CORRECTION

MINISTERIO DE TRANSPORTES
Y COMUNICACIONES
SUBSECRETARIA DE AVIACION CIVIL
DIRECCION GENERAL DE TRANSPORTE AEREO
COMISION DE ACCIDENTES
mp./

Madrid, 16 de Noviembre de 1978

Mr. E. Douglas Dreifus
NTSB
WASHINGTON, DC 20594
U.S.A.

Subject: Correction of the Report on the accident involving aircraft BOEING 747 PH-BUF of KLM and BOEING 747 N 736 PA of PANAM.

Dear Sir:

Please note following corrections:

- On the cover and on the first page the 4th line reads:
  "N 737 PA DE PANAM"

  it should read:
  " N 736 PA DE PANAM".

- On page 58, cause 3, of the english report which due to an error in the translation reads:

  "3. Did not interrupt take off on learning that PANAM was still on the runway".

  It should read:

  "3. Did not interrupt take off when PANAM reported that they were still on the runway".

Kind regards,

Fdo: José Bellido Grela
-SECRETARIO GENERAL-

J O I N T R E P O R T

K.L.M.-P.A.A

12.7.1978

COLISION AERONAVES

BOEING 747 PH-BUF DE

K.L.M Y BOEING 747

N 737 PA de PANAM

EN LOS RODEOS (TENERIFE)

EL 27 DE MARZO DE 1.977

-o-o-o-o-o-

1.- INVESTIGATION

1.1 Flight History

The K.L.M. Boeing 747, registration PH-BUF, took off from Schipol Airport (Amsterdam) at 9:00 hours on March 27, en route to Las Palmas de Gran Canaria. This flight was part of the Charter Series KL 4805/4806 Amsterdam-Las Palmas (Canary Islands)-Amsterdam operated by K.L.M. on behalf of the Holland International Travel Group (H.I.N.T.) Rijswijk-Z.H.

The Boeing 747 registration N 736 PA, flight number 1736, left Los Angeles International Airport, California, U.S.A., on March 26, 1977, local date, at 0129 z hours, arriving at John F. Kennedy International Airport at 0617 z hours. After the plane was refuelled and a crew change effected, it took off for Las Palmas de Gran Canaria (Spain) at 0742 z.

While the planes were en route to Las Palmas, a bomb exploded in the airport passenger terminal. On account of this incident and of a warning regarding a possible second bomb, the airport was closed. Therefore, K.L.M. 4805 was diverted to Los Rodeos (Tenerife) Airport, arriving at 1338 z on March 27, 1977. For the same reason, P.A.A. 1736 proceeded to the same airport, which was its alternate, landing at 1415.

At first the K.L.M. passengers were not allowed to leave the plane, but after about twenty minutes they were all transported to the terminal building by bus. On alighting from the bus, they received cards identifying them as passengers in transit on flight KL 4805. Later, all the passengers boarded K.L.M. 4805 except the H.I.N.T. Company guide, Miss Robina Guiseline

Monique Van Lanschot, who remained in Tenerife.

When Las Palmas Airport was opened to traffic once more, the P.A.A. 1736 crew prepared to proceed to Las Palmas, which was the flight's planned destination.

When it attempted to taxi on the taxiway leading to runway 12, where it had been parked with four other planes on account of the congestion caused by the number of flights diverted to Tenerife, they discovered that it was blocked by K.L.M. Boeing 747, flight 4805, which was located between P.A.A. 1736 and the entrance to the active runway. The first officer and the flight engineer left the plane and measured the clearance left by the K.L.M., reaching the conclusion that it was insufficient in order to let P.A.A. 1736 pass by, obliging them to wait until the former had started to taxi.

The P.A.A. 1736 passengers did not leave the plane during the whole time that it remained in the airport.

K.L.M. 4805 called the tower at 1656 requesting permission to taxi. It was authorized to do so and at 1658 requested to backtrack on runway 12 for take off on runway 30. "The tower controller first cleared the K.L.M. to taxi to the holding position for runway 30 by taxiing down the main runway and leaving it by the (third) taxiway to its left." K.L.M. 4805 acknowledged receipt of this message from the tower, stating that it was at that moment taxiing on the runway, which it would leave by the first taxiway in order to proceed to the approach end of runway thirty. The tower controller immediately issued an amended clearance, instructing it to continue to taxi to the end of the runway, where it should proceed to make a back-track.

The K.L.M. confirmed that it had received the message, that it would make a back-track, and that it was taxiing down the main runway. The tower signalled its approval, whereupon K.L.M. 4805 immediately asked the tower again if what they had asked it to do was to turn left on taxiway one. The tower replied in the negative and repeated that it should continue on to the end of the runway and there make a back-track.

Finally, at 1659, K.L.M. 4805 replied, "O.K., Sir."

At 1702, the P.A.A. called the tower to request confirmation that it should taxi down the runway. The tower controller confirmed this, also adding that they should leave the runway by the third taxiway to their left. At 1703:00, in reply to the tower controller's query to K.L.M. 4805 as to how many runway exits they had passed, the latter confirmed that at that moment they were passing by taxiway C-4. The tower controller told K.L.M. 4805, "O.K., at the end of the runway make one eighty and report ready for ATC clearance."

In response to a query from K.L.M. 4805, the tower controller advised both planes - K.L.M. 4805 and P.A.A. 1736 - that the runway centerline lights were out of service. The controller also reiterated to P.A.A. 1736 that they were to leave the main runway via the third taxiway to their left and that they should report leaving the runway.

At the times indicated, the following conversations took place between the tower and the K.L.M. 4805 and P.A.A. 1736 planes.

Times taken from K.L.M. CVR.

1705:44.6

K.L.M. 4805 The K.L.M. four eight zero five is now ready for

take off and we are waiting for our ATC clearance (1705:50.77).

1705:53.41

Tower — K.L.M. eight seven zero five you are cleared to the Papa Beacon, climb to and maintain flight level nine zero, right turn after take off, proceed with heading four zero until intercepting the three two five radial from Las Palmas VOR (1706:08.09).

1706:09.61

K.L.M. 4805 — Ah - Roger Sir, we are cleared to the Papa Beacon, flight level nine zero until intercepting the three two five. We are now (at take off) (1706:17.79).

1706:18.19

Tower — O.K..... Stand by for take off, I will call you (1706:21.79).

Note: A squeal starts at: 1706:19.39.
The squeal ends at: 1706:22.06.

1706:21.92

P.A.A. 1736 — Clipper one seven three six. (1706:23.39)

1706:25.47

Tower — Ah - Papa Alpha one seven three six report the runway clear. (1706:28.89).

1706:29.59

P.A. 1736 — O.K., will report when we're clear. (1706:30.69)

1706:31.69

Tower — Thank you.

Subsequently, K.L.M. 4805, which had released its brakes to start take-off run 20 seconds before this communication took place, collided with the P.A.A.

The control tower received no further communications from P.A.A. 1736, nor from K.L.M. 4805.

There were no eyewitnesses to the collision.

Place of accident

The accident took place on the runway of TENERIFE Airport (Los Rodeos) at North 28º 28' 30" latitude and West 16º 19' 50" longitude. The field elevation is 2073 feet (632 meters).

Date

The accident occurred on March 27, 1977, at 17 hours 06 minutes 50 seconds G.M.T.

1.2 Injuries to persons

1.2.1. K.L.M. 4805 plane

INJURIES	CREW	PASSENGERS	OTHERS
FATAL	14	234	-
NON-FATAL	-	-	-
NONE	-	-	-
TOTAL	14	234	-

1.2.2 P.A.A. 1736 plane

INJURIES	CREW	PASSENGERS	OTHERS
FATAL	9	317	-
NON-FATAL	7	61*	2**
NONE	-	-	-
TOTAL	16	378	2

* 9 of these passengers subsequently died as a result of injuries received.

** Company employees, sitting on the cockpit jumpseats, who had boarded the plane in Tenerife.

1.3 Damage to the aircraft

Damage to the planes was 100% due to the impact and post-impact fire.

1.4 Other damage

The runway was damaged in the area of impact by the impact itself and by subsequent fire. Costs of repairs thereof amounted to 16,005,464.22 pesetas.

1.5 Crew information

1.5.1 K.L.M. Crew

Captain

JACOB LOUIS VELDHUYZEN VAN ZANTEN

Nationality: Dutch

Date and place of birth: February 5, 1927, in LISSE (Netherlands)

Address: ELBALAAN 3, SASSENHEIM, NETHERLANDS.

LICENCES

Private Pilot's Licence No. 708, issued 21.6.1947

Commercial Pilot's Licence No. 50-10, issued 18.4.1950

Flight Navigator's Licence No. 63-24, issued 6.8.1963

Airline Transport Pilot's Licence No. 56-20, issued 19.10.56 and valid until 16.6.77

Flight Radiotelephone Operator's Licence No. 52-326, issued 22.9.52 and valid until 2.10.80.

Type ratings

Douglas DC-3	28.9.51	until	20.6.62
Convair CV 240/340	23.8.52	"	20.6.62
Lockheed L749/1049	1.10.52	"	20.6.62
Douglas DC-6	12.2.57	"	20.6.62
Douglas DC-7C	6.6.57	"	20.6.62
V. Viscount 803	11.6.59	"	21.7.67
Douglas DC-9	16.3.67	"	9.6.71
Boeing 747	23.1.71	"	16.6.77

Flying experience

Total flying time as of 27.3.77: 11,700 hours

Flying time on Boeing 747 as of 27.3.77: 1,545 hours

Last medical examination

29.12.1976. Result: fit for ATPL

Last proficiency check:

25.1.77: O.K.

Co-pilot (First Officer) KLASS MEURS

Nationality: Dutch

Date and place of birth: 14.2.1935 in OPPERDOES, Netherlands

Address: JEROEN BOSLAAN 6, HEEMSTEDE, Netherlands

LICENCES

Private Pilot's Licence No. 58-56, issued 31.5.1958

Commercial Pilot's Licence No. 60-12, issued 2.3.1960

Flight Navigator's Licence No. 66-12, issued 20.4.1966 and valid until 26.6.77

Flight Radiotelephone Operator's Licence No. 57-168, issued 30.12.1957 and valid until 2.6.81

Airline Transport Pilot's Licence No. 70-36, issued 5.6.1970 and valid until 29.6.1977.

Type ratings

Beechcraft D18S	2.3.1960	until	11.7.1961
Fokker F-27	26.8.1966	"	2.7.1970
Douglas DC-8	13.12.1970	"	29.6.1977
Boeing 747	19.1.1977	"	29.6.1977

Flying experience

Total flying time as of 27.3.77: 9,200 hours

Flying time on Boeing 747: 95 hours

Last medical examination

29.12.1967. Result: fit for ATPL

Last proficiency check

17.1.1967. Result: O.K.

Flight Engineer: WILLEM SCHREUDER

Date and place of birth: 30.8.28 in Amsterdam (Netherlands)

Nationality: Dutch

Address: JOHANNES MEYBEEKLAAN 19, VOORBURG, Netherlands

LICENCES

Flight Engineer's Licence No. 50-07, issued 12.5.1950 and valid until 3.9.77

Flight Radiotelephone Operator's Licence No. 70-185, issued 10.6.70 and valid until 3.9.77

Private Pilot's Licence No. 73-129, issued 6.9.73 and valid until 3.9.77

Type ratings

Douglas DC-3	12.5.50	until	28.3.58
Douglas DC-6	28.3.58	"	24.10.60
Douglas DC-7C	28.3.58	"	24.10.60
Douglas DC-8	24.10.60	"	3.9.76
Boeing 747	22.4.76	"	3.9.77

Flying Experience

Total flying time: 17,031 hours

Flying time on Boeing 747: 543 hours

Last medical examination

16.8.76 Result: fit for Flight Engineer

1.5.2 P.A.A. CREW

Captain

Name and address: VICTOR F. GRUBBS
220 Littleneck Road
Centerport, N.Y. 11721

Nationality:	American
Date of birth:	May 18, 1920
Total flying time:	21,043 hours
Total 747 hours:	564
Total last 30 days:	63:43
Total last 24 hours:	6:33
Total this flight:	0
Last medical examination:	March 23, 1977
Certificates and ratings:	ATP 1274226; 747 and 707 ratings
Last proficiency check:	15.11.76

Co-pilot (First Officer)

Name and address:	ROBERT L. BRAGG 16414 95th St. Howard Beach, N.Y. 11414
Date of birth:	September 14, 1937
Total flying time:	10,800 hours
Total 747 hours:	2,796
Total last 30 days	42:39
Total last 25 hours	6:33
Total this flight	0
Last medical examination:	13.1.77
Certificates and ratings:	ATP No. 1581349; 747 and 707 ratings
Last proficiency check:	17.1.77

Flight Engineer

Name and address:	GEORGE W. WARNS RD No. 1, Box 6 Blairstown, N.Y.
Date of birth:	December 12, 1930
Total flying time:	15,210 hours
Total 747 hours:	559
Total last 30 days:	52:01

Total last 24 hours 6:33

Total this flight: 0

Last medical examination: June 25, 1976

Certificates and ratings: Flight Engineer No. 1313579 - Turbojet rating

1.6 Aircraft information

1.6.1 K.L.M. 4805

Aircraft type: Boeing 747-206B

Registration: PH-BUF

Serial No.: 20400

Year of manufacture: 1971

Manufacturer: THE BOEING COMPANY, SEATTLE, WASHINGTON, U.S.A.

Airworthiness Certificate: No. 11877

Date of first issue: October 19, 1971 (as Certificate of Validation, valid for three months) issued by the Department of Civil Aviation, Aeronautical Inspection Directorate

Date of definitive First Issue: 13.12.71

Date of last renewal: 15.11.76

Date of expiry: 13.2.77

Maintenance record

Total airframe hours as of 27.3.77: 21,195

Total number of landings: 5,202

Last Major Overhaul/Inspection: January 1975, at 13,200 hours total aircraft time

Last Periodical Inspection: March 18, 1977; D-11 check at 20,898 hours total aircraft time

Maintenance Release: No. 8076 of March 18, 1977, signed by A. A. M. Jansen, No. M-086

Engines

Number of engines: four (4)

Engine type: Pratt and Whitney JT-9 D-7

Engine position	Serial No.
Position 1	663056
" 2	685641
" 3	662694
" 4	662800

On the day of the accident, engine no. 1 had accumulated 15,080 total flying hours; no. 2 had accumulated a total of 16,677 hours; no. 3, 6,716 hours; and no. 4, 13,692 hours. The corresponding number of cycles was as follows: no. 1: 3,340 cycles; no. 2: 3,337 cycles; no. 3: 1,687 cycles; and no. 4: 3,399 cycles.

1.6.2 P.A.A. 1736

Aircraft type: Boeing 747-121

Registration: N736PA

Serial no. 19643, manufactured in January 1970 under a Standard Airworthiness Certificate, Transportation Category

Total hours: TT: 25,725

TC: 7,195

(These hours and cycles go up till 27.3.77 in JFK Airport)

Owner: PAN AMERICAN (PAA)

Flight number: 1736

Maintenance record

The plane was equipped with an instrument flying panel in accordance with airline requirements under CFR 14, U.S. Code Far 121 and 25.

On March 17, 1977, at 25,726 total aircraft time, the aircraft received a Preflight Inspection in accordance with the PAA FAA Approved Maintenance Program.

Engines

Engines: Pratt and Whitney JT 9 D-7CN

No. 1 - Serial no. P 662403 CN :	total hours:	14,364
	total cycles:	4,234
No. 2 - Serial no. P 662996 CN :	total hours:	13,350
	total cycles:	2,824
No. 3 - Serial no. P 662256 CN :	total hours:	18,511
	total cycles:	6,666
No. 4 - Serial no. P 662307 CN :	total hours:	16,281
	total cycles:	4,838

NOTE: Not included are the flying hours from JFK (John F. Kennedy Airport in New York to Tenerife, i.e., 6:33 hours).

1.7 Metecrological information (Appendix 2)

At Los Rodeos Airport, this is provided by:

1.- A weather observation tower located at about 400 meters south west of the approach end of runway 30.

2.- Another tower located at about 200 meters north east of the approach end of runway 12.

3.- A visibility transmissometer, located at about 70 meters south of the runway 30 approach.

4.- A ceilometer located in the same place.

5.- Barometric pressure, temperature and dew point recording equipment.

6.- Teletype for route weather information.

7.- Visibility is reported by the tower controller when the approach to the runway in service is in sight. Otherwise, this is done by an observer in the weather observation tower.

8.- Runway visual range (RVR) is not reported.

9.- The following visibility values are given:

- Horizontal and slant approach
- Runway
- Taxiway

Pertinent weather observations (QAM) as from 16:30 hours were as follows:

QAM at approach end of runway 30 at 16:30 hours

horizontal Approach/visibility:	10 km
Runway visibility:	3 k.
Approach slant visibility:	7 to 8 kilometers
Present weather:	Intermittent light rain and fog at distance
Cloud coverage:	1/8 at zero meters, 2/8 at 30 meters, 2/8 at 120 meters, 2/8 at 180 meters
Field altimeter setting (QNH):	1023 Mb (30.21 Hg)
Sea level barometric pressure (QFE) Runway 30 approach end:	949 Mb.
Temperature:	14º C
Dew point:	13º C

QAM at approach end of runway 30 at 16:45 hours

horizontal Approach/visibility:	8 to 10 kilometers

Runway visibility:	2 to 3 kilometers
Approach slant visibility:	7 to 8 kilometers
Present weather:	Intermittent light rain and fog patches
Cloud coverage:	2/8 at zero meters, 2/8 at 30 meters, 2/8 at 90 meters, 2/8 at 150 meters.
Field altimeter setting (QNH):	1023 Mb. (30.21 Hg)
Sea level barometric pressure (QFE) Runway 30 approach end:	951 Mb.
A.D.:	948 Mb.
Runway 12 approach end:	949 Mb.
Temperature:	14º C
Dew point:	13º C

QAM at approach end of runway 30 at 16:50 hours

Approach horizontal visibility:	2 to 3 kilometers; intermittent 8 kilometers
Runway visibility:	2 to 3 kilometers
Approach slant visibility:	2 kilometers; intermittent to 7 km.
Present weather:	Light rain and fog patches
Cloud coverage:	4/8 at zero meters, 2/8 at 30 meters, 2/8 at 60 meters.

QAM at approach end of runway 30 at 17:02 hours

Approach horizontal visibility:	500 meters; intermittent to 5 km.
Runway visibility:	300 meters
Approach slant visibility:	500 meters; intermittent to 5 k.
Present weather:	Light rain and fog patches
Field altimeter setting (QNH):	1023 Mb. (30.21 Hg.)
Sea level barometric pressure (QFE) Runway 30 approach end:	951 Mb.
A.D.:	948 Mb.
Runway 12 approach end:	949 Mb.

Temperature:	14º C
Dew point:	13º C

QAM at approach end of runway 30 at 17:10 hours

Approach horizontal visibility:	4 to 5 kilometers; intermittent 7 kilometers
Runway visibility:	1 kilometer
Approach slant visibility:	4 to 5 kilometers; intermittent to 6 kilometers
Present weather:	Intermittent light rain and fog patches
Cloud coverage:	5/8 at zero meters, 2/8 at 30 meters, 2/8 at 90 meters.

QAM at approach end of runway 30 at 17:25 hours

Approach horizontal visibility:	1 kilometer, intermittent 3 kilometers
Runway visibility:	300 meters
Approach slant visibility:	1 kilometer; intermittent 3 km.
Present weather:	Light rain and fog patches
Cloud coverage:	7/8 at zero meters, 1/8 at 30 meters

QAM at approach end of runway 30 at 19:25 hours

Approach horizontal visibility:	100 meters
Runway visibility:	100 meters
Approach slant visibility:	100 meters
Present weather:	Light rain and fog patches
Cloud coverage:	8/8 at zero meters
Field altimeter setting (QNH):	1022 Mb. (30.19 Hg.)
Sea level barometric pressure	
(QFE) Runway 30 approach end:	950 Mb.
A.D.:	948 Mb.
Runway 12 approach end:	948 Mb.

Temperature	13º C
Dew point	13º C

1.8 Aids to navigation

1.8.1 K.L.M. 4805

The aircraft was equipped with the following aids to navigation:

VOR/ILS			
Bendix RNA-26C	108-117, 95	MH/Z	3 systems
Marker Beacon			
Bendix MKA-28C	75	MH/Z	1 system
ADF			
Collins 51Y-7	190-1750	KH/Z	2 systems
DME			
Collins 860 e-3	1000	MH/Z	2 systems
ATC Radar Beacon			
Collins 621A-3	1030-1090	MH/Z	2 systems
Weather Radar			
Bendix RDR-1F	9375	MH/Z	2 systems
Radio Altimeter			
Collins 860F-1	4300	MH/Z	3 systems
Inertial Navigation System			
Delco Carousel IV			3 systems
Emergency Radio Beacon			
Garret Rescue-99	121.5/243	MH/Z	4 systems

1.8.2 P.A.A. 1736

The aircraft was equipped with the following aids to navigation:

Description	Make	Model	No. of systems
ADF	Collins	51Y4	2 systems
DME	Collins	621A-3	2 systems
VOR/ILS	Collins	51RV2B	2 systems
Radar	(AVQ-30X) RCA	MI-592041	2 systems
Radio Altimeter	Bendix	ALA-51A	2 systems
Radar Beacon	Collins	621A-3	2 systems
Inertial Navigation System	Delco Elect	7883450-041	3 systems

1.9 COMMUNICATIONS

1.9.1 K.L.M. 4805

The aircraft was equipped with the following communication instruments:

HF COM Collins 61 8T-2	2-30 MH/Z	2 systems
VHF COM Collins 618M-2B	118-135.97 MH/Z	3 systems
Selcal Motorola NA-135	1 Dual Decoder	
Cockpit Voice Recorder (CVR) Sundstrand AV-557B		1 system

1.9.2 P.A.A. 1736

The aircraft was equipped with the following communication instruments:

Description	Make	Model	No. of systems
VHF	King	KTR-9100A	2 systems
HF	Collins	61T82	2 systems
Audio-Interphone	Ford	1-X00-185-3	1 system
Selcal	Motorola	NA-126AV	1 system

1.10 Aerodrome and ground facilities

Los Rodeos (Tenerife) Airport is located at an elevation of 632 meters (2,073 feet). The 12/30 runway is 3,400 meters (11,155 feet) long, plus two stopways of 60 meters. It is 45 meters wide. The elevation at the approach end of runway 30 is 2,001 feet and that of runway 12 is 2,064 feet. The highest point of the airport is near the intersection of taxiway 3.

On account of its altitude and location in a sort of hollow between mountains, the airport has distinctive weather conditions, with frequent presence of low-lying clouds.

The Los Rodeos Airport was equipped with the following radio-aids to navigation at the time of the accident:

VOR/DME, TFN 112'5 Mc	Normal operation
ILS 110'3 Mc	" "
FP Beacon, 243 Kc	" "
NDB, TX, 410 Kc	" "
NDB LD, 370 Kc	Out of service (NOTAM II 573/76).

Los Rodeos Airport was equipped with the following visual approach aids at the time of the accident:

Approach lights	In service
VASIS	" " (that of runway 12 was being tested)
Flashers on runway 30	" "
Precision approach lighting	" "
Runway centerline indicated	

The airport was equipped with the following beacon marking system at the time of the accident:

Lighting of the flight runway	In service
Lighting of the taxiway	" "

The runway centerline lights were out of service (NOTAM II 92/77).

The air-ground communication radio frequencies in service at the time of the accident were as follows:

- 119'7 Mc for Approach
- 118'7 Mc for Taxiing

The following NOTAMs were in force at the time of the accident, with regard to the Los Rodeos Airport radio-aids and air-ground visual and communication aids.

1.- On 15.3.77, NOTAM I, National no. 643, International No. 382, contained the following text: "Runway 12/30 centerline lights out of order until further notice." (This NOTAM was changed to NOTAM II-A, no. 92/77 on 15.3.77.)

2.- On 19.3.77, NOTAM I, National no. 791, International no. 463, contained the following text: "Frequencies 121'7 and 118'7 MH/Z being tested." (On 25.3.77, this NOTAM was changed to NOTAM II A, no. 108/77).

1.10.1 Magnetophone Recording Points in the Tenerife Control Tower equipment:

RADIO (Appendix 3)

a) Radio channels recording

The radio channels recording is performed by operator posts in the following manner:

The reception signals heard over the loudspeaker are recorded immediately after the loudspeaker line amplifier at the point indicated in the "Rx loudspeaker record" diagram.

The reception signals heard by earphones are recorded immediately after the earphone line amplifier at the point indicated in the "Rx earphone"diagram..

The transmission signals are recorded immediately before the transmission line amplifier at the point indicated in the "Tx record" diagram.

All these signals are appropriately mixed in order to be fed into the magnetophone recording channels in the following manner:

Operator Post	A	Channel 7
"	B	Channel 8
"	C	Channel 9
"	D	Channel 10
"	E	Channel 11

b) General Radio Recording

All the signals received by the Tower receivers, whether coming from aircraft or from the airport's own ground transmitters, are recorded at a point immediately before the radio control system, indicated in the "Rx lines record" diagram.

These signals coming from all the receivers are conveniently mixed and fed into Channel 12 of the magnetophone.

TELEPHONY

Telephone transmissions and messages received are also recorded by Operator posts and taken from the points indicated on the diagram as "telephone record" and "L.C. loudspeaker record", being conveniently mixed and fed into the magnetophone in the following manner:

Operator post A	Channel 2
Operator post B	Channel 3
" " C	Channel 4
" " D	Channel 5
" " E	Channel 6

Channel 1 of the magnetophone records the time signals.

1.11 FLIGHT RECORDERS

1.11.1 K.L.M. 4805

K.L.M. Boeing 747, registration PH-BUF, flight number 4805, was equipped with a digital flight data recorder (DFDR) and a cockpit voice recorder (CVR).

Digital flight data recorder (DFDR)

This is a Sundstrand model 573 A with 41 parameters. The box was considerably damaged by the impact and fire. The front aluminum panel was missing, so that the tape covering could be seen. Therefore, no serial number was immediately available, and this was obtained from the K.L.M. recordings.

1.11.2 P.A.A. 1736

Boeing 747, registration N736PA, belonging to Pan American World Airways Company, flight number 1736, was equipped with a Digital Flight Data Recorder (DFDR) by Lockheed Aircraft Service Co. (LAS), Model 209-E, serial number 375.

The DFDR was not damaged by fire and suffered only slight damage due to the impact.

It was also equipped with a cockpit voice recorder (CVR), model Fairchild A-100, serial number 504.

Both recorders were transported, duly sealed, by the Spanish Civil Aviation Authorities to the N.T.S.B. in Washington for transcription.

1.12 AIRCRAFT WRECKAGE

A 1:2,000 scale plan showing the position of the wreckage of the K.L.M., PH-BUF, and of the PANAM, N736PA, is herewith attached.

1.13 MEDICAL AND PATHOLOGICAL INFORMATION

On account of the magnitude of the disaster, the Spanish, Dutch and American medical authorities, as well as the Spanish Judicial Authority, agreed that the pathological teams should work together in the tasks of identification, embalming and possible autopsies.

It was not possible to perform autopsies on the members of the K.L.M. crew on account of the state of the bodies.

1.14 FIRE

Alarm and mobilization of the Firefighting Team

The weather conditions (See Appendix 2), with fog patches at

zero meters, prevented the accident being immediately and directly visible from the control tower, where they only heard one explosion followed by another, without being able to localize them nor ascertain their cause.

Moments later, an aircraft located on the parking apron advised the tower that it had seen a fire, without specifying the exact place nor its cause.

The tower immediately sounded the fire alarm for the fire service, informing them that there was a fire and that they should be prepared for an urgent departure. The tower had not yet been able to locate the fire.

Subsequently, a member of the CEPSA Co. arrived at the fire station parking lot, where the firemen were all ready and prepared, and told them that there was a fire "to the left of the parking area".

This was the first, though vague, indication regarding the location of the fire. The firemen immediately communicated this information to the tower, and set out at the greatest possible speed, which nevertheless was very low on account of the weather conditions which carried the serious risk of collision with persons, vehicles and planes, in view of the fact that they had to cross the very congested parking apron diagonally.

Finally, they saw a bright light through the fog and when they came closer, although they were as yet unable to see the flames, they suffered the effects of strong heat radiation.

When there was a slight clearing, they saw for the first time that there was a plane totally envelopped in flames, the only visible part being the rudder.

after they had already begun to fight the fire, a greater clearing in the fog took place and they saw a bright light further away, which they thought at first was a part of the same plane which had broken off and was also burning.

They divided up the fire trucks and, on approaching what they thought was only a second focal point of the same fire, they discovered a second plane on fire. They immediately concentrated their main efforts on this second plane because the first was already totally irrecoverable.

As a result of this action, they were able - in spite of the tremendous range of the fire in this second plane - to save the left side, from which between fifteen and twenty thousand kilos of fuel were subsequently removed.

Meanwhile, because of the dense clouds surrounding it, the tower was still unaware of the exact location of the fire, and whether one or two planes had been involved in the accident.

1.14.2 The impact, start of and extinguishing of the fire

There is no indication of any failure prior to the impact. The distance from the approach end of runway 30 to the PANAM wreckage was about 1,385 meters. From here to the main K.L.M. wreckage there was a distance of about 450 meters.

The PANAM was at an angle of about 45º relative to the center of the runway, i.e., at about 75º magnetic. It is possible that it continued to move after the impact.

Apparently, the K.L.M. no. 1 engine only grazed the tip of the

PANAM's right side; the nose and front landing gear overshot the latter plane and the main landing gear smashed against it in the area of its no. 3 engine. (See Appendix 4 showing the position of the two planes at the moment of impact.)

The K.L.M. was already entirely airborne when the impact took place. Its taildrag had scraped the runway in an excessive rotation for a distance of 65 feet; the tracks on the runway began about 300 feet before the place of impact.

Some sections of the right side of the PANAM were found near the KLM, indicating that indeed there was an impact there.

The K.L.M. fuselage skidded over the PANAM aft fuselage, destroying it and shearing off the empennage. The K.L.M. continued in flight, hitting the ground about 150 meters further on and sliding another 300 meters on the runway. It caught fire suddenly and violently.

The four available turret trucks, with their corresponding crews, were initially used for extinguishing the fire. Later, all the airport Fire Service vehicles, except one which was out of service and the two first-aid Land Rovers, were added. Likewise, within a few minutes, firefighting units from La Laguna and Tenerife joined in, with three tank trucks. The fire was not totally extinguished until 3:30 a.m. on March 28.

5,000 kilos of foam (Tutogene) and about 500,000 liters of water were used in order to put out the fire.

1.14.3 Firefighting equipment

a) The Tenerife Airport Firefighting Unit had the following equipment available at the time of the accident:

- 2 Walter Yankee 4,200 l. water and 840 kg. foam Turret Trucks

- 2 Walter Yankee 4,200 l. water and 800 kg. foam Turret Trucks
- 1 Walter Yankee 3,550 l. water and 650 kg. foam Turret Truck
- 1 Walter Yankee 12,000 l. water truck
- 1 International 5,6860 l. water and 600 kg. foam truck
- 1 International 750 kg. foam truck (dry chemical)
- 2 Land Rover 250 kg. powder first-aid vehicles

One Walter Yankee turret truck was out of service, as indicated in the NOTAM.

b) Training of Firefighting Team

Theoretical training takes place practically every day, in the form of classes and explanations regarding deployment, using the wall-mounted visual displays in the fire station.

All equipment is tested and personnel are drilled three times a month with fire-pit exercises and dry runs - with a constant view to achieving optimum readiness as well as maximum efficiency and rapidity of response.

Eight men are regularly kept partially suited during peak airport traffic periods. In practice, two men are ready at all times and all the fire station trucks are ready to roll within 30 to 45 seconds after the alarm sounds.

4.4 Rescue and survival

There were no survivals in the K.L.M. aircraft, even though the impact both against the PANAM and against the ground could not

have been excessively violent; however, an immediate and raging fire must have prevented adequate emergency operations because all the aircraft's evacuation doors remained shut even though the fuselage was not significantly deformed.

In the PANAM aircraft, the first-class lounge disappeared as a result of the impact, as well as nearly the whole of the top of the fuselage. The lounge floor gave way, which meant that the crew had to jump to the first-class section and get out through a hole in the left wall, behind the L.1 exit. This hole was the main escape route for the passengers located in the forward part of the aircraft. None of those in the first-class lounge survived.

According to the survivors, the shock of impact was not excessively violent, leading them to believe that the cause was an explosion. They jumped to the ground through openings in the left side, or through door L.2, which was duly opened, from a height of 20 feet (6 meters). The left engines were still turning and there was a fire under the wing at this side. A large number of passengers escaped off this wing, jumping from it to the grass. Explosions were already taking place, and the ambulances appeared almost immediately.

At the center and aft of the plane, the accumulation of wreckage and twisting of metal sheets of the fuselage must have been such that, apart from the fire which suddenly broke out, it formed a kind of trap, preventing forward exit of the passengers.

Total evacuation time is estimated to have been about one minute.

The crew and "extra crew" helped effectively in the evacuation. Subsequently, airport personnel and even private individuals who

happened to be there also provided effective help.

There were five ambulances in the airport at the time of the accident.

The general plan of evacuation worked very much in accordance with what had been planned in case of emergency. In general, it was carried out very rapidly and there was a free traffic flow between the airport and the hospitals. This operation was directed by the Civil Guard for Traffic.

Local radio transmitters requested that anyone who could help should go to the airport. This appeal, which undoubtedly was made with the best of intention, nevertheless had negative consequences because, when most of the people arrived, the P.A.A. injured had already been evacuated, and a traffic jam occurred which could have made the providing of further help more difficult.

There were large-scale blood donations. All the injured were promptly and duly taken care of in the Santa Cruz hospitals, so that it was not necessary to make use of the three surgical teams and 89 hospital beds made available in Puerto de la Cruz.

1.15 TESTS AND INVESTIGATIONS

1.15.1 In the investigation of this accident, the following tapes play a very important role:

The two digital flight recorders (DFDR), one belonging to the Pan American Boeing 747, N736PA, and the other to the K.L.M. Boeing 747, PH-BUF; the two cockpit voice recorders (CVR), one of which also belonged to each plane; and the Tenerife Control Tower transmission tapes.

The K.L.M. DFDR and CVR were located in the plane's tail section. The PANAM DFDR was located in the tail section and the CVR in the cockpit.

1.15.1 K.L.M. DFDR

The K.L.M. DFDR box was considerably damaged by the impact and fire. The front aluminum panel was missing, so that the tape cover was visible. Therefore, no serial numbers were immediately available, and these had to be obtained from the K.L.M. Company records. The unit's stainless steel cover was deformed and it could not be taken out of the structure. It had to be removed by opening the welded joint by means of a hammer and chisel. At first large scissors were used to try and cut the casing in order to open it, but this attempt failed. Once the casing had been removed, the shock-proof cover was separated from the electronic section by means of an iron lever (the cover was attached to the electronic section with an anti-shock mounting). The lid bolts were removed from the shock-proof cover, and it was taken off. The DFDR heat insulation material had been singed and separated from the lid.

The teflon sheaths of the magnetic recording wire connectors were not burned and had kept their original colors. These would probably have been discolored by temperatures above their MST temperatures of 400º to 472º F. The nylon cord used to tie the wire reels was discolored. The MST for the nylon used is 250º to 300º. There was no proof of melted welding, which indicates that the temperature did not reach 360º F. Therefore, it is probable that the temperature to which the cover was subject was between 250º and 360º F.

Burn marks were found on the steel disc covering the upper reel,

as well as on the reading head and on the reels themselves. The aluminum reels had a slightly golden color. This shade of color could have been caused by some material which gave off gases inside the cover during the fire.

The tape was found intact, without breakages. It was smudged and discolored in the places where it was revolving around the reels and the heads at the moment that the recorder stopped working.

The mechanism had a burned area at its point of contact with the tape. It was possible to remove the heaviest bits from the tape by using alcohol, cotton and cotton tips. It was possible to read all the data on the tape after adequate cleaning.

The whole of the tape except for the last six meters was on the bottom reel. The accident data were on track 1.

DFDR tapes are made of a material called Vicalloy. They are 0.64 cm. wide and 247 m. long. Four tracks are recorded - two forward and two backward. Only one track records at a time and each track lasts approximately 6.25 hours, making a total time of 25 hours. There are two recording heads - one going forward and the other backward - as well as two playback and two eraser heads. The tape-recording speed is 1.09 cm./sec. and the playback speed is 14.2 cm./sec.

1.15.3 The PAN AMERICAN DFDR

The P.A.A. aircraft DFDR was not damaged by fire, and only slightly damaged by the impact. The inner and outer seals (dated March 22, 1977) were intact, as were the four screw seals for the box (S/N 1413).

The DFDR box is a shock-proof casing. The heat indicator is outside the tape cover. A temperature indicator (TEM PLATE) outside the tape cover showed a temperature of between 110º and 120º F, indicating that this was the highest temperature to which the box had been exposed.

When the tape covering was opened up, the tape was found to be intact, without any breakages, and in excellent condition. On account of the strong impact to which this unit was subject, the tape had come off the reel and two revolutions had fallen off the lower reel. The tape was handled carefully and replaced onto the reels. Most of it was on the lower reel, with approximately 28 meters remaining on the upper reel.

There was no problem with playback. The data were found between 105-113 meters on track 3.

The DFDR LAS tape is based on Mylar, with an instrumentation grade 1.0 mm. thick, 0.64 cm. wide and approximately 145 meters long (of which about 142 meters are used for recording). Six tracks are registered, three forward and three backward. Only one track is recorded at a time and each one lasts approximately 4.2 hours, making a total recording time of 25 hours. There are two recording heads (one going forward and the other backward), and two playback heads. There are no eraser heads. The tape's recording speed is 0.94 cm./sec. and the playback speed is 30 cm./sec.

1.15.4 Boeing 747, N736PA, Cockpit Voice Recorder

As previously stated, the Pan American plane CVR was an A-100, with its identification plate missing. Pan American records show that the serial number was 504. This Fairchild CVR was only blackened. The tape was removed, copied and transcribed in accordance with normal procedures.

This CVR has four channels, which are recorded simultaneously. Recording is continuous, but only the last 30 minutes are kept. On one of the channels - that corresponding to the cockpit microphone area, all the latter's sounds are recorded. On the other three channels are recorded the communications from the Captain, First Officer and Flight Engineer, respectively.

Transcription of this flight recorder was carried out in the N.T.S.B. laboratories in Washington.

1.15.5 K.L.M. Company Boeing 747, registration PH-BUF, Cockpit Voice Recorder

It was not possible to transcribe this plane's CVR at the N.T.S.B. because there was no reading equipment for this recorder in the N.T.S.B. laboratories, as the U.S. Airline Companies had not acquired this type of CVR. It was taken by a representative of the Spanish Civil Aviation Authorities to the Sundstrand equipment manufacturers in Seattle (USA) on April 5, 1977. Members of the N.T.S.B. and K.L.M. accompanied this representative. When copies of the CVR were taken to the N.T.S.B., it was observed that there were noises and echos, and for this reason the said representative returned to Sundstrand on April 7. New copies were made, partially suppressing the noises and echos and obtaining recordings of satisfactory quality.

Like the PANAM CVR, this CVR has four channels, which are:

- Channel 1 Flight Engineer's communications
- Channel 2 Co-pilot's communications
- Channel 3 Captain's communications
- Channel 4 Sounds in cockpit area.

The transcription of said tapes on paper was carried out in the

N.T.S.B. laboratories.

1.15.6 Tape of Tenerife Control Tower's Communications

The Spanish Authorities made a cassette copy of the Tenerife Control Tower tape available. The original is in the hands and under the custody of said Authorities. A problem arose when an attempt was made to correlate the times of the tower tape with those of the PANAM and K.L.M. CVRs. The codified signal and the conversation in the tower were recorded simultaneously on the cassette and it was difficult to read the times signal. Moreover, the tape apparently changed speeds, making it difficult to correlate the time elapsed. Therefore, the PANAM CVR was used as a basic time reference, being in perfect agreement with this aircraft's DFDR.

The GMT time was determined by means of a transcription of the tower tape, whose chronology it was possible to ascertain with an acceptable degree of accuracy. This technique proved to be satisfactory as it was in agreement with the PANAM and K.L.M. CVR times. The P.A.A. and K.L.M. speeds were adjusted in such a way that the plane's 400 Hz. energy was synchronized with the audio laboratory clock and, therefore, with the real time. The PANAM CVR times were the most accurate during the initial period, on account of the Sundstrand B 557 B recording method. The degree of error is negligible. The Sundstrand tape is not continuous, but rather reverses its direction every 15 minutes.

The tape's basic time reference was determined by simultaneously recording the CVR and a digital watch on a video tape.

Subsequently the Spanish Authorities made copies of the control tower tape available; these did not give rise to time correlation problems.

1.18 HUMAN FACTORS

There is no evidence of contributory medical causes.

Socio-psychological causes

1.- Limits on duty time of Dutch crews.

Until a few years ago, the Flight Captain was able, at his own discretion, to extend the limit on his crew's activity in order to complete the service. However, this was recently changed in the sense of imposing absolute rigidity with regard to the limit of activity. The Captain is forbidden to exceed it and, in case he should do so, may be prosecuted under the law.

Moreover, until December 1976, it was very easy to fix said limit of activity by taking only a few factors into account, but this calculation has now been made enormously complicated and in practice it is not possible to determine it in the cockpit; for this reason it is strongly recommended that the Company should be contacted in order to determine it.

This was the situation in Tenerife, and for this reason Captain Veldhuyzen spoke by HF to his Company's operations office in Amsterdam. There they told him that if he was able to take off before a certain time it would seem that there would be no problems, but that if there was any risk of exceeding the limit they would send a telex to Las Palmas.

This uncertainty of the crew at not being able to determine their time limit exactly must have constituted an important psychological factor.

2.- Those who serviced the K.L.M. plane in Tenerife stated that the

crew appeared calm and friendly; nevertheless, they perhaps felt a certain subconscious - though exteriorly repressed - irritation caused by the fact that the service was turning out so badly, with the possible suspension of the Las Palmas-Amsterdam flight and the resulting alteration of each person's plans, which would be aggravated by the existence of other possible sources of lateness such as ATC delays, traffic congestion in Las Palmas, etc.

3.- Behavior.-

3.1. Care.- This can be divided into voluntary and involuntary, or subconscious. The increase in one brings with it a decrease in the other.

Visibility both before and during the accident was very variable. It changed from 1500 to 300 meters or less in very short periods of time. This undoubtedly caused an increase in subconscious care to the detriment of conscious care, part of which was already directed toward take-off preparation (completing of check-lists, taxiing with reduced visibility, decision to take off or to leave the runway clear and execute a difficult 180º turn with a 747 on a 45 meter runway, in fog).

3.2. Fixation.-

Two kinds: a fixation on what is seen, with a consequently diminished capacity to assimilate what is heard, and another fixation on trying to overcome the threat posed by a further reduction of the already precarious visibility. Faced with this threat, the way to meet it was either by taking off as soon as possible, or by testing the visibility once again and possibly refraining from taking off (a possibility which certainly must have been considered by the K.L.M. Captain).

3.3. Relaxation.-

After having executed the difficult 180º turn, which must have coincided with a momentary improvement in the visibility (as proved by the CVR, because shortly before arriving at the runway approach they turned off the windscreen wipers), the crew must have felt a sudden feeling of relief which increased their desire to finally overcome the ground problems: the desire to be airborne.

4.- Possible biometrical factors.-

4.1. Fatigue.-

Although within reasonable limits, fatigue began to be felt.

4.2 Overload.-

Problems were accumulating for the Captain to a degree far greater than that of a normal flight. Likewise for the Co-pilot, who did not have much experience in 747s.

4.3. Low-frequency electromagnetic waves.-

According to certain studies, these have a deleterious effect on man's intellectual performance (e.g., 400-cycle alternative current waves in an aircraft).

4.4 Noise and vibration.-

Their level is quite high in a 747 cockpit.

5.- Other possible causes.-

5.1. Route and pilot-instruction experience.-

Although the Captain had flown for many years on European and intercontinental routes, he had been an instructor for more than ten years, which relatively diminished his famili-

arity with route flying. Moreover, on simulated flights, which are so customary in flying instruction, the training pilot normally assumes the role of controller - that is, he issues take-off clearances. In many cases no communications whatsoever are used in simulated flights, and for this reason take off takes place without clearance.

5.2 Authority in the cockpit.-

Although nothing abnormal can be deduced from the CVR, the fact exists that a co-pilot not very experienced with 747s was flying with one of the pilots of greatest prestige in the Company who was, moreover, K.L.M.'s chief flying instructor and who had certified him fit to be a crew member for this type of plane. In case of doubt, these circumstances could have induced the Co-pilot not to ask any questions, assuming that this Captain was always right.

2. ANALYSIS AND CONCLUSIONS

2.1 ANALYSIS

On March 27, 1977, a bomb exploded in the terminal building of Las Palmas Airport (Canary Islands), and for this reason the passenger terminal was evacuated. As there had been a threat of a second explosion, much of the traffic arriving at Las Palmas Airport was diverted to that of Los Rodeos on Tenerife Island. For this reason, the parking area at the latter airport was saturated with planes.

The K.L.M. Boeing 747 PH-SUF arrived at Los Rodeos Airport at 13:38 and was parked at the end of the taxi runway next to a Breathens Boeing 737 (SAFE). Subsequently, a Sterling Boeing 727, a SATA DC-8 and the PAN AMERICAN 747, N1736, were parked in the same area.

The PANAM Boeing 747 which arrived at Los Rodeos Airport at approximately 14:15 was parked on the taxi runway next to the above-mentioned Breathens Boeing 737, Sterling Boeing 727, SATA DC-8 and the K.L.M. Boeing 747, PH-BUF, which had arrived at Los Rodeos Airport at 13:38 h.

Once Las Palmas Airport had been reopened, the PANAM N1736 plane called the tower requesting permission to start up its engines; in reply, it was told that there was no ATC delay, but that they could have problems taxiing on account of the K.L.M. plane which was ahead of it, and that taxiing on the taxiway would not be possible on account of the aircraft congestion on the main apron.

Indeed, when the time came to taxi, the PANAM was forced, on account of the position of the K.L.M. which was blocking its way, to wait for the latter's departure. The three other planes parked there had already departed.

Approximately one hour later, K.L.M. 4805 requested an estimated departure time. They said that they needed to refuel and that this would take approximately 30 minutes. They filled up with 35,500 liters, while the passengers remained on board. Later, the K.L.M. requested permission to start up its engines, and then clearance to taxi.

- It was cleared to taxi towards the holding position of runway 12 and to change its surface frequency of 118.7 to the approach frequency of 119.7.

- A few minutes later, PANAM called again in order to request clearance to start up its engines, and was cleared to do so.

If we keep in mind that the Tenerife-Las Palmas flight is one of about 25 minutes duration, the taking on of 55,500 liters of fuel leads us to suppose that the K.L.M. Captain thereby wished to avoid the difficulties of refuelling in Las Palmas, with the resulting delay, because a great number of planes diverted from Tenerife would be going there later. The aircraft could, in fact, have returned to Amsterdam with the fuel it had without refuelling in Las Palmas.

The conversations which took place between K.L.M. 4805 and the control tower until the plane started to taxi on the main runway were as follows:

The times are those taken from the K.L.M. CVR.

TIME	SOURCE	CONTENT
1658:14.8	KLM 4805	Approach KLM four eight zero five on the ground in Tenerife.
1658:21.5	APP	KLM - ah - four eight zero five Roger.
1658:25.7	KLM 4805	We require back track on one two for take off runway three zero.
1658:30.4	APP	O.K. four eight zero five ... taxi ... to the holding position runway three zero taxi into the runway and - ah - leave runway (third) to your left.
1658:47.4	KLM 4805	Roger sir, (entering) the runway

TIME	SOURCE	CONTENT
		at this time and the first (taxiway) we, we go off the runway again for the beginning of runway three zero.
1658:55.3	APP	O.K. KLM eight zero - ah - correction, four eight zero five taxi straight ahead - ah - for the runway and - ah - make - ah - back track.
1659:04.5	KLM 4805	Roger, make a "back track".
1659:10.0	KLM 4805	KLM four eight zero five is now on the runway.
1659:15.9	APP	Four eight zero five roger.
1659:28.4	KLM 4805	Approach, you want us to turn left at charlie one, taxiway charlie one?
1659:32.28	APP	Negative, negative, taxi straight ahead - ah - up to the end of the runway and make "back track".
1659:39.9	KLM 4805	O.K., sir.

At 1703:14.4, K.L.M. 4805 asked the Tower Controller if the runway centerlights were in service because, as the weather conditions were becoming worse, he wished to have this information in connection with the minimum required take-off conditions.

at 1704:58.7, the Tower Controller, after having checked, replied

that the runway centerlights were out of service, while he also passed on this information to the P.A.A. Clipper 1736.

At 1705:27.08, K.L.M. 4805, which was already at the approach end of runway 30, completed the turn in order to face in the direction for take off.

From this point on, see the diagram (Appendix 5) showing the time correlation between the tower, the K.L.M. 4805 and the Clipper 1736 CVR tapes, as well as the data obtained from the K.L.M. 4805 DFDR during the last 88 seconds.

At 1705:27.98, the engine braking begins and lasts for 2.54 seconds.

At 1705:36.7, the Co-pilot finishes the take-off check list and at 1705:41.22 (67.81 seconds before the impact), a slight forward movement due to opening of the throttle is observed (increase of continued EPR in the four engines). At 1705:41.5, the Co-pilot says: "Wait a minute, we don't have an ATC clearance." To which the Captain replies, "No, I know that, go ahead, ask."

At 1705:44.6, K.L.M. 4805 tells the control tower: "Ah - the K.L.M. four eight zero five is now ready for take off, and we're waiting for our ATC clearance." This message ended at 1705:50.77.

This communication was heard in the P.A.A. 1736 cockpit.

At 1705:53.41, the Controller gave K.L.M. the following ATC instructions:

K.L.M. eight seven zero five - uh - you are cleared to the Papa beacon, climb to and maintain flight level nine zero,... right turn after take off, proceed with heading zero four zero until intercepting the three two five radial from Las Palmas VOR." The message

ended at 1706:08.9. At 1706:07.33, i.e., 0.7 seconds before the message ended, the aircraft Captain said, "Yes", and 44.31 seconds before the impact the nos. 3 and 4 engines slightly increased their EPR.

At 1706:09.61, the Co-pilot repeated the ATC instructions given by the Tower Controller, at the following times and as follows:

TIME	SOURCE	CONTENT
1706:09.61	KLM 4805 (RD 2)	Ah- Roger sir, we are cleared to the Papa beacon flight level nine zero, right turn out zero four zero until intercepting the three two five. we are now at take off.

At 17:17.79, the Co-pilot's repetition of the ATC instructions ended.

At 1706:11.08, the brakes in the K.L.M. 4805 were released.

At 1706:12.25, the aircraft Captain said, "Let's go ... check thrust.", ending this sentence at 1706:16.11.

The following was ascertained from the DFDR data:

1706:11.70 (37.33 seconds before impact): it was deduced from the LONG that the plane began to move with longitudinal acceleration.

1706:13.99 (35.04 seconds before impact): the EPR have risen above the figures for idling (1.12-1.12-1.14-1.14).

1706:14.94 (34.09 seconds before impact): the start of change of course was observed from the HEAD.

1706:17.17 (31.86 seconds before impact): from the VANE it can be ascertained that lift had begun. Value reached was 6.80º. Air speed was increasing (46.41). Direction straightened out.

From everything that happened during this time, it is seen that while the First Officer was repeating the ATC instructions given by the Controller, K.L.M. 4805 had already started its ground run, while at 1706:14.00, moreover, the sound of engines starting to accelerate is observed.

At 1706:18.19, the Controller replied to the read-back of his ATC clearance in the following way: "O.K.", and at 1706:20.08, i.e., 1.89 seconds later, added: "Stand by for take off ... I will call you," ending said message at 1706:21.79.

During this time, at 1706:19.35, the K.L.M. 4805 take-off EPR had already been reached and stabilized (1.39 to 1.42).

Simultaneously, in the PANAM cockpit, on hearing this conversation, the Pilot says "No, uh", and the Co-pilot says, "and we are still taxiing down the runway, the Clipper one seven three six". This communication caused a shrill noise in the K.L.M. cockpit, which started at 1706:19.39 and ended at 1706:22.06.

At 1706:25.47, the Tower Controller confirmed reception of the PANAM message in the following way:

"Papa Alpha one seven three six report runway clear."

This was audible in the K.L.M. cockpit.

The message ended at 1706:28.89.

At 1706:29.59, the P.A.A. replied: "O.K., will report when we're clear." This reply was audible in the K.L.M. cockpit.

The control tower replied, "Thank you", and then the following sentences were spoken in the K.L.M. cockpit:

TIME	SOURCE	CONTENT
1706:32.43	C3	Is he not clear, then?
1706:34.10	C1	What do you say?
1706:34.15	PA	Yup
1706:34.70	C3	Is he not clear that Pan American?
1706:35.70	C1	Oh, yes. (emphatic)

At 1706:43.49, the Co-pilot intoned the V1 and subsequently on the DFDR PCC the following were observed: a pulling of the control column, with the plane nose pointing up, 16% of the way back from a 44% forward position and from Pitch 2, plane nose pointing up.

At 1706:46.04, i.e., 2.99 seconds before impact, increased direction toward the right is observed in the HEAD; 0.46 seconds later, a curving of the plane to the left is seen in the Roll

parameter (ROLL) and, 1.54 seconds before impact, a roll to the right is observed in the Roll Control Wheel Position parameter (RCW).

At 1706:47.44, the Captain utters an exclamation, while the impact takes place shortly afterwards.

On listening to the P.A.A. CVR, it may be deduced that its crew saw the K.L.M. 9.5 seconds before the impact.

From the actions of the Tenerife Control Tower, it may be inferred that their ordering the K.L.M. to leave the runway by the third taxiway was so that they should leave the main runway as soon as possible and they proceed along the parallel taxiway. This third taxiway was the first by which it was possible to take the plane off the main runway because access to the parallel taxiway by C1 and C2 was not possible on account of the aircraft congestion on the parking apron.

Later, in order to make the manoeuvre easier, the Controller chose to order this plane to continue down the right side of the main runway and at the end of same make an 180º turn.

Likewise, he indicated to the P.A.A. that they should leave by ehe third taxiway. At first there was some confusion regarding the words "first" and "third". But this was finally dispelled because the Controller made the following clarification: "The third one Sir, one, two, three, third one."

The situation deteriorated further when low-lying clouds reduced visibility to the point at which neither planes taxiing on the main runway, nor some of those located in the parking area, were visible from the tower.

It transpires from careful listening to the K.L.M. CVR that although cockpit operation was correct and the checklists were adequately kept, there was some feeling of anxiety regarding a series of factors, which were: the time margin remaining to them, to the point of straining the allowable limit of their duty time; the poor and changing visibility which, especially as the runway centerlights were not operative, might prevent the possibility of take off within the weather limits required by the Company); the inconvenience for the passengers, etc. It is also observed that, as the time for take off approached, the Captain - perhaps on account of all these worries - seemed a little absent from all that was heard in the cockpit. He enquired several times, and after the Co-pilot confirmed the order to backtrack, he asked the tower if he should leave the runway by C-1, and subsequently asked his Co-pilot if he should do so by C-4. On arriving at the end of the runway, and making an 180º turn in order to place himself in take-off position, he was advised by the Co-pilot that he should wait as they still did not have an ATC clearance. The Captain asked him to request it, which he did, but while the Co-pilot was still repeating the clearance, the Captain opened the throttle and started to take off. Then the Co-pilot, instead of requesting take-off clearance or advising that they did not yet have it, added to his read-back, "We are now at take off." The tower, which was not expecting the aircraft to take off as it had not given clearance, interpreted the sentence as, "We are now at take-off position"(1) and the Controller replied: "O.k., ... stand by for take off ... I will call you." Nor did the PANAM, on hearing the "We are now at take off", interpret it as an inequivocal indication of take off. However, in order to make their own position clear, they said, "We are still taxiing down the runway." This transmission

(1) When the Spanish, American and Dutch investigating teams heard the tower recording together and for the first time, no-one, or hardly anyone, understood that this transmission meant that they were taking off.

coincided with the "Stand by for take off ... I will call you", causing a whistling sound in the tower transmission and making its reception in the K.L.M. cockpit not as clear as it should have been, even though it did not thereby become unintelligible.

The communication from the tower to the P.A.A. requested the latter to report when it left the runway clear. In the cockpit of the K.L.M. which was taking off, nobody at first confirmed receiving these communications (Appendix 5) until the PANAM responded to the Tower's request that it should report leaving the runway with an "O.K., we'll report when we're clear." On hearing this, the K.L.M. Flight Engineer asked: "Is he not clear then?" The Captain didn't understand him and he repeated: "Is he not clear that Pan American?". The Captain replied with an emphatic "Yes" and, perhaps influenced by his great prestige, making it difficult to imagine an error of this magnitude on the part of such an expert pilot, both the Co-pilot and the Flight Engineer made no further objections. The impact took place about thirteen seconds later.

From that moment until the next call to the planes, the Tower took care of the IB-185 and the BX-387 and awaited the communication from the PANAM 1736 reporting the "runway clear". It also received information coming from two planes located in the parking area that there was a fire in an undetermined place on the field, sounded the alarm, informed the Firefighting and Health Services, and broadcasted the news of the emergency situation; it then called the two planes on the runway, not receiving any reply.

The conversations which took place in the PANAM cockpit and between the planes and the control tower from 1701:57.0 were as follows:

The times were taken from the P.A.A. CVR.

TIME	SOURCE	CONTENT
1701:57.0	CL1736	Tenerife the Clipper one seven three six. (1702:00.2
1702:01.8	APP	Clipper one seven three six Tenerife.
1702:03.6	RDO-2	Ah- We were instructed to contact you and also to taxi down the runway, is that correct? (1702:07.4)
1702:08.4	APP	Affirmative, taxi into the runway and -ah- leave the runway third, third to your left, ((background conversation in the tower)).
1702:16.4	RDO-2	Third to the left, O.K. (17:02.18.3)
1702:18.4	CAM-3	Third he said.
	CAM-?	Three.
1702:20.6	APP	-ird one to your left.
1702:21.9	CAM-1	I think he said first.
1702:26.4	CAM-2	I'll ask him again.
	CAM-?	**
1702:32.2	CAM-2	Left turn.
1702:33.1	CAM-1	I don't think they have take-off minimums anywhere right now.

TIME	SOURCE	CONTENT
1702:39.2	CAM-1	What really happened over there today?
1702:41.6	CAM-4	They put a bomb (in) the terminal Sir, right where the check-in counters are.
1702:46.6	CAM-1	Well we asked them if we could hold and -uh- I guess you got the word, we landed here * *
	CAM-X	* * *
1702:49.8	APP	KLM four eight zero five how many taxiway -ah- did you pass?
1702:55.6	KLM	I think we just passed charlie four now.
1702:59.9	APP	O.K. ... at the end of the runway make one eighty and report -ah- ready -ah- for ATC clearance ((background conversation in the tower)).
1703:09.3	CAM-2	The first one is a ninety degree turn.
1703:11.0	CAM-1	Yeah, O.K.
1703:12.1	CAM-2	Must be the third ... I'll ask him again.
1703:14.2	CAM-1	O.K.
1703:16.6	CAM-1	We could probably go in it's ah ...

TIME	SOURCE	CONTENT
1703:19.1	CAM-2	You gotta make a ninety degree turn.
1703:21.6	CAM-1	Yeah, uh.
1703:21.6	CAM-2	Ninety degree turn to get around this ... this one down here it's a forty five.
1703:29.3	RDO-2	Would you confirm that you want the clipper one seven three six to turn left at the third intersection? ((1703:35.4)). ((PAA: "third" drawn out and emphasized)).
1703:35.1	CAM-1	One, two.
1703:36.4	APP	The third one Sir, one, two, three, third third one ((1703:38.3)).
1703:38.3	CAM-?	One two (four).
1703:39.0	CAM-1	Good
1703:39.2	RDO-2	Very good, thank you ((1703:40.4)).
1703:40.1	CAM-1	That's what we need right, the third one.
1703:42.9	CAM-3	Uno, dos, tres.
1703:44.0	CAM-1	Uno, dos, tres.
1703:44.9	CAM-3	Tres - uh - si.
1703:46.5	CAM-1	Right

TIME	SOURCE	CONTENT
1703:47.6	CAM-3	We'll make it yet.
1703:47.6	APP	...er seven one three six report leaving the runway.
1703:49.1	CAM-2	Wing flaps?
1703:50.2	CAM-1	Ten, indicate ten, leading edge lights are green.
1703:54.1	CAM-?	Get that.
1703:55.0	RDO-2	Clipper one seven three six ((1703:56.4))
1703:56.5	CAM-2	Yaw damp and instrument?
1703:58.6	CAM-1	Ah- Bob we'll get a left one *.
1703:59.3	CAM-2	I got a left.
1704:00.6	CAM-I	Did you?
1704.00.9	CAM-2	And -ah- need a right.
1704:02.6	CAM-1	I'll give you a little *
1704:03.8	CAM-2	Put a little aileron in this thing.
1704:05.0	CAM-1	O.K. here's a left and I'll give you a right one right here.

TIME	SOURCE	CONTENT
1704:09.7	CAM-1	O.K., right turn right and left yaw.
1704:11.4	CAM-2	Left yaw checks.
1704:12.4	CAM-1	O.K., here's the rudders.
1704:13.6	CAM-1	Here's two left, center, two right center.
1704:17.8	CAM-2	Checks.
1704:19.2	CAM-2	Controls.
1704:19.6	CAM-1	Haven't seen any yet!
1704:20.3	CAM-2	I haven't either.
1704:21.7	CAM-1	They're free, the indicators are checked.
1704:24.6	CAM-2	There's one.
1704:25.8	CAM-1	There's one.
1704:26.4	CAM-1	That's the ninety degree.
1704:28.5	CAM-?	O.K.
1704:34.5	CAM-?	* * *
	CAM-2	Weight and balance finals?
1704:37.7	CAM	((Sounds similar to stabilizer trim)).
		((1704:44.8))

TIME	SOURCE	CONTENT
1704:37.2	CAM-1	We were gonna put that on four and a half.
1704:39.8	CAM-3	We got four and a half and we weigh five thirty four ((sound of stabilizer trim)).
1704:44.6	CAM-2	Four and a half on the right.
1704:46.8	CAM-2	Engineer's taxi check.
1704:48.4	CAM-3	Taxi check is complete.
1704:50.5	CAM-2	Take-off and departure briefing?
1704:52.1	CAM-1	O.K., it'll be standard we gonna go straight out there till we get thirty-five hundred feet then we're gonna make that reversal and go back out to [illegible] fourteen.
1704:58.2	APP	-m eight seven zero five and clipper one seven ... three six, for your information, the centerline lighting is out of service. ((APP: transmission is readable but slightly broken.))
1705:05.8	KLM	I copied that.
1705:07.7	RDO-2	Clipper one seven three six.

TIME	SOURCE	CONTENT
1705:09.6	CAM-1	We got centerline markings (* only) ((could be "don't we)) they count the same think as .... we need eight hundred meters if you don't have that centerline... I read that on the back (of this) just a while ago.
1705:22.0	CAM-1	That's two.
1705:23.5	CAM-3	Yeh, that's forty-five there.
1705:25.7	CAM-1	Yeh.
1705:26.5	CAM-2	That's this one right here.
1705:27.2	CAM-1	(Yeh) I Know.
1705:28.1	CAM-3	O.K.
1705:28.5	CAM-3	Next one is almost a forty-five, huh yeh.
1705:30.6	CAM-1	But it goes...
1705:32.4	CAM-1	Yeh, but it goes ... ahead, I think (it's) gonna put us on (the) taxiway.
1705:35.9	CAM-3	Yeah, just a little bit yeh.
1705:39.8	CAM-?	O.K., for sure.
1705:40.0	CAM-2	Maybe he, maybe he counts these (are) three.

TIME	SOURCE	CONTENT
	CAM-?	Huh.
1705:44.8	CAM-?	I like this.
1705:44.8	KLM	Uh, the KLM ... four eight zero five ... is now ready for take off ... uh and we're waiting for our ATC clearance.
1705:53.4	APP	KLM eight seven * zero five uh you are cleared to the Papa beacon climb to and maintain flight level nine zero ... right turn after take off proceed with heading zero four zero until intercepting the three two five radial from Las Palmas VOR. ((1706:08.2)).
1706:09.6	KLM	Ah roger sir we're cleared to the Papa beacon flight level nine zero, right turn out zero four zero until inter- cepting the three two five and we're now (at take off). ((1706:17.9)).

From the foregoing it may be inferred that the PANAM crew at first had difficulty in understanding "third", thinking that it was "first". In any case, the Co-pilot asked again and this doubt was dispelled at 1703:36.4 as the Tower Controller told him: "The third Sir, one, two, three, the third, third", and the Co-pilot confirmed this at 1703:39.2.

As a result of the poor visibility, the crew had difficulty in localizing the exits from the runway whose position they were following on the little map that they had with them. Nevertheless, at 1704:26.4 the Captain identified C-1 (which is the 90

degree exit). At 1705:22.0, they also identified C-2. Then, perhaps through error, or thinking that C-4 was an easier exit than C-3, they overshot the exit ordered by the Tower.

From Apendix 5, which gives the time correlation between the conversations taking place with the tower and inside the K.L.M. 4805 and Clipper 1736 cockpits, as well as the data obtained from the K.L.M. 4805 DFDR during the last 88 seconds before impact, the following may be ascertained:

When, at 1706:17.9, K.L.M. 4805 finished reading back the ATC clearance given by the control tower and added, "We are now (at take off)" and before the Controller finished the sentence "O.K..... stand by for take off, I will call you.", only "...k" is heard in the PANAM cockpit. The pilot says: "No uh ..." and the Co-pilot says "And we're still taxiing down the runway, the Clipper one seven three six..." (1706:23.6). These communications caused a shrill noise in the K.L.M. cockpit, which lasted approximately 3.74 seconds.

During this time the K.L.M. take-off EPR was reached and stabilized (1.39 to 1.42).

At 1706:25.6, the Tower Controller gave PANAM confirmation in the following manner: "Roger alpha one seven three six report the runway clear" - to which the PANAM replied at 1706:29.6, "O.K., we'll report when we're clear." The tower replied, "Thank you", but the K.L.M. had already started its take-off run. The PANAM crew saw the K.L.M. plane approximately 8.50 seconds before the impact. Amidst logical exclamations of alarm they accelerated in order to try to get off the runway, but the collision was already inevitable.

2.2 CONCLUSIONS

From all of which it may be ascertained that the K.L.M. 4805 Captain, as soon as he heard the ATC clearance, decided to take off.

The fundamental cause of this accident was the fact that the K.L.M. Captain:

1. Took off without clearance.

2. Did not obey the "stand by for take off" from the tower.

3. Did not interrupt take off on learning that the PANAM was still on the runway.

4. In reply to the Flight Engineer's query as to whether the PANAM had already left the runway, replied emphatically in the affirmative.

Now, how is it possible that a pilot with the technical capacity and experience of Captain Veldhuyzen Van Zauten, whose state of mind during the stopover at Tenerife seemed perfectly normal and correct, was able, a few minutes later, to commit a basic error in spite of all the warnings repeatedly addressed to him?

An explanation may be found in a series of factors which possibly contributed to the occurrence of the accident.

1.- A growing feeling of tension as the problems for the Captain continued to accumulate. He knew that, on account of the strictness in the Netherlands regarding the application of rules on the limitation of duty time, if he did not take off within a

relatively short space of time he might have to interrupt the flight - with the consequent upset for his company and inconvenience for the passengers. Moreover, the weather conditions in the airport were getting rapidly worse, which meant that he would either have to take off under his minima or else wait for better conditions and run the risk of exceeding the aforementioned duty-time limit.

2.- The special weather conditions in Tenerife must also be considered a factor in themselves. What frequently makes visibility difficult is not actually fog, whose density and therefore the visibility which it allows can be fairly accurately measured, but rather layers of low-lying clouds which are blown by the wind and therefore cause sudden and radical changes in visibility. The latter can be zero meters at certain moments and change to 500 meters or one kilometer in a short space of time, only to revert to practically zero a few moments later. These conditions undoubtedly make a pilot's decisions regarding take-off and landing operations much more difficult.

3.- The fact that two transmissions took place at the same time. The "stand by for take off ... I will call you" from the tower coincided with PANAM's "we are still taxiing down the runway", which meant that the transmission was not received with all the clarity that might have been desired. The whistling sound which interfered with the communication lasted for about three seconds.

The following must also be considered factors which contributed to the accident:

1.- Inadequate language. When the K.L.M. Co-pilot repeated the ATC clearance, he ended with the words, "we are now at take off", The Controller, who had not been asked for take-off clearance, and

who consequently had not granted it, did not understand that they were taking off. The O.K. from the tower, which preceeded the "stand by for take off" was likewise incorrect - although irrelevant in this case because take off had already started about six and a half seconds before.

2.- The fact that the PANAM had not left the runway at the third intersection. This plane should, in fact, have consulted with the tower to find out whether the third intersection referred to was C-3 or C-4, if it had any doubts, and this it did not do. However, this was not very relevant either since PANAM never reported the runway clear but, to the contrary, twice advised that it was taxiing on it.

3.- Unusual traffic congestion which obliged the tower to carry out taxiing manoeuvres which, although statutory, as in the case of having planes taxi on an active runway, are not standard and can be potentially dangerous.

Although contributing to the accident, the following occurrences must not be considered direct factors in it: the bomb incident in Las Palmas, the K.L.M. refuelling, the latter's take off at reduced power, etc.

3. RECOMMENDATIONS

3.1 Placing of great emphasis on the importance of exact compliance with instructions and clearances.

3.2. Use of standard, concise and unequivocal aeronautical language.

3.3. Avoidance of the word "TAKE OFF" in the ATC clearance and adequate time separation between the ATC clearance and the TAKE-OFF clearance.