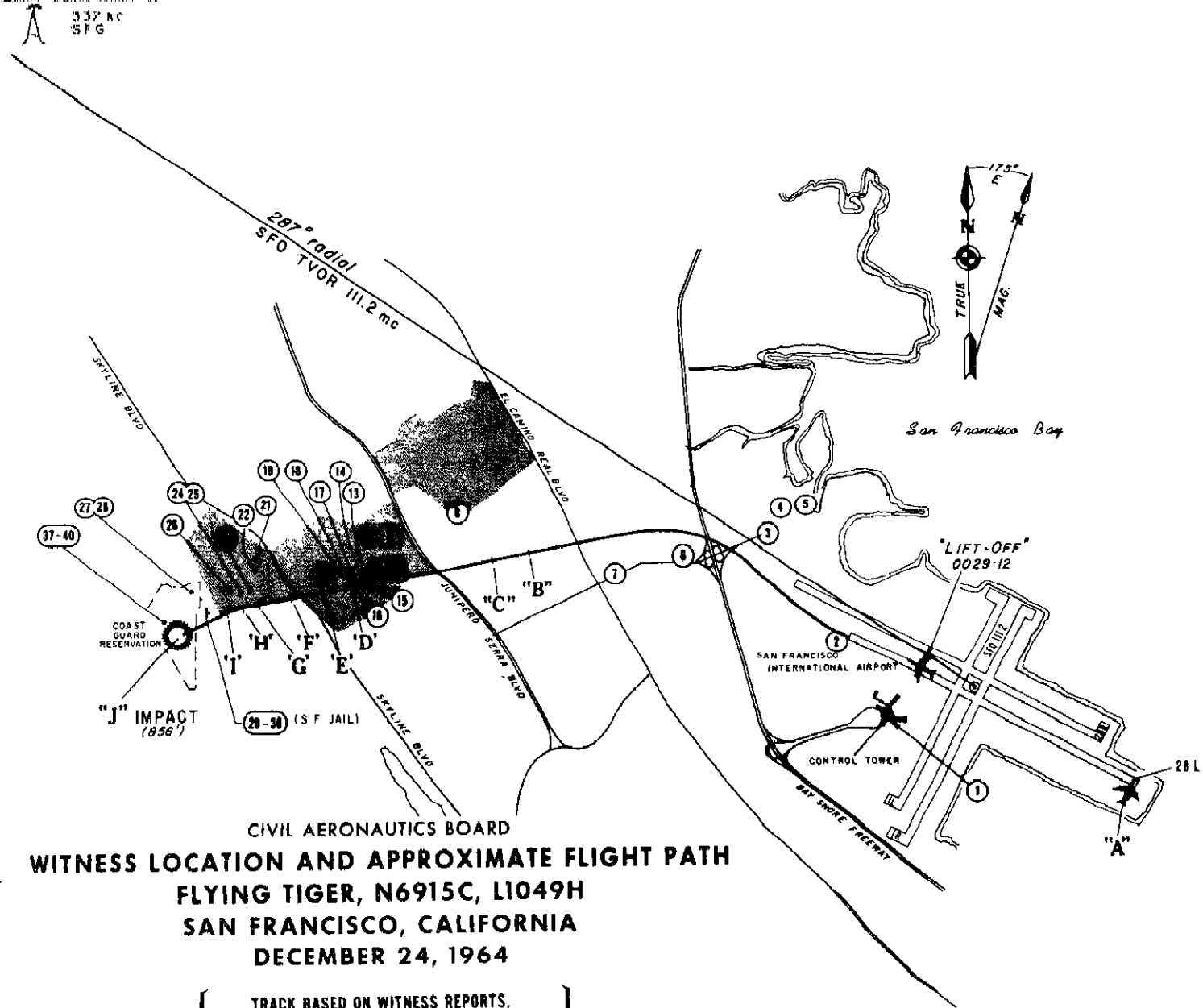
/s/ CHARLES S. MURPHY
Chairman

/s/ ROBERT T. MURPHY
Vice Chairman

/s/ G. JOSEPH MINETTI
Member

/s/ WHITNEY GILLILLAND
Member

/s/ JOHN G. ADAMS
Member



0028:00 PST "A"

TIGER 915:

"NINE ONE FIVE ROLLING"

0030.22 PST "B"

LOCAL CONTROLLER

"TIGER NINER FIFTEEN CONTACT DEPARTURE CONTROL"

0030:29 PST "C"

TIGER 915:

"NINE FIFTEEN ROGER"

0030.52 PST "D"

TIGER 915:

"AH DEPARTURE TIGER NINE FIFTEEN YOU GOT US-AH-OVER"

0030:57 PST "E"

DEPARTURE CONTROL:

"FLYING TIGER NINE FIFTEEN SAN FRANCISCO DEPARTURE CONTROL RADAR CONTACT REPORT--ah-- LEAVING 1,000 ft ALTITUDES OVER"

0031.05 PST "F"

TIGER 915:

"ROGER HOW DO YOU HAVE US TRACKING TOWARD THA--ah-- --1HA GAP?"

0031:13 PST "G"

DEPARTURE CONTROL:

"Ah--TIGER NINE FIFTEEN WHAT ALTITUDE ARE YOU LEAVING NOW"

0031:16 PST "H"

TIGER 915

"NINE HUNDRED"

0031.20 PST "I"

DEPARTURE CONTROL:

"NINER HUNDRED ROGER IT SHOWS YOU GOING DIRECTLY OUT, ON THA---ah -WELL YOU'RE LEFT OF COURSE OF THE SAN FRANCISCO 287"

APPROX
0031.30 PST "J"

AIRCRAFT DISAPPEARED FROM SCOPE

"IMPACT"

CIVIL AERONAUTICS BOARD

WITNESS LOCATION AND APPROXIMATE FLIGHT PATH
FLYING TIGER, N6915C, L1049H
SAN FRANCISCO, CALIFORNIA
DECEMBER 24, 1964

[TRACK BASED ON WITNESS REPORTS, ATC RECORDS, AND ACFT PERFORMANCE DATA]

SCALE

½ 0 1 MILE

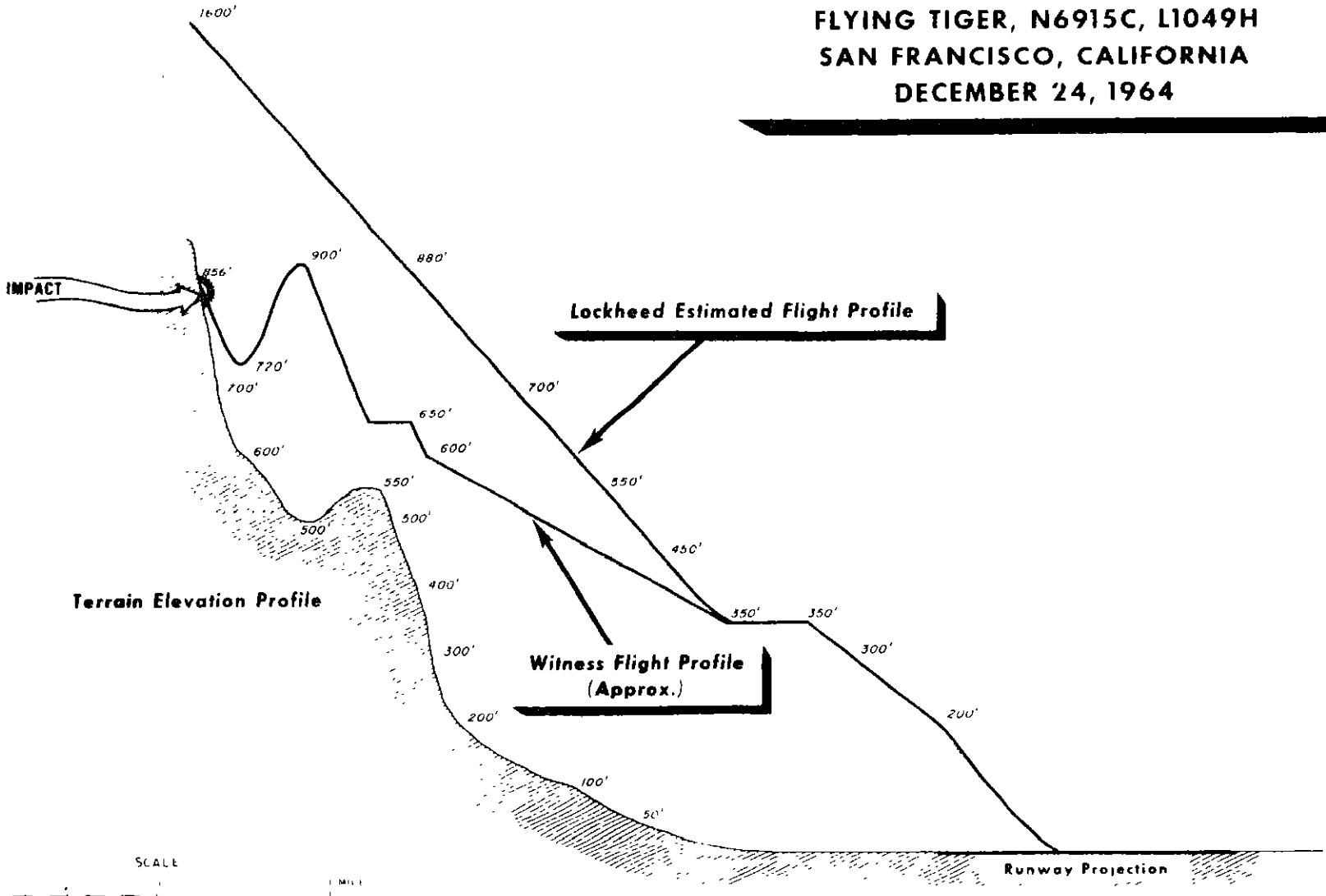
(30) WITNESS LOCATIONS

wal - 2-12-65

ATTACHMENT #2

CIVIL AERONAUTICS BOARD

TERRAIN AND ALTITUDE PROFILE CHART
FLYING TIGER, N6915C, L1049H
SAN FRANCISCO, CALIFORNIA
DECEMBER 24, 1964



ATTACHMENT # 3

SAN FRANCISCO INTERNATIONAL SID's

STANDARD INSTRUMENT DEPARTURES

MAXWELL (CALIF) Effective 0501Z 10 DEC 1964
MXW 110.0 to 0501Z 7 JAN 1965
Chan 37
(L-2)

GOLDEN GATE ONE DEPARTURE

Via San Francisco 287 radial to intercept and proceed via Sausalito 215 and 035 radials to Richmond Intersection. Then via (transition) or (assigned route)

Maxwell Transition - Via **Napa** 164 radial to **Napa**. Then via **Napa** 346, **Maxwell** 170 and 340 radials and **Red Bluff** 160 radial to **Red Bluff**.

Linden Transition - Via **Sausalito** 035 and **Linden** 252 radials to **Linden**.

Sacramento Transition - Via **Sausalito** 035 and **Sacramento** 215 radials to **Sacramento**.

SAUSALITO TWO DEPARTURE

Via Sausalito 127 radial to **Sausalito**. Then via **Sausalito** 035 radial to Richmond Intersection Then via (transition) or (assigned route) Cross **Oakland** 250 radial at (minimum 1,700').

Maxwell Transition - Via **Napa** 164 radial to **Napa**. Then via **Napa** 346, **Maxwell** 170 and 340 radials and **Red Bluff** 160 radial to **Red Bluff**.

Linden Transition - Via **Sausalito** 035 and **Linden** 252 radials to **Linden**.

Sacramento Transition - Via **Sausalito** 035 and **Sacramento** 215 radials to **Sacramento**.

RICHMOND TWO DEPARTURE

Via Sausalito 127 and San Francisco 342 radials to **Richmond** Intersection. Then via (transition) or (assigned route)

Maxwell Transition - Via **Napa** 164 radial to **Napa**. Then Via **Napa** 346, **Maxwell** 170 and 340 radials and **Red Bluff** 160 radial to **Red Bluff**.

Linden Transition - Via **Sausalito** 035 and **Linden** 252 radials to **Linden**.

Sacramento Transitions - Via **Sausalito** 035 and **Sacramento** 215 radials to **Sacramento**.

LEGEND

- V138 — LOW ALTITUDE AIRWAY
- (L-3) — LOW ALTITUDE CHART
- J103 — HIGH ALTITUDE JET ROUTE
- (H-3) — HIGH ALTITUDE CHART
- DME 51 TVE — DME FIX, DISTANCE & FACILITY IDENT
- NORMAL DEPARTURE ROUTE
- STANDARD INSTRUMENT DEPARTURE ROUTE
- STANDARD INSTRUMENT TRANSITION ROUTE
- CROSSING ALTITUDE RESTRICTION INDICATED IN SID DESCRIPTION

MAXWELL
LAKE
NAPA
APC 112.1
ELMIRA
SACRAMENTO
RIO
CROCKETT
LINDEN
BAY POINT
RICHMOND
COMMODORE
SAUSALITO
SAU 110.4
Chan 41
ORINDA
COLLEGE
UKIAH
RED BLUFF
GOLDEN GATE
SUTRO
OAKLAND
MERRITT
OAKLAND
OAK 116.8
Chan 115
SAN RAMON
ALTAMONT
MULFORD
SAN FRANCISCO GAP
SFG 332
SALINAS
SHARK
BRINY
SHRIMP
SAN FRANCISCO
SFO 111.2
Metro Oakland Intnl
San Francisco Intnl

ORINDA THREE DEPARTURE

Via San Francisco 010 radial to **Orinda** Intersection Then via (transition) or (assigned route). Cross **Merritt** Intersection at or above **2,500'**.

Bay Point Transition: Via heading 040 to intercept **V-6**.

Attachment # 4

SAN FRANCISCO INTERNATIONAL SID's

STANDARD INSTRUMENT DEPARTURES

Effective 0501Z 22 JUL 1965

to 0501Z 19 AUG 1965

Overlaps Enroute Charts Nr L-2, H-1 & H-2

STADIUM ONE DEPARTURE

Via **Sausalito 127** radial to 1700'. Turn left heading 270 to intercept **San Francisco 287** radial. Then via (transition) or (assigned route).

Fort Ross Transition - Via San Francisco 287 and **Ukiah 154** radials to **Ukiah**

Pillsbury Transition - Via San Francisco 287 and **Ukiah 154** radials to **Ukiah**. Then via **Ukiah 019** and **Red Bluff 200** radials to **Red Bluff**.

NOTE: This SID requires a minimum climb rate of 250' per mile to 2000'.

SUTRO ONE DEPARTURE

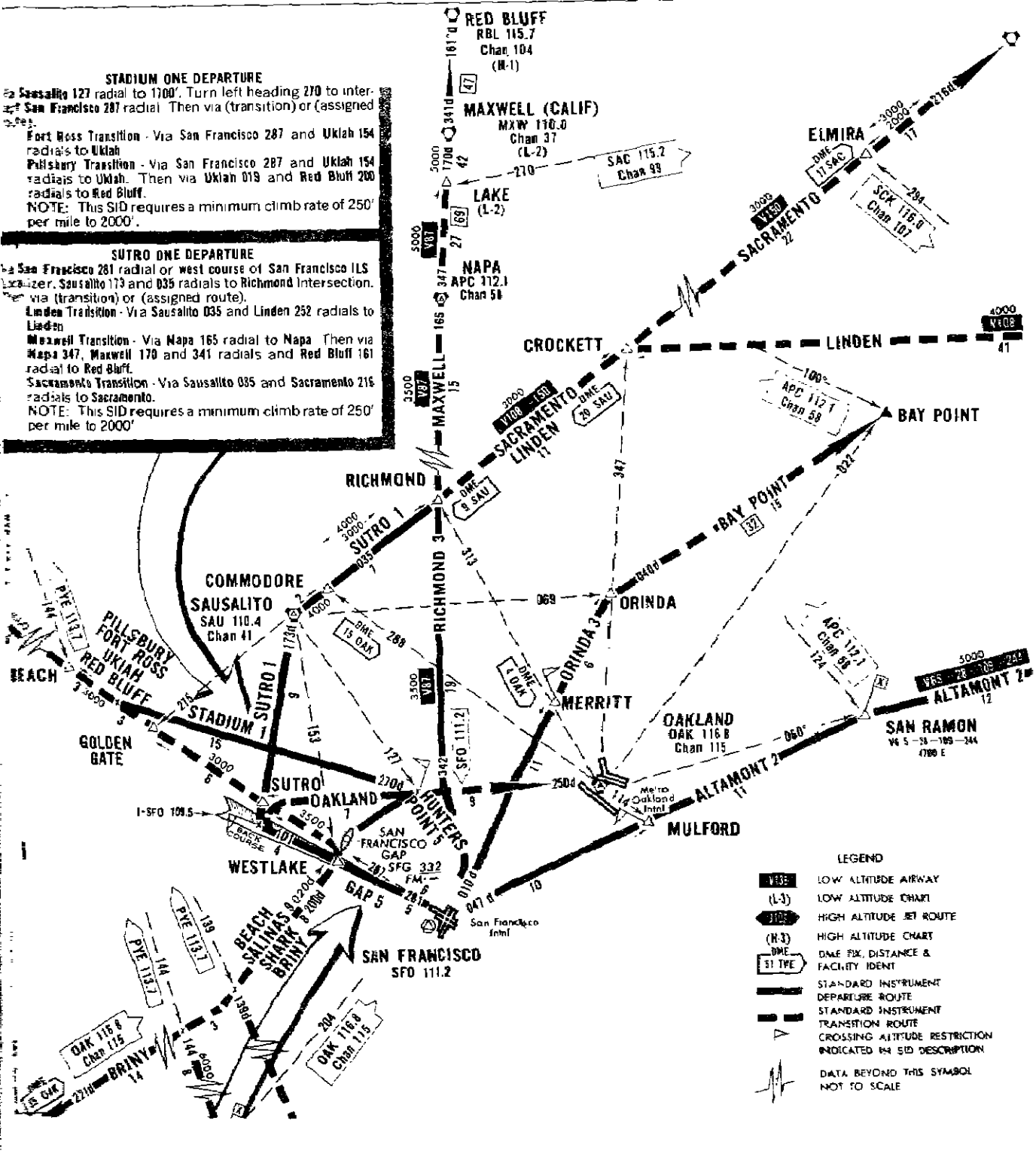
Via **San Francisco 281** radial or west course of **San Francisco** ILS Localizer, **Sausalito 173** and **035** radials to **Richmond** Intersection. Then via (transition) or (assigned route).

Linden Transition - Via **Sausalito 035** and **Linden 252** radials to **Linden**

Maxwell Transition - Via **Napa 165** radial to **Napa**. Then via **Napa 347**, **Maxwell 170** and **341** radials and **Red Bluff 161** radial to **Red Bluff**.

Sacramento Transition - Via **Sausalito 035** and **Sacramento 216** radials to **Sacramento**.

NOTE: This SID requires a minimum climb rate of 250' per mile to 2000'



COPY

ATTACHMENT V

April 22, 1965

Mr. George S. Moore
Director
Flight Standards Service
Federal Aviation Agency
Washington, D. C. 20553

Dear Mr. Moore:

The Board's investigation of the accident involving Flying Tiger Line Lockheed 1049H, N6915C, at San Francisco, California, on December 24, 1964, indicates a hazardous condition that we wish to bring to your attention together with our recommendations for corrective action.

The Board's investigation of this accident revealed that N6915C made a left turn of approximately 60 degrees shortly after takeoff and flew into a hillside. During this investigation another Flying Tiger L1049H aircraft, N6917C, experienced an error of approximately 30 degrees in its VOR system. All of the major components of the VOR system of N6917C were shop examined and found to be working properly. An internal detailed examination of the Deviation Indicator switch, Lockheed Part Number 319122, revealed many small pieces of wire interspersed among moving parts of the multi-pole switch. These pieces of wire varied in length from 1/16 inch to 1/4 inch and appeared to be ends trimmed off the electrical leads soldered to the terminals. An analysis of the possible electrical shorts because of the contamination indicates that navigation bearing angles could be in error as great as 60 degrees. Two other switches of the same type are used on 1049H airplanes of this configuration. These switches are in the ADF and Integrated Flight System.

Although these switches on the aircraft involved in the accident were destroyed by ground fire, a fleet campaign being conducted by Flying Tiger Line has disclosed some contamination on three of six airplanes checked to date.

As a result of these findings it is recommended that the Federal Aviation Agency initiate a fleet campaign of all operators of this type aircraft using this switch to determine whether such contamination exists elsewhere and take such steps as are necessary to eliminate further contamination.

Personnel of our Engineering Division have discussed this problem with Messrs. J. Hemingway of FS-305 and R. W. Thompson of Systems and Equipment Branch, WE-413; J. Long of ACDO, Burbank, California; and T. O'Leary, ACDO, Newark, New Jersey.

If we can be of any further assistance in consideration of this recommendation please feel free to contact us.

Sincerely yours,

/s/ B. R. Allen

B. R. Allen
Director, Bureau of Safety

ATTACHMENT V

COPY

FEDERAL AVIATION AGENCY
Washington, D. C. 20553

July 16, 1965

In Reply
Refer To: FS-102

Mr. B. R. Allen
Director, Bureau of Safety
Civil Aeronautics Board
Washington, D. C. 20428

Dear Mr. Allen:

This will supplement our April 28, 1965, acknowledgement of your letter of April 22, 1965, reference B-80-96, relative to the Board's investigation of the accident involving Flying Tiger Line Lockheed 1049H, N6915C, at San Francisco, California, on December 24, 1964.

An airworthiness directive was issued on May 14, 1965, requiring disassembly and inspection of each radio transfer switch assembly, P/N 319122 for wire clippings, within 300 hours time in service.

We believe that this action will preclude difficulties associated with contamination.

Sincerely yours,

/s/ George S. Moore

George S. Moore
Director
Flight Standards Service

COPY

ATTACHMENT VI

July 23, 1965

Mr. Archie W. League
Director
Air Traffic Service
Federal Aviation Agency
Washington, D. C. 20553

Dear Mr. League:

During the course of our continuing investigation of aircraft accidents, it became apparent that certain limitations pertaining to air traffic services were not clearly understood by the pilot.

When there are airspace limitations where radar vectoring service may be provided i.e., antenna coverage limitations, terrain clearance problems, etc., the extent of such limitations should be prominently displayed on appropriate aeronautical charts and disseminated through other media to the users. An example of the application of this recommendation is enclosed.

It is our belief that the use of the term "Radar Contact" tends to create a false sense of security in the mind of the pilot that navigational guidance for course correction or to avoid hazardous situations is being automatically supplied under IFF conditions. For example, it has been the belief of some pilots that when advised in "Radar Contact" that correction of errors in navigation and collision avoidance vectors are the prime functions of radar air traffic control services.

A suggested change in phraseology which would tend to eliminate recurrence of this situation would be the substitution of the term "Proceed as Cleared" until such time as it is known that the aircraft is within the useable airspace for vectoring purposes. At this time the term "Radar Contact" should then be used.

This matter has been discussed with Mr. Harold B. Helstrom of your Airspace Regulations and Procedures Division and Mr. Joseph C. Zacko of our Investigation Division.

Sincerely yours,

/s/ Marion F. Roscoe

for B. R. Allen
Director, Bureau of Safety

Enclosure

ATTACHMENT VI

COPY

FEDERAL AVIATION AGENCY
Washington, D. C. 20553

August 3, 1965

In Reply
Refer To: AT-500

Mr. B. R. Allen
Director, Bureau of Safety, B-80
Civil Aeronautics Board
Universal Building
Washington, D. C. 20428

Dear Mr. Allen:

This is in reply to your letter of July 23, 1965, in which you expressed a belief that the term "Radar Contact" is creating in the minds of pilots a false sense of security and that certain limitations pertaining to air traffic service are not clearly understood by them.

Your comment with respect to the use of the term "Radar Contact" is quite timely since we have recently taken action to clarify its use. We would agree that certain radar terms may not have been conveying to the users the fact that radar services would be provided at the discretion of the ATC system and should not be expected in every case. In view of this, we have redefined some of the terms used and they will, as you have suggested, be published in the Airman's Information Manual. Enclosed is a copy of the pertinent terms as they will be defined in a forthcoming issue of AIM.

We trust that publication of these terms and their associated definitions will clarify the subject for pilots and further we believe are responsive to your recommendations. In the event they are not responsive or if we have misconstrued your suggestion, we would welcome an opportunity to discuss the subject further at your convenience.

Your recommendation to prominently display, on appropriate aeronautical charts, areas wherein the provision of radar services may have limitations, would also appear to have some merit. However, there are certain factors, which after further consideration tend to indicate this to be an unwise course of action and even precludes such action. For example, publication of such data could mislead pilots into the belief that certain services will always be provided in the charted area when, in fact, it would only be provided as necessary or required for traffic control purposes. Charting information as to radar coverage would also compromise the security of joint-use radar systems.

In view of the above, we do not believe it would be appropriate to take any further action.

We appreciate your interest in this matter.

Sincerely yours,

/s/ Clifford P. Burton

for Archie W. League, Director
Air Traffic Service

Enclosure

RADAR CONTACT - The term air traffic controllers use to indicate that an aircraft is identified on the radar display and that radar service can be provided until radar identification is lost or radar service is terminated.

RADAR FLIGHT FOLLOWING - The radar tracking of identified aircraft targets and the observation of the progress of such flight sufficiently to retain identity.

RADAR HANDOFF - That action whereby radar identification of, radio communications with and, unless otherwise specified, control responsibility for an aircraft is transferred from one controller to another without interruption of radar flight following.

RADAR SERVICE - A term which encompasses one or more of the following services based on the use of radar which can be provided by a controller to a pilot of a radar-identified aircraft.

Radar Separation - Radar spacing of aircraft in accordance with established minima.

Radar Navigational Guidance - Vectoring aircraft to provide course guidance.

Radar Monitoring - The radar flight following of aircraft, whose primary navigation is being performed by the pilot, to observe and note deviations from its authorized flight path airway, or route. This includes noting aircraft position relative to approach fixes and major obstructions.

RADAR SURVEILLANCE - The radar observation of a given geographical area for the purpose of performing some radar function.

RADAR TARGET - The indication shown on a radar display resulting from a primary radar return or a radar beacon reply.

RADAR TRAFFIC INFORMATION - Information on any aircraft observed on the radar scope which, in the judgment of the controller, appears to constitute a hazard to the operation of an aircraft being controlled.

RADAR VECTOR - A heading issued to an aircraft to provide navigational guidance by radar.

RADIAL - A magnetic bearing extending from a VOR/VORTAC/TACAN.

ATTACHMENT VII

COPY

September 24, 1965

Mr. Archie W. League
Director
Air Traffic Service
Federal Aviation Agency
Washington, D. C. 20553

Dear Mr. League:

During our investigation of the Flying Tiger Line accident at San Francisco, California on December 24, 1964, an evaluation was made of pertinent departure procedures.

The facts disclosed by the Board's investigation of the FTL accident show that Flight 915C departed runway 28 with an IFR clearance to proceed via the then current Golden Gate Standard Instrument Departure. Following lift-off, the aircraft was identified on radar by the departure controller within one mile from the end of the runway. Shortly after identification was made the aircraft deviated from its course approximately 40 degrees. However, the change in the aircraft's track was not observed by the departure controller at that time. In response to a request from the crew for track information, the controller changed his scope range setting from the 30 miles to the ten mile range in order to obtain more precise information. The aircraft's position became apparent to the controller and the flight was advised that it was left of the course (287° RAD). Seconds later the aircraft impacted Sweeney Ridge at a point four miles west of the airport and about 2½ miles to the left of the desired course to be flown. No acknowledgment for the advisory issued to the flight was received.

Radar vectoring is not provided to an aircraft departing runway 28 via the SID, until the aircraft reaches an altitude of 1500 feet. A study of the terrain west of the airport, and the departure procedures utilized for aircraft proceeding in that direction, (confirmed by Messrs. Peterson and Rebuschaitis of Flight Standards Service) disclosed evidence that standard obstruction clearance from the terrain, vertical or lateral, cannot be achieved insofar as present criteria are concerned.

We recognize the need for continued use of runway 28, and the basis for the SID procedures associated with that runway. The recent changes accomplished by your Agency in the pertinent departure and approach procedures for SFO, which note minimum climb performance required for compliance with SID's, and the note showing that standard obstruction clearance is not provided over the terrain west of the airport, are definite steps toward a safer operation. However, it must also be recognized that "GAP" SID's, as they exist, provide very small margins of safety when we consider the performance data for many of the aircraft operating from the SFO airport.

The facts in this case show that even a small lateral deviation from the specified departure course, if not detected immediately by the pilot or controller could result in a disastrous accident within a matter of seconds. Further, in the FTL accident the aircraft was climbing at the approximate 250' per mile minimum rate of climb specified in the current SID's (Gap 5 and Sutro 1). This fact emphasizes the critical lateral limits involved.

To enhance the safety of such operations, it is recommended that the SFO departure controller be provided with an additional radar display, to be operated on a suggested 6-mile range setting. This will provide the controller with the capability for more effective radar monitoring service to departing aircraft at this location which has a terrain-critical departure route.

In your reply of August 3, 1965, to our letter of July 23, 1965, it was indicated that you did not deem it appropriate to prominently display on pertinent aeronautical charts, "areas wherein the provision of radar services may have limitation." Our previously suggested wording for the box at the top of the sample chart perhaps was misleading to you as to our intent.

The note might also be written in the negative, as follows:

"Runway 28 Departures --- Radar vectoring service not available below 1500 feet m.s.l."

In view of the foregoing, we respectfully request that this matter be reconsidered.

In addition to the personnel mentioned heretofore, this matter has been discussed with Messrs. Bernard Curtis and Edward Krupinski. Should you desire additional information, please contact our Investigation Division.

Sincerely yours,

/s/ Marion F. Roscoe

for B. R. Allen
Director, Bureau of Safety

ATTACHMENT VII

FEDERAL AVIATION AGENCY
Washington, D.C. 20553

Dec 22, 1965

In Reply
Refer to: AT-200

Mr. B. R. Allen
Director, Bureau of Safety
Civil Aeronautics Board
Universal Building
Washington, D. C. 20428

Dear Mr. Allen:

In response to your letter of September 24, 1965, we sent a specialist to San Francisco to make a personal study of the problem area concerned, and to discuss your recommendations at the region and local level. Our findings with respect to the recommendations in your letter are as follows:

The GAP departure, which is not dependent upon the use of radar, has been used for many years. History indicates that when properly used, it is as safe as any other procedure (arrivals or departures) which depends on close pilot adherence to route assignments by the pilot for operation over or alongside terrain or other obstructions. We cannot relieve the pilot of his responsibility to adhere to route assignments in these areas.

As you noted in your letter, recent changes were accomplished by the Agency to enhance the safety of aircraft climbing westbound out of San Francisco. In addition to these changes, we have provided two methods of navigation for the GAP route, the 281 radial and the west course of the San Francisco ILS localizer. This gives the pilot a backup and a double check of his instruments.

You recommended an additional radar display operated on a six-mile range to be used by the San Francisco departure controller to provide for more effective radar monitoring service on GAP departures. While this display could increase the monitoring capability of the departure controller, it could at the same time distract his attention from the longer range display necessary for him to perform his primary duty of providing radar

separation between aircraft under his control or vice versa. Also, the additional six-mile display would still be subject to the same limitations of providing radar service that the controller has now; i.e., it would be an additional service which we may not always be in a position to provide as explained in our Procedures Handbook, AT P 7110.1B, paragraph 351.1, Note.

However, in our continuing efforts to improve air traffic services, approval was granted on September 28, 1965, to the Western Region to proceed with the development of a common terminal radar control facility for the San Francisco/Oakland area. It will be located at the Oakland Airport. Use of the present Oakland ASR-4 radar equipment with its increased resolution and expanded display will provide the type of coverage you recommend for San Francisco departures to the west. This equipment, in addition to being responsive to your recommendation, will have the advantage of requiring the controller to observe only one scope. This will be accomplished as soon as the facility and appropriate procedures can be developed.

Our reconsideration of your recommendations relating to the display of notes on Aeronautical SID charts of areas wherein the provision of radar services may have limitations, reveals that our answer of August 3, 1965, on this subject is still appropriate. We believe that it would be of limited value and that possible misunderstandings could result from adopting this type of depiction on charts.

Sincerely yours,

/s/ Archie W. League, Director
Air Traffic Service