Runway Collision, Korean Air Lines, McDonnell Douglas DC-10-30, HL7339, Southcentral Air Piper PA-31-350, N35206, Anchorage, Alaska, December 23, 1983

Micro-summary: **This DC-10 collided with a Piper PA-31-350 head-on on runway 6L.**

Event Date: **1983-12-23 at 1406 Yukon standard time**

Investigative Body: **National Transportation Safety Board (NTSB), USA**

Investigative Body's Web Site: **http://www.ntsb.gov/**

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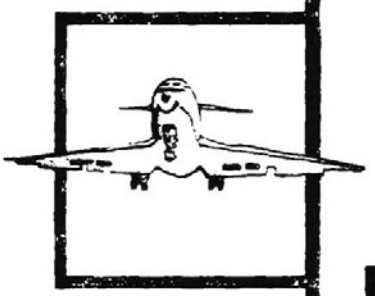

NATIONAL TRANSPORTATION SAFETY BOARD

WASHINGTON, D.C. 20594

AIRCRAFT ACCIDENT REPORT

KOREAN AIR LINES
McDONNELL DOUGLAS DC-10-30, HL7339,
SOUTHCENTRAL AIR PIPER PA-31-350, N35206
ANCHORAGE, ALASKA
DECEMBER 23, 1983

NTSB/AAR-84/10

UNITED STATES GOVERNMENT

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AIRCRAFT ACCIDENT REPORT

Adopted: August 9, 1984

KOREAN AIR LINES McDONNELL DOUGLAS DC-10-30, HL7339
SOUTHCENTRAL AIR PIPER PA-31-350, N35206
ANCHORAGE, ALASKA
DECEMBER 23, 1983

SYNOPSIS

At 1406 Yukon standard time, on December 23, 1983, Korean Air Lines Flight 084, a scheduled cargo flight from Anchorage, Alaska, to Los Angeles, California, collided head-on with SouthCentral Air Flight 59, a scheduled commuter flight from Anchorage to Kenai, Alaska, on runway 6L-24R at Anchorage International Airport. Both flights had filed instrument flight rules flight plans, and instrument meteorological conditions prevailed at the time of the accident. The SouthCentral Air Piper PA-31-350 was destroyed by the collision impact, and the Korean Air Lines McDonnell Douglas DC-10-30 was destroyed by impact and postimpact fire. Of the eight passengers aboard Flight 59, three were slightly injured. The pilot was not injured. The three crewmembers on Flight 084 sustained serious injuries.

The National Transportation Safety Board determines that the probable causes of the accident were the failure of the pilot of Korean Air Lines Flight 084 to follow accepted procedures during taxi, which caused him to become disoriented while selecting the runway; the failure of the pilot to use the compass to confirm his position; and the decision of the pilot to take off when he was unsure that the aircraft was positioned on the correct runway. Contributing to the accident was the fog, which reduced visibility to a point that the pilot could not ascertain his position visually and the control tower personnel could not assist the pilot. Also contributing to the accident was a lack of legible taxiway and runway signs at several intersections passed by Flight 084 while it was taxiing.

1. FACTUAL INFORMATION

1.1 History of the Flight

On December 23, 1983, the pilot of SouthCentral Air Flight 59 (SCA 59), a Piper PA-31-350, filed an instrument flight rules (IFR) flight plan for a scheduled domestic passenger flight from Anchorage, Alaska, to Kenai, Alaska, with a requested altitude of 2,000 feet. 1/ At 1215:36, 2/ SCA 59 was cleared to Kenai via an Anchorage eight departure, as filed, and to maintain 2,000 feet. When the clearance delivery controller advised him while still parked at the terminal gate to expect a delay in his departure time until 1244 because of dense ground fog, the pilot shut down the engines and returned with his passengers to the terminal building. The pilot and the passengers later reboarded the airplane, and the pilot restarted the engines. He called the tower at 1234:47. At 1244:10, clearance delivery switched SCA 59 to the ground control frequency.

1/ All altitude and terrain elevations referred to in this report are mean sea level unless otherwise indicated.
2/ All times are Yukon Standard Time based on the 24-hour clock unless otherwise noted.

At 1339:36, after about an hour's delay at his parking spot, the pilot of SCA 59 requested taxi clearance since the runway visual range (RVR) had begun to improve. SCA pilots need a minimum of 1,800 feet RVR for takeoff at Anchorage. The pilot was given the option of departing via runway 6 right (6R) or runway 6 left (6L). The pilot elected to use the full length of runway 6L for his departure in accordance with company policy. He reported to the ground controller passing the approach end of runway 32 at 1343:17, and he reported arriving at taxiway W-3 at 1344:08. (See figure 1.)

At 1344:18, the pilot of SCA 59 reported on the local control frequency that he was holding short of runway 6L and that he would be ready for departure as soon as the RVR improved to 1,800 feet. The local controller responded ". . . it's not quite there yet, we got a thousand, I'll let you know when it comes up."

The flightcrew of Korean Air Lines Flight 084 (KAL 084), a McDonnell Douglas DC-10-30, filed an IFR flight plan for a scheduled cargo flight from Anchorage to Los Angeles International Airport, California, on December 23, 1983. The requested flying altitude was Flight Level 330. 3/ At 1352, the Anchorage air traffic control tower clearance delivery controller cleared KAL 084 to Los Angeles via an Anchorage eight departure, the filed route, and told the flightcrew to expect Flight Level 330 after departure.

KAL 084 called the Anchorage ground controller from the cargo ramp of the International Satellite Terminal requesting engine start and taxi clearance. The ground controller gave the captain an option of departing the airport via runway 32 or runway 6R. The operating specifications for KAL stated that a prevailing visibility of 1/4 mile was required for takeoff on runway 32 and that a reading of 600 feet on the touchdown zone, midfield, and rollout RVR transmissometers was required for takeoff on runway 6R. The captain selected runway 32 and, at 1357:37, the ground controller cleared KAL 084 to taxi to runway 32. The ground controller could not observe KAL 084 taxiing to the runway because the fog was restricting surface visibility at the airport to 1/8 mile. He requested and received a report from the captain when KAL 084 reported entering the east-west taxiway at 1401:45. The ground controller then requested the captain to hold short of runway 32 and change to the local control frequency.

At 1402:36, the captain of KAL 084 reported on the local control frequency that he was taxiing on the east-west taxiway and was ready for takeoff. At 1402:54, the local controller cleared KAL 084 to taxi into position and hold at runway 32 and reported the RVR of runway 6R as 1,200 feet, the midfield RVR as 1,400 feet, and the rollout RVR as 800 feet. At 1403:39, the local controller requested the pilot of SCA 59 to confirm his position. The pilot confirmed that he was holding at the W-3 intersection. At 1404, KAL 084 was cleared for takeoff on runway 32. The captain acknowledged the clearance. At 1405:28, SCA 59 was cleared onto runway 6L to hold for takeoff by the tower controller who reported that the RVR had risen to 1,800 feet. At 1406:18, the captain of KAL 084 transmitted that he was starting the takeoff roll.

KAL 084 collided with SCA 59 on the ground at the departure end of runway 24R (approach end of runway 6L). The KAL 084 captain sighted the PA-31-350, awaiting takeoff clearance, seconds before the collision and rotated the DC-10-30 and applied left rudder which caused the nose gear to lift and the center main body gear to swing to the right of its previous runway centerline position. The pilot's actions resulted in the center main and left main gears straddling the PA-31-350 fuselage and the nose gear passing over it.

3/ A level of constant atmospheric pressure related to a reference datum of 29.92 inches of mercury. Each level is stated in three digits that represent hundreds of feet. For example, Flight Level 330 represents a barometric altimeter indication of 33,000 feet.

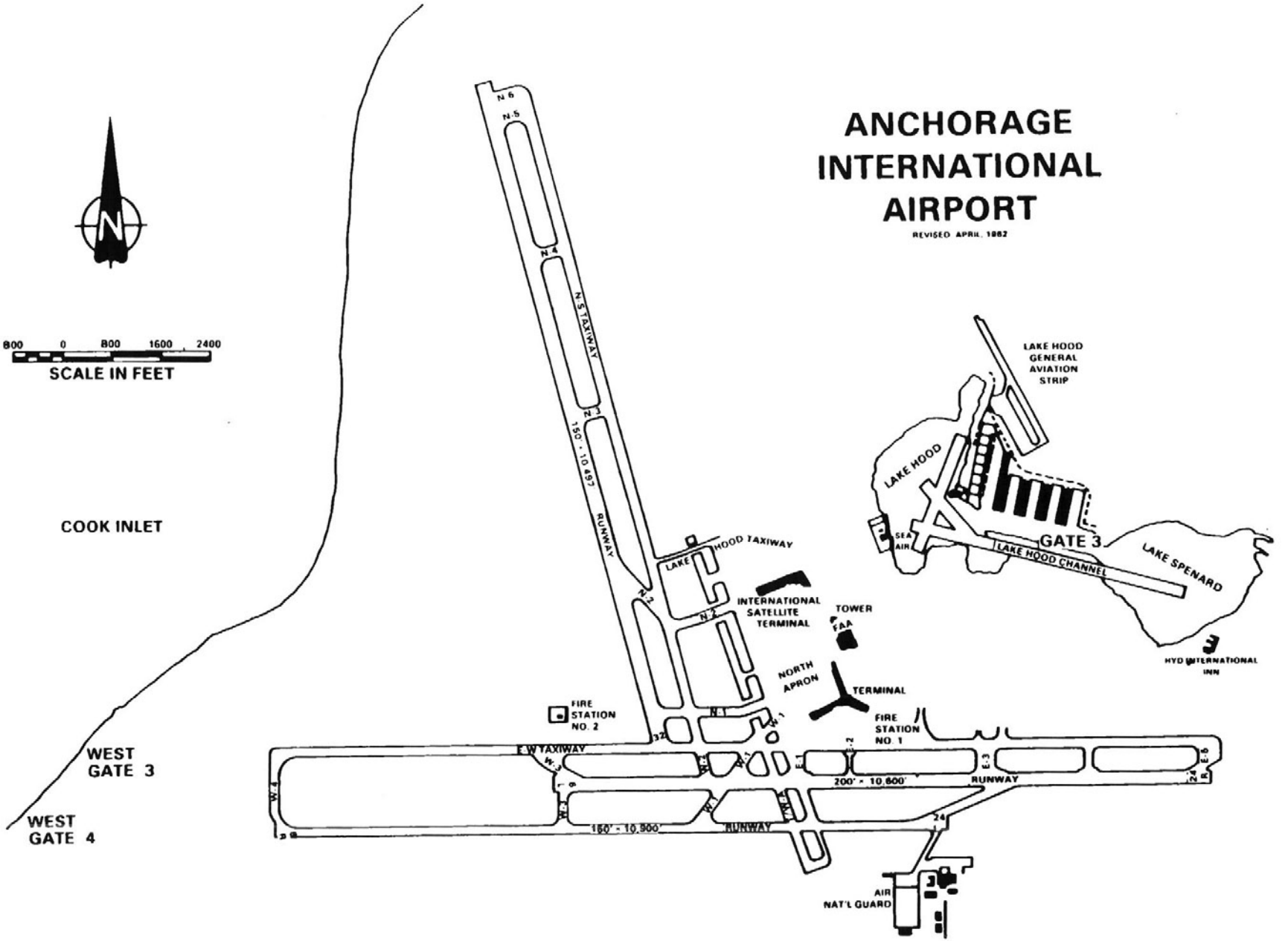

Figure 1.--Plan view of Anchorage International Airport.

The PA-31-350 was pushed rearward by the collision impact but remained on the runway. The right wing of the PA-31-350 was sheared off at the wing root, and the left wing was separated outboard of the left engine nacelle. There were scrape marks and an indentation along the top of the fuselage extending aft from over the cockpit area. The vertical stabilizer was separated and the PA-31-350 came to rest on its nose gear, left main gear, and aft lower fuselage.

The DC-10-30 continued off the departure end of runway 24R, demolished seven approach light stanchions (the approach light system for runway 6L), passed through a wooded area, down a gully, and slued to the right before coming to a stop. A fire erupted immediately and destroyed the DC-10-30.

No fatalities resulted from the accident. The airport was closed at 1410 and reopened at 2030 for operations on runways 6R/24L and 14/32. The accident occurred about 1406:40 during daylight hours, at latitude 61°10' N and longitude 149°59' W.

1.1.1 Flightcrew Interviews

The pilot of SCA 59 stated in part:

> . . .about 1330-1345, found out weather was going back up, gotten above 1800. . . .our minimums. . . .went out again and after 5 to 10 minute delay told to taxi out. . . .cleared me to taxi to 6L. . . . Gate 37. . . .taxied out. . . .on the diagonal to the east-west, down the east-west to W-3. . . .fog wasn't cleared. . . .a JAL plane almost mistook taxiway (W-3) for W-4 (access to runway 6R). . . .he started to pull into it. . .realized. . . .mistake. . . went straight. . . . behind me. . . .fog was pretty dense. . . .told to taxi into position and hold. . . .wait for KAL to jet out on 32. . . .heard them clear KAL. . .for departure. . . .30, 40 seconds later saw headlights down the runway. . . .truck on runway? . . .lights got bigger and bigger and kept going faster and faster. . . .ducked below cockpit and told passengers to do the same. . . .we felt impact.

The pilot also stated that because of his familiarity with the airport layout and slow taxi speed, he did not have undue difficulty during taxi out.

The captain of KAL 084 stated in part:

> I left the North ramp at 1357. I was instructed to taxi to runway 32, and I turned the aircraft to the left. I could not see the yellow taxi-line, so I turned slightly to the right, attempting to see the taxi-line. I saw the line very dimly through the heavy ice fog. While I was concentrating heavily on following the line, the tower advised me to go on to the east-west taxiway. I thought I saw the taxiway on my right and turned to the right onto it. The visibility was so poor that it was difficult to see the taxiway markings. I continued to taxi, and my copilot [the first officer] confirmed that the north-south taxiway was to the right. At that time, we informed the tower that we were entering the east-west taxiway. The tower then instructed us to hold short on 32 holding point. We thought runway 32 was to the right of the aircraft. The tower then told us to taxi into position and hold. I turned right, entered runway 32, and stopped. Due to the poor visibility, I felt unsure that the aircraft was on the correct runway. I looked for identifying markings, but could not see any. I discussed this with my copilot who felt sure that we were

on the correct runway. After 3-4 minutes of discussion, I considered taking runway 6R because of my uncertainty. However, the runway size and lighting appeared to be correct, so I decided to take off. I asked for clearance. I received clearance, and started to take off. 6-7 seconds after beginning my take-off, I saw the other aircraft directly in front to me. I knew that a head-on collision would be fatal for the people aboard both planes, so I turned slightly to the left and lifted the nose of my aircraft. A moment later, I felt and heard the crash. . . .

The captain also stated that the pretakeoff checklist was completed before the start of the takeoff roll.

The first officer of KAL 084 stated in part:

. . . .requested taxiing instructions. Ground control gave us a choice between runway 32 and runway 6R. After the captain and I discussed the choice, we decided on runway 32, and informed ground control of our decision. Ground control agreed and suggested that we switch from ground frequency to tower frequency. The tower instructed us to tell them when we entered the east-west taxiway. In spite of poor visibility, our aircraft advanced and was able to get onto the east-west taxiway. We notified the tower of our position, and the tower told us to hold short on 32 holding point. We held short and asked clearance for takeoff. After checking power and going through the checklist, we advised the tower that we were rolling. The tower responded, "Roger," so we released the brakes and started to roll. When the aircraft's speed reached about V1, I caught sight of a small aircraft about 15 meters in front of us and almost instantly heard and felt the crash. . . .

It seems that I lost my sense of direction due to the heavy ice fog, and I confused the east-west taxiway with the north-south taxiway.

Interviews with the crewmembers of KAL 084 substantiated their statements and did not reveal any physiological or psychological problem that would have affected their abilities to successfully complete the flight.

1.2 Injuries to Persons

SouthCentral Air Flight 59

Injuries	Crew	Passengers	Others	Total
Fatal/Serious	0	0	0	0
Minor	0	3	0	3
None	1	5	0	6
Total	1	8	0	9

Korean Air Lines Flight 084

Injuries	Crew	Passengers	Others	Total
Fatal	0	0	0	0
Serious	3	0	0	3
Minor/None	0	0	0	0
Total	3	0	0	3

1.3 Damage to Aircraft

The SouthCentral Air Piper PA-31-350 was destroyed by the collision impact forces. The Korean Air Lines DC-10-30 was destroyed by the collision impact forces, postcollision impact forces, and postcrash fire.

1.4 Other Damage

There was extensive damage to the runway 6L approach lighting system.

1.5 Personnel Information

The flightcrews of both airplanes were properly certificated and qualified for their respective flights. (See appendix B.)

On December 22, 1983, the day preceding the accident, the pilot of SCA 59 was on duty from 0500 to 1630, a total of 11.5 duty hours. He flew 5 hours during this period. On December 21, 1983, he was off duty for the entire 24 hours. He reported for duty at 0700 on December 23, 1983, and had flown 2 hours 30 minutes before the accident occurred.

The captain of KAL 084 had logged flights into and out of Anchorage International Airport over a period of 8 years 6 months. During this period he had logged 73 landings and 78 takeoffs from Anchorage. On November 16, 1983, he was pilot-in-command of KAL 018 from Kimpo International Airport, Seoul, Republic of Korea, to Anchorage, and logged 7 hours 38 minutes. He remained on the ground for 48 hours 16 minutes and departed for Los Angeles as pilot-in-command of KAL 084, aboard HL7339 (the accident airplane), on November 18, 1983, flying 4 hours 34 minutes. The captain of KAL 084 again piloted HL 7339 on December 8, 1983, on a flight from Anchorage to Los Angeles, logging 4 hours 43 minutes.

The captain of KAL 084 was the pilot-in-command of KAL 501 from Bangkok, Thailand, to Abu Dhabi, United Arab Emirates, on December 17, 1983. He logged 6 hours 47 minutes on this trip. On December 19, 1983, he was the pilot-in-command of KAL 502 on a flight from Abu Dhabi to Seoul. He logged 10 hours 30 minutes on this trip. These two trips represent the most recent flights flown by the pilot before the accident.

The first officer of KAL 084 had operated into and out of Anchorage for a period of 3 years 9 months. During this time, he logged 66 landings and 66 takeoffs from Anchorage.

The flight engineer of KAL 084 had operated into and out of Anchorage for 2 months before the accident. During that time he logged 6 landings and 5 takeoffs from Anchorage.

On December 22, 1983, the captain and the other crewmembers of KAL 084 were nonrevenue passengers on a direct flight from Seoul to Anchorage. The flight took 7 hours 19 minutes. They were off duty for 29 hours 45 minutes before reporting for the scheduled cargo flight from Anchorage to Los Angeles on December 23, 1983. Korean Air Lines provides layover quarters for its crewmembers in Anchorage. The hotel staff, food, ambience, and decor are Korean to create a familiar environment for the crews.

1.6 Aircraft Information

The PA-31-350, N35206, was of United States registry. The DC-10-30, HL7339, was of Korean registry. Both airplanes were certificated, equipped, and maintained in accordance with applicable Federal Aviation Administration (FAA) and Korean Civil Aviation Bureau requirements. (See appendix C.)

The maximum ramp weight for the PA-31-350 is 7,045 pounds. The maximum gross takeoff weight (GTO) is 7,000 pounds with a forward center of gravity (CG) limit of 126 percent mean aerodynamic chord (MAC) and a rear CG limit of 135 percent MAC. For the flight on December 23, 1983, N35206 weighed 6,568 pounds and the CG was 130.2 percent MAC. The pilot's seat was occupied by the pilot. Seat Nos. 3, 5, 7, and 9 behind the pilot's seat were occupied by passengers. The copilot seat and seats Nos. 6, 8, and 10 behind the copilot seat were occupied by passengers. Seat No. 4 behind the copilot seat was unoccupied.

The estimated takeoff gross weight (TOGW) for HL7339 was 502,760 pounds. The cargo weight was 145,260 pounds. The computed CG was 20.9 percent MAC. According to performance charts, based on the TOGW, the temperature of 15 degrees F., and the field elevation of 144 feet, the runway length required for takeoff was 8,150 feet.

1.7 Meteorological Information

The surface weather observations for Anchorage International Airport on the day of the accident were, in part, as follows:

1254: Indefinite ceiling 0 feet--sky obscured; visibility--1/8 mile; fog; temperature--13° F; dew point--7° F; wind 120° at 3 knots; altimeter setting--31.07 inches of Hg; runway 6R visual range--800 feet variable 1,200 feet.

1350: Indefinite ceiling 0 feet--sky obscured; visibility--1/8 mile; fog; temperature--15° F; wind—150° at 3 knots; altimeter setting--31.06 inches of Hg; runway 6R visual range--800 feet variable 1,200 feet.

1415: Indefinite ceiling 0 feet--sky obscured; visibility--1/16 mile, fog; temperature--14° F; dew point--10° F; wind--050° at 03 knots; altimeter setting 31.06 inches of Hg; runway 6R visual range--1,000 feet variable 1,600 feet.

The point of observation is the west end of runway 06L.

Surface weather observations at the airport were made by weather observers employed by Northern Weather Service. These observers were certified by the National Weather Service to take weather observations. The observer on duty at the time of the accident stated:

> During the entire morning and early afternoon we observed widespread heavy fog with visibility conditions varying from 1/16 mile to 1 mile. Runway 6R RVR conditions varied from 6,000 feet to as low as 800 feet and the sky conditions varied from thin obscured to totally obscured during the same time period. At the time I was notified of the accident, the weather conditions were: sky conditions totally obscured, visibility

1/16 mile in fog, wind 050° at 3 knots, and runway 6R RVR reading was 1,000 feet variable to 1,600 feet. The visibility and sky conditions were uniform in all directions from the observation point.

1.8 Aids to Navigation

There were no reported difficulties with the navigational aids.

1.9 Communications

There were no reported difficulties with communications. The pilots of both airplanes were on the same radio frequency (local control) at the time of the collision.

1.10 Aerodrome Information

Anchorage International Airport is located 5 miles southwest of Anchorage at latitude 61°10' N and longitude 149°59' W. The field elevation is 144 feet, and the magnetic variation is 24.9 degrees east. The landing area consists of three runways: runway 6R/24L, runway 6L/24R, and runway 14/32.

Runway 6R/24L is asphalt-surfaced and is 10,897 feet long and 150 feet wide. Runway 6R is the primary instrument runway and has six instrument approaches.

Runway 6L/24R is asphalt-surfaced and is 10,600 feet long and 200 feet wide. A safety area extends westward for 200 feet beyond the threshold of runway 6L. The magnetic heading for runway 24R is 244.9 degrees. Runway 24R is equipped with high-intensity runway edge lights (HIRL), runway end identifier lights (REIL), and visual approach slope indicator (VASI). Runway 6L is equipped with a simplified short approach light system with runway alignment indicator lights (SSALR), HIRL, REIL, VASI and RVR predicated on the midfield RVR for runway 6R/24L. Due to sharply descending terrain immediately beyond the 200-foot-long safety area, the approach lights were installed on steel towers up to approximately 30 feet tall. The pavement is old (originally constructed about 1949) with a rough surface and is weight restricted when the ground is not frozen to aircraft weighing no more than 12,500 pounds. The runway is used primarily for light aircraft departures and arrivals. The runway has all-weather, white painted runway markings. Unlighted distance-remaining markers are installed along the side of the runway. The distance from the intersection of runway 6L/24R and taxiway W-1, where KAL 084 began its takeoff roll, to the departure end of runway 24R is 2,400 feet.

Runway 14/32 is asphalt-surfaced and is 10,496 feet long and 150 feet wide. The magnetic heading of runway 32 is 319.9 degrees. Runway 32 is equipped with HIRL, REIL, and VASI. The runway has all-weather, white painted runway markings. There is no published instrument approach procedure for runway 14/32. The threshold lights for runway 32 are embedded in the pavement. There are two published instrument departure procedures for runway 32, and the runway is used primarily for heavy aircraft departures.

All the taxiways are equipped with standard taxiway edge lights and yellow markings. Standard size 3 (12-inch-high legend on an 18-inch-high sign face) taxiway guidance and runway identifier signs as outlined in FAA Advisory Circular, Taxiway Guidance Sign System were located as shown in figure 2 and displayed information as shown in figure 3. These signs had black lettering on a yellow background. The west side of the international parking apron between taxiways N-1 and N-2 was equipped with standard apron edge lighting.

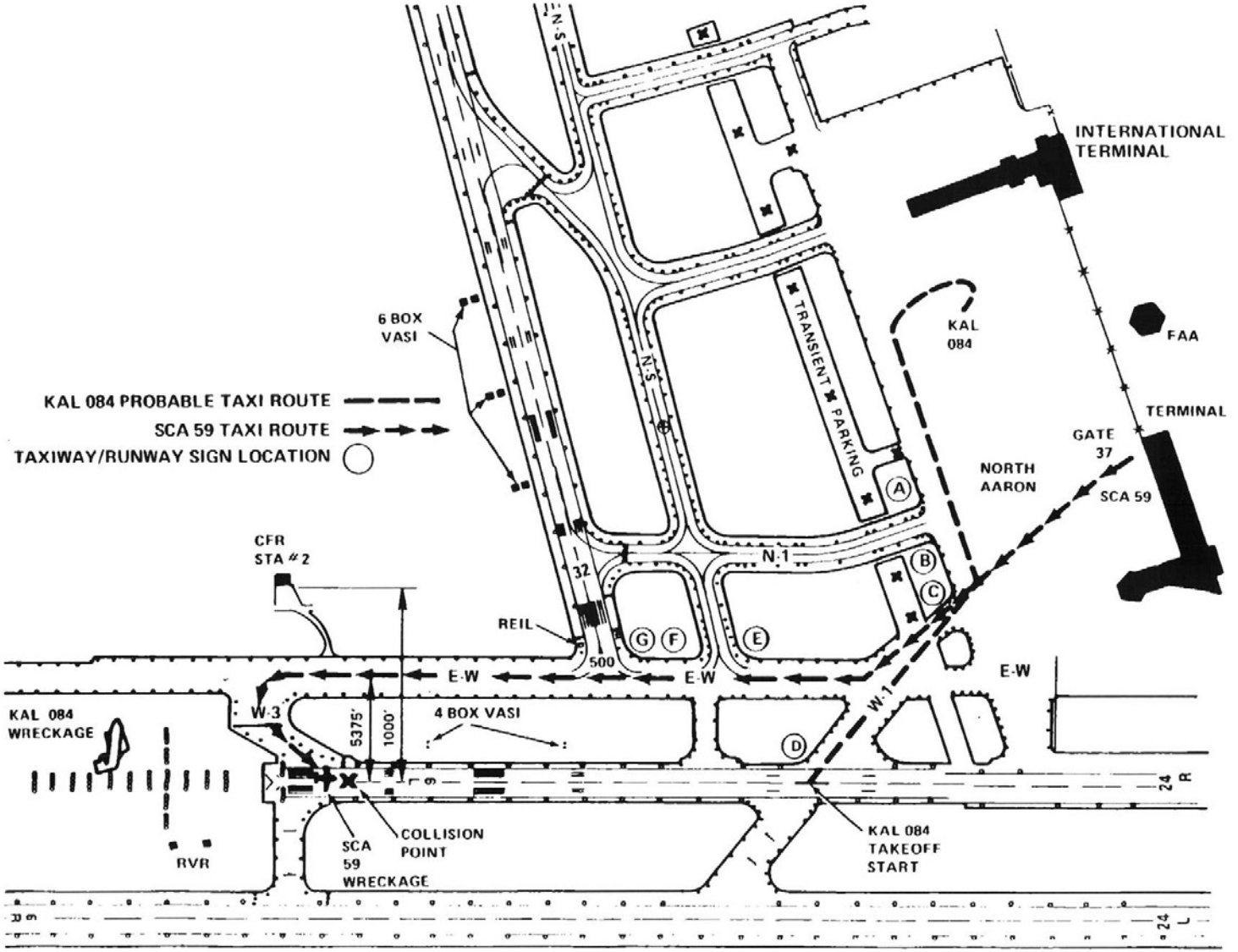

Figure 2.-Airplane taxi routes. Circled letters show locations of corresponding signs in figure 3.

Taxiway Sign Locations and Condition

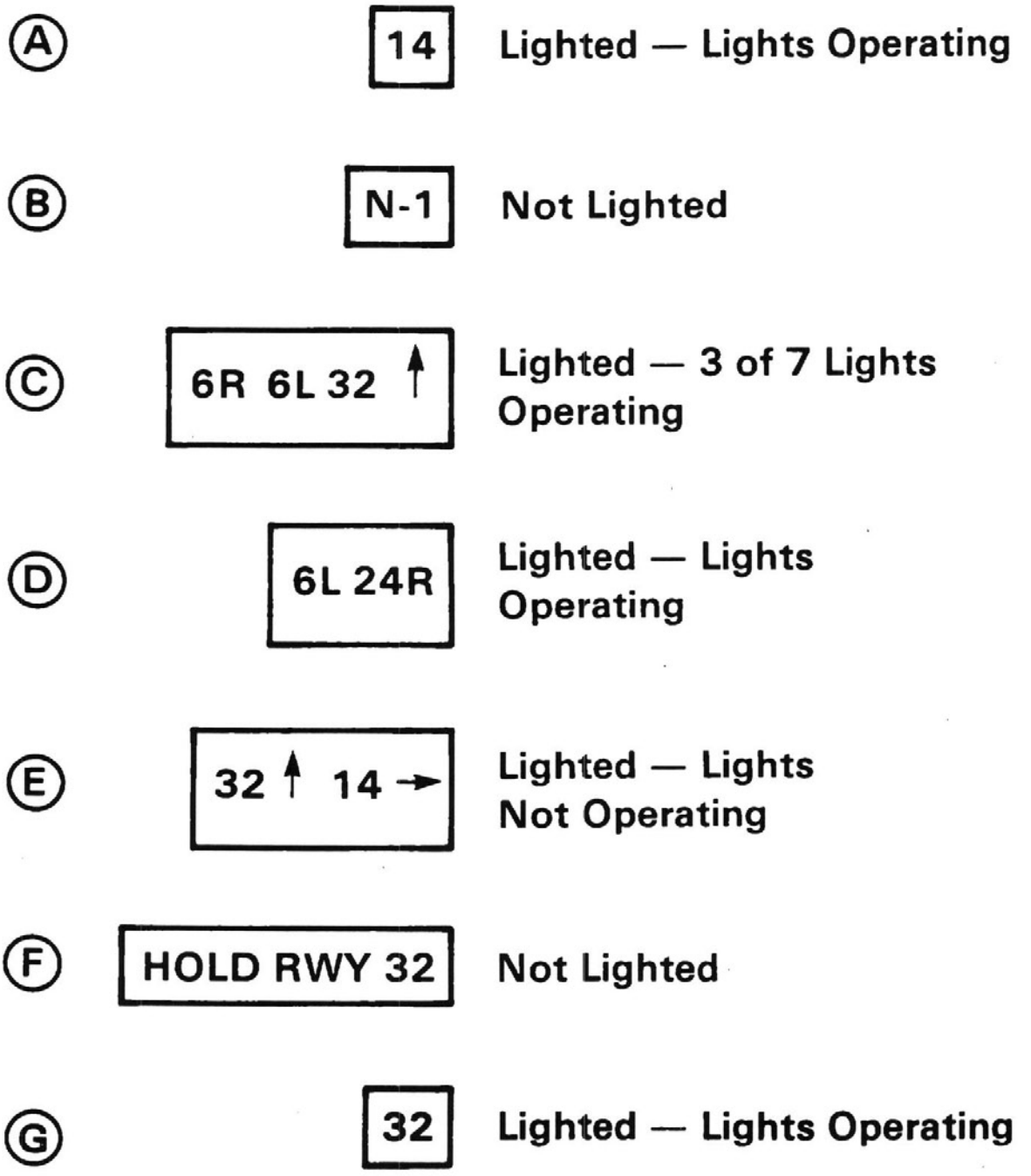

Figure 3.—Taxiway signs.

The Anchorage Terminal Radar Approach Control Facility is a level III facility 4/ equipped with airport surveillance radar 5/ and automated radar terminal service. 6/ The air traffic control tower is equipped with a BRITE IV 7/ display. Transmissometers 8/ are located north of the touchdown zone for runway 6R, near midfield abeam taxiway W-3, and south of the touchdown zone for runway 24L.

1.11 Flight Recorders

The PA-31-350 was not equipped with a cockpit voice recorder or a flight data recorder, and neither was required.

The remains of the digital flight data recorder were recovered from the DC-10-30 and brought to the Safety Board's laboratory for examination and readout. The cockpit voice recorder was not recovered. The digital flight data recorder had sustained significant heat damage, but the recording tape was removed, cleaned, and mounted for playback. The entire 25 hours of recorded data were examined; however, no data could be found pertaining to the accident flight. The maintenance records revealed that the recorder had failed on the inbound flight from Seoul and that corrective action by KAL at Anchorage was to remove, remount, and operationally check the recorder as satisfactory on the ground. All indications are that the recorder was not operating during the accident sequence.

1.12 Wreckage and Impact Information

The accident site was Anchorage International Airport. The collision occurred at the departure end of runway 24R. The runway was covered by a thin layer of snow, frost, and ice, and there were about 30 inches of snow on the airport infield area.

PA-31-350.—The PA-31-350 was pushed backwards about 125 feet by the collision and came to rest about 380 feet from the runway 6L threshold identification lights. (See figure 4.) The fuselage of the airplane was aligned with runway 6L. The airplane was resting on the left main gear, nose gear, and aft portion of the fuselage. The right cockpit windshield was cracked through on the right side and the upper section was missing. The top of the fuselage on the right side was creased and caved inward from the windshield attachment area aft to the side window rear post. There were black marks on the dented area.

4/ A radar approach control facility which handles an average of 20 to 59 hourly operations between 0700 and 2300 local time for the 183 busiest traffic days of the year.
5/ Search radar which provides azimuth and range information at lower levels of flight within approximately a 50-mile radius of the airport.
6/ An automated system of terminal air traffic control which provides flight data processing and radar data processing capability. The radar controller's operating position will display alphanumeric data associated with the secondary radar target.
7/ Bright Radar Indicator Tower Equipment allows viewing of radar indicators under bright sunlight or high ambient lighting conditions. BRITE radar units are 16-inch television-type radar displays of sufficient brightness, contrast, and resolution for use in the extremely high and variable light levels normally encountered in control tower cabs.
8/ A transmissometer is an apparatus used to determine visibility by measuring the transmission of light through the atmosphere. It is the measurement source for determining runway visual range (RVR) and runway visibility value (RVV).

Figure 4.—Wreckage of SouthCentral Air Piper PA-31-350, N35206.

The right wing of the PA-31-350 was sheared from the fuselage at the wing root. All portions of the right wing, right engine and propeller, and right main landing gear were located and identified. The left wing was separated just outboard of the left engine nacelle. The left engine and associated propeller remained attached to the nacelle structure. A large section of engine cowling remained partially attached to the nacelle lower structure. One of the three propeller blade tips was bent in the aft direction. The wing span of the PA-31-350 is 40 feet 8 inches. The distance from the sheared right wing root to just outside of the left engine nacelle is about 10 feet 6 inches. The upper half of the vertical stabilizer was torn away. The upper portion of the rudder also was torn away but remained attached to the vertical stabilizer at its lower attachment point. The horizontal stabilizer remained intact and attached to the fuselage structure. Both sections of the horizontal stabilizer and associated elevator assembly tip were bent aft. There was no indication of any preaccident malfunction of the airplane's structure, systems, powerplants, or flight control system.

DC-10-30.—The DC-10-30 continued straight off the departure end of runway 24R, smashed through seven nonfrangible, high-intensity approach lighting towers, slewed after impact to the right, and came to rest 1,434 feet from the end of the runway 40 feet north of the extended centerline. (See figure 5.) The airplane fuselage was centered on a heading of 330°. The nose, right, left, and body main landing gear were separated from the airplane. The as-built distance between the centerlines of the right and left main landing gear was 35 feet. The main body gear were located at the fuselage centerline in line with the right and left main gear. The distance from the nose gear to the main landing gear is 72 feet 5 inches.

Figure 5.—Wreckage of Korean Air Lines DC-10-30, HL7339.

The nose radome was torn away. The cockpit separated from the fuselage just aft of the first right exit door and was angled downward and slightly twisted to the right. The main cabin structure above the floor line from the cockpit section back to the aft pressure bulkhead was gutted and had been consumed by postcrash fire. The empennage section had separated just forward of the aft pressure bulkhead and was angled downward to the left. The left horizontal stabilizer was crushed and bent upward at midpoint. The right horizontal stabilizer was attached with no evidence of damage.

The right wing remained attached to the airplane; it had been subjected to intense postcrash fire. The outboard half of the wing structure had been consumed by fire. The trailing edge flaps had separated from the wing structure and were found along the wreckage path. An inboard leading edge slat remained attached to the right wing; it was in the extended position. The left wing remained attached to the airplane; it had been subjected to severe ground impact forces. Sections of the wing's leading edge slats and trailing edge flaps were recovered along the wreckage path.

The left engine remained attached to its wing structure. The center engine remained within the empennage structure. The right engine had separated from the right wing and was recovered along the wreckage path. There was no indication of any preaccident malfunction of the airplane's structure, systems, powerplants, or flight control system.

1.13 Medical and Pathological Information

The KAL 084 crewmembers were seriously injured during the accident sequence, suffering compression fractures of the spine, fractures, contusions, and cuts. They were hospitalized for about 2 weeks and released. The results of toxicological examination of blood samples taken from the three crewmembers were negative for alcohol, drugs, and carbon monoxide. A medical examination immediately after the accident did not reveal any physiological condition which may have affected their performance.

Of the nine persons aboard SCA 59, three were slightly injured. These persons and the pilot were examined and treated in a hospital emergency room and released.

1.14 Fire

The PA-31-350 did not burn. The DC-10-30 burst into flames immediately after coming to a stop when some of its fuel tanks were ruptured. Although the initial fire was contained, the fire reignited periodically for 3 days after the accident, and the fuselage above the cabin floor and most of the cargo were consumed by fire.

1.15 Survival Aspects

The accident was survivable since neither the cockpit nor cabin areas of either airplane was penetrated and the decelerative forces of the collision were not excessive.

1.16 Tests and Research

1.16.1 Airport Survey

On December 26, 1983, Safety Board accident team investigators inspected the runways and taxiways believed to have been associated with the accident. There had been no precipitation or above-freezing tempertures at Anchorage since the accident. The surface of runway 6L/24R was covered with a thin layer (up to 1/2-inch thick) of a combination of snow, frost, and ice, which obliterated the white, all-weather runway markings. Runway 14/32 was covered with a thin layer of snow, frost, and ice; however, the runway markings were visible for the first 1,000 feet of runway 32 due to large turbojet airplanes blowing away and clearing the frost and snow from the center portion of the runway.

Taxiways W-1, W-2, and N-1 also were covered with a thin layer of snow, frost, and ice at the time of the inspection. No taxiway surface markings were visible through the snow, frost, and ice. The parking apron surfaces of the airport also were covered with a thin layer of snow, frost, and ice, rendering most markings invisible.

All runway, taxiway, and apron edge lighting in the area of movement of the two airplanes involved in the accident was operating normally at the time of the inspection. The signs identifying runways and taxiways were found in the following condition (see figures 2 and 3):

a. Runway 14 - lighted; all lights operating
b. Taxiway N-1 - not lighted
c. Runways 6R, 6L/32 - lighted; three of seven lights operating
d. Runway 6L/24R - lighted; all lights operating
e. Runway 32/14 - lighted; no lights operating
f. Hold runway 32 - not lighted
g. Runway 32 - lighted; all lights operating

The sign designating runway 6L/24R was dirty, which reduced the contrast between its background and lettering.

The most recent airport certification inspection at the airport was completed on December 2, 1983. No violations of 14 CFR Part 139 were noted at the time with respect to the airport operating surfaces, although it was noted that markings on all runways were faded. All runway markings at the airport were last painted white during the summer of 1983.

Conversion of the nonfrangible approach light towers serving runway 6L, which were destroyed in the accident, to frangible structures was planned for fiscal year 1985 according to the most recent Alaskan Region Ten Year Plan issued by the FAA.

The Anchorage air traffic control tower is not equipped with airport surface detecting equipment (ASDE). ASDE is radar equipment specifically designed to detect all principal features on the surface of an airport including aircraft and vehicular traffic and to present the entire image on a radar indicator console in the control tower. This equipment is used to augment visual observation by tower personnel of aircraft and/or vehicular movements on runways and taxiways. Criteria for installation of ASDE at an airport is based upon aircraft movements and meteorological data. The FAA is planning to purchase 29 state-of-the-art ASDE. Specifications are to be completed in September 1984, and the first delivery is expected in March 1988. Twelve of the ASDE's will replace existing facilities, and 17 will be new installations. The ASDE that was installed at the FAA Technical Center in Oklahoma City is being moved to Anchorage and is planned to be in place and operational by the end of 1984.

1.16.2 Taxi Route of KAL 084

SCA 59 arrived at the intersection of runway 6L and taxiway W-3 at 1344. KAL 084 started to taxi at 1355, 11 minutes after SCA 59 had completed taxiing. The Safety Board investigation team examined possible taxi routes used by KAL 084 to determine which route was most likely used. A transcript of recorded communications between Anchorage tower controllers and the pilots of both airplanes was zero-timed to the start of KAL 084's taxi. (See appendix D.) A SouthCentral Air Piper T1040 turboprop airplane was used and was taxiied at a speed comparable to that of observed heavy turbojet aircraft. The transcript was read aloud as the airplane taxied from the parking ramp to the intersection of runway 6L/24R and taxiway W-1 and to runway 32 by various routes. A VHS audio and video record was made by the team member who occupied the copilot seat. The best correlations of time and position were accomplished using the following route (see figure 2):

1. A left turn of about 240° from the parking spot on the International Satellite Terminal apron to a southerly heading along the west edge of the parking apron. Timing started at 1357:40 when KAL 084 confirmed taxi instructions.

2. Taxi south on the apron and turning about 60° right onto taxiway W-1. Turn initiated at time (1401:45) corresponding to transmission from KAL 084 stating that it was entering the east-west taxiway.

3. Taxi southwest on taxiway W-1 crossing the east-west taxiway and stopping at the intersection of runway 6L/24R and taxiway W-1. The time (1402:42) the east-west taxiway was crossed corresponded to the time when KAL 084 transmitted that it was taxiing to the hold point on the east-west taxiway.

4. Turning about 50° right onto runway 24R and stopping near the center of the runway. Taxi onto the runway corresponded to the transmission time (1402:57) of KAL 084's acknowledgement of clearance to taxi onto the runway. A transmission from KAL 084, 3 minutes 21 seconds later, stated that the airplane was rolling.

1.17 Additional Information

1.17.1 Accident History

There were four air carrier accidents worldwide between December 7 and 23, 1983, involving collisions on active runways, including the KAL 084/SCA 59 accident.

On December 7, 1983, an Iberia Air Lines Boeing 727 collided with an Aviaco Airlines McDonnell Douglas DC-9 while taking off on runway 33 at Barajas Airport, Madrid, Spain. The DC-9 pilot had been cleared to taxi to runway 01. All 42 persons aboard the DC-9 and 73 of the 93 persons aboard the Boeing 727 were killed. Both airplanes were damaged. There was a dense fog covering the airport at the time of the accident.

On December 19, 1983, a Japan Air Lines Boeing 747 was cleared to land on Runway 6R at Anchorage International Airport at the same time an airport vehicle was on the runway taking runway friction measurements. The flightcrew did not see the truck in the restricted visibility conditions and struck the truck from the rear during the landing rollout. The driver of the truck survived but required amputation of both legs. The Boeing 747 incurred minor damage, but the truck was demolished.

On December 20, 1983, an Ozark Air Lines DC-9 struck a snow sweeper while landing on runway 21 at Sioux Falls, South Dakota. The collision broke the right wing off the airplane 10 feet from the fuselage. There was an initial fireball at impact, but the airplane spun around 180 degrees and the fire extinguished itself as the airplane proceeded backward down the runway. The snow sweeper was destroyed, and the driver was fatally injured. No one among the crew or 77 passengers onboard the DC-9 was injured. The weather was 1,000 feet obscured ceiling with 1 mile visibility in snow.

1.17.2 Runway Incursions

The Eighth Quarterly Report, issued October 1978, of the Aviation Safety Reporting System (ASRS) of the National Aeronautics and Space Administration (NASA) contains an article entitled "Human Factors Associated with Runway Incursions." A study of 165 incidents was conducted to focus on the behavioral aspects of potential and actual runway conflicts on controlled airports. There were 41 conflict occurrences involving multiple air transport airplanes. The person believed to have been most responsible for the incident was the air traffic controller in 54 percent of the incidents, the pilot in 39 percent of the incidents, and the operator of a ground vehicle in 4 percent of the incidents. Three percent of the incidents could not be categorized.

One incident involved a collision (wing tip with motor vehicle), 37 involved near collisions, and 50 involved less than safe separation. In 47 cases, the problem was recognized before a conflict occurred. There was no actual or threatened conflict in 30 cases, because no other aircraft or vehicle was in the vicinity. Either one or both aircraft was in either the hold, taxi, or takeoff phase of flight in 88 percent of the incidents. Disorientation or confusion accounted for 21 percent of the pilot-responsible incidents. There were factors of cockpit coordination in 11 percent and of pilot technique in 43 percent of the pilot-responsible incidents. Airport lighting and markings were factors in 4 percent of the incidents, and weather was involved in 4 percent of the incidents.

1.17.3 Operation of Foreign Air Carriers in the United States

Title 14 CFR Part 129, Operations of Foreign Air Carriers, describes rules governing the operation within the United States of each foreign air carrier holding a permit issued by the Civil Aeronautics Board (CAB) or appropriate economic or exemption authority. Each foreign air carrier is to conduct its operations within the United States in accordance with operating specifications issued by the FAA. Applications for the issuance (or amendment) of operating specifications must be submitted at least 30 days before beginning operations in the United States. Aircraft operated by foreign air carriers must have a current registration and airworthiness certificate issued or validated by the country of registry and must have registration marks of that country.

Part 129 states that no person may act as a flight crewmember unless he holds a current certificate or license issued or validated by the country in which the aircraft is registered, showing his ability to perform duties connected with operating that aircraft. Each foreign air carrier is to equip its aircraft with radio equipment necessary to properly use the air navigation facilities and to maintain communications with ground stations in the United States. Each pilot must be familiar with the applicable rules and procedures of the areas traversed by him in the United States and be checked on those procedures by the foreign air carrier. Each foreign air carrier is to conform to the practices, procedures, and other requirements prescribed for United States air carriers for the areas to be operated in.

These requirements are in compliance with provisions to the International Civil Aviation Organization (ICAO) agreements pertaining to international air commerce. The United States and the Republic of Korea are signatories of these agreements. Article 37 of the Chicago Convention agreement states that each contracting state will undertake to collaborate in securing the highest practicable degree of uniformity in regulations, standards, procedures, and organization in relation to aircraft, personnel, airways, and services in matters which such uniformity will facilitate and improve air navigation. To this end, ICAO may adopt and amend from time to time international standards and recommended practices and procedures dealing with:

a. Communications systems and air navigation aids, including ground markings;
b. Characteristics of airports and landing areas;
c. Rules of air and air traffic control practices;
d. Licensing of operating and mechanical personnel;
e. Airworthiness of aircraft;
* * *
i. Aeronautical maps and charts;
* * *
k. Aircraft in distress and investigation of accidents;

and such other matters concerning the safety, regularity, and efficiency of air navigation as may appear appropriate.

Responsibility for compliance with the provisions of the ICAO agreement rests with the state of registry. Infractions of the agreements may be referred to the Air Navigation Committee of ICAO; however, member states do not have the right to inspect or regulate the operations of the international air carriers of other member states.

Title 14 CFR Part 213, Terms, Conditions and Limitations of Foreign Air Carrier Permits, and Part 375, Navigation of Foreign Civil Aircraft Within the United States, promulgated by the CAB, regulate foreign air carrier service in the United States and comply with FAA and ICAO directives.

2. ANALYSIS

2.1 General

Both airplanes were certificated and maintained in accordance with approved procedures. There was no evidence of preaccident failure or malfunction of either airplane's structures, systems, powerplants, or flight control systems, with the exception of the digital flight data recorder on KAL 084. The pilot of SCA 59 was properly certificated and qualified for this scheduled domestic passenger flight and his actions did not contribute to the accident. The flightcrew of KAL 084 were certificated and qualified for this scheduled international cargo flight. All of the involved flightcrew members held current medical certificates.

2.2 Weather

The surface visibility at Anchorage International Airport was restricted, as evidenced by the 1350 surface observation which reported 1/8 mile visibility and the 1415 observation which reported 1/16 mile visibility. The local controller advised SCA 59 that the RVR was 1,000 feet at 1344:18, and the RVR did not improve to 1,800 feet until 1405:28, at which time SCA 59 was cleared to taxi into position and to hold on runway 6L. An RVR of 1,800 feet was the minimum takeoff visibility for the pilot of SCA 59.

The captain of KAL 084 stated that, after he began taxiing from the parking ramp, he could see the yellow taxi lines "very dimly through the heavy ice fog." He described the visibility as "so poor that it was difficult to see the taxiway markings." After the accident, the first officer of KAL 084 concluded a written statement as follows: "It seems that I lost my sense of direction due to the heavy ice fog, and I confused the east-west taxiway with the north-south taxiway."

The restricted visibility caused the flightcrew of KAL 084 to experience difficulties while operating on the taxiways and runways at Anchorage International Airport and adversely affected their operational performance.

2.3 Collision Analysis

According to applicable performance charts, based on the estimated TOGW of 502,760 pounds, the temperature of 15 degrees F., and the field elevation of 144 feet, the departure runway length required for KAL 084 was 8,150 feet. The distance from the intersection of runway 6L/24R and taxiway W-1, where KAL 084 began its takeoff roll, to the departure end of runway 24R is 2,400 feet. Based on these data, it can be concluded that the attempted takeoff by the KAL 084 flightcrew would not have been successful even if their takeoff run had not been interrupted by the collision with SCA 59.

KAL 084 was equipped with three main gears, one being a centered body gear. Given the dimensions of both airplanes, and the impact marks on SCA 59, it appears that the nose gear of KAL 084 struck SCA 59 on the right windscreen at the top and grazed the skin of the right fuselage over the cockpit, missed the remainder of the fuselage, and struck the vertical stabilizer. As the captain of KAL 084 turned left to miss SCA 59, the main body gear swung to the right and struck the left wing of SCA 59, knocking the wing off outboard of the engine nacelle. The left main gear of KAL 084 struck the right wing of SCA 59 in the area of the engine and sheared off the wing at the wing root, and continued back and struck the right horizontal stabilizer of SCA 59. As a result, while the wings and vertical stabilizer were separated, the fuselage of SCA 59 remained intact and

the passengers suffered no serious injuries. If the captain of KAL 084 had failed to take these actions, either the nose gear or the center main body gear of KAL 084, or both, might have struck the fuselage of the smaller airplane and probably would have resulted in fatalities aboard SCA 59 and possibly aboard KAL 084.

2.4 KAL 084 Flightcrew Operational Factors

The KAL 084 crewmembers were experienced in operating the DC-10; the captain had logged over 6,000 hours in the airplane and the first officer almost 3,000 hours. Additionally, the captain and first officer were experienced in operating at Anchorage International Airport. The captain had logged 73 landings and 78 takeoffs from the airport in an 8 1/2-year period prior to the accident, and the first officer had logged 66 landings and 66 takeoffs in a 3 3/4-year period.

The captain's decision to use runway 32 for departure was not in accordance with KAL operating specifications. A prevailing visibility of 1/4 mile was required and the prevailing visibility at the time of the accident was 1/8 mile. The RVR readings for runway 6R were above minimums and the capain should have selected that runway for departure. While the captain's decision did not directly bear on the accident since he attempted takeoff on a runway other than the runway to which he was cleared, it was an operational deficiency and indicates performance not in keeping with that expected of an air carrier captain.

The Safety Board cannot determine precisely the procedures the KAL crew used while taxiing since the cockpit voice recorder was not recovered. Anchorage ground control cleared KAL 084 to taxi to runway 32 and asked the flightcrew to report entering the east-west taxiway. The captain stated that while taxiing, he attempted to keep the airplane centered on the yellow taxi line but because of snow and ice ground cover and the reduced visibility, he could not positively identify his location on the airport once the airplane left the cargo ramp. The captain stated that he turned the aircraft right from the north apron to what he and the first officer believed was the east-west taxiway. The Safety Board believes that the crew actually turned, not about 100° to the right which would have turned them onto the east-west taxiway, but about 60° right or to taxiway W-1. From there, the captain later turned the airplane about 50° right, instead of about 90°, to what the flightcrew believed was runway 32, but to what was, in fact, runway 24R. The taxi tests strongly support this as the most likely taxi route.

Because of the large size of the DC-10-30, which may distort the pilot's sense of motion and the restricted surface visibility, the Safety Board believes that the captain of KAL 084 could have experienced difficulty in distinguishing between the turn of 60° instead of 100° or the turn of 50° instead of 90° while taxiing slowly and straining to see the taxiway and runway markings, since outside visual cues were limited. It is difficult to understand, however, why the captain and first officer, following some discussion about runway uncertainty, did not use their directional gyros or the standby compass to orient themselves with regard to headings, especially after they had aligned the airplane with what they believed was runway 32 and had discussed it for 2 to 3 minutes. If any one of the flightcrew had checked the heading indicators, it should have been apparent before the takeoff roll that the airplane was positioned on the wrong runway. The KAL checklist did not require a pretakeoff heading check; however, other airline checklists require pretakeoff runway confirmation and accepted practice is to check heading indicators before starting takeoff.

The first officer's statement concerning the sighting of SCA 59—"when the aircraft's speed reached about V1, I caught sight of a small aircraft about 15 meters in front of us . . ."—was most likely inaccurate and may further indicate some degree of misperception on his part. The airspeed would have been about 100 knots at that point, well below V1, and the accurate judgment of distances in those circumstances would have been difficult. These comments were another indication of misperception by the first officer.

The primary sources of information that are ordinarily available to crewmembers for guidance on airport surfaces were either partially or completely unavailable to the crew of KAL 084. At nighttime or under limited visibility conditions, crewmembers rely on runway surface markings such as taxiway lines and runway numbers, taxiway and runway lights, and runway and taxiway signs to provide them with information concerning their location on the airport. If the visibility is adequate, or if the airport is equipped with ASDE, ground controllers can assist the aircraft crewmembers by providing information on their location. The flightcrew of KAL 084 operated essentially without external information to assist them while taxiing since the visibility was restricted and the airport did not have ASDE.

2.5 KAL 084 Flightcrew Medical and Behavioral Factors

The medical examination of the KAL 084 crewmembers immediately after the accident and the toxicological testing of blood samples did not reveal any physiological condition which might have affected their performance. Each crewmember was well rested before the flight, having been off duty for over 29 hours prior to the scheduled departure time. The crewmembers were housed in facilities operated by Korean Air Lines for employees laying over in Anchorage to insure that crewmembers rest in an undisturbed environment with Korean food and a familiar atmosphere. The performance of the crewmembers cannot be attributed to fatigue resulting from excessive duty time or to stress created by unfamiliar surroundings. Similarly, interviews with the crew and their statements did not reveal any significant event in their lives that may have caused them stress or tension or affected their decisionmaking abilities. The flight was not significantly delayed, nor was the crew facing an imminent deadline for completing the flight, such as deteriorating weather at destination, curfews, or excessive duty time.

From the response of the captain of KAL 084 to questioning, the Safety Board could not determine why an experienced crew, such as this crew, did not verify whether they were on the correct runway by checking their heading instruments. The Safety Board could not find any factor which may have adversely affected the crew's vision, coordination, or decisionmaking capabilities to determine that their heading was 80° from the correct runway bearing. The failure of the crew to verify the runway heading may indicate that the initial or recurrent training the crew received or the operating procedures established for KAL crewmembers are deficient. It may be that verification of runway heading is such a rudimentary procedure that the air carrier believed that specialized training was not necessary. While such a belief may have been reasonable and reflective of accepted practice, that this crew failed to carry out this basic step indicates that a deficiency which needs to be addressed may exist in air carrier crew training and certification procedures.

The Safety Board cannot explain why the captain of KAL 084 decided to take off in the face of his uncertainty as to whether his airplane was holding at runway 32. The captain stated:

> . . . I felt unsure that the aircraft was on the correct runway. . . . I discussed this with my copilot [the first officer] who felt sure that we were on the correct runway. After 3-4 minutes of discussion, I considered taking runway 6R because of my uncertainty. However, the runway size and lighting appeared to be correct so I decided to take off.

This statement indicates that the captain failed to recognize that his familiarity with the airport would not compensate for the limitations in other sources of information he would use ordinarily to confirm the aircraft's location. The captain failed to exercise proper decisionmaking responsibility by relying too heavily on the first officer's belief that the airplane was on the correct runway. Proper command procedures should have dictated to the captain not to commence takeoff without confirming that he was holding at runway 32.

The captain's statement indicates that he felt that the first officer, who had a higher level of recent experience at the airport than the captain, was more certain about the aircraft's location than the captain was. The first officer stated that, "In spite of poor visibility, our aircraft advanced and was able to get onto the east-west taxiway." The evidence indicates that KAL 084 was never on the east-west taxiway. Unlike the captain, the first officer in his statement did not manifest any uncertainty about the aircraft's location. The Safety Board believes that the first officer's strong belief about their location may have influenced the captain's decision to commence takeoff. The first officer's confidence regarding being on the correct runway in the face of the captain's uncertainties constituted a slight role reversal in that the captain's overall command authority when deciding to take off was influenced by the first officer's comments. In the past, the Safety Board has encouraged assertiveness training for first officers, to exercise their responsibilities as part of the cockpit team; however, a companion responsibility for captains to exercise positive cockpit crew management must exist. In this instance, the crew concept broke down. This breakdown may have been due to the crew's intense concentration on the airport surface markings and runway and taxiway signs in order to confirm their location. The Board believes that such a situation may lead to a breakdown in carrying out individual cockpit responsibilities unless the crewmembers have been trained to recognize and react to the situation.

Because the crew of KAL 084 commenced takeoff in spite of the uncertainty regarding their location on the airport, the Safety Board is concerned that the crew was not properly trained in ground operations in marginal meteorological conditions existing at the time. A common procedure for takeoffs in restricted visibility is for pilots to cross-check their gyro/compass heading with the runway heading prior to commencing takeoff. Crews should be trained to perform such a procedure regardless of how selfevident their position may appear to them. As a result of this accident and similar errors in air carrier ground operating procedures demonstrated by ground collision accidents at airports during restricted visibility conditions, as well as by the ASRS data, the Safety Board is concerned that flightcrews are not being adequately trained in managing cockpit resources and coordinating their responsibilities when operating in marginal ground maneuvering conditions that require intense concentration. The need for specific training in ground operation procedures for crews is especially important since there are no requirements for standardized, illuminated, and easy-to-read runway and taxiway signs at airports certificated for air carrier operations. When there is obscuration of taxiways and runways added to restricted visibility, the need for a crew that is well trained in ground operations becomes critical. It is not possible for air traffic controllers during these conditions to verify an aircraft's location on the airport, in the absence of a radar such as ASDE that tracks airport surface traffic, other than relying on the crew to accurately report their location.

2.6 Airport Signs and Environment

The demands on the crew of KAL 084 while they were taxiing were not excessive for a highly experienced crew, despite the lack of much of the information that crews usually rely on to taxi caused by the limited visibility and absence of ASDE. The Safety Board examined several of the runway and taxiway signs at the airport to determine if all of the available sources of ground location information external to the airplane were adequately presented to the KAL 084 crew. The KAL airplane passed four signs identifying runways and taxiways along the route that the Board believes it took while taxiing. One of the four signs, the sign designating taxiway N-1, was not equipped for electrical illumination. At night in restricted visibility conditions when additional guidance is most needed, such as existed at the time of this crash, this sign would provide no information or guidance to flightcrews. Another of the four signs was only partially illuminated, because only three of its seven lights were operating at the time of the accident. The other two signs, which identified runway 14 and runway 6L/24R, were illuminated.

Airports certificated under 14 CFR Part 139 are not required to have taxiway/runway guidance signs installed. However, if the signs are installed, 14 CFR 139.47(b) requires that the operator "must show that any guidance signs installed at the airport are in operable condition." For each airport certificated under 14 CFR Part 139, the FAA approves an Airport Operations Manual (AOM), which, in part, lists key elements of the airport, such as runway lights, that are required to be inspected daily to ensure that they are in operable condition. For many airports, including Anchorage International, the approved AOM does not include guidance signs in the list of key elements. Therefore, although 14 CFR 139.47(b) requires that the signs be in operable condition, the FAA has not supplied guidance to the airport operators on how or when this requirement will be met.

The Safety Board believes that as KAL 084 taxied along taxiway W-1, the crew thought that they were on the east-west taxiway, and that when they crossed the east-west taxiway, they thought it was the north-south taxiway and continued to what they believed was runway 32 but was instead runway 24R. There were no signs along this ground path to indicate, first, that the taxiway they had entered was W-1 and, second, that the first intersection they then crossed was the east-west taxiway. The crew of KAL 084 had no external source of information to designate either the taxiway they were on or the taxiway they were crossing as the airplane taxied to the intersection of taxiway W-1 and runway 6L/24R. Since the accident, signs have been installed at both intersections to designate the intersecting taxiways. The FAA should require under 14 CFR Part 139 that airport operators place appropriate runway or taxiway signs at each intersection along airport taxiways to designate either the intersecting taxiway or runway.

The crew of KAL 084 did not indicate in their statements that they saw the fully illuminated sign designating runway 6L/24R. Several factors may have contributed to the failure of the crew of KAL 084 to notice this sign, even though it was fully illuminated. The sign was dirty, which reduced the contrast between its background and lettering. Since the airport surfaces were obscured partially by snow, frost, and ice, the crew was looking intently for ground markings. Moreover, the visibility was restricted, which further limited the crew's ability to see the sign, particularly since the location of the DC-10 cockpit is about 30 feet above the ground increases the slant range from cockpit to guidance signs placed aside taxiways and runways.

Contributing to the crew's failure to notice the runway sign was that, despite the different purposes that the runway and taxiway signs serve, the signs had common shape, color, and dimensional characteristics. The runway and taxiway signs had identical amber backgrounds with black lettering. The characters on the signs were identically sized. The signs, which were the same height, differed only in their width according to the number of characters on the sign. The Safety Board is concerned that in similar situations other flightcrews or vehicle operators could inadvertently enter an active runway. Runway and taxiway intersection signs should reflect, in their sizes, shapes, colors, and dimensions, the particular route they mark; a sign identifying a taxiway intersection should have a different appearance from a sign identifying a runway, and these signs should then be installed at airports certificated under 14 CFR Part 139.

2.7 Runway Incursions

The October 1978 ASRS article concerning human factors associated with runway incursions, as well as the three subsequent accidents described earlier, substantiates problems and causal elements similar to those in this accident. While the December 19, 1983, accident at Anchorage and the collision at Sioux Falls involved air traffic control, the accident at Madrid was similar to this accident. The Aviaco Airlines DC-9 pilot did not taxi as instructed at Barajas Airport during restricted visibility conditions. While the KAL 084 crewmembers did not ignore tower instructions, the factors of crewmember disorientation, cockpit coordination, and pilot technique cited in the ASRS article were evident in this accident. Flightcrews must be especially vigilant during taxi, hold, and takeoff operations and must make extraordinary efforts if needed to stay aware of their position on the airport at all times. Crew coordination procedures should be enhanced and particular alertness should be practiced when visibility is reduced by inclement weather.

3. CONCLUSIONS

3.1 Findings

1. Both airplanes were certificated and maintained in accordance with approved procedures.

2. There was no evidence of preaccident failure or malfunction of either airplane's structures, systems, powerplants, or flight control systems.

3. The pilot of SouthCentral Air Flight 59 (SCA 59) was properly certificated and qualified for this scheduled domestic passenger flight. His actions did not contribute to the accident.

4. The flightcrew of Korean Air Lines Flight 084 (KAL 084) were properly certificated and qualified for this scheduled cargo flight.

5. The flightcrew of both airplanes involved held current medical certificates.

6. Both the captain and the first officer of KAL 084 had extensive experience operating into and out of the Anchorage International Airport, which should have reduced the probability of crew disorientation while taxiing in the low-visibility conditions.

7. The decision of KAL 084's captain to use runway 32 for departure was not in accordance with KAL operating specifications.

8. The obscuration of runway and taxiway markings at the airport adversely affected the performance of the flightcrew of KAL 084 by causing them to give disproportionate attention to locating the runway markings.

9. The most likely taxi route, taken in error, by KAL 084 was south along the west side of the north apron, right onto taxiway W-1, and right again onto runway 24R.

10. The flightcrew of KAL 084 could have determined that their airplane was lined up on the wrong runway if they had cross-checked their heading indicators.

11. Based on the estimated takeoff gross weight of KAL 084, the runway length required for takeoff was 8,150 feet. Since the actual length available to KAL 084 on runway 24R was about 2,400 feet, an accident would have resulted even if KAL 084 had not collided with SCA 59.

12. By raising the nose of his airplane and turning his airplane slightly to the left, the captain of KAL 084 avoided inflicting extensive damage to the fuselage of SCA 59 and probable fatal injuries to the crews and passengers onboard both airplanes as a result of the collision.

13. Of the four runway and taxiway signs KAL 084 would have passed on the most likely taxi route it erroneously took, one had no illumination, one was only partially illuminated, and two were fully illuminated.

14. There was no taxiway guidance sign at the intersection of taxiway W-1 and the east-west taxiway.

15. Operators of airports certificated under 14 CFR Part 139 are not required to place standardized signs at each taxiway/runway and taxiway intersection.

16. Runway signs should be sufficiently different in design from taxiway signs so that they alert the operators of all surface vehicles and airplanes of the nature of the intersection.

17. Lighted runway/taxiway signs should be inspected daily to ensure their operability and maintained as required.

3.2 Probable Cause

The National Transportation Safety Board determines that the probable causes of the accident were the failure of the pilot of Korean Air Lines Flight 084 to follow accepted procedures during taxi, which caused him to become disoriented while selecting the runway; the failure of the pilot to use the compass to confirm his position; and the decision of the pilot to take off when he was unsure that the aircraft was positioned on the correct runway. Contributing to the accident was the fog, which reduced visibility to a point that the pilot could not ascertain his position visually and the control tower personnel could not assist the pilot. Also contributing to the accident was a lack of legible taxiway and runway signs at several intersections passed by Flight 084 while it was taxiing.

4. RECOMMENDATIONS

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

Require that airports certificated for air carrier operations install signs at all runway and taxiway entrances, exits, and intersections that indicate the identity of the runway or taxiway. (Class II, Priority Action) (A-84-98)

Require that the graphics on taxiway/runway identification signs be standardized and of sufficient size to enable them to be legible to aircraft crewmembers in all meteorological conditions in which air carrier operations are authorized. (Class II, Priority Action) (A-84-99)

Require that airport operators inspect and maintain the lights illuminating airport taxiway/runway identification signs as part of the daily airport inspection requirements. (Class II, Priority Action) (A-84-100)

Require at all airports certificated for air carrier operations that uniform signs be installed which are classified by function (e.g., runway entrance, runway exit, taxiway intersection) with each function having a unique shape, color, and/or size so that runway entrance signs are distinguishable from all other advisory signs on airport property. (Class II, Priority Action) (A-84-101)

Require that air carriers incorporate in training of their crewmembers procedures and responsibilities during ground operations in restricted visibility conditions, to enable them to operate safely in such conditions. (Class II, Priority Action) (A-84-102)

BY THE NATIONAL TRANSPORTATION SAFETY BOARD

/s/ JIM BURNETT
Chairman

/s/ PATRICIA A. GOLDMAN
Vice Chairman

/s/ G.H. PATRICK BURSLEY
Member

/s/ VERNON L. GROSE
Member

August 9, 1984

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APPENDIXES

APPENDIX A

INVESTIGATION AND HEARING

1. Investigation

The Safety Board was notified of the accident about 1900 e.s.t. on December 23, 1983. A partial team was dispatched from the Washington, D.C., headquarters and arrived onscene on December 24, 1983. Working groups were established for airworthiness and air traffic control/operations.

Parties to the investigation were the Federal Aviation Administration, Korean Air Lines, SouthCentral Air, Korean Civil Aviation Bureau, and the State of Alaska. A representative from the Korean Civil Aviation Bureau was designated as the official accredited representative.

2. Public Hearing

A public hearing was not held. Depositions were not taken.

APPENDIX B

PERSONNEL INFORMATION

Captain Gary R. Holt

Captain Holt, 33, the single pilot aboard SouthCentral Air Flight 59 was employed by SouthCentral Air on October 24, 1983. He holds Airline Transport Pilot Certificate No. 246826533, dated December 27, 1978, with an airplane multiengine land rating, and with commercial privileges in airplane single-engine land and sea. His most recent first-class medical certificate was dated December 21, 1983, with the limitation that the holder shall wear correcting lenses while exercising the privileges of his airman certificate.

Captain Holt completed a pilot proficiency check, graded satisfactory, on October 24, 1983. He completed his initial ground training and flight training in the PA-31 airplane on October 24, 1983. He flew his first line flight with SouthCentral Air on November 18, 1983.

Captain Holt logged 43 flight hours with SouthCentral Air in November 1983, and 72.5 hours in December 1983, for a total of 115.5 flying hours with the company. He listed 5,000 total pilot hours as of October 17, 1983, on his employment record. Included in this logged time were 1,500 hours airplane single-engine land, and 3,500 hours airplane multiengine land. This, together with 115.5 hours logged with SouthCentral Air for the months of November and December, totaled about 5,115.5 flying hours as of the day preceding the day of the accident.

Captain Bum Hee Lee

Captain Lee, 48, of Korean Air Lines Flight 084, was employed by KAL on August 17, 1970. He holds Korean Civil Aeronautics Board (KCAB) Airline Transport Pilot Certificate No. 275, dated December 4, 1973, with class ratings in single-engine land and multiengine land airplanes, and type ratings in the F-27, Boeing 727, and DC-10. His most recent first-class medical certificate was dated December 12, 1983, with no limitations. His last flight check was completed on November 14, 1983.

Captain Lee had logged a total of 12,562:45 flying hours as of the date of the accident. He had logged 2,227:22 of his total flying hours as pilot-in-command (PIC). He had logged 6,471:35 flying hours in DC-10 airplanes, with 1,789:22 of these hours logged as PIC. For the 3 months prior to the accident, Captain Lee logged 167 hours 16 minutes of flying time.

First Officer Bong Hyun Cho

First Officer Cho, 51, was employed by KAL on July 19, 1979. He holds KCAB Airline Transport Pilot Certificate No. 486, dated December 29, 1979, with a multiengine land rating and a DC-10 type rating. He obtained his DC-10 type rating on February 16, 1980. His most recent first-class medical certificate was dated August 2, 1983, with the limitation "Holder shall wear lenses that correct for distant vision and possess glasses that correct for near vision while exercising the privilege of his airman's certificate." His last flight check was completed on November 9, 1983.

First Officer Cho had logged a total of 8,157 hours 21 minutes of flight time as of the date of the accident. He had logged 2,995 hours 21 minutes in DC-10 airplanes. For the 3 months prior to the accident, First Officer Cho had logged 169 hours 32 minutes of flying time.

Flight Engineer Myong Koo Lee

Flight Engineer Lee, 34, was employed by KAL on February 12, 1979. He holds KCAB Flight Engineer License No. 27, dated December 29, 1978, with type ratings in Boeing 727 and DC-10 airplanes. His second-class medical certificate was dated December 23, 1983, with no limitations. His last flight check was completed on November 3, 1983.

Flight Engineer Lee had logged a total of 2,174 hours 57 minutes of flying time as of the date of the accident. He had logged 184 hours 13 minutes of this time in DC-10 airplanes. For the 3 months prior to the accident, Flight Engineer Lee had logged 136 hours 12 minutes of flight time.

APPENDIX C

AIRCRAFT INFORMATION

PA-31-350 Navajo

The Piper Aircraft Corporation PA-31-350 Navajo is a twin-engine, retractable landing gear, normal category airplane. The fuselage is a conventional semimonocoque structure. The airplane is 34 feet 7 1/2 inches in length. The top of the fuselage measured from the ground with the landing gear extended is 7 feet 8 inches in height. The top of the vertical stabilizer measured from the static ground line is 13 feet in height. The wing is an all-metal, cantilever, semimonocoque structure.

The PA-31-350 is powered with turbocharged Avco Lycoming TIO-540-J and LTIO-540-J series engines. The left engine rotates clockwise, and the right engine rotates counterclockwise as viewed from the pilot's seat. The six-cylinder engines develop 350 hp each at 2,575 rpm. The propellers are Hartzell, three-blade, constant speed, controllable pitch and full feathering.

DC-10-30

The McDonnell Douglas DC-10-30 CF is a low-wing, wide-body transport category airplane powered by three General Electric Model CF6-50C1 engines which generate 49,000 pounds of thrust. The space between the right and left main gear is 35 feet with the nose gear and main body gear centered looking aft from the nose. The bottom of the fuselage measured from the ground with the gear extended is 7 feet 6 inches high ahead of the wing and 7 feet high under the wing. The wing span from wing tip to wing tip is 165 feet 4 inches.

APPENDIX D

TRANSCRIPT OF RECORDED TRANSMISSIONS

This transcription covers the time period from 1353:44 to 1407:28, December 23, 1983.

Agencies making transmissions	Abbreviation
Anchorage Tower Ground Control	GC
Anchorage Tower Local Control	LC
Korean Air Lines Flight 084	KAL 084
SouthCentral Air Flight 59	SCA 59

Time	Elapsed Time	Agency	Transmission
1353:44	00:00	KAL 084	Anchorage Ground Korean Air 084
1353:47	00:03	GC	Korean Air 084 heavy ground
1353:49	00:05	KAL	084 ready for starting
1353:53	00:09	GC	Korean Air 084 heavy start engines your discretion plan runway 32 or 6R
1353:59	00:15	KAL	Would like 32
1354:01	00:17	GC	Roger
1355:27	01:43	GC	Korean Air 084 heavy, what's your position?
1355:30	01:46	KAL	Cargo ramp
1355:33	01:49	GC	Roger
1357:32	03:48	KAL	Ground Korean Air 084 request taxi
1357:37	03:53	GC	Korean Air 084 heavy taxi to runway 32
1357:40	03:56	KAL	Roger taxi 32
1359:17	05:33	GC	Korean Air 084 heavy report entering the east-west taxiway
1359:22	05:39	KAL	Ah roger
1401:45	08:01	KAL	Anchorage ground Korean Air 084 entering east- west taxiway

1401:50	08:06	GC	Korean Air zero eight four heavy roger hold short of runway three two and contact tower holding short good day
1401:55	08:11	KAL	Roger
1402:36	08:52	KAL	Anchorage Tower Korea zero 084
1402:40	08:56	LC	Korean Air 084 heavy tower
1402:42	08:58	KAL	Korean Air 084 we're taxiing on east-west taxiway to hold point
1402:48	08:04	LC	Korean 084 heavy, understand runway 32 for departure
1402:52	09:08	KAL	Affirmative, ready for takeoff
1402:54	09:10	LC	Korean Air 084 heavy, taxi into position and hold runway 32
1402:57	09:13	KAL	084 roger
1403:08	09:24	LC	The current touchdown RVR is 1200, midfield 1400, rollout is 800
1403:14	09:30	Unknown	Well, it's moving
1403:20	09:36	LC	Departure on 32 help it a little bit
1403:22	09:38	Unknown	Yeah
1403:39	09:55	LC	SouthCentral 59 what intersection are you at?
1403:42	09:58	SCA59	I'm at W-3
1403:44	10:00	LC	Thank you
1404:00	10:16	LC	Korean Air 084 heavy, runway 32 cleared for takeoff, advise airborne
1404:04	10:20	KAL	Roger
1405:28	11:44	LC	SouthCentral 59 the midfield RVR is 1800 taxi into position and hold 6L

1405:32	11:48	SCA59	Roger, position and hold
1406:18	12:34	KAL	Anchorage tower Korean Air 084, we're rolling
1406:21	12:37	LC	Korean Air 084
1407:28	13:44	Unknown	What's that smoke out there?

End of Transcript

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