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FILE NO. A-0002

AIRCRAFT ACCIDENT REPORT

JAPAN AIRLINES CO., LTD.
DC-8-62, JA 8032
SAN FRANCISCO BAY
SAN FRANCISCO, CALIFORNIA
NOVEMBER 22, 1968
ADOPTED: DEC. 31, 1969

NATIONAL TRANSPORTATION SAFETY BOARD
Bureau of Aviation Safety
Washington, D. C. 20591

JAPAN AIR LINES CO., LTD.
 DC-8-62, JA8032
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DEPARTMENT OF TRANSPORTATION
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DC-8-62, JA 8032
San Francisco Bay
San Francisco, California
November 22, 1968

SYNOPSIS

Japan Air Lines, Douglas DC-8-62, JA8032, made an unintentional water landing in San Francisco Bay while operating as Flight 2, departed Tokyo International Airport at 0836Z (1736 Tokyo Time) on November 22, 1968, with 96 passengers, including six infants and a crew of 11 for a nonstop Instrument Flight Rules (IFR) flight to the San Francisco International Airport, San Francisco, California.

The flight arrived in the San Francisco area at 1654Z (0854 Pacific standard time) after a routine flight. Normal communications were established, and the crew was radar vectored to the Woodside VHF Omnidirectional Range (VOR) and thence to intercept the Instrument Landing System (ILS) for Runway 28L at the San Francisco International Airport.

The flight crossed the Woodside VOR at 1716Z at approximately 4,000 feet and, at 1718:30Z, was cleared to descend to 2,000 feet. The flight descended in a constant, uninterrupted rate of descent from this time until about 6 seconds before water impact at 1724:25Z. The aircraft was on the localizer and contacted the water about 2½ miles from the end of Runway 28L.

These were no injuries to any of the passengers or crew during the accident and ensuing evacuation. The aircraft was recovered from the waters of San Francisco Bay about 55 hours after the accident.

The Board determines that the probable cause of this accident **was** the improper application of the prescribed procedures to execute **an** automatic-coupled ILS approach. This deviation **from** the prescribed procedures **was**, in **part**, due to a lack of familiarization and **infre-**quent operation of the installed flight director and autopilot system.

1. INVESTIGATION

1.1 History of Flight

The crew for Japan Air Lines Flight 2 (JAL 2) arrived at Flight Operations at 1530, Tokyo time, November 22, 1968. Flight briefing and aircraft preflight were completed. Scheduled block time was 1700 Tokyo time. However, required maintenance for the pilot instrument panel resulted in a delay of about 27 minutes, and block time was 1727 Tokyo time. This requirement for maintenance was caused by a difference of 100 feet at flight level 280 between the captain's and first officer's altimeters on the previous flight.

JAL 2, with a crew of 11 and 96 passengers including **six** infants, departed Tokyo International Airport, Tokyo, Japan, at 0836Z, 1/ (1736 Tokyo time) November 22, 1968, for a nonstop Instrument Flight-Rules (IFR) flight to San Francisco, California. The takeoff and climbout were normal except that when the crew first raised the landing gear handle, it felt to them as though the nose gear did not latch. On the second try, the crew stated that the latch check was good and the flight continued.

The en route portion of the flight was conducted without incident. Doppler, Loran, and celestial methods were used for navigation. The captain stated that the aircraft was controlled by autopilot for most of the flight. The en route cruising altitudes were 29,000 feet for about an hour and 15 minutes, 33,000 feet for about 4 hours, then 37,000 feet for 2 hours and 50 minutes.

At 1654Z, Oakland Air Route Traffic Control Center (OAK Center) established radar contact with JAL 2 when the aircraft was over the Maple Intersection (169 nautical miles from the Oakland VHF Omnidirectional Range/Tactical Air Navigation (VORTAC) on the 257" radial). At that time, the flight was cleared to the San Francisco Airport via a direct course to the Woodside, California, VORTAC, thence direct to San Francisco, to cross a point 21 miles west of Woodside at, and maintain, 8,000 feet. The controller provided the Bay area altimeter setting of 30.31 inches (from the 0800 P.s.t. San Francisco surface weather observation). At 1656Z, after coordination with the Oakland Terminal Radar Control Facility (Bay TRACON), the controller advised JAL 2, "... San Francisco has three quarters of a mile visibility, the RVR 2/ is more than six thousand, they say it should hold."

1/ "Z" Greenwich mean time, the mean solar time used as the prime basis of standard time throughout the world.

2/ RVR - Runway Visual Range

At 1659Z, JAL 2 reported leaving Flight Level 370, which had been its last assigned cruising flight level. At 1710Z, in response to the OAK Center Oceanic Radar Sector Controller's query, the flight reported leaving 13,000 feet. One minute later, just prior to transferring control of JAL 2 to the Bay TRACON, the controller advised that the San Francisco RVR was down to 3,500 feet.

In-flight reversing of the two inboard engines was utilized to insure that descent to the 8,000-foot level would be accomplished in time to conform with the ATC clearance.

The transfer of control to the Bay TRACON was effected when the aircraft was 1 mile west of the Briny Intersection (or 29.5 miles west of woodside) at 1711Z. At 1711:49.7Z, JAL 2 established radio contact with the TRACON, whereupon the flight was cleared to descend to 5,000 feet. At 1712:54.3Z, JAL 2 reported leaving 8,000 feet descending, and at 1714:11.3Z, reported to another sector in the TRACON, which had assumed control of the flight, that he was out of 6,500 feet.

At 1714:52.9Z, JAL 2 advised: "Due to the weather at San Francisco we'd like a long final (approach) rather than direct to the outer marker."

The captain had requested that the flight be vectored to a point more than 6 miles east of the outer marker because of the weather reported at San Francisco Airport and his desire for an extended straight-in approach.

At 1716Z, the controller advised JAL 2 that the San Francisco (SFO) Runway 28 RVR was 4,000 feet; cleared the flight to descend to and maintain 4,000 feet; and instructed it to turn left to a heading of 040°. The aircraft's radar target at this time was over the Woodside VORTAC. During the same minute, the controller inquired concerning JAL 2's air-speed; was advised, "... slowing down to one eight zero (knots)"; and requested the flight to hold 180 knots until being turned onto final approach.

At 1718:30Z, a new heading of 020° was assigned, and at 1719:40Z, JAL 2 was cleared to descend to and maintain 2,000 feet. At 1720:11Z, the controller transmitted as follows: "Japan Air two turn left heading three one zero, position eight miles from outer marker, cleared for ILS approach, cross the outer marker at one six zero knots." JAL 2 replied: "Japan Air two, roger." At 1720:44Z, the controller transmitted: "Japan Air two start your left turn, you're going through the localizer, and assigned heading now two eight zero." JAL 2 replied, "Roger, turning left two eight zero."

The captain stated that he had planned and was executing an automatic-coupled approach, ^{3/} utilizing the autopilot and flight director to fly the aircraft. After departing Woodside VOR and being cleared for an ILS approach, the flight director controller mode switch was placed in the NAV/AUTO position; the radio switch on the same panel was placed in the APP position; and the autopilot NAV selector was placed in the VOR LOC position.

The first officer stated that the descent was almost continuous. When the aircraft passed through the localizer and left turn to 270° was initiated, Captain Asoh called for flaps 23°. At this time, the first officer noticed that the autopilot NAV selector switch was in the VOR/LOC position. The "Before Landing Checklist" was then called for by the captain.

After the aircraft crossed the localizer course 8 miles east of the outer marker, the inbound turn to the left brought the aircraft back onto the localizer. After localizer capture, the captain stated that he placed the autopilot NAV selector switch in the ILS position.

The captain allowed the autopilot to continue to control the aircraft and at 1720:54Z, the controller advised the flight, "...continue left heading two seven zero, you're delaying traffic by your delaying your turn, position is six miles from the outer marker now and you're cleared for approach. Cross the outer marker at one six zero knots." This was acknowledged by the flight and, at 1721:40Z, JAL 2 was instructed to contact SFO Tower on 120.5 MHz (local control frequency).

The captain may have checked the ILS glide slope arm light; however, he is not sure on this point. He stated that after capturing the localizer, he switched the autopilot to ILS and the altimeter "showed 2,500 feet with IAS 160 knots." He expected his pitch command bar on the E-6B (Attitude Director Indicator) to actuate for glide slope tracking; however, it did not. The glide slope deviation indicator (a pointer on the right side of the HZ-6B) was fluctuating and because of this, the captain stated that he felt that the RD-201 (Radio Direction Indicator) was more reliable than the HZ-6B so he used it as his primary instrument for the approach.

3/ An automatic-coupled approach is one in which the aircraft is flown to a position adjacent to the localizer beam and below the glide slope beam. This positioning is accomplished prior to reaching the outer marker. The flight director and autopilot switches are then set to fly the aircraft into the localizer beam, electronically couple the autopilot to localizer signals, and automatically turn the aircraft in toward the runway along the centerline of the localizer. As the aircraft flies in toward the outer marker, it flies into the glide slope beam from underneath, couples to the signals of this beam, and pitches over to fly down the centerline of the glide slope beam.

Prior to reaching the outer marker, the captain asked the first officer to check his glidepath (copilot position). The first officer, as nearly as he can remember, said that the vertical and horizontal bars on the HZ-6B instrument appeared to be normal. He does not remember checking the glide slope deviation pointer on either the HZ-6B or the RD-201 instruments.

During the continuing descent, the landing gear and full flaps were extended and the landing checklist was completed. As near as the captain can remember, the rate of descent was about 1,000 feet per minute.

The captain indicated that he felt he could not trust his pressure altimeter because of its erratic performance earlier in the flight. During the initial climb and cruise portion of the flight he noticed that although he would level off after climb with both his and the copilot's pressure altimeter reading the same, the captain's altimeter would indicate continuing climb for an additional 120 feet. This occurred at each level-off (29,000, 33,000 and 37,000 feet). For these reasons, during the final portion of the approach he relied on the radio altimeter.

At 1721:55Z, JAL 2 established radio contact with SFO Tower and the flight was advised that its position was $3\frac{1}{2}$ miles east of the outer marker and that it was No. 2 on approach, following a Boeing 727 6 miles ahead. At 1723:39Z, in response to the local controller's query, JAL 2 reported that its airspeed was 157 knots. The flight was then advised of radar-observed traffic at one o'clock, 1 mile, southbound, slow moving. No acknowledgment was received for this advisory. At 1724:28Z, the local controller cleared JAL 2 to land and advised that the wind was from 350° at 5 knots. No reply to this transmission was received from the flight.

In addition to the earlier altimeter problems, the captain stated that when the approach had progressed to where the radio altimeter read 500 feet, he cross-checked his pressure altimeter and found that it read 600 feet. He then asked the first officer for his altimeter reading for another cross-check. However, the first officer responded with "30.31," which was the latest altimeter setting given the crew by Air Traffic Control.

The first officer indicated in his statement that, as they descended, he started calling out altitude and airspeed in 100-foot intervals at 500 feet, in accordance with the captain's briefing for landing; however, the captain stated he did not hear these calls after the approach had progressed below 500 feet.

The captain had set his MDA (Minimum Descent Altitude) light actuator at 211 feet. When the MDA light came on, the captain stated that he cross-checked his instruments; saw that his pressure altimeter read 300 feet; and looked up to see if he could see the runway lights.

As the MDA light came on, the first officer called, "Breaking out of the overcast - I cannot see the runway light." He then called out, "We are too low - pull up, pull up." He noticed that the captain had already started forward with the power levers and was also starting to rotate the aircraft for the go-around. He also stated that as the go-around was initiated, the main gear struck the water. He noticed his pressure altimeter on water impact and saw that it read 100 feet with the barometric pressure setting of 30.31.

After the MDA light came on and the captain heard the first officer's call, he moved the throttles forward to start his go-around. However, at this time the right main gear and then the left touched the water. The captain stated that he felt the wheels touch the water and pulled the throttles back because he was afraid that the airplane might nose over on its back if he continued the attempt to go around.

After touchdown in the water, the DC-8 came to a stop on a heading of 216°. The captain reported that he felt that the landing gear was on the bottom of the Bay and he was then sure that the airplane would not sink. The emergency exits were opened and the captain ordered the evacuation of the crew and passengers. The captain and purser made the final checks of the interior prior to leaving the aircraft. They departed in the last liferaft and reached shore about one-half hour later. The aircraft remained upright and intact during the water landing. The crew and passengers all evacuated the aircraft without injury.

The aircraft came to rest at 37°35'25" North latitude, 122°18'19" West longitude at zero elevation at 1724:24Z (0924:24 P.s.t.), November 22, 1968.

After the aircraft came to a stop, the first officer attempted to call San Francisco Tower without success. He then turned off several switches, which he could not identify, and went aft to assist the other crewmembers and passengers.

The flight engineer stated that he felt the approach to be normal and all landing checklist items had been covered except for the "auto-pilot off." He observed the captain's radio altimeter to be reading 200 feet. At this time they were breaking out of the clouds and he could see water. He stated that he realized that they were still descending so he called out, "pull up, pull up." The flight engineer reported that the initial water touchdown was very light, then a second water impact occurred which he classed as moderate. The fuel tank valves were turned off; the firewall shutoff valves closed; pressure outflow valve closed; and the battery switch was placed in the "off" position. The flight engineer then went aft to assist in launching the rafts and to help the passengers evacuate the aircraft.

1.2 Injuries to Persons

<u>Injuries</u>	<u>Crew</u>	<u>Passengers</u>	<u>Others</u>
Fatal	0	0	0
Nonfatal	0	0	0
None	11	96	

There were no injuries sustained as a result of the accident or the ensuing evacuation.

1.3 Damage to Aircraft

There was no apparent impact damage to the fuselage or tail surfaces of the aircraft. The underneath wing-to-fuselage fairings sustained **minor** damage. Extensive damage was inflicted on all flaps and the in-board section of the right wing, aft of the rear spar. All landing gear doors, the No. 5 (left rear outboard) wheel, and the landing gear leveling cylinders were separated or broken by impact forces.

The entire aircraft was subject to salt water immersion, and the full extent of corrosion damage is not known.

1.4 Other Damage

None

1.5 Crew Information

Captain Kohei Asoh

Captain Asoh, a Japanese citizen, 46 years of age, was in command. He holds Japan Certificate of Competence for Airline Transport Pilot No. 202 and Japan Aircraft Crew License No. 31097. He holds a third-class flight radio operator certificate. He has a type rating in E-4, DC-6, ~~E-3~~ DC-8, and F1T-880, and B-727 airplanes. He was employed by JAL in April 1954. In December 1966, he was assigned captain on DC-8 equipment. Captain Asoh, as of October 31, 1968, ^{4/} had a total of 9794:34 hours flight time with 1062:05 hours in DC-8 equipment. His route check (Tokyo to San Francisco) was accomplished on January 4, 1968. Prior to this flight, Captain Asoh had a rest of more than 8 days.

4/ The flight times for all crewmembers, as furnished by Japan Air Lines, were through October 31, 1968.

Captain Asch's frequency of flights in a DC-8-62 series aircraft since familiarization training in April 1968 was:

<u>Date</u>	<u>Aircraft</u>	<u>From</u>	<u>To</u>
7/11	8032	TYO	SFO
7/12	8031	SFO	HNL
7/14	8032	HNL	TYO
8/7	8033	TYO	SFO
8/8	8033	SFO	HNL
8/9	8032	HNL	TYO
9/3	8034	HNL	TYO
9/14	8034	TYO	SFO
10/21	8034	TYO	SFO
10/23	8034	SFO	HNL
11/22	8032	TYO	---

There were no recorded automatic-coupled ILS approaches on any of the flights in a E-8-62 series aircraft from July through October.

Captain Joseph Hazen

Captain Hazen, a U. S. citizen, 34 years of age, was assigned as first officer on this flight. He holds a USA-FAA Air Transport Pilot Certificate No. 1314088 and a Japan Certificate of Competence for Airline Transport Pilot No. 1005 and Japan Aircraft Crew License No. 31238. He holds type ratings in DC-4, DC-6, and DC-7 airplanes. He is a former Air America pilot, and holds captain's rating on DC-6's. He was employed by Japan Air Lines in July 1968 and attended DC-8 school during July and August 1968. Captain Hazen, as of October 31, 1968, had a total of 9611:45 hours flying time with 17:45 hours in the E-8. Prior to reporting for duty, he had a rest of about 3 days.

night Engineer Richard Fahning

M Fahning, a U. S. citizen, 40 years of age, holds a USA-FAA Flight Engineer Certificate No. 1455581 and a USA-FCC Radio Operator Certificate No. 2N9566. He holds a USA-FAA type rating for reciprocating, turboprop, and turbojet, and Japan Certificate of Competence for Flight Engineer with DC-8 type rating No. 390 and Japan Aircraft Crew License No. 3121. He was employed by Japan Air Lines on January 13, 1968. He had, as of October 31, 1968, total flying time of 4705:06 hours with 557:06 hours in the E-8 equipment. **M** Fahning had more than 5 days rest prior to reporting for duty.

Navigator Ichiryo Suzuki *hired 9T25*

M Suzuki, a Japanese citizen, 27 years of age, holds Japan Certificate of Competence for First-Class Navigator No. 107 and Japan Aircraft Crew License No. 3075. He was employed by Japan Air Lines on April 1, 1966. He received his Navigator's rating December 16, 1967, and has a total of 653:17 hours flight time, all of which is in DC-8 equipment. Rest time prior to this flight was more than 4 days.

Cabin Attendants

The cabin crew consisted of a purser, two stewards, and four stewardesses. ~~A~~ of these crewmembers had received ditching training and were current in their qualifications.

1.6 Aircraft Information

The following is general information concerning aircraft SA-8032:

Company Name	SHIGA
Model	DC-8-62
Serial Number	45954
Date of Manufacture	May 18, 1968
Date of Delivery	May 27, 1968
Fuselage Number	362
Registration Number	1241
Airworthiness Certificate No.	43-005
Call Sign	JBCEI
Sel-Cal Code	DJ-BC
Type Engines	JT3D-3B Pratt & Whitney

The aircraft and the four installed engines had accumulated a total of 1707:54 hours since new.

The serial numbers of the engines are:

No. 1 Engine	P669407-DL
No. 2 Engine	P669404-DL
No. 3 Engine	P669299-DL
No. 4 Engine	P669411-DL

The aircraft had received a No. 3 check (equivalent to major service inspection) on November 17, 1968, at Tokyo, Japan, with an aircraft total time since new of 1628:28.

The aircraft had accumulated approximately 80 hours since the No. 3 check **until** the time of the accident. There were no carryover items to be completed since the No. 3 check. There were four flight discrepancies

listed on the previous flight which **was** from Tokyo to Okinawa and return. **All** discrepancies were corrected before this flight departed from Tokyo as Flight 2. There were no flight discrepancies listed in the official **flight** logbook at the time of the accident. However, on a separate form ("Flight Engineer Memos"), used to report; discrepancies observed, there were three:

- (1) Slight hydroseep left-hand aileron boost;
- (2) Copilot's side window leaks air on takeoff;
- (3) Gear unlatch light came "ON" during up latch check on first try as if nose gear **was** unlatched - OK on second try.

The flight had been delayed prior to departure from Tokyo for approximately 30 minutes, of which 13 minutes had been charged to mechanical difficulties. This difficulty was corrected by relocating a static system hose behind the captain's instrument panel. There was no record of a static leak check being performed after this maintenance work **was** accomplished.

A review of the log pages, from delivery by McDonnell-Douglas Aircraft Corporation until the accident, disclosed **that** all flight discrepancies written by the flightcrews were signed off by the maintenance facility as the repair having been accomplished.

Maintenance check period statistics:

<u>Type</u> <u>Inspection</u>	<u>Date</u>	<u>Time</u> <u>Since</u> <u>Change</u>	<u>Total</u> <u>Time</u> <u>Hours</u>
1B	June 30, 1968	108:04	108:04
2B	July 14, 1968	244:51	244:51
3B	July 27, 1968	389:18	389:18
#1 Check	July 31, 1968	435:41	435:41
1B	Aug. 14, 1968	146:14	581:55
2B	Aug. 26, 1968	292:16	727:57
3	Sep. 7, 1968	430:00	865:41
#2 Check	Sep. 17, 1968	545:46	981:27
1B	Sep. 29, 1968	117:29	1,098:56
2B	Oct. 11, 1968	248:06	1,229:35
3B	Oct. 23, 1968	390:06	1,371:35
4B	Nov. 4, 1968	524:02	1,505:29
#3 Check	Nov. 14, 1968	647:01	1,628:28

On November 21, 1968, when the aircraft left Tokyo, the total time was 1,695:00 hours. The total flying time for November 22, was 12:54 hours, making the total aircraft time 1,707:54 hours.

The aircraft **was** fueled with 153,000 pounds of Jet "B" fuel. Takeoff weight **was** computed to be 322,012 pounds. This included the crew of 11 and 96 passengers. The weight and balance at takeoff center of gravity

was computed to be 25.3 percent MAC. The landing weight was 212,012 pounds with a center of gravity of 25.0 percent MAC. Total fuel at touchdown was 40,000 pounds.

The maximum takeoff gross weight is 335,000 pounds. The c.g. limits are 18.2 percent forward and 32.3 percent aft MAC for an aircraft weighing 195,000 pounds.

1.7 Meteorological Information

Synoptic Situation

The November 22, 1968, morning surface weather charts showed a cold front well north of the accident area. The 1000 ^{5/} chart showed (in part) a small high-pressure area centered near Sacramento with the cold front extending from northern Nevada through northern California, near Red Bluff, thence southwestward into the Pacific.

Aviation Weather Observations

San Francisco

0907, special - ceiling indefinite 300 feet, sky obscured, visibility 3/4 mile, fog, wind 360°, 6 knots, Runway 28L RVR 4,000.

0922, special - partial obscuration, ceiling measured 300 feet, overcast, visibility 3/4 mile, fog, temperature 52°, dew point 50°, wind 360°, 5 knots, altimeter 30.34, Runway 28L RVR 4,500, fog obscuring 6/10 sky.

Oakland

0855, record special - ceiling indefinite 300 feet sky obscured, visibility 1/2 mile, fog, smoke, temperature 52°, dew point 52°, wind calm, RVR Runway 29, 1,000 variable to 2,200, tower visibility 3/16.

0931, special - partial obscuration, visibility 3/4 mile, fog, smoke, wind calm, RVR Runway 29, 2,800 variable to 3,800, fog obscuring 8/10 of sky.

0942, special - partial obscuration, visibility 1 mile, ground fog, smoke, wind calm, RVR Runway 29, 2,400 variable to 3,800.

^{5/} **A** times used in Section 1.7 are Pacific standard based on the 24-hour clock.

Alameda

0858, ceiling indefinite 200 feet, sky obscured, visibility $\frac{1}{2}$ mile, fog, haze, temperature 52° , dew point 49° , wind 020° , 3 knots, altimeter 30.33.

0943, ceiling indefinite 200 feet, sky obscured, visibility $\frac{1}{2}$ mile, fog, haze.

Moffett Field

0855, ceiling indefinite zero, sky obscured, visibility zero, very light drizzle, fog, temperature 52° , dew point 50° , wind 340° , 3 knots, altimeter 30.34, Runway Visibility Value (RVV) Runway 32 not operating, drizzle began 0845.

0930, special - ceiling indefinite 100 feet, sky obscured, visibility $\frac{1}{4}$ mile, very light drizzle, fog, wind 350° , 6 knots, altimeter 30.34, RVV Runway 32 not operating.

Pilot Reports

At 0452, a pilot reported the top of an overcast in the San Francisco area as 900 feet.

At 0720, a pilot reported the top of an overcast in the San Francisco area as 1,100 feet.

The following pilot report **was** transmitted in the 0925 teletype summary by San Francisco:

Ukiah to Oakland, valleys vicinity Bay area all fogged in.

Upper Air Information

The Oakland 0400 radiosonde ascent at lower levels (below 5,000 feet m.s.l.) showed a ground-based 9" C inversion, top near 1,600 feet, conditionally unstable air to near 4,000 feet, and an isothermal layer above. The air was close to saturation near the surface, with drying aloft and a sharp moisture breakoff at the base of the isothermal layer.

The winds aloft observation associated with the latter ascent was in part as follows:

<u>Heights</u> <u>(1,000 ft. m.s.l.)</u>	<u>Direction</u> <u>(degree true)</u>	<u>Velocity</u> <u>(knots)</u>
(Surface)	-	Calm
1	090	2
2	360	5
3	010	6
4	350	9
6	315	9

Forecasts

Forecasts for northern and central California are prepared by the Weather Bureau, San Francisco. The aviation area forecast issued at 0445, valid for a 12-hour period beginning at 0500, was in part as follows:

Heights above sea level unless noted. At the surface stationary front Ft, Arena to Alturas line extending south-west offshore with weak wave moving toward northern California coast. High pressure remains quasi-stationary over Nevada and off the southern California coast. Westerly flow at 500 mb. over northern California becoming light northerly to northeasterly Nevada central California.

Central California clear to variable high cloudiness above 15,000 except for fog and low cloudiness along coastal sections and in the San Joaquin Valley. Ceilings and visibilities of fog and stratus variable from ceiling zero to 300 feet, visibility zero to 2 miles, fog to 300-1,000 broken variable to overcast, 2-6 miles fog, smoke. Fog and stratus lifting or dissipating 0900-1200.

Occasional light icing in clouds vicinity front. Freezing level 8,000 north to 12,000 south.

Possible moderate clear air turbulence extreme northern California, western Nevada below 38,000.

At the time of the accident, there were no SIGMET's 6/ in effect pertinent to the time and place of concern.

The terminal forecast for San Francisco issued at 0245, valid for a 12-hour period beginning at 0300, was as follows:

0300-0900, 25,000 scattered, 3 miles, ground fog, smoke, occasional partial obscuration, 3/4 mile fog, smoke.

0900-1500, 25,000 thin scattered, 5 miles, haze and smoke.

The Oakland VOLMET 7/ broadcast contained current and forecast San Francisco weather, plus weather information from other terminals. At 0340, the Weather Bureau Forecast Office, San Francisco, issued for

6/ SIGMET's - Significant Meteorological Information
7/ VOLMET broadcast, by international agreement, are scheduled broadcasts of meteorological information directed to aircraft in flight. At Oakland the broadcasts are made from H / 05 to H / 10 and H / 35 to H / 40 on frequencies of 2980, 5519, and 8905 kHz.

transmission to JAL Flight 2, a re-analysis of winds at 33,000 and 37,000 feet to San Francisco via 40° 30' N, 160° W and 39° 50' N, 140° W. Also appended were terminal forecasts for San Francisco and Oakland. Such forecasts are issued routinely for eastbound flights from the Pacific into San Francisco.

The accident occurred during daylight hours. However, the weather in the vicinity **was** characterized by low cloudiness and fog. The approach from the outer marker to the airport **was** over water, and there were no terrain features to distinguish between the surface and sky under the existing visibility conditions.

1.8 Aids to Navigation

The ILS-Runway 28L instrument approach aids for SFO provides as follows:

Localizer	- 109.5 MHz
Glide slope	- 332.6 MHz
Glide slope angle	- 2° 42'
Outer marker	- 75 MHz
Outer marker compass locator	- 379 kHz - SF
Middle marker	- 75 MHz
Approach light system with sequence flashing lights	

Localizer course 281° magnetic

Minimum altitudes (applicable to JAL 2's flight path) 1600 (glide slope interception altitude) from point of localizer capture to outer marker.

Glide slope altitudes:	Outer marker	1603 ft.
	Middle marker	231 ft.

Distances:	Outer marker to touchdown	5.7 miles
	Outer marker to middle marker	4.7 miles
	Middle marker to threshold	0.6 miles

There **was** ASR (surveillance radar) available. However, there **was** no PAR (precision approach radar) at the San Francisco International Airport.

Status of Facilities

There were no reported difficulties with, or outages of, radar or approach aids.

Subsequent to the accident, the FAA conducted both a flight- and ground-check of the ILS. The results of these checks revealed that the ILS **was** operating within prescribed tolerances.

The approach light system **was** being operated on Step 5 (maximum intensity) with the sequence flashing lights on. The high intensity runway lights were also on Step 5, as were the touchdown zone and centerline lights.

During the course of the ILS flight-check, the local control communications frequency of 120.5 MHz **was** also checked and found to be satisfactory.

The transmissometer and associated FVR computer and display equipment were checked and found to be operating satisfactorily.

1.9 Communications

A review of the recorded communications between the aircraft's crew and the various control facilities personnel revealed that normal communications were established and maintained from 1640Z until the time of impact at 1724:24Z.

Handling of this flight by air traffic control facilities **was** without remarkable incident with one exception. In accordance with current procedural manuals, under the weather conditions which prevailed at SFO on the morning of November 22, 1968, the approach control facility was required, without exception, to provide to arriving aircraft, upon first radio contact or as soon as possible thereafter, the following information:

- a. Ceiling and visibility if at or below highest circling minima for the airport and, thereafter, subsequent changes as necessary.
- b. Altimeter setting.

The highest circling minima applicable to SFO are: Ceiling 1,100 feet, visibility 2 miles. The weather at the time of first radio contact with the approach control facility **was**: Indefinite ceiling 300 feet, sky obscured, visibility 1 mile.

A review of the transcription of recorded communications between JAL 2 and the Bay TRACON fails to reveal evidence that this information **was** provided.

As a result of the disappearance of JAL 2 from the SFO Tower radar display, the succeeding aircraft on approach, a United Air Lines Boeing 727 **was** instructed to execute a missed approach. Subsequent to this, 8 aircraft landed on Runway 28L without reported difficulties with either weather, navigation aids, or approach lighting aids. The decision to continue operations **was** made by the supervising local controller on the basis of his observation of the Airport Surface Detection Equipment (ASDE) radarscope and his determination therefrom that there **was** no unidentified targets depicted on Runway 28L.

1.10 Aerodrome and Ground Facilities

The San Francisco International Airport and its facilities were not involved since the aircraft did not reach the airport.

1.11 Flight Recorder

A United Control Data Division flight data recorder, Model FA-542, Serial No. 2265, **was** installed in the aircraft at the time of the accident. The recorder **was** removed from the aircraft and forwarded to the Safety Board in Washington, D. C., for examination and readout of the recorded traces.

The recorder **was** found to be completely intact with no evidence of mechanical damage. The recording medium **was** removed, and the examination disclosed that all parameters were functioning up to the time of the accident and all recorded traces were readable. A readout **was** performed encompassing the last 27:15 minutes of flight prior to the accident for the parameters of pressure altitude, indicated airspeed, magnetic heading, and vertical acceleration. A data graph **was** prepared reflecting the results of the readout.

The flight recorder data graph indicated that the flight began descent from cruising altitude some 26:00 minutes prior to the accident. A fairly steady rate of descent **was** maintained down to 15,500 feet m.s.l., at approximately 2,000 f.p.m. A short level-off **was** indicated at this altitude for about 20 seconds before descent **was** continued. At this point, the altitude, airspeed, and vertical acceleration traces indicated that a definite change had occurred. This **was** indicated by a distinct variation in the altitude and airspeed traces, and increased activity in the vertical acceleration trace. The indications in the recorded altitude and airspeed traces were characterized by rapid fluctuations of the recording styli. This condition prevailed down to an altitude of 9,000 feet m.s.l., at which time all recorded traces resumed their prior steady appearance. The fluctuations, notwithstanding the general slope of the altitude trace, evidenced a slightly increased rate of descent, while the airspeed trace varied between 245 to 255 KIAS. The scope of these indications coincides with the crew statements that the inboard engines were reversed in flight between 15,000 and 9,000 feet m.s.l. A fairly steady heading of approximately 080° magnetic **was** maintained during the descent from cruising altitude down to 9,000 feet m.s.l.

The flight passed through the 9,000-foot level 12 minutes and 20 seconds prior to the accident, still on the heading of about 080° magnetic, **and** leveled at 5,100 feet m.s.l. The rate of descent during this period averaged about 1,000 f.p.m. The flight remained at this level for 45 seconds, during which time a left turn to 040° **was** made. A descent of about 800 f.p.m. **was** initiated 7 minutes and 26 seconds prior to impact and **was** continued for 1 minute and 32 seconds. The aircraft was leveled at 4,050 feet. The altitude of the aircraft slowly increased to 4,100

feet over the next 1 minute and 30 seconds. While at this nearly constant altitude, a left turn to a heading of 020° magnetic was made.

The aircraft vacated 4,100 feet on a heading of 020°, 4 minutes and 46 seconds before impact. A nearly constant rate of descent down to 150 feet was recorded during the next 4 minutes and 40 seconds. While in this descent, the aircraft was turned left to a heading of 000° magnetic for 35 seconds, left to 250°, right to 290°, and then right to 280°. A general heading of 280° was maintained for the final 2 minutes of the flight.

The aircraft passed through 2,500 feet, 3 minutes and 12 seconds prior to impact, while in the left turn from 000° to 250° at an airspeed of 152 knots.

The aircraft passed through the outer marker crossing altitude of 1,600 feet, 1 minute and 44 seconds prior to impact, at an airspeed of 138 knots. This was at least 2 miles prior to reaching the outer marker. There was no deviation from the established rate of descent at this point or until the aircraft reached 150 feet m.s.l., 6 seconds prior to impact. At this point, the altitude trace started to flatten out.

A tabulation chart of the flight recorder data graph for the last 4 minutes and 46 seconds is as follows:

Time Prior to Impact Min Sec	Elapse Time Per Segment (Seconds)	Altitude Passing	Airspeed (+) = Increasing (0) = Steady State (-) = Decreasing	Heading (0) = Steady (*) = Turning (L/R) = Turn Reversal Left to Right (R/L) = Turn Reversal Right to Left	Segment Rate of Descent (f.p.s.)	Average Rate of Descent (f.p.m.)
4 46	0	4100	148 (-)	021° (0)	0	0
4 40	6	4000	147 (0)	020° (0)	16.7	
4 21	19	3675	154 (+)	020° Start left	17.1	
4 0 8	13	3395	159 (+)	000° (L/R)	a.5	
3 3 58	10	3150	162 (0)	004" (0)	24.5	
3 3 46	12	2925	161 (-)	004° (0)	18.8	1175
3 3 32	14	2700	158 (0)	000° (*)	16.1	
3 3 04	28	2375	151 (0)	274° (*)	11.6	
2 2 54	10	2275	153 (+)	242° (L/R)		
2 2 46	8	2175	155 (+)	261° (*)		750
2 2 40	6	2100	156 (0)	272° (*)		
2 2 24	16	1975	146 (-)	292° (R/L)		
2 2 10	14	1825	142 (-)	284° (L/R)		
1 1 59	11	1675	138 (0)	287° (R/L)		
1 1 46	13	1500	138 (0)	286° (*)		675
1 1 30	16	1275	138 (Start +)	282° (*)	14.1	
1 1 14	16	1075	142 (+)	280° (L/R)	12.5	
0 0 46	28	725	150 (+)	281° (0)	12.5	775
0 0 41	5	650	153 (Start -)	281° (0)	15.0	
0 0 14	n	300	135 (-)	283° (0)	5.6	
0 0 06	8	150	132 (-)	282° (0)	18.7	
0 0 00	6	0	125 (-)	281° (0)	25.0	

1.12 Wreckage

Not applicable. The aircraft was virtually intact following the accident. The aircraft was recovered from the waters of San Francisco Bay 55 hours after the accident.

1.13 Fire

Fire did not occur.

1.14 Survival Aspects

Aircraft Cabin Configuration

The Japan Air Lines, Douglas DC-8-62, JA8032, was configured in a two-class arrangement. The forward passenger compartment contained 12 double seats for 24 passengers (eight rows on the left side and **four rows--5,6,7 and 8--**on the right side) and an aft-facing jump seat attached to the cockpit bulkhead for two cabin attendants.

Two type I exits are located in the forward passenger section, one on each side of the fuselage. On the left side the main entry door was 34.5 x 72 inches, while the right door in the forward galley area was 33.5 x 64 inches.

Two liferafts were stowed in ceiling compartments over the aisle adjacent to rows 1 and 2.

The aft passenger cabin contained 22 rows of seats, each row consisting of two triple seats with a center aisle between, permitting a maximum of 132 passengers in this compartment. A forward-facing jump seat was located at the aft main entrance door on the left side of the cabin.

Two type I exits were located in the aft passenger cabin. The main entry door on the left side was 34.5 x 72 inches, while the one on the right side in the galley area was 34 x 64 inches. Additionally, in the aft passenger compartment, there were four type III exits, 20 x 38 inches, located over the wing, two on each side of the airplane at rows 12 and 15 (there **was** no row designated 13).

Five 25-man liferafts were stowed in ceiling compartments in the aft passenger compartment. Three of these were in the area of the over-wing exits over the aisle seats at rows 12 and 14 and two in tandem were over the aisle at row 31 the last row of seats, and just aft of this row.

A lifejacket was available for each aircraft occupant. The passenger jackets were stored in fabric compartments under each passenger seat.

Evacuation

During the descent for landing at San Francisco International Airport, the landing gear **was** lowered and flaps fully extended. When they broke out below the fog, the first officer called, "Breaking out of the overcast - I cannot see the **runway** light." He then called out, "We are too **low** - pull up, pull up." The captain who **was** flying the aircraft applied power and started to rotate the aircraft when water contact was made. The crew reported that the right main gear hit the water first, followed immediately by the left gear striking. After water contact, the airplane reportedly made **a slow** turn to the left. The captain reported that his speed at the time of water contact **was** 137 knots.

The deceleration of the aircraft was likened to a hard landing on the airport. Many passengers did not know they were in the water until they looked out of the windows. In some instances, it was reported that the carry-on baggage moved up the aisle one or two rows, while other such baggage remained in place and did not move. Just prior to the accident, a steward seated himself on the aft jump seat. At impact, he was in the process of buckling his seat belt. He managed to hold himself on the seat by the belt straps during the first impact deceleration. He described a second jolt during which he was unable to hold on to the straps. He ended up in the aisle next to the last row of seats.

Blankets and pillows were thrown from the overhead rack during the deceleration. Many of the covers for the cove lights under the overhead racks came loose during the deceleration. These covers were propelled through the passenger cabin. In the description of these covers, the passengers likened them to javelins. No one was injured by the covers.

The aircraft came to rest with its landing gear on the bottom of the Bay. The fuselage assumed an attitude of approximately 4° noseup. The divers reported that the nose gear was intact and that it was resting on a mound of sea shells. As a result of this attitude and the water depth, the forward type I exits were about 6 feet above the water level, while the door sills of the aft type I exits were underwater. The waterline on the three aft exits was between 12 and 15 inches below the port-hole in the door. Soon after the accident, the depth of the water in front of the radome and aft of the tail cone was measured. It was reported that the depth was 10 to 11 feet at each of these points.

Immediately after the aircraft stopped, the purser reassured the passengers that the airplane would not sink since it was resting on the bottom. The passengers were advised to don lifejackets. Some reported difficulty in extracting the jacket from its compartment due to the jamming of the carry-on luggage under the seats. Others reported difficulty in donning the jacket since they could not determine the front from the back (these were reversible type jackets). Many of the passengers reported that there was considerable indecision on the part of the crew whether to evacuate the aircraft. About 5 minutes after stopping, the captain noted fuel in the water at the forward main entry door and ordered the evacuation.

Some difficulty was experienced by one of the stewards in opening the forward main entry door. There was probably a positive differential pressure within the aircraft. After the pressure was bled off, no further difficulty was experienced with this door.

The two forward stowed liferafts were removed from their compartments. One was launched at the main door and the other was launched through the forward service door.

Two of the four rafts stowed in the over-wing area were utilized. One was launched from each wing. One of the rafts stowed in the aft portion of the fuselage was carried forward and launched over the right wing. All of the wing-launched rafts were deployed from the leading edge of the wing.

Although some of the tourist-class passengers evacuated from the forward doors, generally the first-class entered the two forward rafts, while the tourist passengers entered the raft at the left wing and one of the rafts at the right wing. The remaining raft on the right wing was occupied by the captain and JAL employees.

From the passenger and crew statements, it was estimated that 29 passengers (no crewmembers) evacuated through the forward left door; 16 persons, including the flight engineer, navigator, and a stewardess, evacuated through the forward service door; 28 evacuated from the left wing, including at least two stewardesses and three JAL male employees; 25, including the first officer and a stewardess, occupied the inboard raft on the right wing; and nine, including the captain, purser, and two stewardesses, occupied the outboard raft on the right wing.

The evacuation line stard above the aft left over-wing exit could not be used. The webbing was twisted. Unfortunately, it was pulled out before the investigators could measure the load required to extract the webbing.

1.15 Tests and Research

Following recovery of the aircraft, the flight director, autopilot, navigation, pitot, static, all warning and annunciator systems were functionally tested on the aircraft prior to removal. The components of these systems were then removed and tested in the appropriate United Air Lines repair shop or at the manufacturer's plant. All components were found to be operable and within the appropriate overhaul specifications.

1.16 Other

Japan Air Lines Procedures

The procedures, as outlined in Japan Air Lines Operations Manual, Volume 111, Section 5, in effect at the time of the accident, for making an automatic-coupled approach were in part:

(2) a. * * *

- b. Trim the airplane for hands-off flight and engage autopilot. The NAV selector switch on the autopilot controller is in "Heading Select" position. The pitch selector switch is in "Vertical SPEED" position.

- c. Control the airplane using the vertical speed wheel and the heading select knob.
- d. Set the mode switch on the flight director controller to "HDG" position and the radio switch to "1" position. Select the VHF-1 receiver to appropriate ILS frequency and set the localizer inbound heading.

(3) Initial Approach

- a. When the procedure turn altitude or ILS level altitude is reached, set both the vertical speed wheel and flight director at "ALT HOLD" and maneuver intercept localizer beam. Turn the flight director radio switch to "APP" position.
- b. * * *, turn the flight director mode selector to "NAV AUTO" position. After confirming "V/L ARM" light on, turn the autopilot NAV selector to "ILS" position.
NOTE: The autopilot NAV selector should be turned to "ILS" well before the flight director is captured with localizer beam.

F/D Roll Annunciator ^{8/} * * * "V/L ARM"
A/P Glidepath Armed Light ^{9/} * * * ON

- c. When the localizer bar on the RD-201 indicator indicates approximately 2 dots, the autopilot and flight director will be coupled to the localizer beam, * F/D Roll Annunciator "V/L"

^{8/} F/D (Flight Director) Roll Annunciators are two vertically mounted annunciator lights located at the top left side of both the captain's and first officer's HZ-6B instrument. The top light is "V/L ARM" (system armed to capture the localizer beam) and the bottom light is "V/L" (system has captured the localizer beam).

^{9/} A/P Autopilot Glidepath Armed Light is an amber light mounted on the right side of the autopilot indices. It is the middle light of three mounted vertically in this area. Light is on when system is armed to capture the glide slope beam and goes off when system locks on (couples) to the beam signal.

F/D Pitch Annunciator 10/ * * * "G/S ARM"

- d. When glide slope bar indicates approximately fly up $1\frac{1}{2}$ dot, extend landing gear and set flaps 35".
* * *
- e. * * *
- f. When glide slope bar indicates fly up $\frac{1}{2}$ dot, set flaps to full down and adjust thrust *
* * *
- g. * * *

(4) Final Approach

- a. When the glide slope bar is approximately centered, the autopilot and flight director will automatically be coupled with the glide slope signal and the airplane will start descending on the glide slope beam at 700 ft/min. The following events will occur:
 - (a) Glide path armed light will go out.
F/D pitch annunciator shows "G/S."
 - (b) The vertical speed wheel follows the descent rate and the altitude hold of the flight director will be automatically off.
 - (c) * * *
- b. The first officer should confirm and report passing Over markers. After passing outer marker, the first officer should call out altitude and indication of the speed command indicator every 500 feet. Below 1,000 feet * * * every 200 feet.

(5) Others

* * *

- d. At decision height, if visual contact cannot be established * * * the captain should immediately execute missed approach procedure.

10/ F/D (Flight Director) Pitch Annunciator are two vertically mounted annunciator lights on the right side of both the captain's and first officer's HZ-6B instrument. The top light is "G/S ARM" (system armed to capture the glide slope beam) and the bottom light is "G/S" (system has captured/coupled (to) the beam signals).

Subsequent JAL DC-8-62 Occurrence

Following the accident on November 22, 1968, another Japan Air Lines E-6-62, operating as Flight 2 on January 7, 1969, from Tokyo to San Francisco, was diverted from San Francisco to the Oakland International Airport, Oakland, California, because of below minimum weather. An ILS approach was initiated, and the captain noted he had a discrepancy between his HZ-6B and his RD-201 course indications. The approach, including the descent, was continued as the captain attempted to correct the discrepancy in the localizer indication by switching the flight director selector. The captain of this flight had set his MDA selector for 400 feet, and when the light came on prior to reaching the outer marker, a go-around was initiated and successfully completed. A second approach to a landing was made without difficulty. The aircraft was observed by FAA tower personnel to pass over the Hayward Airport, approximately 5 miles southeast of the Oakland Airport, at an estimated 100 to 150 feet.

Remedial Actions

As a result of the above occurrence and the accident, the Japanese Civil Aviation Bureau recommended that several steps be taken by Japan Air Lines in order to enhance the safety of operations. In general, the program stressed command responsibility, crew coordination, training of flightcrews, transition time for new type of aircraft, and an overall reevaluation of the training program.

Japan Air Lines instituted the recommended program with prompt and positive action.

Douglas Aircraft Company and Sperry Flight Systems Division sent representatives to Japan Air Lines and a complete review of training procedures plus re-indoctrination of Japan Air Lines flightcrews operating the DC-8-62 series aircraft was accomplished. Japan Air Lines manuals, which had been translated from English to Japanese and then back to English, were reviewed and corrections in the translations were made where necessary.

2. ANALYSIS AND CONCLUSIONS

2.1 Analysis

The aircraft and all of its components were operable and are not considered to be in the causal area of this accident.

The weather existing in the San Francisco area prior to and during the approach was adequately forecast and properly reported. Eased on crew statements, passenger statements and photographs, and the Board's analysis of the weather, it was established that the flight was operating clear of the clouds until on the final approach. Low-lying clouds and fog covered the entire Bay area with tops of the clouds between 1,000 and 1,200 feet, a ceiling of 300 feet, and a visibility below the clouds of three-fourths mile in fog.

The restriction to visibility below the overcast and the lack of contrast between the sky and the calm waters of the bay could be considered to be a factor in the crew's not visually recognizing the undershoot, until it was too late. Had the crew followed the published and basic procedures of crossing the outer marker at the designated altitude and, thereafter, descending on the glide slope, they would have had the approach lights and the runway for references when the aircraft broke out of the clouds.

The procedures utilized by the captain to execute the autopilot controlled descent from the Woodside VOR and an automatic-coupled approach on the ILS were not in accord with the Japan Air Lines procedures as published.

The rate of descent of the aircraft, as recorded by the flight recorder, equates to a setting of one unit down of the vertical speed wheel of the autopilot. With a setting of one unit down on the vertical speed wheel and the aircraft in steady state flight meeting this requirement, the horizontal bar on the HZ-6B would be in a near centered position. It would have the same appearance as a glide slope being flown on the centerline with the exception of the annunciator lights for both the flight director and the autopilot being in the "Glide Slope Arm" position.

It is evident that the captain did not follow the published procedures for capturing the localizer and then the glide slope for this approach. The flight director/autopilot coupling systems contains a blocking relay so that the glide slope cannot be captured until the aircraft has coupled to the localizer.

By the captain's own statement, he did not set the autopilot for ILS capture until after the aircraft had crossed, and been turned inbound toward, the localizer. This occurred at 2,500 feet, about 3 minutes and 7 seconds prior to impact. The aircraft, at this time, was between 75 and 100 feet below the bottom edge of the glide slope, in a steady state descent, that was not interrupted or broken until just before water contact. All indications in the cockpit; i.e., annunciator lights, ILS raw data indicators, and the descent through the ILS level altitude, before reaching the outer marker, should have been sufficient to alert any of the crewmembers to the unsafe conditions and should have dictated that the approach be abandoned, long before the accident occurred.

Statements taken from both the captain and the first officer indicated neither fully understood the capabilities nor the operating techniques of the Sperry Flight Director System. Additionally, information received from several other Japan Air Lines flight personnel indicated an overall feeling of insecurity when operating the flight director. This feeling was based on a lack of information and training before the pilot started to use the system.

As a result of this accident and the subsequent occurrence, the Aircraft Company and the Sperry Flight Systems Division sent representatives to Tokyo to assist Japan Air Lines in revamping their DC-8-62 aircraft training program. Additional training aids and additional ground school courses were provided in order to qualify properly the flightcrews in the operation of the automatic flight systems. A special training curriculum on the flight director and autopilot procedures on DC-8-62 series aircraft was prepared and implemented by Japan Air Lines.

The captain's lack of familiarity with this aircraft did delay his actions in disconnecting the autopilot, while looking for the runway, after reaching the Decision Height. This does not pertain to his knowledge of the location of the autopilot release switch but to his familiarity and ability to use it rapidly in times of stress or emergency. The crew's statements, during interview, indicated that they were not concerned during the approach. Even though the captain noted discrepancies in his flight director as well as his barometric altimeter, it is clear that he was surprised when the necessity for a go-around arose at the last moment. The delay of even the small amount of time for a surprise reaction to the go-around requirement would have resulted, in all likelihood, in an undershoot.

It has been demonstrated that in order to abort successfully an approach to present Category I minimums, the aircraft must be at the proper speed, sink rate, and position and that the initiation of the go-around must be precisely at the Decision Height and not delayed past this height, for any reason. In order to accomplish this maneuver properly, crew coordination must be precise and almost automatic. There is not sufficient time for the captain to look for the runway after the first officer calls, "Minimums, runway not in sight." There must be sufficient understanding, coordination, and confidence between crewmembers that the pilot flying the aircraft reacts to the other pilot's calls in a manner much the same as if he himself is looking through the other's eyes.

It is evident that the captain did not receive the assistance he could expect and should have had under the crew concept of operations. The language difference between the captain and the first officer could have been the cause of the improper responses by the first officer when the captain questioned the reading of the barometric altimeter and the indications he was receiving on his HZ-6B during the final approach. Again, it is incumbent upon a company, operating in this atmosphere, to have adequate procedures and training to preclude any possibility of such misunderstanding. This is particularly true when information is requested that is in addition to the normal flow of communications necessary to execute any particular maneuver or operation.

2.2 Conclusions

a. Findings

1. The aircraft was certificated and maintained in accordance with the governing regulations under which it was operating.
2. The flightcrew and the cabin attendants were certificated for the operation involved.
3. All navigation and approach aids were in normal operation at the time of the accident.
4. The aircraft and all its systems were operating normally.
5. The existing weather was in excess of the required minimums for this approach.
6. The restriction to visibility and lack of contrast between sky and water beneath the overcast did delay the visual recognition of the undershoot.
7. Had the approach been properly initiated and executed, the crew would have had the approach and runway lights for contrast.
8. The captain was attempting to make an automatic-coupled approach.
9. The aircraft was coupled to the localizer beam of the ILS.
10. The aircraft was not coupled to the glide slope beam of the ILS.
11. The captain did not follow the prescribed basic procedures for making an ILS approach or a coupled approach.
12. The aircraft descended below the ILS level altitude of 1,600 feet before crossing the outer marker.
13. The rate of descent from 4,100 feet to impact was equal to one unit of "darn" flight on the vertical speed wheel of the autopilot.
14. The first officer did not call the ILS level altitude or the crossing of the outer marker in accordance with the Japan Air Lines procedures.

15. After the Decision Height had been reached and the first officer had called "Minimums, runway not in sight," the captain delayed the initiation of a missed approach.
16. There was a language difference between the captain and first officer.
17. The first officer responded improperly when the captain requested information concerning the reading of the barometric altimeter and the ILS indications on the HZ-6B.
18. Neither the captain nor the first officer fully understood the flight director system, its limitations, or the necessary operating procedures.
19. Japan Air Lines has taken action to prepare and implement a special training curriculum on the flight director and autopilot procedures on E-8-62 series aircraft.

b. Probable Cause

The Board determines that the probable cause of this accident was the improper application of the prescribed procedures to execute an automatic-coupled ILS approach. This deviation from the prescribed procedures was, in part, due to a lack of familiarization and infrequent operation of the installed flight director and autopilot system.

BY THE NATIONAL TRANSPORTATION SAFETY BOARD:

/s/ JOHN H. REED
Chairman

/s/ OSCAR M. LAUREL
Member

/s/ FRANCIS H. McADAMS
Member

/s/ LOUIS M. THAYER
Member

Isabel A. Burgess, Member, did not take part in the adoption of this report.