Session 7 *Collaborative Approach (Interactive Session - Good interactive moderator to be identified)*

14:00	15:00	Presentation of a Hazard and multiple considerations (using a Regional example)	Rishi Thakurdin, Airports Company South Africa, Group Manager Safety and Compliance
15:00	15:30	Break	

RUNWAY SAFETY -HAZARDS

AIRPORTS COMPANY
SOUTH AFRICA

LOCAL RUNWAY SAFETY TEAM.

AIRPORTS COMPANY
SOUTH AFRICA

FUBAR AFB IRAQ – 29 DEC 2004
WIP - RUNWAY INCURSIONS

AIRPORTS COMPANY SOUTH AFRICA

NO NOTAM – RUNWAY LIGHTS ON
WIP - RUNWAY INCURSIONS

AIRPORTS COMPANY SOUTH AFRICA

WIP - VEHICLES AND WORKMEN
WORKING WITHIN THE RUNWAY STRIP
RUNWAY EXCURSIONS. WHAT IF?

AIRPORTS COMPANY SOUTH AFRICA

RUNWAY EXCURSIONS – WET RUNWAY
AMERICAN AIRLINES BOEING 737-800
KINGSTON JAMAICA

AIRPORTS COMPANY SOUTH AFRICA

RUNWAY EXCURSIONS – WET RUNWAY
AIR ASIA AIRBUS A320
KUCHING MALAYSIA

AIRPORTS COMPANY SOUTH AFRICA

RUNWAY EXCURSION PREVENTION
CONTINUOUS FRICTION MEASURING EQUIPMENT
HOW OFTEN? MU-METER OR DECELEROMETER

AIRPORTS COMPANY SOUTH AFRICA

RUNWAY EXCURSION PREVENTION
RUBBER CONTAMINATION
REGULAR/SEASONAL REMOVAL (BEFORE RAINS)

AIRPORTS COMPANY SOUTH AFRICA

RUNWAY EXCURSION PREVENTION
GROOVING THE RUNWAY SURFACE
REDUCES EXCURSIONS BY 75% (FAA)

AIRPORTS COMPANY SOUTH AFRICA

RUNWAY EXCURSION PREVENTION

ADEQUATE SHOULDERS FOR RUNWAYS REDUCES VEEROFFS (AND TAXIWAYS!!)

AIRPORTS COMPANY SOUTH AFRICA

RUNWAY EXCURSION PREVENTION

DELETHALISATION FOR BOTH RUNWAY OVERRUNS AND VEEROFFS

AIRPORTS COMPANY SOUTH AFRICA

RUNWAY EXCURSIONS
DELETHALISATION
EXCAVATING 3M X 1M TRENCH AT RUNWAY EDGE

AIRPORTS COMPANY SOUTH AFRICA

RUNWAY EXCURSIONS
DELETHALISATION
COMPLETED EDGE READY FOR BURYING

AIRPORTS COMPANY SOUTH AFRICA

RUNWAY EXCURSIONS
DELETHALISATION
COMPLETE SECTION FROM CAT 1 HOLD TO RUNWAY

AIRPORTS COMPANY SOUTH AFRICA

RUNWAY EXCURSIONS
EMAS
ENGINEERED MATERIALS ARRESTING SYSTEM

AIRPORTS COMPANY SOUTH AFRICA

RUNWAY EXCURSIONS - EMAS

RESULT : EMAS INSTALLED AT JFK IN 1996 ON 2 RUNWAY ENDS – FIRST IN THE WORLD

AIRPORTS COMPANY SOUTH AFRICA

RUNWAY EXCURSIONS - EMAS

RESULT : EMAS INSTALLED AT CHICAGO MIDWAY ON ALL 4 RUNWAY ENDS BY NOV 2006

AIRPORTS COMPANY SOUTH AFRICA

RUNWAY EXCURSIONS - EMAS
CHARLESTON AIRPORT WEST VIRGINIA
HILLTOP LOCATION – NO RESA

AIRPORTS COMPANY SOUTH AFRICA

RUNWAY EXCURSIONS - EMAS
CHARLESTON AIRPORT EMAS = 123M
EQUIVALENT TO 60M RUNWAY STRIP + 245M RESA

AIRPORTS COMPANY SOUTH AFRICA

RUNWAY EXCURSIONS – FOD CONTROL

REVERSE THRUST CAN LIFT ANYTHING

FOD CAN CAUSE ENGINE OR TYRE FAILURE

AIRPORTS COMPANY
SOUTH AFRICA

RUNWAY EXCURSIONS – FOD CONTROL

REVERSE THRUST CAN LIFT ANYTHING

ENGINE FAILURE / TYRE FAILURE

AIRPORTS COMPANY
SOUTH AFRICA

RUNWAY – FOD CONTROL
AIR FRANCE CONCORDE
PARIS CHARLES DE GAULLE FRANCE

AIRPORTS COMPANY SOUTH AFRICA

RUNWAY - FOD CONTROL
AIR FRANCE CONCORDE
113 FATALITIES (4 ON THE GROUND)

AIRPORTS COMPANY SOUTH AFRICA

BIRD AND WILDLIFE MANAGEMENT
BIRD CONTROL

AIRPORTS COMPANY SOUTH AFRICA

BIRDSTRIKE ON LANDING
RYANAIR BOEING 737-800
ROME CIAMPINO ITALY

AIRPORTS COMPANY SOUTH AFRICA

BIRD AND WILDLIFE MANAGEMENT
GRASSLAND MANAGEMENT
SHORT GRASS POLICY (6 TO 10 INCHES)?

AIRPORTS COMPANY SOUTH AFRICA

WILDLIFE MANAGEMENT
RUNWAY INCURSIONS - IT'S AS SERIOUS !!
ADEQUATE RUNWAY FENCING?

AIRPORTS COMPANY SOUTH AFRICA

WILDLIFE MANAGEMENT

RUNWAY INCURSIONS - IT'S AS SERIOUS !!
ADEQUATE RUNWAY FENCING?

AIRPORTS COMPANY SOUTH AFRICA

YOU HAVE LOTS TO THINK ABOUT?

AIRPORTS COMPANY SOUTH AFRICA

AN LRST WILL HELP

ICAO Document 9870 states :

"The LRST should advise the appropriate management on the potential runway incursion issues and recommend mitigation strategies".

The primary purpose of an LRST is prevention of RUNWAY INCURSIONS. However, a secondary purpose of the LRST should be advising on potential issues and recommending mitigation strategies that take into account EACH and EVERY matter that involves runway safety or taxiway safety, and not just limit the LRST to preventing RUNWAY INCURSIONS.

THANK YOU FOR LISTENING

AIRCRAFT INCIDENT REPORT

Reference :	CA18/3/2/0659

Aircraft Registration	ZS-OKD	**Date of Incident**	18 June 2008	**Time of Incident**	0855 Z
Type of Aircraft	Boeing 737-236A (Aeroplane)	**Type of Operation**	Scheduled Commercial		

Pilot-in-command Licence Type	Airline Transport	**Age**	39	**Licence Valid**	Yes
Pilot-in-command Flying Experience	Total Flying Hours	7195.7		Hours on Type	1702.5

Last point of departure	OR Tambo International Aerodrome (FAJS), Gauteng Province
Next point of intended landing	Durban International Aerodrome (FADN), KwaZulu-Natal Province

Location of the incident site with reference to easily defined geographical points (GPS readings if possible)

Partly off the runway approximately 30m from the threshold of Runway 24 at Durban International Aerodrome.

Meteorological Information	The weather at Durban International Airport was cloudy with hard rain

Number of people on board	2+4+87	**No. of people injured**	0	**No. of people killed**	0

Synopsis

On 18 June 2008 the aircraft took off from FAJS on a scheduled flight (BA6203) to FADN. According to the cockpit crew the take-off, climb, cruise and most of the descent were uneventful.

The approach was stable with variable winds; the runway was sighted at approximately 1000 feet (ft) above ground level (A.G.L). At 150 to 50 ft A.G.L, heavy rain was encountered which decreased visibility. At this stage of the flight the aircraft was slightly below the Glide Slope (GS) and right of the localizer. The crews attempted to correct this deviation by increasing engine power, resulting in a higher GS and a fairly high airspeed. The higher GS and airspeed resulted in a deep and a speedy high landing.

After touch-down the aircraft started to veer to the right and the flight crew attempted to correct this by left rudder input and braking, that had no effect. The flight crew also attempted to correct the runway heading by the use of differential reverse thrust, which had no effect either. The aircraft groundlooped through 200º to the right and skidded partly off the runway into the soft mud, causing the left main wheels to sink in. The major part of the aircraft was still on the runway and only the left wing section was off the runway to the right.

The aircraft sustained damage to the left engine, left main gear and under surface of the left wing. None of the passengers and crew on board the aircraft was injured and all were evacuated normally onto the runway through door 1 right.

Probable Cause

The incident was attributed to the incorrect landing technique used by the flight crew, resulting in the aircraft landing deeply and a subsequent ground loop due to

water accumulation on the runway. **Contributory:** Poor management or non-recognition of threats which affected the safe completion of the flight.			
IARC Date		Release Date	

LIST OF ABBREVIATIONS

ACSA	: Airports Company of South Africa
AGL	: Above ground level
AIP	: Aeronautical Information Publication
AMO	: Aircraft Maintenance Organisation
AOC	: Air Operation Certificate
APU	: Auxiliary power unit
ATC	: Air Traffic Controller
ATNS	: Air Traffic Navigation Services
ATPL	: Airline Transport Pilot's Licence
CAA	: Civil Aviation Authority
CAR	: Civil Aviation Regulations
CRM	: Crew Resources Management
CVR	: Cockpit Voice Recorder
DFDR	: Digital Flight Data Recorder
EPRE1	: Engine Pressure Ratio, ENGINE 1
EPRE2	: Engine Pressure Ratio, ENGINE 2
FADN	: Durban Aerodrome
FAJS	: OR Tambo International Airport
Ft	: Feet
GS	: Glide Slope
HEAD	: Heading
ICAO	: International Civil Aviation Organisation
ILS	: Instrument Landing System
Kts	: Knots
LOC	: Localizer
METAR	: Meteorological aeronautical report
MHz	: Megahertz
MOP	: Manual of Procedures
N2E1	: Engine Compressor speed, ENGINE 1
N2E2	: Engine Compressor speed, ENGINE 2
NOTAM	: Notice to airmen
PF	: Pilot Flying
PNF	: Pilot Non Flying
QRH	: Quick Reference Handbook
RALT	: Radio Altitude
RUDPED	: Rudder Pedal

SOP	: Standard Operating Procedures
STAR	: Standard Instrument Arrival
TAF	: Terminal aerodrome forecast
TAS	: True Airspeed
TOD	: Top of descent
VHF	: Very high frequency

AIRCRAFT INCIDENT REPORT

Name of Owner/Operator : Comair Ltd
Manufacturer : Boeing Aircraft Company
Model : Boeing 737-236A
Nationality : South African
Registration Marks : ZS-OKD
Place : Durban International Aerodrome (FADN)
Date : 18 June 2008
Time : 0855Z

All times given in this report are Co-ordinated Universal Time (UTC) and will be denoted by (Z). South African Standard Time is UTC plus 2 hours.

Purpose of the Investigation:

*In terms of Regulation 12.03.1 of the Civil Aviation Regulations (1997) this report was compiled in the interests of the promotion of aviation safety and the reduction of the risk of aviation accidents or incidents and **not to establish legal liability**.*

Disclaimer:

This report is given without prejudice to the rights of the CAA, which are reserved.

1. FACTUAL INFORMATION

1.1 History of Flight

1.1.1 The flight crew was scheduled to fly the aircraft from FAJS to FADN on a scheduled domestic flight. There were two flight deck crew (the Captain and First Officer), four cabin crew and eighty-seven passengers on board the aircraft. The Captain was the Pilot Flying (PF) and the First Officer was the Pilot Not Flying (PNF).

1.1.2 The flight was delayed at FAJS due to adverse weather conditions in the Durban area and departed at approximately 08h03, 1.05 hours after the scheduled departure time. According to the flight crew, the take-off, climb, cruise and the majority of the descent were uneventful. STAR (VAVAN 1A) and approach were briefed at TOD. Weather South West of FADN was avoided in later stages of the descent. Once cleared to intercept runway heading, the gear and flap were selected to get into the approach configuration. On or just after the localiser was captured, the number one generator failed. This resulted in the loss of the Captain's flight director and autopilot. A decision to continue was made and the APU was started and put on bus (electrical power connected to the aircraft's direct electrical supply circuit).

1.1.3 The approach was stable with variable wind conditions and the runway was sighted at approximately 1000 ft A.G.L. At 150 to 50 ft A.G.L heavy rain was encountered, which resulted in a decrease of the visibility, but the runway and approach lights remained visible throughout the approach. At this stage of the flight, the aircraft was below the GS and the attempt to correct resulted in the aircraft being above the GS and also to the right of the localizer.

1.1.4 During the flare, the aircraft floated and touched down deeply. The speed brake and reverse thrust were deployed, and brakes applied. The aircraft started to veer to the right slowly, but positively. The flight crew attempted to correct for runway heading by left rudder input and braking, but that had no effect. The crew also applied differential reverse thrust without any effect either. The aircraft groundlooped and rotated through approximately 200º to the right and skidded partly off the runway into the soft mud, causing the left main wheels to sink into the grass area.

1.1.5 The engines were shut down immediately and the cabin crew ordered to remain seated. After assessing the situation with the assistance of the aerodrome emergency services that had responded to the incident, a decision to disembark through door one right (1R) was made. All passengers and crew disembarked normally through door 1R and were taken to the terminal building by buses.

1.1.6 Due to the weather at FADN during the period between 0600Z to 0855Z (time of the incident), fourteen aircraft had landed and five aircraft were diverted . The incident aircraft was cleared by ATC FADN to land on Runway 06.

1.1.7 The incident occurred during daylight conditions, during heavy rain conditions prevailing at FADN.

1.2 Injuries to Persons

Injuries	Pilot	Crew	Pass.	Other
Fatal	-	-	-	-
Serious	-	-	-	-
Minor	-	-	-	-
None	2	4	87	-

1.3 Damage to Aircraft

1.3.1 The aircraft sustained damage to the left-hand main landing gear door, main landing gear wheels and left-hand engine

Photo1: Indicating damage to aircraft.

Limited damage to the left wing area.

1.4 Other Damage

1.4.1 Damage was limited to the grass area to the right of Runway 06.

1.5 Personnel Information

1.5.1 The flight deck crew was employed on a short-term contract to relieve the operator's roster constraints. The main motivation for the contract was a demanding training schedule for converting permanent crew onto the B737-400, as well as roster commitments. It had become increasingly difficult to cross-qualify all the pilots on the Boeing 737-200 (B737-200) and on B737-400. This cross-qualification was urgently required, as the late introduction of aircraft recently purchased, necessitated (contrary to what was originally planned), additional use of the B737-200 on the schedule.

1.5.1.1 Captain

Nationality	South African	Gender	Male	Age	39
Licence Number	…………….	Licence Type	Airline Transport Pilot		
Licence valid	Yes	Type Endorsed	Yes		
Ratings	Night Rating; Instrument Rating; Test Pilot Rating				
Medical Expiry Date	31 July 2008				
Restrictions	Corrective lenses				
Previous Accidents	None				
Last Simulator test	20 May 2008				

Flying Experience:

Total Hours	7195.7
Total Past 90 Days	52.2
Total on Type Past 90 Days	52.2
Total on Type	1702

1.5.1.2 First Officer

Nationality	South African	Gender	Male	Age	41
Licence Number	……….……….	Licence Type	Commercial		
Licence valid	Yes	Type Endorsed	Yes		
Ratings	Night Rating; Instrument Rating				
Medical Expiry Date	30 September 2008				
Restrictions	None				
Previous Accidents	Unknown				
Last simulator test	27 February 2008				

Flying Experience:

Total Hours	5213.3
Total Past 90 Days	98.6
Total on Type Past 90 Days	98.6
Total on Type	794.7

1.6 Aircraft Information

Airframe:

Type	Boeing 737-236A	
Serial No.	21803	
Manufacturer	Boeing Aircraft Company	
Year of Manufacture	1980	
Total Airframe Hours (At time of Incident)	53791.57	
Total Airframe Cycles (At time of Incident)	40995	
C of A (Issue Date)	05 September 2000	
C of R (Issue Date) (Present owner)	05 September 2000	
Operating Categories	Standard	
Last Maintenance Check (Date & Hours)	Daily Check	18 June 2008
		53791.57
	Weekly Check	13 June 2008
		53771.14

	"A" Check	07 May 2008
		53597.58
	"C" Check	31 August 2007
		52253.37
	"D" Check	28 June 2001
		39804.38
Hours since Last Maintenance Check	Weekly Check (intervals not exceeding 7 days)	20.43 / 5 days
	"A" Check (intervals not exceeding 3600 flight hours)	193.59
	"C" Check (intervals not exceeding 3600 flight hours)	1538.20
	"D" Check (intervals not exceeding 20000 flight hours or 8 years)	13987.19 / 6 years

Engines:

Engine No.1 (Left Hand)

Type	Pratt & Whitney JT8-17
Serial No.	PP709189
Hours since New	41130.33
Hours since Overhaul	12110.09
Cycles since New	31429
Cycles since Overhaul	Not recorded
Date of Overhaul	22 November 2003

Engine No.2 (Right Hand)

Type	Pratt & Whitney JT8-17
Serial No.	PP709205
Hours since New	43123.32
Hours since Overhaul	Not yet overhauled
Cycles since New	Not recorded
Cycles since Overhaul	30896
Year of Manufacture	1988

1.7 Meteorological Information

1.17.1 There were scattered to broken clouds between 700 and 1,600 ft with light to moderate rain. The temperature was 18ºC with a dew point of 17ºC and the QNH was 1030 at 0851Z. The surface wind was 060º to 130º/ 6 to 14 kts and the visibility decreasing to 1500 m in rain. At 0852Z the tower gave a wind check of 090º/12 to 17 kts. At 0853Z another wind check was given as 110º to 150º /12 to 17 kts. For runway 06 this is a direct crosswind, without any tailwind component.

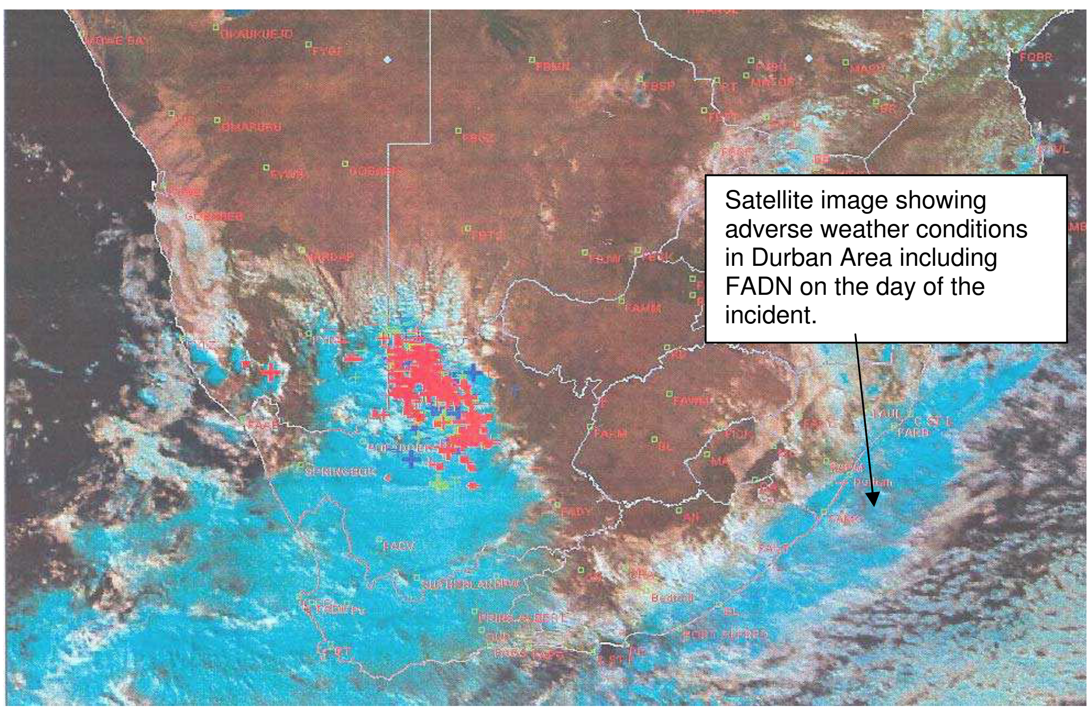


Figure 2. Satellite image showing the weather pattern at or around the time of the incident.

1.8 Aids to Navigation

1.8.1 The radio navigation and landing aids operate 24 hours a day at FADN. The landing aids were in a serviceable condition and no evidence of anomalies was reported by the flight deck crew or ATC FADN.

1.9 Communications.

1.9.1 The flight deck crew were in constant contact, via radio communication with FADN ATC on VHF frequency 118.7 MHz during approach and landing. No aircraft communication system malfunction was reported by the flight crew before, during and after this flight.

1.9.2 The ATC on duty at the time of the incident reported that at 0854Z the tower frequency became blocked and the cause of this malfunction could not be determined by the FADN ATC. At 0855Z the aircraft was observed by ATC FADN, landing approximately halfway down Runway 06. As it touched down, the ATC pressed the crash alarm in order to activate the fire services, as the safe landing was not foreseen by him.

1.10 Aerodrome Information:

Aerodrome Location	Durban, KwaZulu-Natal
Aerodrome Co-ordinates	S295756.08 E0305657.34
Aerodrome Elevation	33 feet
Runway Designations	06/24
Runway Dimensions	2440m x 60m
Runway Used	06
Runway Surface	ASPHALT
Approach Facilities	ILS LLZ, ILS GP, DVOR, UHFDME, DME

1.10.1 FADN had a valid South African Aerodrome Licence No. 1003, Operating Category 9, in compliance with ICAO, Annex 14 and CAR Part 139 requirements, which was issued by the SACAA to ACSA on 30 November 2007. The period of validity of the licence was determined by the SACAA to be from 01 December 2007 to 30 November 2008.

1.10.3 The aerodrome layout of the airside manoeuvring area at FADN is given in the information plate below:

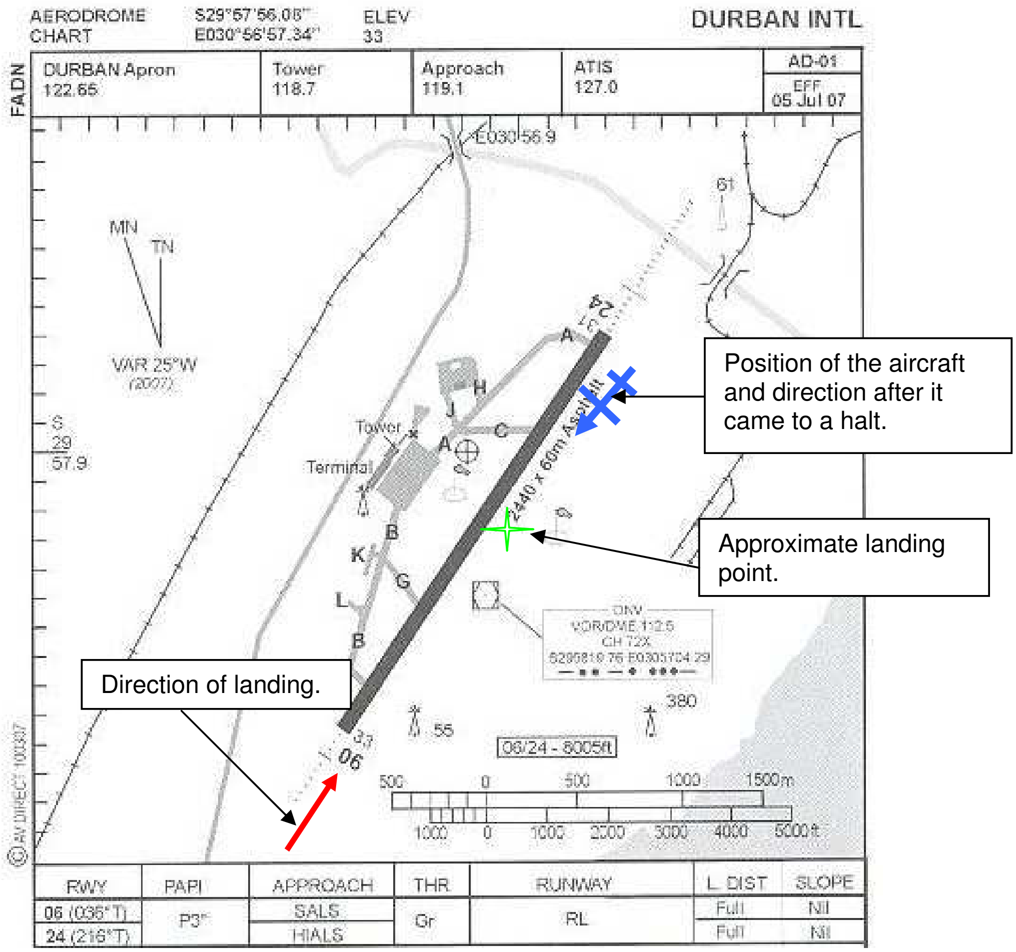


Figure 3. FADN information plate

1.10.4 Runway Friction Level Test

1.10.4.1 Attachment A to Annex 14- *Guidance Material Supplement to Annex 14, Volume 1 (7),* "Determination of friction characteristics of wet paved runways" reads as follows:

Note: 7.3 *Friction tests of existing surface conditions should be taken periodically in order to identify runways with low friction when wet. A State should define what minimum friction level it considers acceptable before a runway is classified as slippery when wet and publish this value in the State's AIP. When the friction of a runway is found to be below this* *reported value, then such information should be promulgated by NOTAM.*

In relation to the above, no evidence could be found which would indicate that the CARS has a requirement defined as specified in the Annex 14 provision.

1.10.4.2 The Aerodrome Management showed evidence of reports of friction tests conducted at FADN runway 06-24 [starting from 06 and 24 at distances 1m to 8m left of Centre Line (CL)]. The results of the friction tests recorded that the friction level of runway 06-24 was 0.43[The maintenance planning level was 0.53]. Due to the fact that no minimum friction level had been defined by the CARS, it is not possible to state in this report whether, the tested friction level (0.43) was within a required limit.

1.10.5 Water on runway and runway water drainage

1.10.5.1 The runway has grooves which allows for the water to flow towards the storm water drain system.

1.10.5.2 According to Annex 14, Chapter 2, it is recommended that an inspection should be carried out to monitor water on runway. The monitoring should be done as follows:

2.9.4 *Whenever water is present on a runway, a description of the runway surface condition on the centre half of the width of the runway, including the possible assessment of water depth, where applicable, should be made available using the following terms:*

(i) Damp – the surface shows a change of colour due to moisture.
(ii) Wet – the surface is soaked but there is no standing water.
(iii) Water Patches – significant patches of standing water are visible.
(iv) Flooded – extensive standing water is visible.

In compliance with the above recommendation, as called for in the ACSA Manual of Procedures, the Aerodrome Management conducted the following "water on runway" inspections and/or bird patrols on the day of the incident.

Time Out	Time In	Remarks
0400Z	0430Z	All In Order (AIO)
0452Z	0502Z	AIO Raining Runway Wet
0530Z	0548Z	AIO No Standing Water
0629Z	0638Z	AIO Rain Stopped
0723Z	0734Z	AIO Raining Heavily
0813Z	0820Z	AIO

A bird patrol was done on 18 June 2008.

1.10.6 Runway lights

1.10.6.1 The runway lights were ON to assist the incoming aircraft with the approach and landing. There was no report of any anomaly experienced with the visibility or serviceability of the runway lights by the flight crew of the aircraft.

1.11 Flight Recorders

1.11.1 The aircraft was equipped with a CVR and DFDR as required by the CARS.

1.11.2 The CVR and DFDR were in good condition when recovered and were not exposed to fire or impact forces. No problems were encountered with the downloading of both recorders and both recorders were in good condition. The data extracted from the two recorders was considered pertinent to this investigation.

1.11.3 The CVR Part Number 93-A100-80; serial number 59738 was downloaded and transcribed.

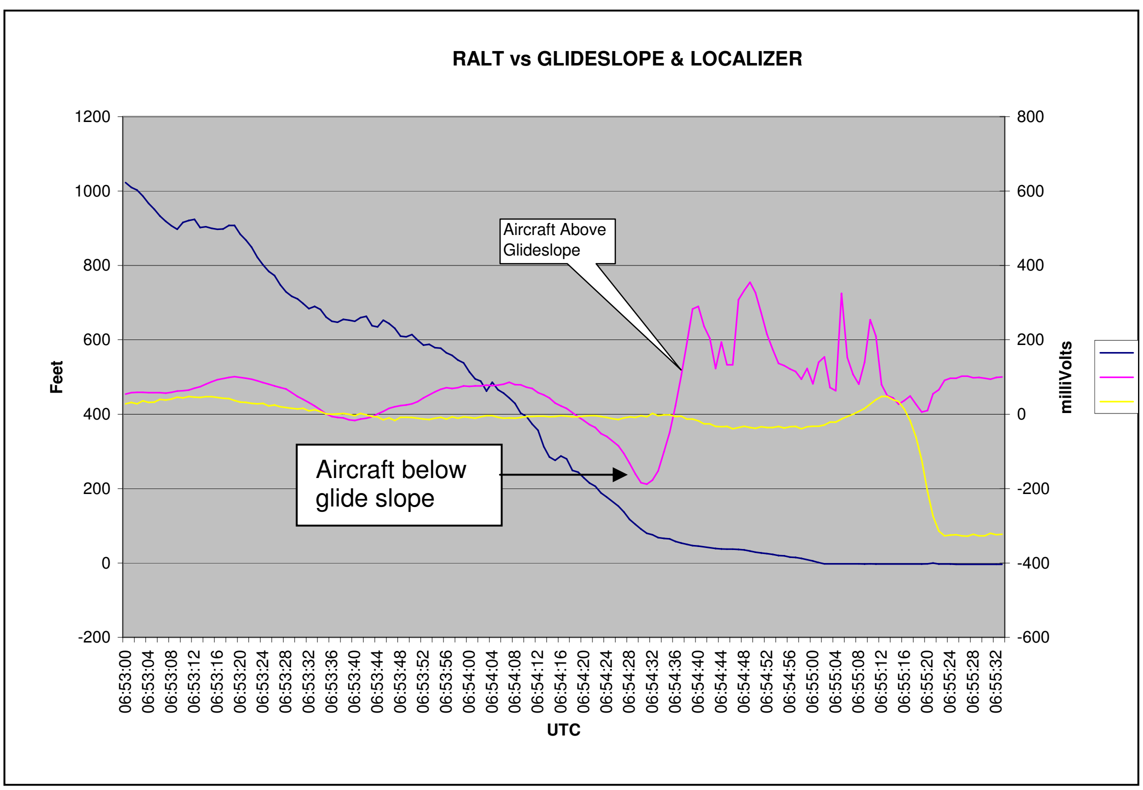
1.11.4 Digital Flight Data Recorder (DFDR).

The flight data recorder system on this aircraft consisted of a Honeywell Solid State Flight Data Recorder (SSFDR, part number: 980-4120-RQUS, serial number: 20263) receiving data from a Teledyne Controls Digital Flight Data Acquisition Unit (DFDAU).

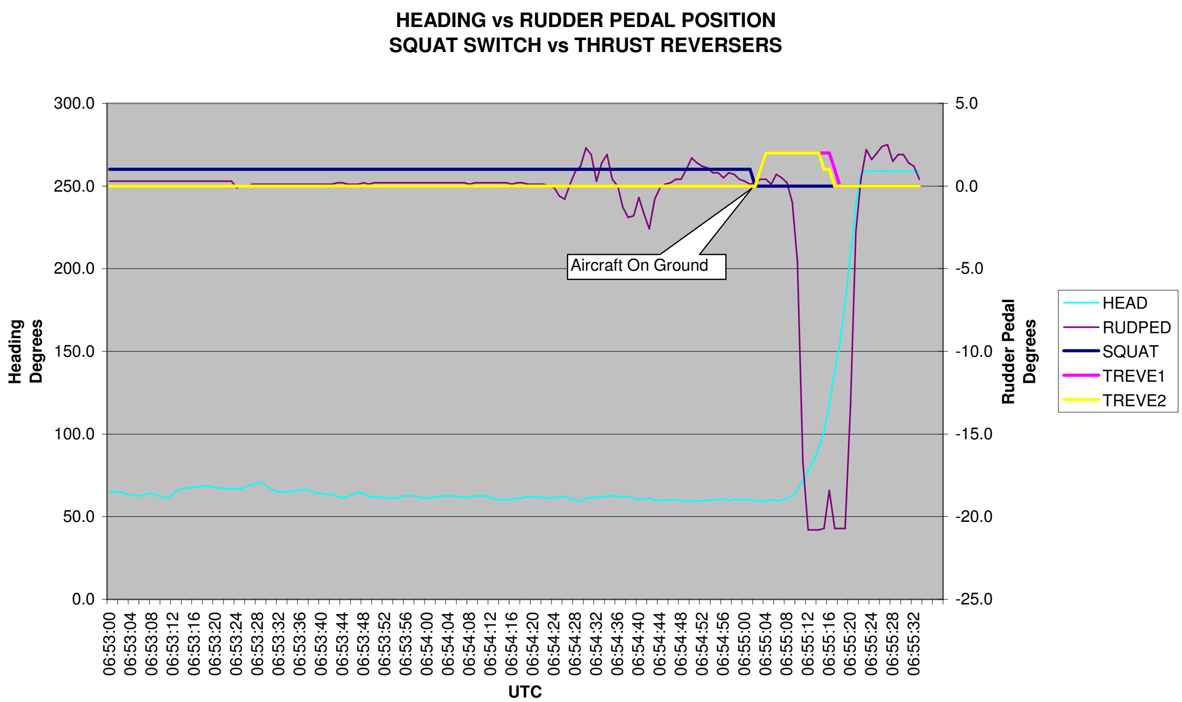
The data was retrieved from the SSFDR using a Honeywell Hand Held Download Unit (HHDLU, part number: 964-0446-001, serial number: 0435).

An EXCEL spreadsheet containing relevant data, converted to engineering units was created in order to analyse the event. The data starts at approximately 0853Z (06:53 GMT) and at a Radio Altitude meter reading of 1023 feet, and ends at approximately 0855Z (06:55 GMT) after the aircraft came to a stop. (Please note that only an Elapsed Timer is recorded and GMT time is derived using the ATC supplied Touch-Down time.)

1.11.4.1 RALT vs. GS & LOC – the graph below shows the relationship between Radio Altitude and the Glide Slope and Localizer deviations. The graph shows that the aircraft was below the glide slope before the pilot attempted to correct, resulting in the aircraft being above the GS. Also, the aircraft appeared to "float" during the final stages of the landing. It is clear that the aircraft descended slowly, as it takes 30 seconds from 80 feet (RALT) to Touch–Down.

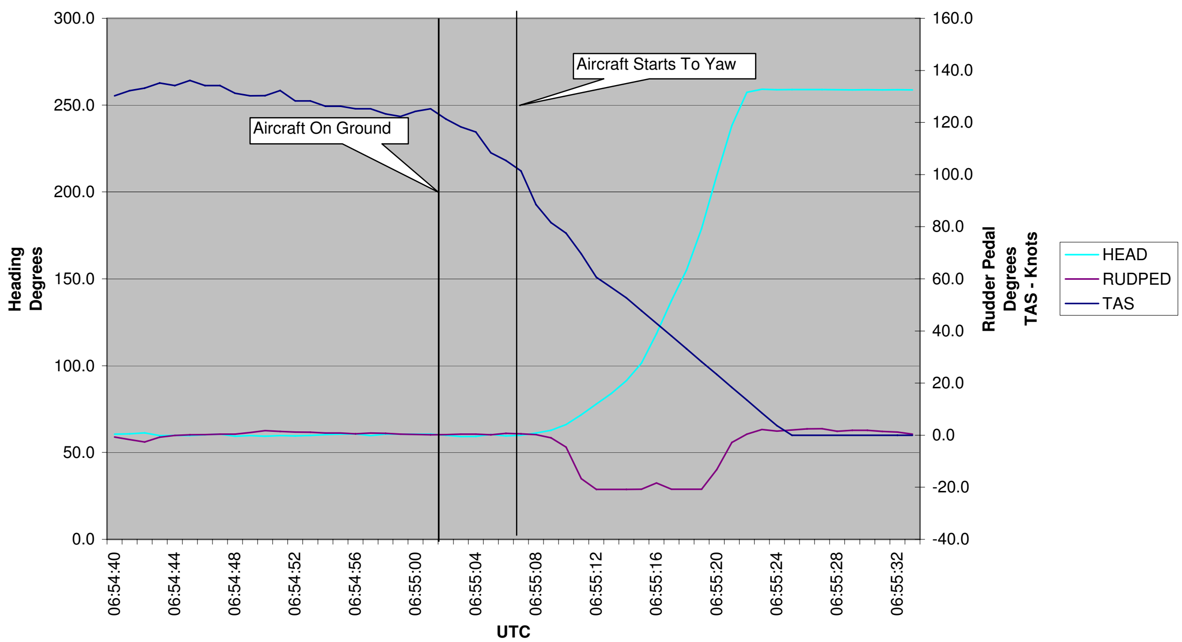


1.11.4.2 HEAD vs. RUDPED – The graph reflects information regarding Heading, plotted against the Rudder Pedal position, as well as Thrust Reverser and Squat Switch Positions. The data indicated that the aircraft had now touched down and then the Left Rudder Pedal was pushed forward, (the right pedal position is recorded, the negative values indicates that the right pedal was pushed back). However, the aircraft was turning to the right, (the value for Heading is increasing from ±60º to 259º). It can also be seen on the graph that the Engine no. 2 Thrust Reverser closed before the Engine no. 1 Thrust Reverser. The data also indicates that Maximum Thrust Reverse was selected.



1.11.4.3 TAS vs. RUDPED – The graph below reflects information regarding Heading plotted against the Rudder Pedal position, as well as the True Airspeed (TAS). The graph indicated that the Heading and the Rudder Pedal input started to change at almost the same point in time. The time scale covers the last 54 seconds of the event.

HEADING vs TAS & RUDDER PEDAL POSITION



1.12 Wreckage and Impact Information

1.12.1 The aircraft's approach was above the GS resulting in a deep landing on Runway 06. It was reported by ATC FADN that the aircraft had touched down in the middle of the runway and started to veer to the right before it groundlooped through 200º. The aircraft then partially skidded off the runway onto the grass-covered, water-logged surface on the right side of Runway 06, causing the left main undercarriage to sink into soft soil. The aircraft came to a stop at GPS Position: S29º57'41.91"E030º57'26.16" approximately 30m from the threshold of Runway 24.

Figure 4. Shows the final position of the aircraft as it came to rest

1.13 Medical and Pathological Information

1.13.1 Not applicable to this incident.

1.14 Fire

1.14.1 There was no evidence of in-flight fire or any fire after the aircraft skidded off the runway.

1.15 Survival Aspects

1.15.1 The Rescue and Fire-Fighting Services are available/operating 24 hours every day at FADN. On the day of the serious incident, the Rescue and Fire-Fighting Services (RFFS) were activated and responded to the incident scene without delay. They arrived on site within approximately 3-4 minutes. The flight deck crew decided that there was no need for deploying the emergency escape slides for evacuation and all the passengers were evacuated normally through door 1R (front right-hand side cabin door) after the mobile stairway was brought in position to accommodate the disembarkation process. The passengers and crew were then taken to the terminal building at FADN.

1.15.2 The incident was considered survivable as there was no damage to the flight deck or cabin area and all the passengers and crew were properly restrained by the safety harnesses. None of the harnesses failed.

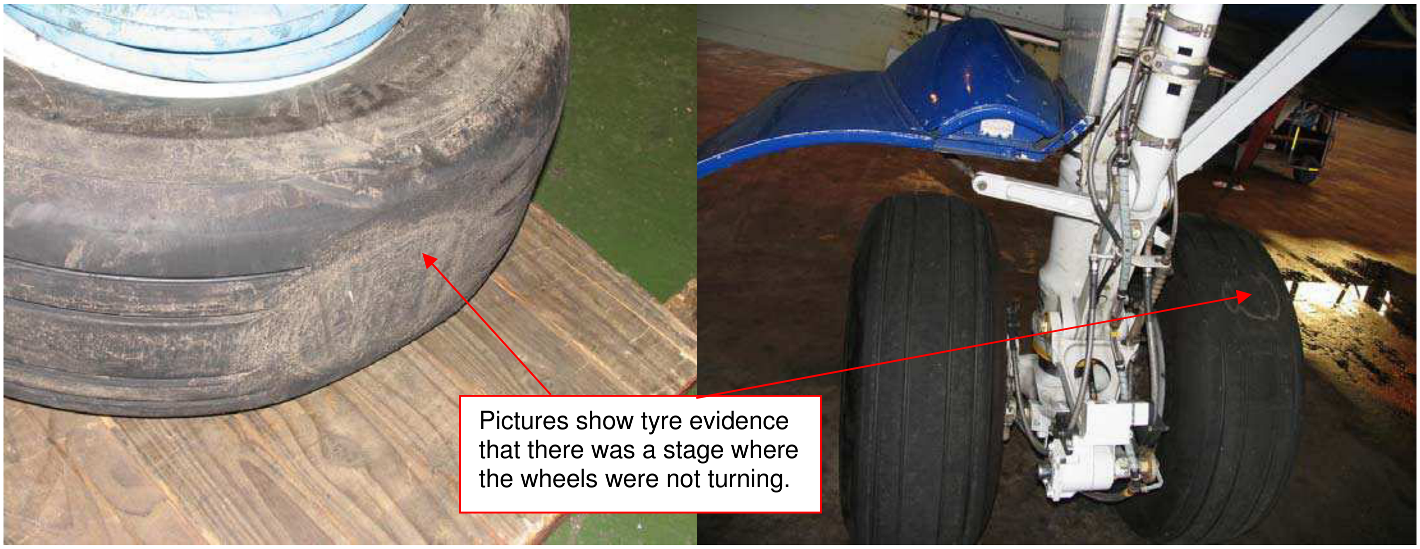
1.16 Tests and Research.

1.16.1 **Hydroplaning: Reference: www.wikipedia.org/wiki/Hydroplaning.**

Hydroplaning or aquaplaning may reduce the effectiveness of wheel braking in aircraft on landing or aborting a take-off, when it can cause the aircraft to run off the runway. Hydroplaning was a factor in an accident to Qantas Flight 1, when it ran off the end of the runway in Bangkok in 1999 during heavy rain. Aircraft which can employ reverse thrust braking have an advantage in such situations, as this type of braking is not affected by hydroplaning, but it requires a considerable distance to operate as it is not as effective as the wheel braking on a dry runway.

1.16.2 Hydroplaning is a condition that can exist when an aircraft is landed on a runway surface contaminated with standing water, slush, and/or wet snow. Hydroplaning can have serious, adverse effects on ground controllability and braking efficiency.

1.16.3 The inspection of the aircraft wheels during the investigation revealed flat spots on the two inner main wheel tyres. The flattened 'heated' area on the two wheel tyres appear to be consistent with a non-turning wheel (hard barracking effect), The pictures below show the flat spot on the aircraft's inner main wheels.



1.17 Organisational and Management Information

1.17.1 Aircraft Maintenance Organisation

1.17.1.1 According to available records, the AMO that maintained the aircraft and who certified the last Maintenance Check (Daily 2 Check) on the aircraft prior to the incident, was in possession of a valid AMO Approval, with an expiry date of 31 October 2008.

Reference	MOP Page number
Conditions requiring a Monitored Approach	P01-S09-94
Landing technique on wet runway – float, speed	P02-S01-10, P02-S01-11 & P01-S09-87
Flap selection for windshear	P02-S01-40
Braking technique when skidding on wet runway	P02-S01-11
Incorrect landing technique used on wet runway	P02-S01-10, P02-S01-11 & P01-S09-87
Windshear considerations	P02-S01-40 & EXPRESS 334 (CVR)
SOPs not followed for Monitored Approach	P01-S09-14,P01-S09-94 & P02-S01-43
Listening out on frequency for windshear reports	EXPRESS 334 (CVR) & P01-S09-87
Failure of correct and timely calls on the ILS	P02-S01-43

1.17.2 Operator

1.17.2.1 The operator was the holder of a Domestic Air Service Licence issued by the Air Services Council in terms of the Air Services Licensing Act No. 115 of 1990. The operator had a valid AOC issued in terms of Part 121 of the Civil Aviation Regulations of 1997, as amended.

1.17.2.2 The operator's MOP was perused to ascertain whether the crew was familiar with the provisions of the operator SOPs. The table below contains references to applicability to the MOP:

1.18 Additional Information

1.18.3 HUMAN FACTORS THEORY (Extracted from "Models of threats, error and CRM in flight operations" by the University of Texas Team Research Project.)

Crew Resource Management (CRM) can broadly be defined as the utilization of all available human, informational, and equipment resources toward the effective performance of a safe and efficient flight. CRM is an active process by crew members to identify significant threats to an operation, communicate them to the PIC, and to develop, communicate, and carry out a plan to avoid or mitigate each threat. CRM reflects the application of human factors knowledge to the special case of crews and their interaction.

1.18.3.1 THE MODEL OF THREAT AND ERROR MANAGEMENT

Data is most valuable when it fits within a theoretical or conceptual framework. Our research group has developed a general model of threat and error in aviation. The model indicates that risk comes from both expected and unexpected threats. Expected threats include such factors as terrain, predicted weather, and airport conditions while those unexpected include ATC commands, system malfunctions, and operational pressures. Risk can also be increased by errors made outside the cockpit, for example, by ATC, maintenance, and dispatch. External threats are countered by the defences provided by CRM behaviors. When successful, these lead to a safe flight.

The response by the crew to recognized external threat or error might be an error, leading to a cycle of error detection and response. In addition, crews themselves may err in the absence of any external precipitating factor. Again CRM behaviors stand as the last line of defence. If the defences are successful, error is managed and there is recovery to a safe flight. If the defences are breached, they may result in additional error or an accident or incident.

1.18.3.2 THE MODEL OF FLIGHTCREW ERROR MANAGEMENT

Errors made within the cockpit have received the most attention from safety investigations and have been implicated in around two-thirds of air crashes (Helmreich & Foushee, 1993**).** Our analyses of error 2, Early Investigations, tended to focus on the crew as the sole causal factor. Today, of course, we realize that almost all accidents are **External Threats:** Expected Events/Risks; Unexpected Events /Risks; External Error. **Internal Threats:** Flight Crew Error. **CRM Behaviors:** Threat Recognition and Error Avoidance Behaviors; Error Detection and Management Behaviors. **Outcomes:** A Safe Flight Recovery to a Safe Flight Additional Error Incident/Accident; have led us to reclassify and redefine error in the aviation context. Operationally, flight crew error is defined as crew action or inaction that leads to deviation from crew or organisational intentions or expectations. Our definition classifies five types of error:

1) **Intentional non-compliance errors** are conscious violations of SOPs or regulations. Examples include omitting required briefings or checklists;

2) **Procedural errors** include slips, lapses, or mistakes in the execution of regulations or procedure. The intention is correct but the execution flawed;

3)**Communication errors** occur when information is incorrectly transmitted or interpreted within the cockpit crew or between the cockpit crew and external sources such as ATC;

4) **Proficiency errors** indicate a lack of knowledge or stick and rudder skill; and

5) **Operational decision errors** are discretionary decisions not covered by regulations and **procedures** that unnecessarily increase risk. Examples include extreme maneuvers on approach, choosing to fly into adverse weather, or over-reliance on automation.

Crew response to error and error outcomes: Three responses to crew error are identified:

1) **Trap** – the error is detected and managed before it becomes consequential;

2) **Exacerbate** – the error is detected but the crew's action or inaction leads to a negative outcome;

3) **Fail to respond** – the crew fails to react to the error, either because it is undetected or ignored.

The definition and classification of errors and crew responses to them are based on the observable process without consideration of the *outcome*. There are three possible outcomes:

1) **Inconsequential** – the error has no effect on the safe completion of the flight, or was made irrelevant by successful cockpit crew error management. This is the modal outcome, a fact that is illustrative of the robust nature of the aviation system;

2) **Undesired aircraft state** – the error results in the aircraft being unnecessarily placed in a condition that increases risk. This includes incorrect vertical or lateral navigation, unstable approaches, low fuel state, and hard or otherwise improper landings. A landing on the wrong runway, at the wrong airport, or in the wrong country would be classified as an undesired aircraft state;

3) Additional error – the response to error can result in an additional error that again initiates the cycle of response.

Undesired states can be **1) Mitigated***, 2)* **Exacerbated***,* or **3) Fail to respond***.*

For example, recognizing an unstable approach and going-around would mitigate the situation. Crew actions may exacerbate the situation, increasing the severity of the state and the level of risk. Just as with error response, there can also be a failure to respond to the situation. There are three possible resolutions of the undesired aircraft state:

1) Recovery is an outcome that indicates that the risk has been eliminated;
2) Additional error - the actions initiate a new cycle of error and management; and
3) Crew-based incident or accident.

1.19 Useful or Effective Investigation Techniques

1.19.1 None.

2. ANALYSIS

1.1.8 2.1 The flight was delayed in FAJS due to the bad weather at FADN. Once FADN started accepting traffic, flight B6203 was cleared for start and pushback. The take-off, climb, cruise and the initial stages of the descent were uneventful. The STAR and approach were briefed at TOD. The weather in the South West of FADN was avoided in the later stages of the descent. Once cleared to intercept runway heading, the gear and flap were selected to get into the approach configuration. On or just after the localiser was captured, the number one generator failed. This resulted in the loss of the Captain's flight director and autopilot. A decision to continue was made, and the APU was started and put on bus (electrical power connected to the aircraft direct electrical supply circuit).

The initial approach was stable with variable winds conditions. The runway was sighted at about 1,000 ft. At 150 to 50 ft, heavy rain was encountered with decreased visibility, but the runway and approach lights remained visible throughout the approach. At this stage they got slightly low (glide slope warning) and this was corrected. Due to being off the centre line to the right, the aircraft was flown onto the centre line. As a result the touch down was deep on a wet and waterlogged runway.

2.3 There was no evidence of aircraft maintenance anomalies and/or defects reported by the crew or by maintenance personnel, prior to the flight and after the incident.

2.4 HUMAN FACTORS, THREAT RECOGNITION - ERROR MANAGEMENT

2.4.1 **Equipment Failure. Recognised: Yes. Managed: Incorrectly.**

The generator failure experienced on the approach just before 1,000 ft A.G.L distracted the PNF from monitoring the approach under severe weather conditions. The PF correctly stated "*don't worry about it*" but the PNF went ahead and got the APU on the bus. His concentration and ability to recognise further threats posed to the flight were impaired, due to this distraction. This was an error, as it would have been prudent to go around, action the QRH and conduct another approach for landing.

2.4.2 **<u>Glide Slope Warning</u>. Recognised: Yes. Managed: No.**

The below glideslope warning was triggered below 150 ft A.G.L with visibility decreasing. Although the glide slope was regained (and in fact exceeded to above glide slope) by increasing thrust to 100% N1, the threat was not managed as this event should have triggered a go-around. This was an error that led to the approach and landing being continued.

2.4.3 **<u>Severe weather and runway conditions (approach and landing)</u>. Recognised: Yes. Managed: No.**

There was moderate rain on the approach which became heavy from 150 ft to 50 ft with reducing visibility and the possibility of encountering a windshear. The threat posed by the heavy rains that had fallen in the area for two days flooding the coastal area, made the runway surface very wet and slippery. The possibility of aquaplaning and the reduced braking effectiveness caused by the prevailing conditions were not discussed by the crew and the threat was not managed. The yaw to the right could have been aggravated by the crosswind component of up to 17 kts from the right. However, once the aircraft started aquaplaning, there was nothing that the crew could do to stop the aircraft from departing the runway. The error made was that these threats were not discussed because they were not recognised.

2.4.4 **<u>Runway length and deep landing</u>. Recognised: No. Managed: No.**

The aircraft crossed the threshold on the glide slope at 100% N1. Because the aircraft was to the right of the centreline, a lot of time and runway length was used up, trying to regain centreline. This resulted in a touchdown with an estimated 897m of runway length remaining on a contaminated 2440m runway. The runway length at this airport was very well known to the crew. The crew CRM was lacking as the PNF was urging the PF to “get it down” instead of urging him to “go around”. The aircraft could probably have been stopped in this distance in perfect dry runway conditions, but not in the conditions that existed at the time of the accident – even at 2.2 EPR reverse thrust on both engines. The error made was that the lack of runway length for landing after the long “float”, given the runway conditions, was not recognised and thus not managed.

2.4.5 **<u>High Workload</u>. Recognised: No. Managed: No.**

During the approach and landing, the workload saturated the crew who became fixated on landing. This meant that the crew was not fully aware of the wind changes occurring, or of how much runway was being used up and they also did not recognise the possible threat when Express 334 reported encountering windshear during take-off. Ultimately the high workload impacted on the decision-making and judgement to continue the landing.

2.5 Information from the FDR data showed that the rate of descent from 80 ft agl to touch-down was less than 200 ft per minute. The Threshold Crossing Height for runway 06 FADN is 60 ft. The aircraft was on the glide slope at 58 ft. Thus, the aircraft was probably over the threshold at that point. The aircraft touched down 25 seconds later. The aircraft’s calibrated air speed was between 137 and 122 kts during this period. With an estimated 10 kts headwind component, the ground speed would have been approximately 120 kts. This would equate to an estimate of 1543 metres of the runway. FADN runway 06/24 is 2440 metres long. Therefore, it is calculated that the aircraft touched down with approximately 897 metres of runway remaining. This confirms eyewitness statements that the touch-down was north of the runway halfway point.

2.6 The PF stated that the surface conditions in terms of ceiling, visibility, wind, standing water and braking action were ascertained by them in advance and were within applicable minima to attempt the landing. In his mind all company and aircraft SOP's and limitations in terms of attempting or continuing with the landing and dealing with the situation as it developed, were complied with at all times. The investigation revealed that the MOP/SOP items stated in 1.17.2.3 above, were not complied with. It is the opinion of the IIC that if the SOPs were complied with, the aircraft could have landed safely.

2.7 The last runway inspection prior to the incident was done between 0813Z and 0820Z. The checklist indicates the remark as AIO (All in Order). There was no evidence to show how much standing water was on the runway at the time of the incident. Thus the investigation could not determine the amount of standing water and can reasonably conclude that it was not measured.

2.8 Although not directly linked to this incident, it is considered as a safety deficiency that the SACAA, as the regulator, had as yet not determined the minimum State friction levels as recommended by ICAO Annex 14.

2.9 It was noted that in the CVR transcript, Express 334 reported encountering windshear just after take-off. At that time the crew of BA6203 seemed to be fixated on preparing the aircraft for landing and did not note the information transmitted. The ATC did not warn or inform any aircraft regarding the reported windshear. If this was reported, it might have alerted the flight crew of the incident aircraft of the possible threat and they might have realised that they should configure the aircraft for windshear conditions.

2.10 The decision-making of the flight crew was deficient in that it appears as if they did not recognise the threats posed to the safety of the flight and therefore did not manage the threat. Ultimately the high workload induced by the inclement weather that reduced visibility and caused a wet runway, as well as the generator failure and Glide Slope Warning, all had an impact on their decision and judgement to continue with the landing.

2.11 The aircraft was off centre line on short final approach and the flight crew had such a landing fixation that they failed to conduct a go-around even after they had flown far past the normal touchdown area. From the CVR recording it is clear that during the long float before touchdown, the PNF urged the PF to "get it down". At no stage did he urge him to "go around".

2.12 The speed brake deployment was normal, thrust reverse and braking were applied and the aircraft seemed to decelerate normally. The aircraft then started aquaplaning to the right, slowly but positively. Left rudder input and braking had no effect. The PF states that he tried differential reverse thrust, but this also had no effect. However, the DFDR data shows that the reversers were stowed asymmetrically at approximately 50 knots, with a split of two seconds – number 2 engines first. The aircraft rotated approximately 200º to the right and skidded partly off the runway into the soft mud, causing the left main undercarriage to sink in.

3. CONCLUSION

3.1 Findings

3.1.1 The flight crew members were licensed and qualified for the flight in accordance with existing regulations.

3.1.2 The aircraft was cleared by ATC-FADN to land on Runway 06.

3.1.3 The aircraft was initially low on the GS slope and following an attempt by the flight crew to correct, the aircraft became high on the GS.

3.1.4 The crew recognized three of the threats on approach. However, they did not act in an appropriate way to avoid the identified threats.

3.1.5 The aircraft landed deep on the wet runway, groundlooped and skidded backwards before coming to rest.

3.1.6 The aircraft groundlooped approximately 200º to the right and skidded partly off the runway backwards into the soft mud, causing the left main undercarriage to sink in.

3.1.7 The weather was considered to have been a contributory factor in this incident.

3.1.8 The crew did not comply with the operator SOPs.

3.1.9 ATC did not warn traffic in the vicinity regarding reported “wind shear”.

3.1.10 The ATC frequency was momentarily (approximately one minute) blocked with no positive voice reception and the cause thereof could not be identified.

3.1.11 The maintenance records indicated that the aircraft was equipped and maintained in accordance with existing regulations and approved procedures.

3.1.12 The airport operator had carried out a runway inspection before the aircraft landed, however, it could not be determined if the procedure used was adequate or accurate, as there were no minimum standards set out by the SACAA in the relevant CARS.

3.1.13 The SACAA as Regulator had opted not to comply with the recommended standards contained in ICAO Annex 14, Volume 1 – Chapter 7, which requires that the State should define the minimum friction level and publish it in the State’s Aeronautical Information Publication (AIP).

3.2 Probable Cause/s

3.2.1 The incident was attributed to the incorrect landing technique used by the crew, resulting in the aircraft landing deep onto the runway and a subsequent ground loop.

3.2.2 Contributory:

Poor management or non-recognition of threats, which affected the safe completion of the flight.

4. SAFETY RECOMMENDATIONS

4.1 It is recommended that ATNS review their procedures regarding the reporting of critical information to pilots, i.e. windshear.

4.2 It is recommended that the Commissioner for Civil Aviation (CCA) instruct the SACAA to conduct an audit into the adequacy of, and adherence to standard operating procedures as applied by the air operator certificate (AOC) holder. The CCA should expand this audit to include other Part 121 AOC holders in due course.

4.3 It is recommended that the SACAA should, in compliance with the recommendation of Annexure 14, Volume 1 (Chapter 7) define the minimum friction level and publish it in the Aeronautical Information Publication (AIP).

4.4 It is recommended that the SACAA should, in compliance with the recommendation of Annexure 14, Chapter 2, develop Regulations with respect to the inspection of wet runways.

5. APPENDICES

None

-END-

Report reviewed and amended by the Advisory Safety Panel
31 March 2009.