AIRCRAFT ACCIDENT REPORT

AIB/DHL/2006/09/07/F

Accident Investigation Bureau

**Report on the Accident Involving
DHL, Registration ZS - DPF,
at Murtala Muhammed International Airport,
Ikeja, Lagos. Nigeria
On 7 September 2006**

This report was produced by the Accident Investigation Bureau (AIB), Murtala Muhammed Airport, Ikeja, Lagos.

The report is based upon the investigation carried out by Accident Investigation Bureau, in accordance with Annex 13 to the Convention on International Civil Aviation, Nigerian Civil Aviation Act 2006, and Civil Aviation (Investigation of Air Accidents and Incidents) Regulations.
In accordance with Annex 13 to the Convention on International Civil Aviation, it is not the purpose of aircraft accident/serious incident investigations to apportion blame or liability.

Readers are advised that Accident Investigation Bureau investigates for the sole purpose of enhancing aviation safety. Consequently, Accident Investigation Bureau reports are confined to matters of safety significance and should not be used for any other purpose.

As the Bureau believes that safety information is of great value if it is passed on for the use of others, readers are encouraged to copy or reprint for further distribution, acknowledging Accident Investigation Bureau as the source.

Recommendations in this report are addressed to the regulatory Authorities of the state (NCAA). It is for this authority to decide what action is taken.

Contents

GLOSSARY OF ABBREVIATIONS USED IN THIS REPORT

AIB	Accident Investigation Bureau
CVR	Cockpit Voice Recorder
DA	Decision Altitude
DH	Decision Height
FDR	Flight Data Recorder
ICAO	International Civil Aviation Organisation
MDA	Minima Decision Altitude
MDH	Minima Decision Height
NCAA	Nigerian Civil Aviation Authority
NOTAM	Notice to Airmen
NTSB	National Transport Safety Board
PAPI	Precision Approach Path Indicator
SA	South Africa
SACAA	South African Civil Aviation Authority
CARS	Civil Aviation Regulations
CATS	Civil Aviation Technological Standards
CB	Cumulonimbus
ASL	Above Sea Level

HPA	**Hecto Pascal**
SD	**Several Direction**
SPECI	**Special Weather Report**


DHL

Aircraft Accident Report No:	**(DHL/2006/09/07/F)**
Registered owner and operator:	DHL Aviation (PTY), Ltd
Aircraft Type and Model:	Boeing 727-277
Registration:	ZS –DPF
Place of Accident:	Murtala Muhammed Airport, Ikeja, Lagos, Nigeria. Runway 18L
Date and Time:	07 September, 2006 at 1305 hrs
	All times in this report are local time (equivalent to UTC + 1) unless otherwise stated)

SYNOPSIS

The accident was reported to erstwhile Accident Investigation and Prevention Bureau (AIPB) now Accident Investigation Bureau (AIB) on the 7th of September, 2006 and investigation commenced same day.

DHL Flight DV 110 took off from Abidjan at 1015hrs for Lagos via Accra. The aircraft finally departed Accra for Lagos at 1145hrs with a total declared cargo weight of 50014 lbs (22733 kgs). The aircraft made contact with Lagos area control at 1242hrs maintaining FL 210 (21,000 ft) and was given an in-bound clearance to Lagos VOR (LAG) for ILS approach on runway 18L. At 1252hrs Lagos approach cleared it to FL 050 (5000ft) and at 12NM; it was further cleared down to 3500ft on QNH 1013hpa, and finally to 2200ft to report established on the ILS.

At 4 NM to the runway, the aircraft reported fully established on ILS and was handed over to control tower for landing instructions. At 1303hrs and 2NM to the runway, the aircraft was cleared to land on runway 18L but to exercise caution, as the runway surface was wet. The aircraft landed and overshot the runway with about 400m into the grass. There was no fire or injuries but there was a severe damage to the aircraft. All the necessary authorities were contacted: the Boeing Company, DHL, Pratt and Whitney and the NTSB, USA.

The investigation identified the following causal and contributory factors.

Causal Factor

The decision of the crew to continue an unstabilised approach despite the prevailing adverse weather condition.

Contributory Factors

- The captain did not take over the control of the flight from the first officer in the known bad weather situation
- The crew resource management (CRM) was inadequate.

Two safety recommendations have been made. Operator's response is in the appendix.

1.0 FACTUAL INFORMATION

1.1 History of Flight

On the day of the accident, Flight DV 110 routing was Abidjan – Accra - Lagos. It departed Abidjan at 1015hrs for Lagos via Accra. The aircraft finally departed Accra for Lagos at 1145hrs with a total declared cargo weight of 50014 lbs (22733 kgs).

The aircraft contacted Lagos Area Control at 1242hrs, while maintaining FL 210 (21, 000ft) and was given an in-bound clearance to Lagos VOR (LAG) for ILS approach on runway 18L. At 1252hrs, Lagos Approach cleared it to FL 050 (5,000ft) and at 12NM, it was further cleared down to 3500ft on QNH 1013 hpa, and finally to 2200ft and to report established on the ILS.

At 4NM to the runway, the aircraft reported fully established on the ILS and was handed over to Control Tower for landing instructions. At 1303 hrs and 2NM to the runway, the aircraft was cleared to land on runway 18L but to exercise caution, as the runway surface was wet.

The cloud was low; the Captain said in his statement that the cloud base was about 100ft above minimum. Speci weather was also available to the crew. The pilot was advised to exercise caution due to the rain and the weather at that time.

In spite of all the warnings the co-pilot was still allowed to proceed with the landing. At the point of touch down the captain observed that it was impossible to stop on the runway and he called for a go-around. The procedure was not properly executed and thus the aircraft overshot the runway 400m into the grass area. There was no fire outbreak and no injury was sustained by any of the crew members. There was serious damage to the aircraft.

The Meteorological information for 1130 UTC was as follows:

Wind:	240/16 KT
Visibility:	10 km
Weather:	Nil
Cloud:	BKN 330 Few 600 m CB (N-S)
Temperature:	27°C
QNH:	1013 hpa
Trend:	NOSIG

SPECI (SPECIAL MET Report)	11:48 UTC
Wind:	080/18MAX30KT
Visibility:	1000m
Weather:	Squall
Cloud:	BKN270M FEW570MCB [SD]
Temperature:	27°C
Dew point:	24°C
QFE:	1011 HPA
QNH:	1013 HPA
Trend:	TEMPO VIS: 0800M
	WX: HEAVY RAIN

1.2 Injuries to Persons

Injuries	Crew	Passengers	Others
Fatal	Nil	Nil	Nil
Serious	Nil	Nil	Nil
Minor/None	Nil	Nil	

1.3 Damage to Aircraft

The aircraft sustained damages to the following structure/components among others:

(i) Nose wheel (sheared off)

(ii) Nos. 1 and 4 main wheels

(iii) Left wing leading edge devices.

See fig 1.3a and 1.3b.

Fig 1.3a Damage to Main gear assembly

Fig 1.3b Wheelwell damage

1.4 Other Damage

Runway 18L localiser antennae and runway end lights were damaged (See fig 1.4).

Fig 1.4 Damage to NAV aids

1.5 Personnel Information

1.5.1 Captain

Date of birth:	27th January 1946
Nationality:	Yugoslav
Licence No:	ATPL SCG637/5353
Validity:	19th July 2010
Aircraft rating:	B727
Medical expiry:	26th November 2006
Total flying time:	17295:00hrs.

Hours on type:	7820:00hrs.

1.5.2 The First Officer

Date of birth:	11th May, 1965
Nationality:	Yugoslav
Licence No:	CPL 2606/10911
Validity:	07th June 2010
Aircraft rating:	B727
Medical expiry:	10th February 2007
Total flying time:	2972:25hrs.
Hours on type:	2422:00hrs.

1.5.3 Flight Engineer

Date of birth:	24th June 1955
Nationality:	Yugoslav
Licence No:	SCG 283/9537
Validity:	28th November 2010
Aircraft rating:	B727
Medical expiry:	25th November 2006
Total flying time:	7216:20hrs.

1.6 Aircraft Information

1.6.1 General Information

Type:	B727 – 277
Serial No.	22644
Manufacturer:	Boeing Aircraft Company, USA
Airframe time:	52728:20hrs
Cycles:	34063
Certificate of Airworthiness:	27th January 2007

1.6.2 Power Plant

Three Pratt and Whitney engines.

No. 1:

Model:	JT8D – 17
Serial No:	688009
Hours:	61882
Cycles:	45249

No. 2:

Model:	JT8D – 15
Serial No:	700179
Hours:	46846
Cycles:	35037

No. 3:

Model: JT8D – 15

Serial No: 700115B

Hours: 42569

Cycles: 32581

Type of Fuel used: Jet A1

1.6.3 Conduct of Flight

The FDR shows inconsistency in the deployment of the thrust reversers and the approach speed. There was no standard call out, the checklist was not adhered to, the Cockpit Resource Management (CRM) was inappropriate.

The Flight Data Recorder provided the longitudinal acceleration, normal load factor, pitch angle, bank angle, heading, pressure altitude, computed airspeed, engine pressure ratios and thrust reverser position discrete. However, the data provided did not include any control (crew input) positions, control surface positions, flap positions, ground speed, drift angle or radio altitude.

Flight Data Recorder analysis showed that the aircraft flight path and airspeed were not stabilized below 1000ft, with speed increasing to a maximum of 186kts at approximately 45ft above the ground. The speed then reduced to approximately 167kts at touchdown with weather reported to have been raining with low cloud cover or ceiling and wet runway. The weight and flap setting supplied by the crew is take-off weight 168898lbs, landing weight 159888lbs and flap 30. The maximum landing weight of the aircraft is 160000lb which will result in a landing reference speed (VREF) of 137kts for flap 30. The indication is that the airplane touched down at least 30kts faster than the reference landing speed.

Below 1000ft, the descent was momentarily arrested twice, first at 550ft and then at 200ft. This is a control problem indicative of a probable excessive weight and the weather factor.

1.7 Meteorological Information

1.7.1 Meteorological and Special Report

The Meteorological and Speci reports available before, during and after landing of the aircraft were as follows:

Time:	**1130 UTC**
Wind:	240/16 KTS
Visibility:	10km
Weather:	Nil
Cloud:	BKN 330 Few 600 m CB (N-S)
Temperature:	27°C
QNH:	1013 hpa
Trend:	NOSIG
Time:	**1148UTC (SPECI)**
Wind:	080/18 MAX 30 KTS
Visibility:	1000 m

Weather:	SQUALL
Cloud:	BKN 270m Few 570m CB (SD)
Temperature:	27°C
QNH:	1013 hpa
Trend:	TEMPO VIS 0800m WX HEAVY RAIN

Time:	**1153 UTC (SPECI)**
Wind:	090/23 MAX 45KTS
Visibility:	600 m
Weather:	SQUALL AND HEAVY RAIN
Cloud:	OBSCURED
Temperature:	27°C
QNH:	1013 hpa
Trend:	TEMPO WX: THUNDERSTORM

Time:	**12:00 UTC**
Wind:	070/22 MAX 30 KTS
Visibility:	600m
Weather:	SQUALL AND HEAVY RAIN
Cloud:	SKY OBSCURED

Temperature:	27^oc
QNH:	1014 hpa
Trend:	TEMPO WX: THUNDERSTORM

Time:	**12:19 UTC (SPECI)**
Wind:	140/05 KTS
Visibility:	1000m
Weather:	MODERATE RAIN
Cloud:	SCT 150m Few 510m CB (SD) OVC 2400m
Temperature:	22^oC
QNH:	1014 hpa
Trend:	TEMPO WX: THUNDERSTORM

Time:	**12:30 UTC**
Wind:	000/00 KT
Visibility:	1000m
Weather:	MODERATE RAIN
Cloud:	SCT 150m Few 510m CB (SD) OVC 2400m
Temperature:	22^oC
QNH:	1013 hpa
Trend:	TEMPO WX:THUNDERSTORM

1.7.2 Satellite Weather Imagery

The Satellite weather imagery received from the Boeing Company showed that ***"there was a shortage of direct meteorological measurements and observation for this case"***. However, utilizing a combination of satellite imagery and atmospheric stability data made it possible to infer the likely conditions that were occurring at the time of the accident. Convective clouds with tops 41000 to 46000ft were found to be -4 at 1300hrs. Thunderstorm was reported east of Lagos from clouds with similar characteristics. Given these facts along with visual characteristics of the convection, it was likely that thunderstorms of moderate intensity were occurring at the time of this accident.

In addition, low level thunderstorm outflow winds were likely present in Lagos at 1400hrs which can be gusty. The accident occurred in day light in rain.

1.8 **Aids to Navigation**

The navigation and landing aids available and their effectiveness on the day of the accident were as follows:

"LAG"	VOR/DME:	serviceable
	ILS/DME:	serviceable
	Glide slope:	serviceable
	Localizer:	serviceable

1.9 Communications

The communication between the aircraft and the Control Tower was good during and after the accident. The statuses of the equipment on the day of the accident were as follows:

VHF 124.7 Control:	serviceable
VHF 118.1 Tower:	serviceable

1.10 Aerodrome Information

Murtala Muhammed Airport has an elevation of 135ft Above Sea Level (ASL) and two runways (18L/36R and 18R/36L). The runway 18R/36L was withdrawn due to major infrastructural upgrade. This closure was also in the NOTAM. The runways are equipped with "PAPI", runway lights and approach lights. The length of runway 18L/36R is 2745m.

1.11 Flight Recorders

1.11.1 Flight Data Recorder (FDR)

Model:	UFDR
Part No:	980-4100-DXUS
Serial No:	2249
Data Code:	8416
Ref. Code:	903
Make:	Allied Signal

1.11.2 Cockpit Voice Recorder (CVR)

Model:	4V557C
Part No:	980-6005-076
Serial No:	11135
Make:	Sunstrand Data Control
Data Code:	8751

1.12 Wreckage and Impact Information

The aircraft landed and overshot the runway into the grass area. The nose wheel landing gear sheared off. The No. 1 and 4 wheels were damaged. The left wing leading edge devices were damaged. The impact also damaged the runway 18L ILS antennae and the runway end lights (See fig. 1.12a-b).

Fig 1.12a Wreckage scene

Fig 1.12b Sheared Nose gear assembly

1.13 Medical and Pathological Information

Not applicable.

1.14 Fire

There was no fire outbreak. The fire fighting crew responded promptly.

1.15 Survival Aspect

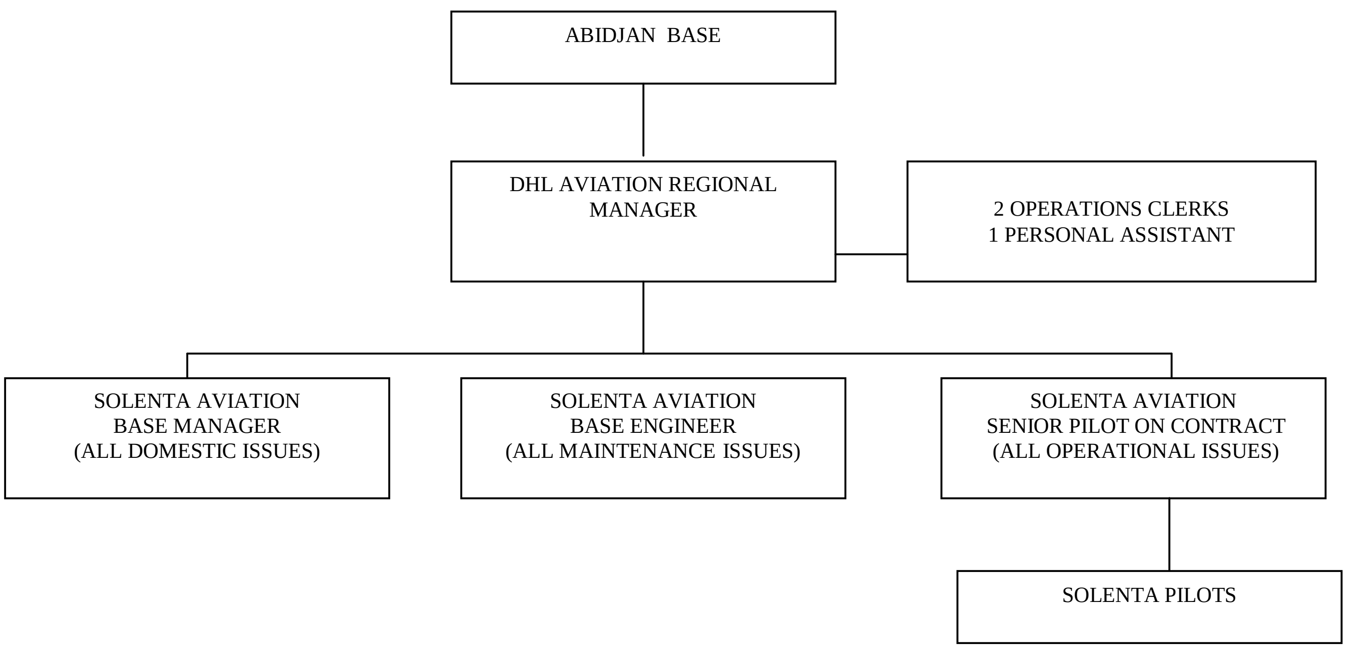
The crew survived without injuries. Although the aircraft suffered serious structural damage but there was no damage to the cockpit. There was enough liveable volume. The fire service asked the crew to disembark but they refused until the arrival of their organization’s representative.

1.16 Test and Research

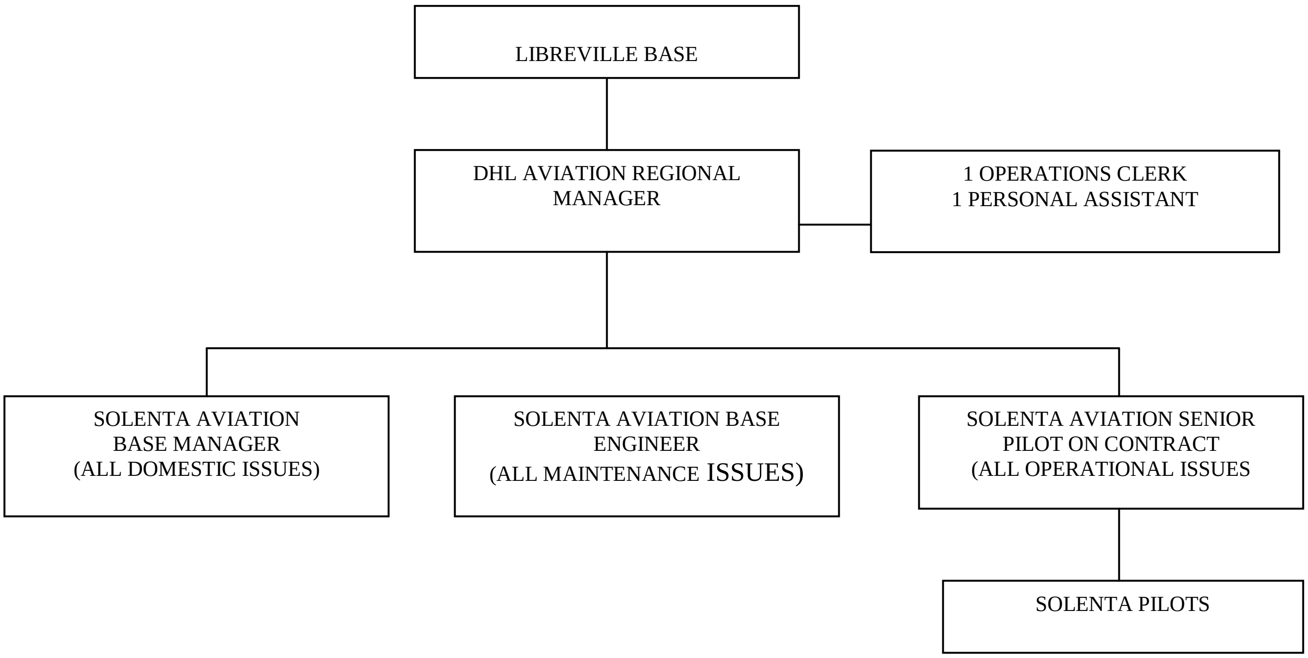
Not applicable

1.17 Organisational and Management Information

DHL AVIATION (PTY) LTD
ORGANOGRAM: ABIDJAN BASE



RQW12
DHL AVIATION (PTY) LTD
ORGANOGRAM: LIBREVILLE BASE



1.17.1 Flight Crew Authorizations

"Further to our recent conversations, I confirm that it is both acceptable and expected that flight crew members (captains, first officers, flight engineers) will carry out and certify the accomplishment of tasks such as refueling, oil quantity checks and preflight inspections in accordance with DHL/SNAS procedures. Often these are accomplished and certified by qualified and authorized ground crew but in their absence these tasks are a flight crew responsibility".

*(**Note:** Not all ground crew are holders of certification authorizations). In addition, the captain must sign the captain's acceptance before each flight.*

The aircraft technical logbook contains a sector, defects and refueling record for each flight. The bottom portion of each page is identified as being "preparations for the next flight" and contains spaces for the certifications mentioned above.

When certifying the above items, the crew members must identify themselves by signature, printed name and authorization number. It is acceptable for crew to use their SACAA flight crew licence number as their authorization number.

I trust this clarifies the situation for our West Africa Operations.

The above was policy statement from the Quality Assurance Manager of the organization (DHL).

1.17.2 Adverse and Potentially Hazardous Atmospheric Conditions

This chapter contains a compilation of hazardous atmospheric conditions and recommended practices and procedures for operating in and/or avoiding those conditions associated with:

1. Thunderstorms

2. Icing conditions

3. Turbulence

4. Windshear

5. Jet streams

6. Volcanic ash clouds

7. Heavy precipitation

8. Sand storms.

1.17.3 Application of Established MINIMA – General Policy

(a) Minima figures of DH/MDA and visibility are the lowest value for which landing or take off should be attempted and except in the case of circling minima, these figures assume the serviceability of the ground and airborne equipment. If, for any reason, the captain considers that the weather minima are too low for safe operation in particular set of conditions, he is authorized to raise the minima accordingly.

(b) *The International Civil Aviation Organization (ICAO) definition of Decision Height/Altitude (DH/DA) means, in effect, that the pilot-by reference to the visual cues available to him – must have satisfied himself by the decision height that:*

(i) *the aircraft is in the correct position;*

(ii) *the aircraft flight path is correct; and*

(iii) *there is sufficient visual reference to control the aircraft for the remainder of the approach and landing.*

(c) *If he is not satisfied that these conditions are fulfilled, he must initiate a missed approach and it is emphasized that the decision must be made by the time the aircraft arrives at decision height/altitude. It may happen that a pilot having decided to land, must subsequently revise this decision because of loss or foreshortening of the visual segment.*

1.17.4 Purpose of the Quality System

The purpose of the quality system within DHL Aviation is to enable management monitor compliance with SA CATS and CARS, the DHL Aviation Operations Manual, the DHL Aviation Safety Manual and any other standard as *required by DHL Aviation and/or the SA CAA to ensure safe operations and airworthy aircraft.*

1.17.5 Flight Time and Duty Period Limitations and rest requirements

1.17.5.1 Definitions

"Duty Period" *means any continuous period throughout which either a flight crew member flies in any aeroplane, whether as a flight crew member or as a passenger, at the behest of his or her employer or otherwise carries out a required duty in the course of his or her employment. It includes any flight duty period, positioning at the behest of the operator, ground training, office duties, flight watch, home reserve and standby duty.*

*"**Flight Duty Period"*** *means any time during which a person operates in an aeroplane as a member of its flight crew. It starts when the flight crew member is required by an operator to report for a flight and finishes at on-chocks or engines off, on the final sector for that flight crew member.*

1.17.5.2 **General Principles**

(a) *The prime objective of this scheme of flight, duty and rest time regulations is to ensure that crew members are adequately rested at the beginning of each flight duty period. As such, DHL Aviation has designated the person responsible for fight operations to establish the flight and duty times limitations and rest scheme, as they apply to the avoidance of fatigue in flight crew members. These rules aim at taking all reasonable precautions to ensure that:*

(i) *Neither the tiredness occurring during a particular flight or sequence of flights nor the accumulated tiredness resulting, after a period of time, from flights and other tasks, will hamper the safety of a flight; and*

(iii) *Crew members are adequately rested at the beginning of each flight duty period.*

(b) DHL Aviation therefore agrees to take into account the inter-related planning constraints of:

(i) Individual duty and rest periods, and

(ii) the length of cycles of duty and the associated periods of time off;

(iii) cumulative duty hours within specific periods.

*1.17.6 **Pilot-In-Command/Captain***

1. The DHL Aviation will nominate one of the pilots to be in command for each flight or series of flights.

2. The pilot-in-command shall take all reasonable steps to:

(a) Maintain familiarity with all relevant aviation regulations, notices, circulars and procedures.

(b) Maintain familiarity with the contents of this operations manual.

3. *The pilot-in-command shall:*

(a) *Be responsible for the safe operation of the aeroplane and safety of its occupants and cargo during flight time.*

(b) *Have authority to give all commands he deems necessary for the purpose of securing the safety of the aeroplane and of persons or property carried there in and all persons carried in the aeroplane shall obey such commands.*

(c) *Ensure that all operational procedures and check list are complied with in accordance with operations manual:*

(i) *Not permit any crew member to perform any activity during take-off, initial climb, final approach and landing except those duties required for the safe operation of the aeroplane;*

(ii) *In an emergency situation that requires immediate decision and action, take any action he considers necessary under the circumstances. In such cases he may deviate from rules, operational procedures, and methods in the interest of safety;*

(iv) *The pilot-in-command has the authority to apply greater safety margins, including aerodrome operating minima, if he deems it necessary.*

1.17.6 ***Qualifications:***

The minimum requirements for appointment as co-pilot for B-727 are as follows:

- *Must be in possession of a valid Airline Transport Pilot Licence (ATPL) with IF rating.*
- *Minimum of 1500 hours TT and 500 hours turbine/multi-engine time.*
- *Hours on type required will be according to the approved conversion course.*

*1.17.7 **RECENT EXPERIENCE – CO-PILOT***

***DHL Aviation** shall not assign a co-pilot to serve at the flight controls during take-off and landing unless, on the same type of aeroplane within the preceding 90 days, that co-pilot has served as co-pilot at the flight controls or has otherwise demonstrated competence to act as co-pilot.*

1.18 **Additional Information**

The aircraft is South African registered; and operated by DHL Aviation International with their procedures based on the South African Civil Aviation Authority. The aircraft load sheet was prepared in Accra.

The aircraft overshot the runway and in the process broke some runway end lights and ILS antennae leaving high voltage armoured cables exposed which constituted hazard to personnel.

1.19 **Useful or effective investigation techniques**.

Not applicable

2.0 ANALYSIS

2.1 Aircraft Information

The aircraft left Abidjan for Lagos via Accra and landed in Accra to pick up more cargo before departing for Lagos with 50014lbs of cargo on board. It made contact with Lagos tower and was cleared to land with caution due to the wet runway as it was raining in Lagos.

The aircraft was registered in South Africa with DHL Aviation as the Operator and all documents were in conformity with the South African Civil Aviation Regulations.

2.2 Meteorological Information

From the weather report available, the trend from 1230 hrs with wind of 240/16kts was on the increase. The speci at 1248 hrs showed an increase in the wind to 080/18 kts, 090/23kts and 070/22 MAX 30kts with a squall and heavy rain reported by Nigerian Meteorological Agency.

The satellite weather imagery from Boeing showed that there was shortage of direct meteorological measurement and observation at the time of the accident. However, the totality of the data available to Boeing Company made them to infer that there was convective cloud with tops 41000ft to 46000ft found to be -4^0C at 1300hrs. Thunderstorms of moderate intensity were occurring at the time of the accident which can be gusty. The accident occurred at 1305hrs.

With all the weather and speci reports, the captain should have taken over control from the first officer before landing but did not. With 600m visibility, squall and heavy rain, sky obscured, the decision to land by the crew was not appropriate particularly when the co-pilot was the pilot flying. The co-pilot in his statement saw the approach light at 430ft.

2.3 Flight Recorders

Cockpit Voice Recorder (CVR)

There was good communication between the aircraft and the Control Tower. However, going through the voice recorder one will conclude that the crew was not coordinated. There was no standard call out by the Pilot monitoring; the checklist was not adhered to. The captain was noticed to be under pressure, which was evident when he replied the tower request for confirmation of clearance with an offensive word as revealed by the CVR read-out.

The weather existing at the time of the accident and the unstable approach should have made the captain to take over from the first officer and discontinue with the approach and landing. The decision by the captain to go ahead and land under the severe weather condition was unprofessional, and shows inability to interpret the weather condition accurately.

The flight engineer did not make any remarkable contribution throughout the phases of the flight; he did not remind the captain of the descent and approach checklist and go around briefing.

Flight Data Recorder (FDR)

The Flight Data Recorder provided the longitudinal acceleration, normal load factor, pitch angle, bank angle, heading, pressure altitude, computed airspeed, engine pressure ratios and thrust reverser position discrete. However, the data provided did not include any control (crew input) positions, control surface positions, flap positions, ground speed, drift angle or radio altitude.

Flight Data Recorder analysis showed that the aircraft flight path and airspeed were not stabilized below

1000ft, with speed increasing to a maximum of 186kts at approximately 45ft above the ground. The speed then reduced to approximately 167kts at touchdown with weather reported to have been raining with low cloud cover or ceiling and wet runway. The weight and flap setting supplied by the crew is take-off weight 168898lbs, landing weight 159888lbs and flap 30. The maximum landing weight of the aircraft is 160000lb which will result in a landing reference speed (VREF) of 137kts for flap 30. The indication is that the airplane touched down at least 30kts faster than the reference landing speed.

Below 1000ft, the descent was momentarily arrested twice, first at 550ft and then at 200ft. This is a control problem indicative of a probable excessive weight and the weather factor.

There were also inconsistencies in the deployment of the thrust reversers. In the data analysis, when the airplane touched down, the thrust reverser discrete showed the reversers deployed immediately and the airplane began to decelerate. Approximately 17 seconds after touchdown, the longitudinal acceleration became positive for a few seconds. The positive acceleration corresponds with a change in the thrust reverser discrete which showed the thrust reversers momentarily stowed during the landing roll. The reversers then redeployed approximately 5 seconds later.

The positive longitudinal acceleration during the landing roll contributed to the amount of runway overrun as the airplane departed the runway at a greater airspeed than if the deceleration had remained throughout the landing roll.

These inconsistencies in the deployment and redeployment of the thrust reversers were an indication of lack of coordination among the crew, evidence of pressure on the crew and lack of total knowledge of what to do.

During the data analysis, an estimated ground track showed the touch down occurred at approximately 4680ft beyond the threshold and at approximately 167kts airspeed i.e. 30kts more than the maximum landing speed.

From the foregoing and the available information from the Flight Data Recorder it was not expected to have a safe landing on the wet runway.

Below is the detailed NTSB FDR Data Analysis

Boeing FDR Performance Analysis, DHL 727-200 ZS-DPF Landing Overrun Accident in Lagos, Nigeria – 7 September 2006

FDR Data Analysis

The data provided were limited, and consisted of longitudinal acceleration, normal load factor, pitch angle, bank angle, heading, pressure altitude, computed airspeed, engine pressure ratios, and thrust reverser position discretes. The data are shown in Figure 1. The data provided did not include any control (crew input) positions, control surface positions, flap positions, ground speed, drift angle, or radar altitude. Figure 1 shows the airplane flight path and airspeed were not stabilized below 1000 feet, with speed increasing to a maximum of 186 knots at approximately 45 feet above the ground. The speed then reduced to approximately 167 knots at touchdown with weather reported to have been raining with low cloud cover and wet runway. The weight and landing flap of the event airplane are unknown. However, the heaviest maximum landing weight (160,000lb) results in a landing reference speed (V_{REF}) of 137 knots for flaps 30, indicating that the aircraft touched down at least 30 knots faster than the reference landing speed and close to the maximum Airplane Flight Manual stated flaps 30 placard speed of 185 knots.

Below 1000 feet, the descent was momentarily arrested twice, once at 550 feet and a second time at 200 feet. Once the airplane touched down, the thrust reverser discretes showed the reversers deployed immediately and the airplane began to decelerate. Approximately 17 seconds after touchdown, the longitudinal acceleration becomes positive for a few seconds. This positive acceleration corresponds with a change in the thrust reverser discretes which show the thrust reversers momentarily stowed during the landing roll. The reversers then re-deployed approximately 5 seconds later. The positive longitudinal acceleration during the landing roll contributed to the amount of runway overrun as the airplane departed the runway at a greater airspeed than if the deceleration had remained throughout the landing roll.

Ground Track Analysis

Figure 1 identifies three key events during the landing based on the change in character of the recorded normal load factor and longitudinal acceleration, 1) the touchdown, 2) the runway departure, and 3) the full stop. In order to provide a touchdown point and speed it was necessary to compute the ground track shown in Figure 2. The process for computing a ground track relies on the aircraft ground speed which, as noted above, was not available. A ground speed was estimated by integrating the longitudinal and normal accelerations, in conjunction with the recorded pitch angle, and constraining the solution by anchoring it to the point at which the aircraft came to a stop. Normally, a kinematic analysis is performed in order to determine the typical accelerometer bias that must be applied to correct for known sensor and mounting errors. In this case, the limited data does not allow for the development of an accurate kinematic analysis. As such, a bias is applied to the longitudinal acceleration so that the slope of the ground speed approximately matches the slope of airspeed between the runway departure and recorded airspeed of 60 knots. Figure 2 shows the calculated ground track angle required to achieve a track consistent with the runway exit path observed on site. It can be seen that the point at which the aircraft exits the runway does not correlate to the change in character of the load factor data. While the change in the character of the load factor data most likely indicates runway departure, this cannot be confirmed without additional on-site ground track evidence. Due to these discrepancies, the accuracy of the touchdown is believed to be no better than ±500 feet.

Investigation participants Per ICAO Annex 13, do not release this information without Nigerian AIB consent

Enclosure to 66-ZB-H200-ASI-18332

Boeing FDR Performance Analysis, DHL 727-200 ZS-DPF Landing Overrun Accident in Lagos, Nigeria – 7 September 2006

Figure 3 shows the ground track analysis results of a hypothetical scenario assuming the thrust reversers had not been stowed. This analysis assumed the longitudinal deceleration remained relatively constant while the airplane was still on the runway. Figure 3 shows that the airplane still would have departed the end of the runway had reverse thrust been maintained throughout the landing rollout.

Conclusion

The NTSB reported that a DHL Bahrain (DHB) 727-200 (QD046) overran the runway during landing at Lagos, Nigeria on 07-SEP-06. The FDR data were provided to Boeing for analysis, but did not include data critical to ground track analysis, such as ground speed and drift angle. An estimated ground track showed the touchdown occurred at approximately 4680 feet beyond the threshold and at approximately 167 knots airspeed. The weight and flap of the event airplane are unknown, but this touchdown speed is 30 knots faster than the reference landing speed associated with maximum landing weight at flaps 30. The accuracy of the touchdown point is estimated to be no better than ±500 feet largely due to the lack of recorded ground speed and drift angle. The FDR data also show a momentary positive longitudinal acceleration corresponding with a change in the thrust reverser discretes, indicating the reversers were stowed. The thrust reversers were then re-deployed and the deceleration continued as the airplane departed the runway. This momentary positive longitudinal acceleration contributed to the amount of runway overrun. However, additional ground track analysis shows that the airplane still would have departed the end of the runway had reverse thrust been maintained throughout the landing rollout.

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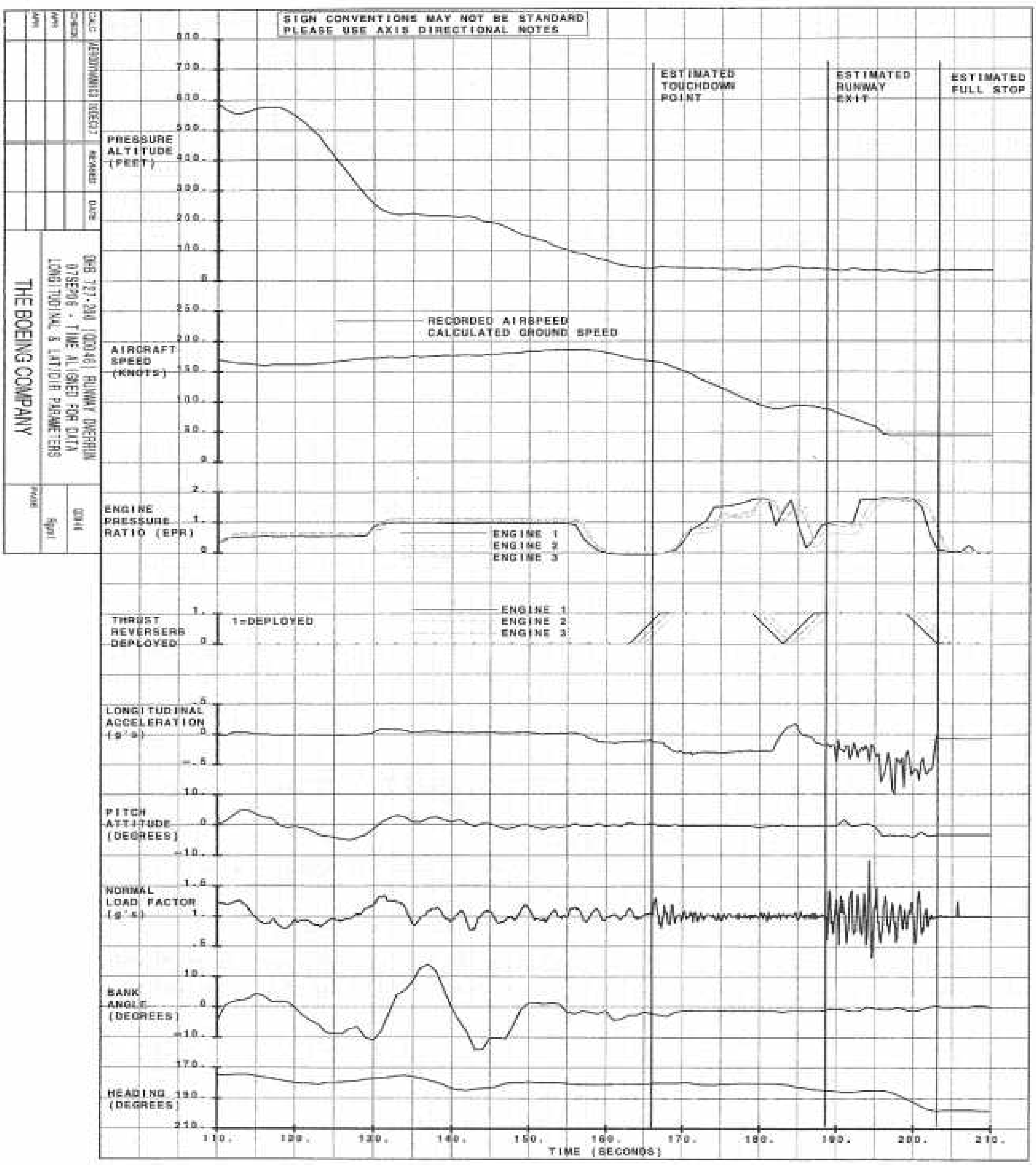

Investigation participants: Per ICAO Annex 13, do not release this information without Nigerian AIB consent

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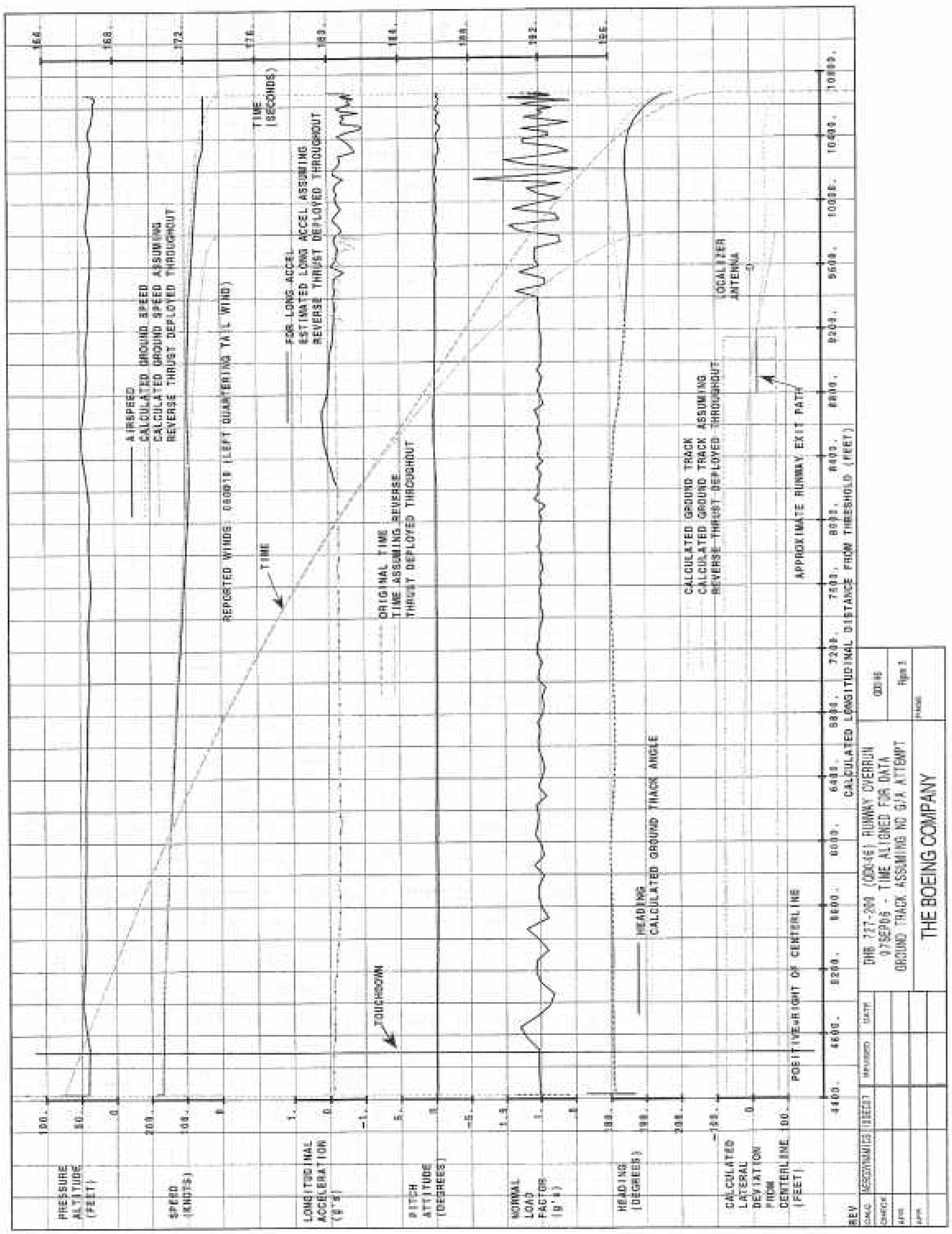

Investigation participants: Per ICAO Annex 13, do not release this information without Nigerian AIB consent

2.4 Operator's Policies Procedures

2.4.1. DHL Aviation Policies

DHL Aviation has some policies that need to be reappraised. A policy letter was written to defend the policy of not carrying a load master and ground engineer on board. The Company's rest period and fatigue policy raises questions taking cognizance of the stressful nature of cargo operations.

The crew members according to the policy letter are authorized to do the job of a load master and ground engineer. The time that should have been used for rest or stretch-out during a routine flight will be used by the crew members to monitor the loading and offloading of cargo. Stress and fatigue are sometime caused by work overload and tight schedule. The job of monitoring is stressful on its own. It is also impossible to replace the duty of licenced engineer by any of the crew member.

DHL Aviation must endeavour to remove the work load on the crew member by either carrying a licensed engineer and load master or by positioning these personnel in all the route operated by the DHL aviation i.e. there must be a licenced and load master positioned in cities like Abidjan, Accra, Lagos, Libreville, etc.

2.4.2 **Procedures During Go-around**

The procedure where the captain called for a go-around and the co-pilot (pilot flying) retarded the thrust levers was inappropriate if not dangerous. There was no co-ordination between the crew members. Their Cockpit Resources Management (CRM) was inadequate.

2.4.3 Captain's Authority

Captain has the authority to command, and make sure the aircraft flies in a safe condition, but that was not evident, since the captain sensing that the weather was bad and still allowed the first officer to fly into a squall, thunderstorm and heavy rain. The captain should have taken over the control of the aircraft long before the landing.

2.4.4 Captain's Statement compared with FDR Analysis

There were contradictions in the personal statement written by the captain about the accident. The captain stated the following that:

(i) the crew established stable and positive glide path around 4NM.

(ii) at 430ft, the crew saw the approach lights and the captain helped the First Officer (F/O) to adjust to center line, because he was slightly left of the center line.

(iii) the crew saw the runway lights at about 100ft above minimum.

(iv) below 200ft, the crew felt that there was a change in the wind direction and velocity which looked like a windshear but without aural signal of the windshear in the cockpit. By this time the crew had a feeling of a tail wind component and also that the rain intensified to heavy rain.

(v) touchdown was in the normal 1000ft zone and found that the runway was totally covered with more water than the crew expected and slippery.

(vi) he decided to go-around when the crew realized that it was impossible to stop the aircraft on the runway.

(vii) while he called for the go-around, the First Officer (F/O) retarded the throttle to idle and pushed the control column.

(viii) the crew had the aircraft on the center line with full reversers deployed and brake applied.

From the analysis sent to the AIB by the NTSB it was stated in their report that:-

(i) below 1000ft, the descent was momentarily arrested twice, first at 550ft and then at 200ft.

(ii) the weight and landing flap of the event airplane were unknown. However, the maximum landing weight (160000lb) corresponding to a landing reference speed (Vref) of 137kts for flaps 30, indicating that the aircraft touched down at least 30kts faster than the reference landing speed (137kts).

(iii) the FDR read-out showed a ground track touchdown occurred at approximately 4680ft beyond the threshold.

(iv) the FDR analysis also showed a momentary positive longitudinal acceleration corresponding to a change in the thrust reverser discretes, indicating the reversers were stowed. The thrust reversers were then redeployed and the deceleration continued as the airplane departed the runway. This momentary positive longitudinal acceleration contributed to the amount of runway overrun. However, additional ground track analysis showed that the airplane still would have departed the end of the runway had reverse thrust been maintained throughout the landing rollout.

2.4.5 **Load Sheet**

The aircraft loadsheet clearly showed that the crew operated at the maximum take off, zero fuel and max landing weight of the airplane. The maximum cargo uplift was almost exceeded but for 2lbs of cargo.

Operating at the maximum operating limit and with the prevailing weather, the captain should have exercised his command responsibility to take over much earlier than the last minute attempt to go-around.

There was no guarantee that the weights declared by the ground personnel in the load sheet were accurate:

(i)	ZFW max	146500lbs
	ZFW actual	146498lbs
		2lbs
		====
(ii)	Take-off wt max	168900lbs
	Actual	168898lbs
	Difference	2lbs
		====
(iii)	Landing wt max	160000lbs
	Actual	159888lbs
	Difference	112lbs
		=====
(iv)	Allowed payload	50016lbs
	Actual traffic load	50014lbs
	Difference	2lbs
		====

.L Aviation B727/EAT4 LOADSHEET (Rel. 2.3.10) Printout NR: 2

FROM/TO	FLIGHT	A/C REG	ACM	DATE	TIME
ACC/LOS	DHV110	ZSDPF	0	07-Sep-2006	10:20

Data Rev. Date: 06-Aug-2002

ALL WEIGHTS IN LB

---------------- UPPERDECK --------------------------------

	P1	P2	P3	P4	P5	P6	P7	P8	P9	P10	P11	P12
	1409	1382	0	1570	4773	5952	5952	5964	5964	3860	5952	1947
IDX	-8.08	-6.81	0.00	-5.20	-11.96	-10.10	-5.30	-0.49	4.32	5.91	13.93	6.13

---------------- LOWERDECK --------------------------------

	3L	4L	10L	12L
	1226	4063	0	0
IDX	-5.26	-12.98	0.00	0.00

CAPTAIN: A

		WGT LB	INDEX
DRY OPERATING WGT		96484	79.34
BALLAST		0	0.00
ACM		0	0.00
TOTAL TRAFFIC LOAD		50014	-35.88
ZERO FUEL WEIGHT	(Max: 146500)	146498	43.46
TAXI FUEL		600	-0.10
TAKE OFF FUEL	MTOW	22400	-6.06
TAKE OFF WEIGHT	(Op. Max: 168900)	168898	37.40
TRIP FUEL		9010	-1.87
LANDING WEIGHT	(Max: 160000) MLW	159888	39.27
ALLOWED PAYLOAD		50016	

CAPTAINS INFO BEFORE LMC

IMBALANCE 0.0%
NOTOC YES

ACTUAL WEIGHT USED FOR CARGO

LOADING CERTIFICATE- I CERTIFY THAT THE LOADING OF THIS A/C IS IN ACCORDANCE WITH CURRENT LOADING INSTRUCTIONS AI LOADPLAN, AND CERTIFY THAT THE SECURITY MEASURES AS DEFINED IN EU2320/ECAC DOC 30 HAVE BEEN APPLIED TO THE AIRCRAFT AND CARGO

BALANCE CONDITIONS

		FWD		AFT
ZFW MAC	21.3 %	12		37
TOW MAC	19.5 %	8		37
LDG MAC	19.9 %	12		37
STABTRIM	25: 6.70	15: 6.15	5: 5.49	

UNDERLOAD BEFORE LMC: 2 LB

LOAD SUPERVISOR: (PRINT NAME)

(SIGNATURE)

CPT ACCEPTANCE: (SIGNATURE)

LAST MINUTE CHANGES			
DEST	SPEC	CL/CPT	WGT

LOADSHEET CHECKED AND APPROVED BY:

Loadsheet

3.0 CONCLUSIONS

3.1 Findings:

3.1.1 The captain had over 17000 flying hours

3.1.2 The co-pilot was the Pilot Flying (PF)

3.1.3 The co-pilot did not have ATPL as required by The SACAA approved DHL Aviation Operations Manual (Ops. Manual part1 5.2.1e)

3.1.4 The weather was bad at the time of accident with wet runway.

3.1.5 There was no ground engineer and load master on board.

3.1.6 There was no proper coordination among the crew (CRM).

3.1.7 The aircraft had a valid C of A.

3.1.8 The crew licences were valid as at the time of the accident.

3.1.9 There was damage to navigational aids.

3.1.10 Nose wheel sheared off.

3.1.11 There was no outbreak of fire.

3.1.12 No injury was sustained by the crew.

3.1.13 The aircraft overran the runway and in the process broke some runway end lights and ILS localizer antennae leaving high voltage armoured cables exposed.

3.1.14 DHL captains, first officers and flight engineers are authorized to perform transit checks.

3.1.15 Inappropriate deployment of Thrust Reversers on touchdown.

3.1.16 There was no evidence that the SPECI weather reports was passed to the crew of DHV 100.

3.1.17 The SPECI weather at 1153 and 1200 UTC had a visibility of 600m which was below the state minima. The state minima for ILS approach was 800m.

The investigation identified the following causal and contributory factors.

3.2 Causal Factor

The decision of the crew to continue an unstabilised approach despite the prevailing adverse weather condition.

3.3 Contributory Factors

- The captain did not take over the control of the flight from the first officer in the known bad weather situation

- The crew resource management was inadequate.

4.0 SAFETY RECOMMENDATIONS

4.1 SAFETY RECOMMENDATIONS 2010 - 023

DHL should improve on the quality of their crew training to include decision making in adverse weather conditions and crew resource management (CRM).

4.2 SAFETY RECOMMENDATIONS 2010 - 024

DHL should reduce the pressure and stress on the crew by either carrying an engineer and a load master on board or making an alternative arrangement that will not involve the crew members.

Appendix A

RESPONSE TO SAFETY RECOMMENDATIONS

SAFETY RECOMMENDATIONS 2010 – 023

DHL should improve on the quality of their crew training to include decision making in adverse weather conditions and crew resource management.

RECOMMENDATION AGREED AND IMPLEMENTED

"SA CAA regulations 121.03.6 (8) requires air crew to be suitably trained and SA CATS 121-03.5 specifies the requirements for CRM training. Instruction of DHL crew required in these regulation is performed by SA Approved Training Organisation (ATO). DHL ensures compliance of these regulations is maintained through its own Quality, Safety and Management System (QSMS) audit program, which encompasses internal audits and in conjunction with SA CAA audit of DHL and the ATOs to determine CRM effectiveness.
As a result of this accident, DHL has revised its crew training with enhanced CRM including decision making in adverse weather conditions".

SATEFY RECOMMENDATION 2010 – 024

DHL should reduce the pressure and stress on the crew by either carrying an engineer or a loadmaster on board or make an alternative arrangement that will not involve crew members.

RECOMMENDATION AGREED AND IMPLEMENTED

"DHL terminated B727 service and its fleet today only consists of 2 B 1900s and 1 C 2008. Professional flight Engineers holding mechanic endorsements for the aircraft are no longer needed. All maintenance is performed by personnel and W & B calculations are performed by personnel other than the flight crew, however, the crew must attend to the aircraft to ensure it is loaded in accordance with the load plan and must sign the W & B as is the norm for the size of the aircraft. If DHL returns to flying large category aircraft it will ensure load master are included".