No. 6

Canadian Pacific Air Lines Ltd., Douglas DC-8, CF-CPK, accident at Tokyo International Airport, Tokyo, Japan, on 4 March 1966. Report released by the Civil Aviation Bureau, Ministry of Transport, Japan on 4 March 1968

1.- Investigation

1.1 History of the flight

Flight 402 was a scheduled international flight from Hong Kong to Tokyo and Vancouver. It took off from Hong Kong at 1614 hours Japan Standard Time and was routed via Taipei, Kagoshima and Ohshima. At 1908 hours it flew over "Spencer Victor" at 25 000 ft and started to descend gradually; at 1912 hours it crossed "Rice Victor" at 18 000 ft and two minutes later entered the Kisarazu holding pattern at 14 000 ft where it waited for an improvement of the weather conditions at Tokyo International Airport (TIA).

At 1942 hours the flight notified Tokyo air traffic control that if the weather conditions failed to improve within 15 minutes, it would divert to Taipei (alternate airport). Ten minutes later, at 1952 hours the flight was advised by Tokyo ATC that the RVR was 2 400 ft and the pilot then asked for a clearance for approach and landing. The approach clearance was given and the aircraft proceeded to descend to 3 000 ft, in the holding pattern. However, the weather conditions at TIA worsened and the aircraft did not proceed with the approach. The pilot requested a clearance to divert to Taipei at 1958 hours and commenced climbing.

At 2005 hours, while heading for Tateyama en route to Taipei the flight was advised by Tokyo air traffic control that visibility at TIA had improved to $\frac{1}{2}$ mile with RVR 3 000 ft. Consequently, the pilot requested a clearance to return to Kisarazu and began descending from 11 500 ft. At 2011 hours the aircraft arrived over Kisarazu at 3 000 ft and began another approach under instructions of the GCA. At this time the flight was quite normal.

When the aircraft was 8 NM from touchdown at an altitude of 1 500 ft, it was advised that there was a light tail wind 150°/5 kt and was cleared to land on runway 33R.

The rate of descent for final approach was begun about 5.3 NM from touchdown at approximately 2012:58 hours. The aircraft was on course and on the glide path with a ground speed of approximately 174 kt, gradually decreasing to approximately 140 kt at 2 NM and 114 kt after passing 1 NM.

When the aircraft reached one mile from touchdown, the GCA final controller noted that the aircraft was slightly below the GCA glide path and advised "20 ft low, level off momentarily". Nevertheless, the aircraft continued its approach 20 ft below and in parallel with the GCA glide path.

After the aircraft passed the P.M. (precision minimum), the aircraft requested the intensity of the lights to be reduced. Shortly thereafter, the aircraft made a sharp descent and its main landing gear wheel struck No. 14 approach light 2 800 ft from touchdown point approximately in an attitude of level flight. (See Fig. 6-1.)

Following this first contact, the aircraft struck the approach lights one by one until No. 3 damaging or destroying them, and at approximately 2015 hours crashed against the sea wall with the bottom of the fore-fuselage. Then, the aircraft was thrown over near the end of runway 33R, destroyed and caught fire.

1.2 Injuries to persons

Injuries	Crew	Passengers	Others
Fatal	10	54	
Non-fatal		8	
None			

1.3 Damage to aircraft

The aircraft was destroyed by impact and further damage was incurred in the subsequent fire.

1.4 Other damage

Several approach lights and a part of the sea wall were damaged by the impact.

The portion of the sea wall which suffered the most severe damage covered the area from 16 m to 36 m west of the extended centreline of runway 33R.

1.5 Crew information

The pilot-in-command, aged 57, held a valid airline transport pilot licence, a type rating on Douglas DC-8 and a class one instrument flight rating.

He completed his last DC-8 proficiency check on 25 November 1965, and was rated 3* in each item of the check including final approach and landing.

He had passed his last medical examination on 31 August 1965 and his medical certificate was valid until 19 March 1966. He had flown a total of 26 564 hours, including 4 089 hours on DC-8. In the last 90 days preceeding the accident he had flown 237 hours.

The co-pilot, aged 58, also held a valid ATPL with type rating on Douglas DC-8 and a class one instrument flight rating.

He completed his last DC-8 proficiency check on 9 November 1965 and was rated 3* in each item of the check including final approach and landing.

He had passed his last medical examination on 21 January 1966, and his medical certificate was valid until 24 July 1966. He had flown a total of 19 789 hours, including 3 071 hours on DC-8. In the last 90 days he had flown 233 hours.

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* Rating goes from 5 to 1.

The second officer, aged 34, held a valid ATPL with a type rating on Douglas DC-8 and a class one instrument flight rating. He completed his last DC-8 proficiency check on 9 November 1965 and was also rated 3* in each item of the check including final approach and landing.

He had passed his last medical examination on 28 February 1966, and his medical certificate was valid until 16 September 1966. He had flown a total of 7 992 hours, including 3 437 hours on DC-8. In the last 90 days he had flown 255 hours.

Investigation of the flight time of the crew members in the last 90 days and of their activities during the 24 hours preceding the accident revealed no evidence of any factor that could have contributed to the accident.

Post-mortem examination of the crew members did not reveal any evidence of disease or drugs which could have had a bearing on the accident.

1.6 Aircraft information

The aircraft was properly maintained in accordance with CPAL maintenance procedures. It had flown a total of 1 792 hours up to the time of the accident. The take-off weight of the aircraft at Hong Kong was 251 000 lbs and its centre of gravity was at 30 per cent MAC which was within the allowable limits. The amount of fuel on board at the departure was 92 000 lbs, all of which was contained in the wing tanks. It was calculated that the total weight of the aircraft at the time of the accident was 193 736 lbs and its centre of gravity at 26-27 per cent MAC, both within allowable limits.

The fuel on board was ASTM Standard Jet A-1.

1.7 Meteorological information

The 2100 hours weather chart for the day of the accident indicated that a developing low pressure was moving ENE-wards in the south of the Japan Sea and the whole of Japan was in a large low pressure area. There was a warm front extending from the centre of the low almost to the east and a part thereof was crossing the Tokyo Bay.

On the north side of this front, there was light rain, light wind, and very poor visibility was prevailing in a fairly wide area. In and around TIA, the visibility was especially poor due to fog and smoke, it was less than $\frac{1}{2}$ mile.

However, in Osaka, visibility improved to more than 5 miles after 1900 hours and in Fukuoka, it did not reduce below 2 miles throughout the afternoon.

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* Rating goes from 5 to 1.

The weather conditions at TIA before and after the accident were as follows:

TIME (I)	CEILING & SKY	VISIBILITY (Mile)	WEATHER	SEA LEVEL PRESS. (mb)	TEMP. (F)	DEW PT. (F)	WIND		ALTIMETER SET. (ins)	RVR (ft)
							DIRECTION	SPEED (KTS)		
1913	-X E3 OVC	1/8	R-FK				09	07	2969	1,600
1915	-X E3 OVC	-	-				-	-	-	1,200
1928	X2X	1/16	R-FK		56	55	07	07	2968	1,200
1940	W2X	1/8	R-FK				10	04	2968	1,200
1947	W3X	3/16	R-FK				14	01	2968	1,600
1952	-X E3 OVC	3/16	R-FK				11	04	2968	2,400
1958	-X E3 OVC	3/16	R-FK	050	56	55	11	04	2967	2,200
2005	-X E5 OVC	1/2	R-FK				11	04	2966	3,000
2012	-X E5 OVC	5/8	R-FK				13	05	2965	3,000
2020	-X E5 OVC	5/8	R-FK		58	57	16	04	2965	3,000

In addition, VOLMET broadcast from the weather station at TIA gave hourly or special observations of Tokyo, Osaka, Fukuoka, etc. and aerodrome forecast of Tokyo at 10 minutes after the hour. It also gave check observations of Tokyo, hourly or special observations of Osaka, Fukuoka, etc. and aerodrome forecast of Tokyo at 40 minutes after the hour. Special observation at Tokyo at 2005 hours on 4 March was included in the broadcast made at 2010 hours.

The stationary front, which had been lying across the southern part of the Tokyo Bay until about 2000 hours started to move northward and it was estimated that at the time of the accident the front was on a line connecting Kisarazu and the mid-point of Yokohama and Yokosuka. The gradient of that front was estimated as being about 1/360. It was believed that the aircraft crossed the bottom of this front during its final approach at an altitude of about 200 ft.

1.8 Aids to navigation

The operating conditions of NAVAID's and facilities at TIA on the day of the accident were as follows:

T.I.A.	Date of the last flight check	Operating conditions	Operating hours
PAR (33L)	6 Jan., 1966	In operation	24 hours
PAR (33R)	6 Jan., 1966	In operation	24 hours
ASR	4 Feb., 1966	In operation	24 hours
ILS (Glide slope)	4 Nov., 1965	Awaiting flight check*	-
ILS (Localizer)	15 Feb., 1966	In operation	24 hours

* ILS (Glide Slope) of TIA was certified to be operating satisfactorily in the flight check on 5 March 1966. Another special flight check of PAR (33R) on the same day revealed no evidence of malfunction.

T.I.A.	Date of the last flight check	Operating conditions	Operating hours
NDB			
HANEDA NDB (HM)	29 July, 1965	In operation	24 hours
KISARAZU NDB (KZ)	6 Aug., 1965	In operation	24 hours
TATEYAMA NDB (PQ)	14 July, 1965	In operation	24 hours
RANGE			
OHSHIMA RANGE (XA)	15 June, 1965	In operation	24 hours
VOR			
TOKYO VOR (TYO)	29 Jan., 1966	In operation	24 hours
KISARAZU VOR (KZO)	14 Dec., 1965	In operation	24 hours
VORTAC			
OHSHIMA VORTAC (XAC)	6 Jan., 1966	In operation	24 hours

1.9 Communications

The communications between the aircraft and Tokyo ATC during the final phase of the approach were normal and are reproduced underneath.

Time	Communicator	Content of Communication
about 2010:59	402	Empress Jet 402 is by the Outer Marker, and 3 000
	FDR*	Roger Empress 402, descend and maintain 1 500 ft on a heading 320, position 12 miles south-southeast, over
	402	402, Roger descending 1 200
	FDR	Negative, 1 500, over
	402	402, 1 500, we are out of 2 500
	FDR	Empress 402, Wind calm, this time cleared to land 33 right when you have runway in sight and stand by on this frequency for final controller, over
	402	402
about 2011:35	FNL**	Empress Jet 402 make a right turn to heading 325, final controller, do you read over
	402	402 loud and clear
	FNL	Roger, do not acknowledge, turn right 330, 330 is your new heading, radar contact on precision, below the glide path, maintain,
about 2011:57		1 500, lined up on course, 8 miles from touch down, surface wind are tail wind 150° at 5 knots, you have been cleared to land runway 33 right, turn to the left heading 325 again, drifting to the
about 2012:19		right of on course, stand by the rate of descent in 25 seconds, 7 miles from touch down, coming to course very good, right to the

* FDR feeder
** FNL final controller

Time	Commu-nicator	Content of Communication
about 2012:39		left, very slightly right of on course, right turn to heading 328, 328 is your new heading, right turn to heading 329, small correction, 329 new heading, lined up on course, 6 miles from touchdown, right turn to heading 332. 332 is your new heading, lined up on course, stand by for rate of descent in 10 seconds, check gear down and locked, make a right turn to 334, going just slightly left of on course, begin your rate of descent now, 20 feet low, 15, 10, 5, on glide path, lined up on course, 334 is your heading, make left to heading 332, left turn to heading 330, 4 ¼ miles from touch down. I say again cleared to land 33 right, tail wind at 4 kt, gear should be down and locked, steady on course on glide path, very good rate of descent, tracking on course, 3 ½ of a mile from touch down, new altimeter 2965, altimeter 2965, on course, on glide path, dropping low to 5 ft, 10 ft low, turn left 330, left turn to 328, up on the glide path, 328 is your new heading, right of on course, right turn to 330 to line up, lined up on course, on glide path, range 2 miles from touch down, gear should be down and locked, on course on glide path, tail wind at 4 kt, take up heading 329, small correction, 329, on course 1 ¼ miles, turn left 327, 327, left turn to 325, slightly right of on course, on glide path, turn left momentarily 323, 323 new heading, 1 mile, right heading 325, on course, on glide, dropping low, 10 to 15, 20 ft low, level off momentarily, precision minimum, level off, twenty feet low ...
about 2012:58		
about 2013:12		
about 2013:30		
about 2014:00		
about 2014:18		
about 2014:32		
about 2014:39		
about 2014:42	402	Eh.... tower, would you turn your la..ah.. runway lights down.
about 2014:44	FNL	Roger

1.10 Aerodrome and ground facilities

Runway 33R is 3 150 m long, 60 m wide and has an elevation of 2.5 m and a runway gradient less than 0.2 per cent. There is a sea wall approximately 300 ft before the threshold:

the top of this sea wall is approximately one metre below the threshold.

Lighting facilities for runway 33R were as follows:

1) ALPA Type approach lights ranging 3 000 ft long

2) Touchdown zone lights

3) High intensity runway-end lights

4) High intensity runway lights

5) Runway centreline lights

From the lighting facilities routine check report and the indications on the monitoring board on that night, the lighting facilities were operating normally prior to the accident.

1.11 Flight recorders

The aircraft was not equipped with flight recorders.

1.12 Wreckage

Some parts of the aircraft, including No. 2 engine, were found in the Bay of Tokyo, between No. 9 approach light and the sea wall, but the main part of the wreckage was located on the ground in the vicinity of the threshold of runway 33R where the aircraft had been thrown into pieces after it had struck the sea wall.

Paint from the approach lights was found on the nose cowling, right cowling, exhaust nozzle, ejector and leading edge of pylon of No. 1 engine; exhaust nozzle and front inlet guide vane of No. 2 engine; left main gear door; two main gear tyres; left and right inside flaps and fuselage adjacent to the inside flaps.

Detailed examination of the wreckage revealed that, at the time of the accident, the aircraft was in landing configuration and the engines were operating normally at rather low power. No evidence of any structural failure or of a malfunction or failure of any system which might have caused the accident was found. A scar on the pilot-in-command's airspeed indicator showed that the indicated airspeed of the aircraft when it struck the sea wall was in the order of 125 ± 15 kt.

1.13 Fire

It was presumed that the fire resulted from the fact that after crashing against the sea wall, the fuel tanks were destroyed and considerable amounts of fuel were thrown out.

At about 2015 hours the airport fire fighting unit was advised by air traffic control that an aircraft accident had occurred near the threshold of runway 33R. It arrived at the accident site at about 2020 hours. The fire arose from 20 to 30 scattered portions but the main fires were around the central and the aft portions of the fuselage.

The airport fire fighting unit requested the assistance of a fire fighting organization outside of the airport. The fire was extinguished at approximately 2100 hours.

Foam, water and C.B. (chlorobromomethane) fire extinguisher were used.

1.14 Survival aspects

Out of 72 passengers and crew members on board, 8 passengers who were seated near the central portion of the fuselage at the time of accident survived. They escaped through torn portions of the fuselage or the forward door which was believed to have broken off at impact.

All the others were killed due to heavy contusions at impact or burns by the ensuing fire, or a combination of both.

1.15 Tests and research

Tests were conducted on a DC-8-33 type simulator of Japan Airlines as well as a DC-8-43 type simulator of CPAL in an attempt to see if it was possible to fly a DC-8 so as to strike No. 14 approach light starting from the supposed position immediately after P.M. The results thereof revealed that it was difficult but not necessarily impossible to make a manoeuvre to follow such a flight path.

2.- Analysis and Conclusions

2.1 Analysis

The aircraft entered Kisarazu holding pattern at 1916 hours and started descent to 3 000 ft for an approach at 1952 hours. However, the descent was discontinued and a diversion to Taipei was initiated. Five minutes later, air traffic control advised that the visibility had improved to ½ mile and RVR to 3 000 ft. Consequently, plans were changed and a GCA approach was commenced about 2007 hours.

Taking into consideration that some 4 hours had elapsed since departure from Hong Kong and about an hour since entering the Kisarazu holding pattern, the pilot-in-command was certainly concerned about the remaining fuel for the alternate airport. Also, since he had agreed to expedite his approach, it may be inferred that the pilot-in-command was rather in a hurry to take this opportunity for landing in view of the changeable weather conditions.

The first part of the descent for the final approach was smooth. The ground speed which was initially 174 kt, a little faster than normal, started to decrease in the vicinity of 3 NM and was reduced to 114 kt after passing one nautical mile (see Figure 6-2). The initial ground speeds having been somewhat faster than normal could indicate the existence of a considerable tail wind along the course or a desire of the pilot-in-command to expedite the landing. Adjustment of the throttle levers for obtaining a normal approach speed and for controlling a decrease in velocity of the tail wind at low altitude, might have resulted in a slightly low flight path after passing one nautical mile on final. The aircraft went below the glide path on two other occasions, once at the start of the GCA descent, and once at about 3 NM on final; in both cases, the deviation was less than 20 ft and prompt and precise corrective actions were taken in accordance with instructions of the final controller. This might indicate a high degree of proficiency of the pilot-in-command in manoeuvring the aircraft.

Although the glide slope of the ILS was not cleared for operation pending flight check, both glide slope and localizer were operating.

Another flight from Honolulu to Tokyo diverted to Itazuke after attempting two landing approaches at TIA under GCA at about 1830 hours. The pilot-in-command testified that he utilized ILS for reference and that indications of the glide slope coincided with the guidance of GCA. At about 1958 hours the aircraft transmitted on the company frequency that a GCA approach would be made with ILS for reference. An investigation of the wreckage revealed that the ILS frequency was tuned in. From the above evidence it is considered that the pilot-in-command was using ILS as a reference.

A flight check conducted on the day following the accident showed that the ILS was operating normally and that its glide slope was 2.52° and the GCA glide path 2.66°. Both figures fell within the allowable limit of 2.5° ± 0.2°, and the difference of 0.14° between the two glide paths was within the allowable error of 0.2°. The ILS glide slope was somewhat lower, and 20 ft below GCA glide path in the vicinity of P.M. Even with a flight path permanently 20 ft below the GCA glide path, a safe landing could have been made.

The fact that the aircraft proceeded almost parallel with the GCA glide path until it entered a steep descent and did not adjust after receiving the GCA controller's advice of 20 ft below may be attributable to the pilot-in-command having been in full cognizance of his altitude by reference to ILS indications, and it could not be considered as indicating misjudgement of the altitude nor existence of any other abnormalities.

No reason for the sharp descent which followed immediately thereafter was found.

The GCA final controller stated that upon vectoring the aircraft to the P.M., he advised again to "level off, 20 ft low". The aircraft then requested a decrease in the intensity of the lights. He answered in the affirmative and took immediate action, suspending his watch of the radar-scope momentarily. Then his watch was resumed there remained only a wake on the elevation radar scope indicating a sharp descent, the target being in and out among the ground clutters on the horizon, while the target on the azimuth scope surface was still moving. His understanding at that moment was that the flight was still continuing on a lower approach. The image on the scope, however, suddenly faded away near the sea wall and then he realized that something unusual had occurred.

In reality, the aircraft struck an approach light immediately after the sharp descent and the electric circuit of the approach lighting system had been broken before the tower controller was able to reduce the intensity of the approach and runway lighting upon receiving the request notified by the GCA final controller.

It was estimated that the sharp descent directly related to the accident occurred between approximately 2014:44 (about 3 900 to 3 600 ft from touchdown) and approximately 2014:49 to 50 (about 2 800 ft from touchdown).

Due to the approach 20 ft below the glide path, the aircraft was informed of passing P.M. in the vicinity of the ILS middle marker (see Figure 6-3). It was not believed that the pilot-in-command who had a great deal of experience at TIA and had the ILS glide slope as a reference, could have had doubts regarding his position at this stage and mistaken the approach lights for runway lights. However, judging solely from the initial attitude of almost level flight in which the aircraft struck the approach lights, it might be concluded that a landing manoeuvre was being made at this point although this was considered to be unlikely.

The pilot-in-command of the flight which made two landing attempts testified that in both cases he distinguished the approach lights from the runway lights at an altitude of some 400 ft. On his first attempt, he approached with all landing lights on and judged a landing to be possible. However, feeling he might experience difficulty in maintaining directional control of the aircraft during the landing roll owing to irregular reflection of the lights by the fog, he carried out a missed approach. On his second attempt the approach was made with the wing tips landing lights only, but still irregular reflection was severe, and he decided to divert to Itazuke. The RVR at the time of

accident is believed to have been worse than it was when the approaches were aborted by the previous aircraft. Nevertheless, from testimony of a survivor, it was concluded that some lights on the ground were sighted at least at P.M. Another survivor testified that landing lights were flashing on and off and it was concluded that the pilot-in-command had probably some difficulties to obtain sufficient visibility owing to the irregular reflection of lights by the fog. It was also believed in the light of the last communication from the aircraft, that the pilot-in-command was not particularly concerned by the touchdown itself but that his main concern had shifted to manoeuvring on the runway after touchdown.

The aircraft is presumed to have been traversing the bottom of the front between approximately 1 NM final and P.M., and therefore, a decline in the velocity of the tail wind due to wind shear or turbulence may, to some extent, have existed. However, it is hard to believe that the aircraft having flown almost in parallel with the glide path after passing P.M. 20 ft below, might have encountered meteorological conditions such as to make it lose more than 100 ft.

It was concluded that this descent was the result of an intended manoeuvre by the pilot-in-command, who was attempting a decisively low approach in view of possible directional control problems on the runway after touchdown.

Moreover, a calculation made of the chronological sequence indicated that the descent was initiated during his communication with GCA or prior thereto and levelling out was executed within 2 or 3 seconds after the controller acknowledged "Roger" since the initial impact with the approach lights was made in an attitude of level flight.

However, even though this descent may have been deliberate it is difficult to understand why the aircraft was allowed to descend so low as to strike the approach lights. Considering that the first impact with the approach lights was very slight, it was considered that illusions due to fog may have misled the pilot-in-command in his judgement during this phase of descent.

The approach was conducted under very difficult conditions and the abrupt descent during the final stage might be considered as acceptable for a veteran pilot. However, such a technique could hardly be considered as normal landing procedure, and, even though there might have been other unconceivable factors, it was considered that the very judgement of the pilot-in-command to carry out an approach under the circumstances was the principal cause of the accident.

2.2 Conclusions

(a) Findings

The crew was properly certificated and the pilot-in-command and co-pilot had considerable flying experience. The aircraft had a valid certificate of airworthiness and had been properly maintained. The weight and balance of the aircraft both at take-off and at the time of the accident were within allowable limits.

The visibility at Tokyo International Airport was reduced at the time of landing to less than half a mile by fog and smoke, RVR was in the order of 3 000 ft.

The aircraft carried out a GCA approach to runway 33R under very difficult conditions. It was considered that the approach was normal until a point located between 3 900 and 3 600 ft before the touchdown point. It then entered a steep rate of descent between 3 900 and 3 600 ft before the touchdown point, it first struck an approach light 2 800 ft from the touchdown point in an attitude of level flight, then broke several approach light piers and crashed against the sea wall of the airport. The wreckage was thrown over the sea wall near the runway threshold and completely destroyed by the ensuing fire.

The steep rate of descent was considered to be the result of an intentional manoeuvre of the aircraft by the pilot-in-command with a view to executing a final approach at a lower altitude than normal.

Although no certain cause for the excessive descent which led to striking the approach lights could be determined, it was considered that the poor visibility due to illusive fog conditions that night misled the pilot-in-command in his judgement.

(b) Cause or
Probable cause(s)

Pilot misjudged landing approach under unusually difficult weather conditions.

ACCIDENT TO DOUGLAS DC-8, CF-CPK, OF CANADIAN PACIFIC AIR LINES LTD.,
AT TOKYO INTERNATIONAL AIRPORT, TOKYO, JAPAN, ON 4 MARCH 1968

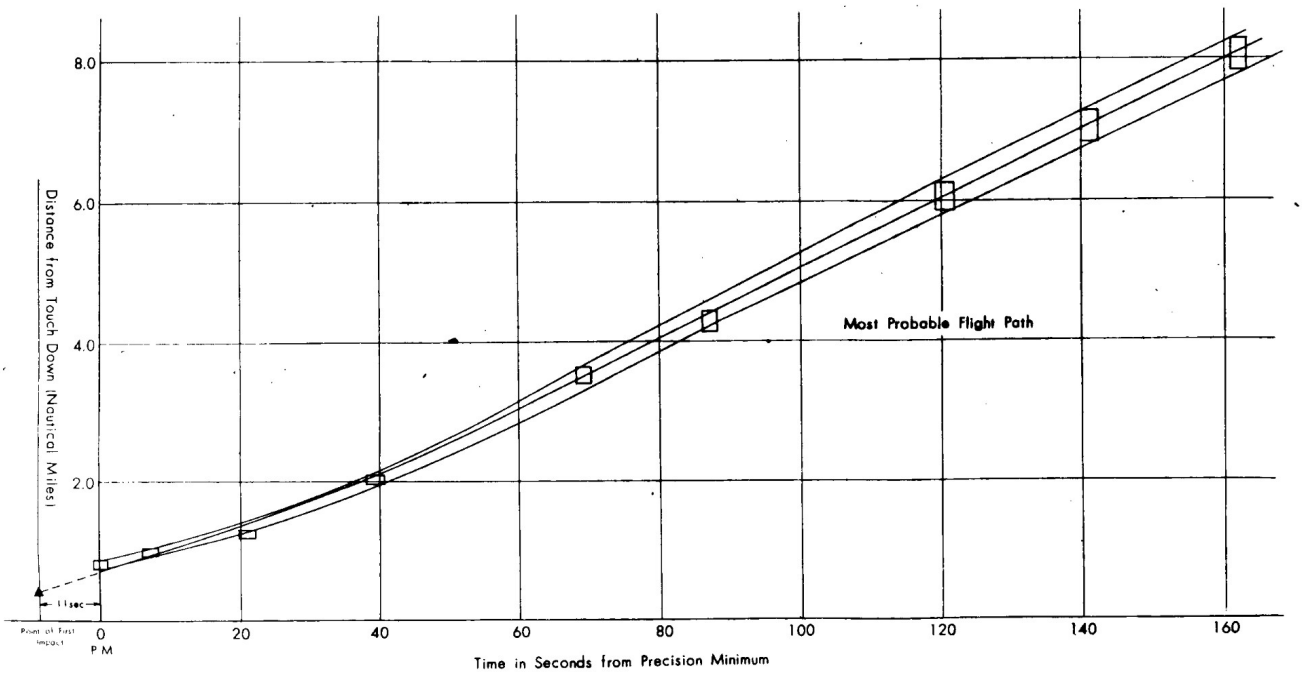

Fig. 6-1.- Time vs. Distance Error Envelope Curves and Most Probable Flight Path Between 8 Nautical Miles and Near P.M.

ACCIDENT TO DOUGLAS DC-8, CF-CPK, OF CANADIAN PACIFIC AIR LINES LTD.,
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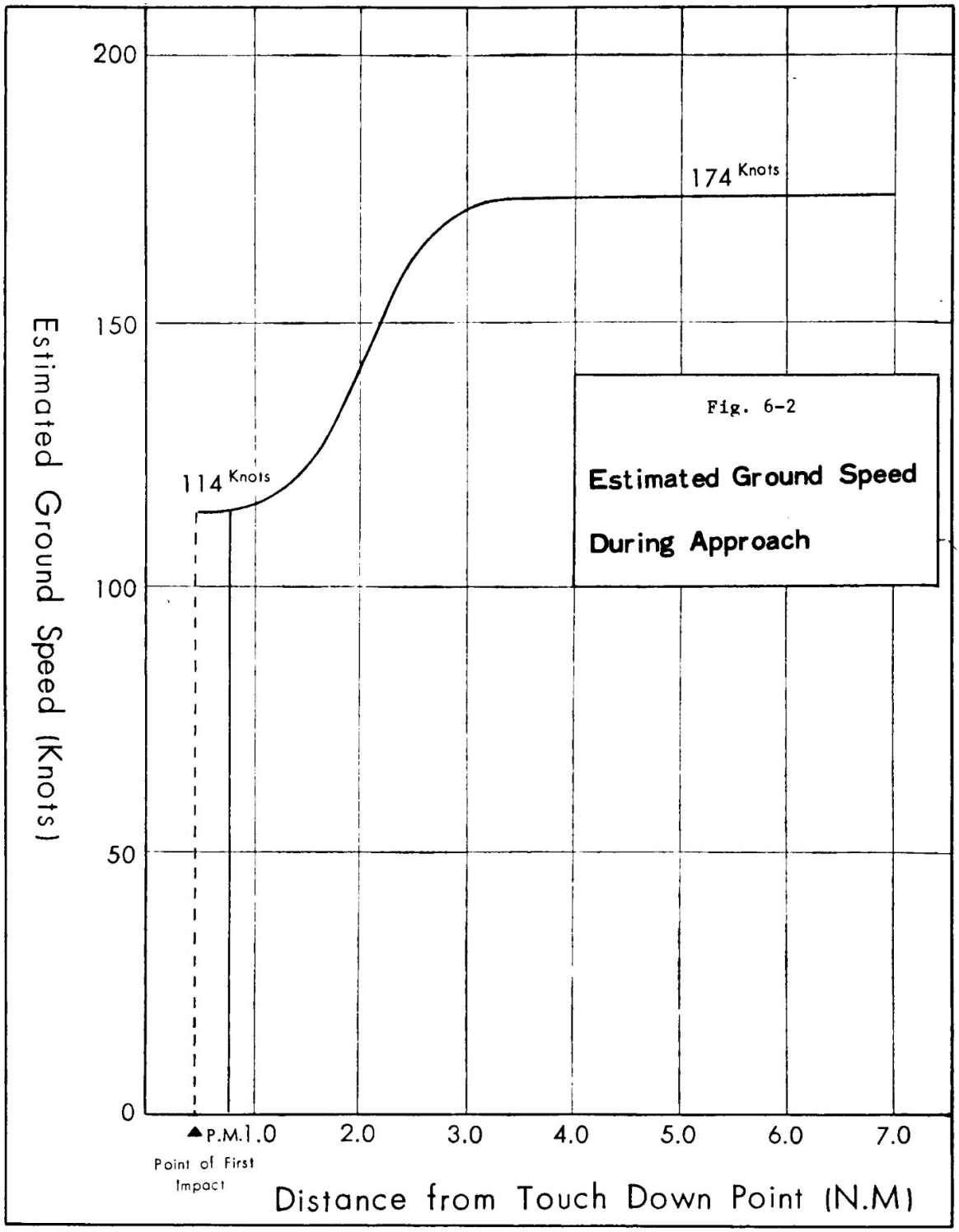

Fig. 6-2

Estimated Ground Speed During Approach

ACCIDENT TO DOUGLAS DC-8, CF-CPK, OF CANADIAN PACIFIC AIR LINES LTD.,
AT TOKYO INTERNATIONAL AIRPORT, TOKYO, JAPAN, ON 4 MARCH 1968

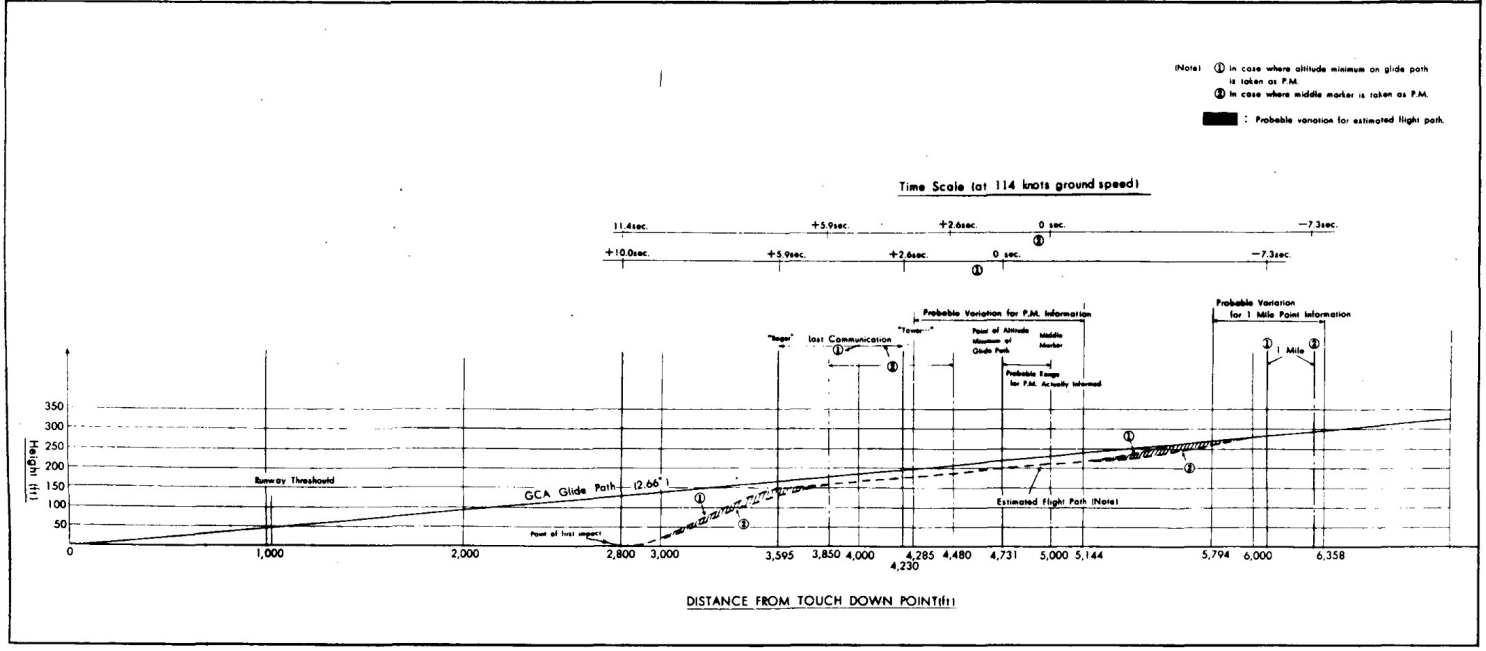

Fig. 6-3.- Estimated Flight Path after approx. 1 Nautical Mile