FINAL REPORT

AIRCRAFT ACCIDENT INVESTIGATION REPORT

GENERAL

Report / File. No:	-	**AAIIU: 3/1/22/3**
Name of Operator	-	**FLY JAMAICA AIRWAYS**
Aircraft Manufacturer	-	**BOEING AIRCRAFT COMPANY**
Aircraft Model/Type	-	**BOEING 757-200**
Nationality & Registration Marks	-	**N524AT**
Place of Accident/Region	-	**CHEDDI JAGAN INTERNATIONAL AIRPORT (ICAO REFERENCE SYCJ), DISTRICT REGION 4, TIMEHRI, EAST BANK DEMERARA, GUYANA, SOUTH AMERICA**
Date of Accident	-	**9TH NOVEMBER 2018**
Time of Accident	-	**06:53 UTC (02:53 GST)**

REPORT / FILE #: AAIIU 3/1/22/3

This investigation was conducted in accordance with the methodology and requirements of ICAO Annex 13, and therefore, it is not intended to apportion blame, or to assess individual or collective liability. Its sole objective is to draw lessons from the occurrence which may help to prevent future accidents. Consequently, the use of this Report for any purpose other than for the prevention of future accidents could lead to erroneous conclusions.

GENERAL NOTE:

All times in this Report are Coordinated Universal Time (UTC) unless otherwise stated. UTC is four hours ahead of Guyana Standard Time (GST), that is, GST+4. Where Greenwich Mean Time (GMT) is quoted, it only relates to that specific topic or section, and correlates with UTC (denoting a similar time difference with GST).

SPECIAL NOTE:

The Cheddi Jagan International Airport Corporation (CJIAC) is the corporate body responsible for the control and management of the Cheddi Jagan International Airport (CJIA).

SYCJ is the International Civil Aviation Organisation's (ICAO) reference assigned to the CJIA.

Thus, wherever used in this Final Report, SYCJ and CJIA is being used interchangeably to refer to the same Airport. SYCJ is mostly used to refer to Pilot's reference for the Airport, while CJIA is used in the general sense as the official name assigned to the Airport.

TABLE OF CONTENTS

SUBJECT **PAGE NO.**

Title Page 1
Table of Contents 3
Glossary of Abbreviations and Terms 6
SYNOPSIS 10
1. FACTUAL INFORMATION 11
1.1 History of Flight 11
1.1.1 Summary of Flight Details 11
1.1.2 Timeline Details 12
1.2 Injuries to Person 16
1.3 Damage to Aircraft 16
1.3.1 External Condition 16
1.3.2 Flight Condition 17
1.3.3 Cabin Condition 18
1.3.4 Emergency Exits Condition 18
1.3.5 Cargo Holds Condition 19
1.3.6 Powerplants – RB211-535E4 Condition 19
1.3.7 Flight Controls Condition 20
1.3.8 Landing Gears Condition 21
1.3.9 Hydraulic Systems Condition 22
1.4 Other Damage 23
1.5 Personnel Information 24
1.5.1 Captain - Pilot-in-command 24
1.5.2 First Officer – Pilot Second-in-command 24
1.5.3 Flight Crew Interviews 25
1.5.4 Cabin Crew Interviews 27
1.5.5 Air Traffic Services 28
1.6 Aircraft Information 30
1.6.1 General 30
1.6.2 Maintenance 31
1.6.2.1 Records 31
1.6.2.2 Examination of Aircraft Parts by MOOG/NTSB 32
1.6.2.3 Examination of Aircraft Parts by EATON/NTSB 37
1.6.3 Mass and Balance 39
1.7 Meteorological Information 39
1.8 Aids to Navigation 46

1.8.1 Instrument Approaches at CJIA 46
1.8.2 SYCJ (CJIA) RNAV RWY06 Approach 46
1.9 Communications 46
1.10 Aerodrome Information 47
1.10.1 General 47
1.10.2 Certification 48
1.10.3 Runway Description 48
1.11 Flight Recorders 53
1.11.1 Cockpit Voice Recorder 53
1.11.2 CVR Audio Recording Description 53
1.11.3 Description of Audio Events 54
1.11.4 Timing and Correlation CVR and FDR 54
1.11.5 Required Duration of CVR 54
1.11.6 Flight Data Recorder Information 54
1.12 Wreckage and Impact Information 56
1.13 Medical and Pathological Information 57
1.13.1 Medical Reports 57
1.14 Fire 57
1.15 Survival Aspects 58
1.15.1 Notification of Accident 58
1.15.2 Actions by the Aerodrome Fire and Rescue Service 58
1.15.3 Actions by the Flight Crew 60
1.15.4 Actions by the Cabin Crew 60
1.16 Passengers 62
1.16.1 General 62
1.16.2 Deceased Passenger 63
1.16.3 Operational Decisions 63
1.16.4 Impact Forces and Passenger Movement 64
1.16.5 Survivable Space 65
1.16.6 Passenger Readiness 65
1.16.7 Cabin Environment 66
1.16.8 Evacuation and Use of Exits 66
1.16.9 Passenger with Special Needs 67
1.16.10 Passenger Injuries 67
1.16.11 Slide Management and Slide Angle 68
1.16.12 Post-Crash Factors 69
1.16.13 Safety Equipment 69
1.17 Organisation and Management 69

1.17.1 Fly Jamaica Airways - General 69
1.17.2 Fly Jamaica Airways – Operations Manual 70
1.17.3 Staff Interviews 71
1.17.3.1 Interview with Senior FJA Operations Staff 71
1.17.3.2 Interview with FJA Director of Maintenance 72
1.17.3.3 Interview with FJA Quality Assurance Manager 75
1.17.3.4 Interview with FJA Chief Pilot 76
1.17.3.5 Interview with FJA Guyana Station Manager 79
1.17.3.6 Interview with FJA Accountable Manager 80
1.18 Additional Information 82
1.18.1 Visit with the JCAA 82
1.18.2 Post Evacuation Issues 84
2. ANALYSIS 85
2.1 The Aircraft 85
2.1.1 General 85
2.1.2 Emergency Equipment 85
2.1.3 Emergency Exits 86
2.1.4 Summary of Events/Consequences 86
2.2 Flight Crew 88
2.3 The Company (FJA) 88
2.3.1 Staffing General 88
2.3.2 Operations Staff 89
2.3.3 Maintenance 89
2.4 The Jamaica Civil Aviation Authority 90
2.5 Air Traffic Services - Guyana 90
2.6 Sequence of Events 90
3. CONCLUSIONS 91
3.1 Major Cause 91
3.2 Contributing Factors 92
4. RECOMMENDATIONS 92

GLOSSARY OF ABBREVIATIONS AND TERMS

AC	-	Alternating Current
ACA	-	Approved Check Airman
ACC	-	Area Control Centre
AD	-	Airworthiness Directive
ADO	-	Airport Duty Officer
AIC	-	Aeronautical Information Circular
AIP	-	Aeronautical Information Publication
AIRMET	-	Airman's Meteorological Information
AKSIN	-	Waypoint - Final Approach RWY06 CJIA 11.2nm from the Threshold
ALTN	-	Alternate
AMM	-	Aircraft Maintenance Manual
AMO	-	Approved Maintenance Organisation
AMSL	-	Above Mean Sea Level
ANS	-	Air Navigation Services
ANSD	-	Air Navigation Services Directorate
AOC	-	Air Operator Certificate
APC	-	Aircraft Proficiency Check
APU	-	Auxiliary Power Unit
ARFFS	-	Aerodrome Rescue and Fire Fighting Service (aka Fire Service)
ATC	-	Air Traffic Control/Air Traffic Controller
ATCO	-	Air Traffic Control Officer
ATS	-	Air Traffic Services
BAC	-	Boeing Aircraft Company
BMS	-	Boeing Material Specification
BRT	-	Boeing Research and Technology
CAA	-	Civil Aviation Authority
CAL	-	Caribbean Airlines Limited
Cabin Crew	-	Flight Attendants
CAM	-	Cockpit Area Microphone
CAVOK	-	Ceiling and Visibility Okay
CEO	-	Chief Executive Officer
CJIA	-	Cheddi Jagan International Airport (ICAO reference SYCJ)

CMM	-	Component Maintenance Manual
CMO	-	Chief Medical Officer
CTS	-	Computed Tomography Scan
CVR	-	Cockpit Voice Recorder
CYYZ	-	ICAO reference for L. B. Pearson International Airport, Toronto, Canada
DG/DGCA	-	Director General Civil Aviation
DOM	-	Date of Manufacture
EDP	-	Engine Driven Pump
ELT	-	Emergency Locator Transmitter/Emergency Location Transmitter
EMP	-	Electrical Motor Pump
EMS	-	Equivalent Maintenance System
EOC	-	Emergency Operations Centre
EQA	-	Equipment Quality Analysis (Boeing Terminology)
FAA	-	Federal Aviation Administration (United States of America)
FDR	-	Flight Data Recorder
FIC	-	Flight Information Centre
FIR	-	Flight Information Region
FJ	-	Fly Jamaica
FJA	-	Fly Jamaica Airways
Flight Crew	-	Pilots (including the Captain and First Officer)
FME Caps	-	Foreign Materials Exclusion Caps
FO	-	First Officer (aka Pilot Second-In-Command)
FOD	-	Foreign Object Damage/Foreign Object Debris
FOI	-	Flight Operations Inspector
FOM	-	Flight Operations Manual
Ft	-	Feet (when used in distance measurement)
GAAIU	-	Guyana Aircraft Accident and Incident Investigation Unit
GAR	-	Guyana Aviation Requirements
GCAA	-	Guyana Civil Aviation Authority
GCAR	-	Guyana Civil Aviation Regulations
GDF	-	Guyana Defence Force (ARMY)
GEO	-	Georgetown (Guyana)
GMT	-	Greenwich Mean Time (plus 4 GST)
GND	-	Ground

GPHC	-	Georgetown Public Hospital Corporation (Guyana)
GPS	-	Global Positioning System
GSC	-	Glasgow Coma Scale
GST	-	Guyana Standard Time (minus 4 UTC, minus 4 GMT)
HF	-	High Frequency
H-Shear	-	Horizontal Shear
ICAO	-	International Civil Aviation Organisation
IFALPA	-	International Federation of Air Line Pilots' Associations
IPC	-	Instrument Proficiency Check
IRS	-	Inertial Reference System
IRU	-	Inertial Reference Unit
JCAA	-	Jamaica Civil Aviation Authority
Kt	-	Knot (1 Nautical Mile per Hour)
LDA	-	Landing Distance Available
LH	-	Left Hand (or Port Side)
m	-	Meter/Metre (when used in distance measurement)
MCM	-	Maintenance Control Manual
METAR	-	Meteorological Aerodrome Report (The format for reporting Weather information)
MEL	-	Minimum Equipment List
MLG	-	Main Landing Gear
MOR	-	Mandatory Occurrence Report
NLG	-	Nose Landing Gear
nm	-	Nautical Mile
NOTAM	-	Notice to Airmen
NTSB	-	National Transportation Safety Board (United States of America)
OLVIK	-	Waypoint - Final Approach RWY06 CJIA 5.2nm from the Threshold
PAPI	-	Precision Approach Path Indicator
PCA	-	Patient-Controlled Analgesia
PCU	-	Power Control Unit
PIC	-	Pilot-In-Command (aka Captain or Commander of the Aircraft)
P/N	-	Part Number
POI	-	Primary Operations Inspector
PORT	-	Left Side

PTU	-	Power Transfer Unit
QRH	-	Quick Reference Handbook
RESA	-	Runway End Safety Area
RH	-	Right Hand or Starboard Side when used to indicate position
RH	-	Relative Humidity when used to indicate weather forecast
RNAV	-	Area Navigation
ROSHEAR	-	Runway Oriented Shear
PWR	-	Power
RWY	-	Runway
SATCO	-	Senior Air Traffic Control Officer
SB	-	Service Bulletin
SIGMET	-	Significant Meteorological Information (A weather advisory containing meteorological information concerning the safety of all aircraft. SIGMETs may be either convective or non- convective.)
S/N	-	Serial Number
SOP	-	Standard Operating Procedures
STN	-	Station
SMS	-	Safety Management System
STAB	-	Starboard (or Right Side)
STBY	-	Standby
SYCJ	-	ICAO reference for Cheddi Jagan International Airport
SYS	-	System
TAF	-	Terminal Area Forecast
Taxiway 'C'	-	Taxiway Charlie (the **'C'** refers to Charlie)
TBO	-	Time Before Overhaul
TORA	-	Take-Off Distance Available
TSN	-	Time Since New
TSO	-	Time Since Overhaul
T&T	-	Trinidad and Tobago
USA	-	United States of America
UTC	-	Coordinated Universal Time (Equivalent to GMT, plus 4 GST)
VHF	-	Very High Frequency
VMC	-	Visual Meteorological Conditions
VOR	-	Very High Frequency Omni-Directional Range

SYNOPSIS

The Fly Jamaica Airways Boeing aircraft designated B757-200, registration N524AT, call sign FJA256, departed Cheddi Jagan International Airport (CJIA/SYCJ), Timehri, East Bank Demerara, Guyana, at 6:10hrs. The intended destination was the L. B. Pearson International Airport (CYYZ), Toronto, Canada. Approximately, ten minutes after takeoff, it was reported that the pilot observed a low quantity level in the left hydraulic system quantity indicator. After completing the appropriate checklists, a decision was made to return to CJIA. Subsequently, an overheat condition in one of the right hydraulic Electric Motor Pumps was indicated. The checklist for this condition was completed. The aircraft touched down on RWY06 CJIA at 6:53hrs. During the landing roll, it was reported that the aircraft initially had braking power, however, the aircraft subsequently lost its braking power (***Pilot had 'pumped' the brakes and brake pressure became depleted***), veered towards the right, and exited the runway. The aircraft came to a stop on the eastern side of the unusable portion of the runway 1,400ft beyond the usable portion of the runway.

On board the aircraft at the time of the accident, there were one hundred and twenty-eight souls, including one hundred and eighteen adults, two infants, and eight Crew Members. All persons on board evacuated the aircraft from the deployed Slides. Ten passengers were injured, and one passenger subsequently died five days after the accident. No Flight or Cabin Crew Members were injured.

The aeroplane came to rest on its port and nose landing gears, aft fuselage, and its starboard wing. The starboard wing tip was buried in several inches of soil and was intact except for some minor impact deformations. Beyond the wing tip, about a third of the starboard wing rested on the ground. The nearly separated starboard engine was oriented with its intake section facing upward (almost vertically). The upper portion of the starboard main landing gear penetrated through the upper starboard wing surface. The nose section and the port wing were elevated. The port wing appeared to be undamaged.

Heavy smoke emanated from the aircraft undercarriage and spread into the passenger cabin. The smoke was extinguished by the Aerodrome Rescue and Fire Fighting Services (ARFFS).

1. FACTUAL INFORMATION

1.1 HISTORY OF THE FLIGHT

1.1.1 SUMMARY OF FLIGHT DETAILS

Note: SYCJ (ICAO reference) is used interchangeably with CJIA (Airport's official name) and refers to the same Airport.

On 9th November 2018, a Boeing B757-200 aircraft, registration N524AT operating as FJA 256, departed SYCJ, Timehri, East Bank Demerara, Guyana, at 06:10hrs with one hundred and twenty passengers, eight Crew Members; and eight hours and one minute of fuel on board. The aircraft was destined for CYYZ, Toronto, Canada. At approximately 06:21hrs, when the aircraft was 75nm northwest of SYCJ, at an altitude of 20,000ft, the Captain reported a loss of hydraulic fluid. He requested Air Traffic Control clearance to stop climb at 20,000ft and indicated the intention to return to SYCJ for a landing.

The Captain's request was approved. He did not declare an emergency. However, after advising the Captain, the Air Traffic Controller on duty activated local emergency stand-by at the airport. The aircraft returned to SYCJ *'**Holding Area**'* where it was configured for landing.

The aircraft landed at 06:53hrs. The final approach and touchdown appeared to be normal. As indicated by the FDR, the aircraft slowed to a speed of 60kts. Halfway down the runway, the aircraft veered towards the right, departed the runway, and came to a stop approximately 1,400ft beyond the end of, and perpendicular to, the active runway. The nose of the aircraft was extended over the airport fence and its nosewheel was about 30ft short of a steep '**drop off**.' The aircraft was stopped when its starboard undercarriage became imbedded in thick, loose sand that was being used for the ongoing runway expansion project. The Aerodrome Rescue and Fire Fighting Service was on standby and responded immediately. The aircraft sustained major (significant) structural damages.

The aircraft was evacuated via the aircraft Slides. There were reports of ten passengers suffering minor injuries and one elderly passenger subsequently died five days after the accident.

1.1.2 TIMELINE DETAILS

Note: The timeline below is a chronological overview of the events that occurred based on review of FDR data, CVR transcript, and crew interviews. The events below are referenced to an estimated elapsed time (+ minutes) from when take-off occurred. All times should be considered approximate.

1. ***Take-off (TO):*** All hydraulic systems (Left, Centre and Right) were normal.

    (a) Left and Right Hydraulic Systems each have one Engine Driven Pump (EDP) and one electric Alternating Current Motor Pump (ACMP).

    (b) Centre hydraulic system has two ACMP's.

        (i) EDP full flow displacement is 2.4 cu.in./rev. The EDP is regulated to a nominal 3,000 psi and at take-off power (3,750 RPM) will deliver approximately 37 GPM.

        (ii) ACMP rated flow is 6 GPM at 2,850 psi, 7 GPM at 2,700 psi and 12 GPM at 1,200 psi.

2. ***TO + ~10 min:*** Flight crew observed a L HYD QTY EICAS message, indicating the Left Hydraulic System fluid quantity was low, and subsequently a L HYD SYS PRESS EICAS message, indicating the Left Hydraulic System pressure was low. The crew performed the QRH Left Hydraulic System low pressure procedure and both the Left EDP and Left ACMP were turned off. The flight crew decided to return to Cheddi Jagan International Airport.

    (a) With low Left EDP pressure, the Power Transfer Unit (PTU) automatically activated, allowing the Right Hydraulic System to pressurise the Left Hydraulic System. During PTU operation, if pressure in the Left Hydraulic System drops below ~250 psi, the Control Circuit Pressure Switch in the PTU output filter module will activate and automatically turn off the PTU.

    (b) Loss of Left Hydraulic System resulted in loss of:

        (i) Two Spoiler Panels on each wing (there are 12 total spoilers, 8 still available).

(ii) Alternate Brakes (Normal and Reserve Brakes and Accumulator Braking was still available).

A. Normal and Reserve Brakes are powered by Right Hydraulic System.

B. Loss of Left and Right Hydraulic System pressure will open an isolation valve and enable limited Accumulator braking.

(iii) Left Engine Thrust Reverser (Right Engine Thrust Reverser was still available).

(iv) Landing Gear actuation (Alternate gear extension was available).

(v) Nose Wheel Steering (rudder and differential braking was available).

(c) With the loss of fluid in the Left Hydraulic System, a failed Control Circuit pressure switch allowed the PTU to continue running in a no-load condition. The Control Circuit Pressure Switch was verified to have failed during this event as determined by post-event testing at Eaton. Failure of this pressure switch is a known occurrence and the subject of Service Bulletin SB 75729-0056, which recommends installation of an enhanced pressure switch. ***The SB was not performed on this aircraft, however, Pressure Switch Part Number 211C223-521 was installed in both locations.***

Note: There is a related SB 757-29-0057, which is for 757-300 model aircraft.

(d) Continuous operation of PTU in no-load condition caused the Right Hydraulic System fluid temperature to increase.

(e) There was an advisory EICAS status message, POWER XFER UNIT, indicating the PTU was operating when it should have been off. Crews are not required to monitor status messages in flight, and there are no procedures for them. The PTU is designed to function automatically and cannot be shut down by the flight crew in flight.

(f) PTU rated output is 21.8 GPM at 2175 psi (Left Hydraulic System), with input of 27.8 GPM at 2680 psi (Right Hydraulic System).

3. ***TO + ~30 min:*** Flight Crew observed a R ELEC HYD OVHT EICAS message, indicating the Right ACMP had overheated, and performed the QRH procedure (Right ACMP turned off). The Right EDP did not annunciate an overheat condition and continued to provide hydraulic power.

   (a) ACMP overheat sensor set points: ACMP overheated (increasing) at 225 ± 8 °F; ACMP not overheated (decreasing) at 195 ± 20 °F.

   (b) EDP overheat sensor set points: EDP Overheated (increasing) at 230 ± 5 °F; EDP not Overheated (decreasing) at 185 ± 20 °F.

   (c) Shutting down the Right ACMP disabled the ability of the flight crew to select Reserve Brakes, but Normal Brakes were still available. Reserve Brakes use the Right ACMP, in conjunction with an isolation valve, to power a dedicated portion of the Normal Brake system, utilising fluid below the standpipe level in the Right Hydraulic System reservoir, for Reserve Brakes.

   (d) Right (EDP only) and Centre (2 ACMPS) hydraulic systems were still functioning.

   (e) If Right EDP had also overheated, it too would have been turned OFF per a QRH procedure, resulting in total loss of Right Hydraulic System pressure. The QRH procedure for the loss of both the Left and Right Hydraulic Systems' pressure advises the flight crew that only accumulator braking is available and to apply steady, increasing brake pressure and hold to a full stop.

4. ***Approach and Descent:*** Airplane was configured for landing with flaps-20^{o} and landing gear extended using the alternate gear extension system, flight crew prepared for high speed (~160 kts) landing with Normal Brakes available and no Nose Wheel Steering.

   (a) During approach, the right engine's RPM was approximately 66% N1 (2475 RPM). With the PTU running in no-load condition, it used virtually all the Right EDP output (full flow capacity) of ~26 GPM to maintain Right Hydraulic System pressure at 3,000 psi.

(b) Around the time flare was initiated, the throttles were further retarded by the flight crew and the engines' RPMs reduced to 40% N1 (1500 RPM), full flow capacity of the EDP is ~15 GPM, which could not meet the demand of the PTU in a no-load condition. The Right Hydraulic System pressure dropped to zero.

(c) Normal brake function was lost and only accumulator braking was available.

5. ***Landing (TO + 43 min.):*** Upon touchdown, the throttles were retarded to Idle (25% N1) by the flight crew and initially accumulator braking power was available. There was no pressure in the Right Hydraulic System, but the flight crew was unaware of this situation.

(a) With no Left Hydraulic System pressure, the flight crew expected Normal Braking to be available from the Right Hydraulic System pressure. However, there was no normal brake pressure available from the right EDP due to PTU's flow consumption.

(b) Initial braking power was provided by the brake system accumulators.

(c) The flight crew reportedly "pumped" the brakes upon landing, which depleted the accumulator braking pressure before the aeroplane stopped. In past events, where there has been a loss of both Left and Right Hydraulic Systems, the QRH instructions to apply steady, increasing brake pressure and hold to a full stop have proven effective.

(d) Loss of Right Hydraulic System pressure occurred just as the aeroplane was landing, not allowing time for the flight crew to assess the situation and act accordingly.

1.2 INJURIES TO PERSONS

TABLE: 1- SHOWING INJURIES TO PERSONS

INJURY	CREW	PASSENGERS	OTHERS	TOTAL
FATAL	0	1	0	1
SERIOUS	0	0	0	0
MINOR/NONE	8	10	109	127
Total	8	11	109	128

Note: The passengers onboard were thirty-five Guyanese, eighty-two Canadians, one American (United States of America), one Trinidadian and one Pakistani. The Crew Members comprised of six Guyanese and two Jamaicans.

1.3 DAMAGE TO AIRCRAFT

1.3.1 EXTERNAL CONDITION

The aircraft came to rest on its port and nose landing gears, its aft fuselage, and its starboard wing. The nose of the aircraft and its port wing were elevated. Approximately, one third of the starboard wing, from its tip, rested on the ground. A plumb bob was hung from the cockpit door frame to determine the aircraft's roll in the resting attitude, the bottom at 25 inches was 4.75 inches from the door frame.

The nearly separated starboard engine was oriented with its intake section pointing upwards (almost vertically). Above, where the aft fuselage rested on the ground, small fuselage ripples (referred to as 'oil canning') were observed in one lower skin panel located aft of the port wing, from beneath the L3 door to beneath the fifth window aft. The starboard wing tip was buried in several inches of soil but appeared to be intact, except for some minor impact deformations.

The port wing appeared undamaged. The upper portion of the starboard main landing gear was displaced through the upper starboard wing surface. The penetration and aft displacement of the landing gear created extensive damage to both the inboard portion of the wing and to the stub spar which supported the aft landing gear trunnion.

1.3.2 FLIGHT DECK CONDITION

When the Investigation Team inspected the aircraft, the following observations were made while inspecting the Flight Deck.

FLIGHT DECK – GENERAL AND FORWARD INSTRUMENT DISPLAYS:

a) The cockpit appeared to be clean, except for a few loose papers that were on the floor.

b) The forward instrument displays were unpowered with 'OFF' flags visible.

c) The auto brakes knob was at 'OFF.'

d) The landing gear handle was in the down position.

e) The guard for the 'ALTN GEAR EXTEND' switch was open, the switch was in the 'OFF' position, and the safety wire (witness wire) was broken.

f) The flap gauge indicated 20°.

g) The 'ALTN FLAPS' selector was at 20°. The flap handle to the right of the throttles was in the position labelled '1'.

h) The brake pressure indicator was at zero ('0').

i) The reserve brake switch was at the 'OFF' position.

FLIGHT DECK - OVERHEAD PANELS:

a) 'STBY PWR' switch was at 'OFF.'

b) All three 'IRS' selectors were at 'OFF.'

c) 'APU' knob was at 'OFF'.

d) Engine start knob was at '1'.

e) Ignition knobs were at 'AUTO'.

f) Seatbelt sign was at 'OFF'.

g) The hydraulic controls were unpowered, showing dark push-lights.

h) The Left 'EDP' and 'EMP' were in the 'OFF' position.

i) The C1 and C2 'EMP' were in the 'OFF' position.

j) The Right 'EMP' was in the 'OFF' position and Right 'EDP' was in the 'ON' position.

k) The only 'tripped' circuit breaker was labelled 'Landing Gear AIR/GND SYS 1'.

FLIGHT DECK - CENTRE PEDESTAL:

a) 'SPEED BRAKE' handle was full forward.

b) Throttles were at the idle stops.

c) Reverser toggles were in the stowed positions.

d) 'FUEL CONTROL' switches were in the 'OFF' positions.

e) Parking brake handle was down.

f) 'STAB TRIM' display was 'OFF.'

g) 'STAB TRIM' guards were in the [normal] closed positions.

h) Fire pull levers (3 levers) were 'UP' and not turned.

1.3.3 CABIN CONDITION

When the Investigation Team inspected the aircraft, the following observations were made while inspecting the Cabin.

Inside the cabin, several oxygen masks along the starboard side were deployed, while very few were deployed on the port side. At the time of inspection, the cabin was relatively clean of papers and personal articles. All the seat cushions were flipped upward. The overhead bins were opened and empty, other than for normal cabin safety equipment. The galley carts were in place and ***investigators were told that the carts had been emptied***.

1.3.4 EMERGENCY EXITS CONDITION

When the Investigation Team inspected the aircraft, the following observations were made while inspecting the Emergency Exits.

The aircraft was equipped with eight cabin exits, four on the left side of the aircraft (Nos. L1 to L4), and four on the right of the aircraft (Nos. R1 to R4). The R4 door was regularly used as the catering and general service entrance and exit. When the Investigation Team reached the site, it was observed that the L2, L3, R1 and R3 doors were opened, and the corresponding slides were deployed. The slides at doors L2, R1 and R3 appeared to be properly deployed. While the slide at door L3 had collapsed and was bent down about quarter-way from the top.

1.3.5 CARGO HOLDS CONDITION

When the Investigation Team inspected the aircraft, the following observations were made while inspecting the Cargo Holds.

There was evidence that some cargo had shifted possibly due to impact. However, the cargo nets were in place. Offloading of the cargo commenced approximately six hours after the occurrence. The No.1 Cargo Hold was partially buried in thick sand which had to be cleared to open the hatch. This Cargo Hold contained live cargo of young Caimans. There was no visible damage to the cargo.

1.3.6 POWERPLANTS - RB211-535E4 CONDITION

When the Investigation Team inspected the aircraft, the following observations were made while inspecting the Powerplants.

From cursory inspection, the port engine appeared to be intact and not damaged. The fan and turbine blades were turning freely (windmilling) in the wind. No significant gouges or physical damages or deformations were observed on the fan or turbine blades, and no remnants, molten debris, or other fragments were in the core exhaust case. The thrust reverser blocker doors were in the stowed positions and the translating cowl was shut. The starboard engine was displaced with the intake section pointing steeply up and resting on the remaining aft core section and fan cowl. The bottom of the fan cowl was crushed. The pin was not in the aft of the drag strut and the strut was laying in the engine pylon. The front pin was in place and the engine mount frame had broken near the top of the fan case. The port and starboard engine mount pins were not accessible.

The starboard fan and turbine blades were visible, and no significant gouges were seen on the fan or turbine blades and no remnants, molten debris, or other fragments were in the core exhaust case. The thrust reverser blocker doors were in the stowed positions, except where displaced by the misshapen outer cowl and impact damage.

A mechanic who claimed that he watched the aircraft landing, reported that the port thrust reverser did not open. However, at the time, he couldn't see the starboard thrust reverser.

1.3.7 FLIGHT CONTROLS CONDITION

When the Investigation Team inspected the aircraft, the following observations were made while inspecting the Flight Controls.

All flight control surfaces were found attached to the aeroplane, except for the starboard outboard leading-edge slat. The slat was found in two pieces near marks corresponding to the contact of the wing with the ground. The horizontal stabilizer and elevator were intact and appeared undamaged. The pitch trim position marked on the side of the aeroplane was slightly above mid-way between the lowest and highest marking. Inside the tail were forty-four (44) pitch trim jackscrew threads showing above the horizontal stabilizer, which was also slightly above the middle of the range of motion. All the flight controls on the port wing were intact and appeared to be undamaged. By visual observation from the ground, the flaps were about mid-range position. The inner aileron was damaged by contact with the inner flap and debris. The outer tip of the outboard right aileron was twisted by ground impact.

The starboard wing leading and trailing edge devices (flaps and slats[1]) appeared to have about the same extensions as observed from the port wing. In the starboard landing gear well, the jackscrew for the starboard inboard flap was extended forty-nine (49) threads. The drive for the actuator had pulled out of a splined connector at the angle gearbox during the accident and the supporting bracket had broken ahead of the jackscrew. The right main landing gear disrupted the inboard right flap. All the right flap track fairings ('canoes') had been damaged by the ground contact (due to impact force). The flap assemblies outboard of the inner aileron were all damaged by ground contact (due to impact force).

The starboard inboard slat between the fuselage and engine was wrinkled and crushed at the outboard end. The slat outboard of the engine was crushed into the engine and bent near the engine. The two slats outboard of that had minor damage at the ends which was mostly caused by being forced into contact with the ground.

The speed brakes were found in the stowed positions, other than where it was disrupted by the landing gear at the root of the starboard wing. The rudder was found deflected to the right, toward the lower side of the roll attitude of the aeroplane.

[1] Unless stated otherwise, the term 'flap' refers to the assembly of the trailing edge flap, vane, and flap track fairing.

1.3.8 LANDING GEARS CONDITION

When the Investigation Team inspected the aircraft, the following observations were made while inspecting the Landing Gears.

Both starboard main landing gear trunnions (upper pivots for vertical strut) had separated from their associated wing locations. The top mount for the retraction cylinder was broken and twisted aft. The starboard main landing gear was found lying on the outboard set of tyre/wheel/brake assemblies. The right nose landing gear tyre was buried to about half of its height/length. The port main landing gear had the front tyres buried and the rear tyres almost buried. The dirt was removed from around the port main landing gear to facilitate examination. A set of four tyre/wheel/brake assemblies were mounted on each main landing gear. The numbering goes across the front row and then across the rear, so that No. 3 and No. 4 were the leading tyres on the right main landing gear, while No. 7 and No. 8 were the rear tyres on the right. Each of the tyre pressures were recorded, the extensions for the unpressurised brake pins were measured, and damage was noted.

TABLE: 2 - SHOWING RECORDED TYRE PRESSURE AND DAMAGE

TYRE No. 1	TYRE No. 2	TYRE No.3	TYRE No. 4	TYRE No. 5	TYRE No. 6	TYRE No. 7	TYRE No. 8
Pressure – none Tread 0.12" Pin 0.5" The Tyre had a cross-shaped burst in the tread, exposing the inner portion.	Pressure – 180psi Tread 0.31" Pin 0.75"	Pressure – 180psi Tread 0.19" Pin 1.38"	Pressure – 180psi Tread 0.44" Pin 1.25" The inner sidewall of the Tyre had extensive damage into the fabric.	Pressure – 176psi Tread 0.31" Pin 0.75"	Pressure– 172psi Tread 0.38" Pin 0.75"	Pressure– 180psi; Tread 0.38"; Pin 0.9"; The Tyre had a gouge in the shoulder which exposed inner fabric material at least 0.5" beneath the surface.	Pressure – Inaccessible in dirt Tread 0.06" Pin 0.75"

The nose landing gear was found in the down and locked position and turned to the right limit of travel. Dirt was packed on the inside of the right wheel but not in the left. Both nose tyres were pressurised, the left one had about 0.01 inch of tread and the right one had 0.44 inch. The brake accumulator was showing a 1,500psi nitrogen pre-charge.

1.3.9 HYDRAULIC SYSTEMS CONDITION

When the Investigation Team inspected the aircraft, the following observations were made while inspecting the Hydraulic Systems.

The Fly Jamaica Airways initial 'Mandatory Occurrence Report' which was sent to the Jamaica Civil Aviation Authority, and a copy submitted to the GCAA, stated that, "ten to fifteen minutes after take-off the Flight Crew reported left hydraulic system reading zero ('0') and a Power Transfer Unit (PTU) message. The aircraft returned to GEO ([GEO] referring to SYCJ/CJIA) and on landing the aircraft overran the runway."

During the investigation, when the APU and aft tail access doors were opened, approximately one gallon of hydraulic fluid flowed to the ground. Examination found that the three Rudder Actuators (PCUs), Rudder Ratio Actuator and the surrounding areas showed no evidence of hydraulic fluid leakage. Components above the horizontal stabilizer were not extensively wet. Hydraulic hoses connected to the left side of the Hydraulic Feel Assembly were found with drips of hydraulic fluid. A structural shelf beneath the hose connections was wet with fresh fluid and awash with grime found throughout the rest of the area. The assembly data tag near the hose connections was marked:

- BAC No 65-44503;
- Serial No SHL-2620; and
- Cylinder Assy – Feel.

Minor amounts of fluid were also seen on the Autopilot Pitch Servos located near the feel assembly. The feel assembly was removed by detaching the other ends of the hoses to not disturb them at the assembly. The pitch actuators were also removed for pressure testing.

The Filter PTU Pressure Module in the port Main Landing Gear Well was marked with Vickers P/N 271N2340-2, S/N -1016A. The two switches on the PTU were P/N 211C223-521. The aft switch S/N - WO1992. The forward switch S/N was concealed by orientation. The wiring to the forward switch had a crimp splice less than an inch from the connector. The exposed three wires coming from the connector were red, blue, and yellow. The wire sleeve was marked W2416003136.

Boeing Service Bulletin SB 757-29-0056, dated February 8, 2001, related to the PTU and switches stated that:

"There have been six reported incidents of dual hydraulic system loss on the Boeing 757 aeroplane. The sequence of events in each case was the depletion of left hydraulic system fluid through a ruptured Main Landing Gear (MLG) down lock hose followed by right system overheat, due to malfunction of a PTU control pressure switch that allowed the PTU to run continuously in a no-load condition."

The aeroplane had three hydraulic systems; left, centre, and right. Samples of fluid and the filters were collected from each. The filters had pins which extend when the filters are being by-passed but none of the pins were in the by-pass position. The filters were the source of fluid samples for the left and right systems. The centre system reservoir was in a bay aft of the port main landing gear well. Each hydraulic reservoir had visual sight glasses to indicate a minimum amount of fluid and the amount of fluid covered the visual indication port. The data tag on each stated that the reservoir normal volume was 6.60 gallons (25.0 litres) with a total volume of 9.20 gallons (34.8 litres), and to service with hydraulic fluid per BMS 3-11.

The left and right hydraulic reservoirs were located at the forward walls of the respective main landing gear wells. The left and right reservoirs were both found completely empty. The left and right reservoirs had standpipes to provide fluid for reserve braking. These standpipes were found empty. Numerous hydraulic lines were broken near the upper portions of the main landing gear and the retraction mechanism. These broken lines were visibly downhill from the right hydraulic reservoir.

The hydraulic Electric Motor Pump in the Starboard Landing Gear Well was Vickers P/N 623303, S/N MX-495187. The connector and the back-shell were tight. The hydraulic valve beneath the right reservoir was in Position '2'. The valve over the right filter was in Position '1'.

1.4 OTHER DAMAGE

The aircraft came to rest in an area that was part of the construction zone for the runway extension. This area was not sealed. This area was 'ploughed up' during the excursion, and gouge marks more than one foot deep were observed in the area. A displaced threshold runway end light was damaged. A concrete block that served to hold the Runway Closed Marking in place was crushed.

1.5 PERSONNEL INFORMATION

1.5.1 CAPTAIN – PILOT-IN-COMMAND

Gender	-	**MALE**
Date of Birth - Age	-	**12TH DECEMBER 1960 – 58YRS**
Nationality	-	**JAMAICAN**
Licence	-	**US FAA ATP #: 2357780**
Date of Issue	-	**16TH OCTOBER 2016**
Date of Last Medical	-	**7TH OCTOBER 2018**
Medical Valid Until	-	**30TH OCTOBER 2019**
Aircraft Type Ratings	-	**A300; A320; A340; B757 AND B767**
Last IPC Valid	-	**1ST NOVEMBER 2019**
Total Hours	-	**11,755.36**
Total Hours on Type	-	**UNKNOWN**
Hours in Last 90 Days	-	**50.14**
Hours in Last 30 Days	-	**44.34**
Hours in Last 7 Days	-	**9.100**
Hours in Last 24 Hours	-	**1**

Captain's Class 1 Medical had a limitation that required him to 'have available glasses for near vision'.

1.5.2 FIRST OFFICER – PILOT SECOND-IN-COMMAND

Gender	-	**MALE**
Date of Birth - Age	-	**28TH OCTOBER 1985 – 33YRS**
Nationality	-	**JAMAICAN**
Licence	-	**US FAA ATP #: 3043353**
Date of Last Medical	-	**11TH JUNE 2017**
Medical Valid Until	-	**30TH JUNE 2018**

Aircraft Type Ratings	-	**B757 AND B767**
Last IPC Valid	-	**AUGUST 2018**
Last Line Check	-	**FEBRUARY 2018**
Total Hours	-	**4,331**
Total Hours on Type	-	**317.09**
Hours in Last 90 Days	-	**97.09**
Hours in Last 30 Days	-	**41.06**
Hours in Last 7 Days	-	**13**
Hours in Last 24 Hours	-	**1**

There was no limitation on the First Officer's Class 1 Medical.

1.5.3 Flight Crew INTERVIEWS

Both Flight Crew were employees of Fly Jamaica Airways and were appropriately qualified. Records provided by the JCAA indicated that both Flight Crew had satisfactorily completed all required company training and checks. This included, ground school, simulator and flight training. Regularly scheduled Proficiency Checks are a standard requirement for all Flight Crew. Records indicated that the flight and duty times for both Flight Crew were within acceptable limits. Both Flight Crew considered that their rest prior to the accident flight was adequate.

The Captain had twenty-five years of experience prior to joining Fly Jamaica Airways in 2018. The First Officer joined the company in January 2017. Both Pilots had previously conducted flights into SYCJ together.

The accident report provided by both Flight Crew stated that approximately ten minutes after take-off, they noted a low quantity level alert in the left hydraulic system. They completed the appropriate checklists, and a decision was made to return to SYCJ. Thereafter, an overheat condition was indicated for one of the right hydraulic pumps (Electric Motor Pumps). The checklist for this condition was completed. The aircraft landed on RWY06 at SYCJ and during the landing, the aircraft overran the runway and came to rest on the eastern side of the unusable portion of the runway. Both Flight Crew stated that they have no information as to what may have caused the problem, but both indicated that they were prepared to fully cooperate with the investigation. During the emergency, the Captain was the flying pilot.

From the Cockpit Voice Recorder (CVR) it was determined that the required checklists were followed. The Captain provided guidance to the First Officer about calculating the landing distance required given the estimated landing weight, existing weather conditions and landing speed. These calculations showed that the landing distance available at SYCJ was adequate for the aircraft to land there. Thus, all expectations were for a normal landing, it was only on landing that the Flight Crew realised that no brakes, no thrust reversers, no rudder, and no nose wheel steering were available. ***"The Captain stated that at this point he felt like a passenger on the aircraft, as he had no control."*** At this time, approximately one minute after touching down and half minute before the aircraft came to a stop, the Captain shouted the emergency commands "**BRACE, BRACE, BRACE**". The Cabin Crew responded about three seconds later and called "**EMERGENCY, EMERGENCY, STAY DOWN, STAY SEATED**". The engines were shut down approximately forty-five seconds after touch down. This information was obtained from the CVR readout.

Both Flight Crew later stated that they did not think that there was anything else that they could have done differently in the situation. The Captain stated that anything else would have been outside the purview of the checklist and during the event it was not the time to consider making up stuff, so they followed the checklist.

With the realisation that due to the failure of the left hydraulic system, there was no left reverse thrust and no auto brakes, thus, the Captain briefed for the use of maximum manual brakes. With the right Electric Motor Pump overheat they configured the aircraft for landing by lowering the flaps. The use of the flap handle showed up as 'Disagree' which resulted in them using the alternate system.

At this time, they did not go to the status page. This was confirmed by the CVR readout. The aircraft was then configured for the landing, at which time, the Captain had noted that it would be a fast landing at a speed of approximately 158kts. With the expectation that right reverse thrust along with normal braking would be available. However, as revealed from the FDR readout, the right hydraulic system failed on touch down. It was only at this crucial time that the Flight Crew realised that no right reverse thrust, and no brakes were available. The Captain stated that within the time frame, from touch down to the time the aircraft stopped, there was not much time to think about anything. The Captain stated that at this point, he was most probably looking outside the aircraft and may not have seen the indication that accumulator braking may have been available, but he recalled that there was good braking immediately after landing. The First Officer recalled seeing the indication and reached over to activate the switch, but perhaps this was done too late for it to be effective.

The Flight Crew said that there was a pre-flight check of all lights, but this was a maintenance check. They did not recall if the brake source light did show up during this check.

1.5.4 CABIN CREW INTERVIEWS

The Cabin Crew consisted of five females and one male with experience on the job ranging from thirty-two years to seven months. The male Cabin Crew was not available for interview. Records show that all Cabin Crew were trained and qualified for their assigned duties on the aircraft.

Individual Cabin Crew described their location in the aircraft prior to and during the accident. Prior to take off they described a delay before departure due to a non-functioning slide light at door No.1 Left (L1 door). This was rectified by ground maintenance and a normal take off was executed. Twenty-one minutes after taking off the Purser was advised by the Captain that the flight was returning to SYCJ due to hydraulics issues. She shared this information with the other Cabin Crew and the cabin was prepared for a normal landing. At this time, the inflight service had not begun, so the cabin was still tidy. The Captain addressed the passengers advising of the plan to return to SYCJ. The passenger briefing for normal landing was done.

The landing seemed to be normal. The aircraft slowed initially, but then started speeding down the runway. As the aircraft continued down the runway, the roll became bumpy. There was a loud bang and then the aircraft veered off the runway and came to a stop. Just before the aircraft came to a stop, the Captain's shout of "**BRACE, BRACE, BRACE**" were recorded on the CVR. These were followed by the emergency commands shouted by the Cabin Crew which were also recorded on the CVR. When the aircraft came to a stop, the Captain's command to evacuate was heard from the cockpit.

The Cabin Crew reported that they were shocked and nervous following the landing and some of them were affected by smoke in the cabin, but they still managed to perform their duties. They also reported that at most, the passengers were calm, this may have been from shock, but they willingly followed instructions. One Cabin Crew reported that she had one 'lift-off' passenger, eleven wheelchair passengers and two children in her section but did not have to assist anyone off the aircraft. They felt that the evacuation was done within the required time. The Fire Service responded and assisted with the evacuation procedure.

1.5.5 AIR TRAFFIC SERVICES (ATS)

The Air Navigation Services Directorate (ANSD) of the GCAA is responsible for, among other things, the provision of Air Traffic Services. This includes Air Traffic Control, Flight Information, and Alerting Services. These services are provided from facilities located at the CJIA Control Tower Complex. At the time of the occurrence, FJA256 was under the control of the Aerodrome and Approach Control Service and the Georgetown Area Control Centre (ACC). All ATC facilities at the ANSD were adequately staffed at the time of the occurrence. Communications between the various facilities were adequate.

The flight departed the SYCJ, at 06:10 hours on 9th November 2019 for CYYZ, Toronto. At 06:21 FJA256 informed the ACC that it wished to stop climbing at Flight Level 200 and that it would have to return to the SYCJ since it had experienced a loss of one of its hydraulic systems. At this time, the aircraft was seventy-five nautical miles northwest of the Airport. ATC issued clearance to return to the Airport following which a left turn was made direct to position AKSIN to align for the approach and landing on RWY06 at the SYCJ.

ATC enquired whether the Aerodrome Rescue and Fire Fighting Service (ARFFS) was needed. The Captain advised that he was not declaring an emergency but had no objection to the local emergency being activated. ATC alerted the ARFFS to be on standby. The aircraft entered the 'holding position' and was configured for landing. During this time ATC activated its standard operating procedures. The ARFFS was briefed about the situation and was instructed to proceed to its standby position. Initial attempts to contact the ARFFS were hampered by a communication failure between ATC and the ARFFS. ***(It was noted that similar failures had been logged in previous Facility Daily Log Sheets.)*** While the aircraft was on final, the Air Traffic Controller requested certain information from the Flight Crew.

Note: From the CVR readout, it was discerned that the Flight Crew were trying to resolve issues to bring the aircraft down safely and would have preferred not to be interrupted during that time.

From the ATC recordings provided, the next transmission from the aircraft was "**Overrun, Overrun, Greenheart 256**!!" The Air Traffic Controller observed the aircraft veering to the right and exiting the runway. The Air Traffic Controller also said that two (2) 'thumps' were heard. The ARFFS was then instructed by ATC to proceed directly to the aircraft. The ACC Supervisor and the Airport Duty Officer were advised of the situation by the Air Traffic Controller.

According to the information and material provided, the aircraft landed at 06:53 and came to a stop beyond the end of the usable portion of the runway and perpendicular to it. No major injuries nor loss of lives were reported at the time. ***(One passenger who was reportedly suffering from some chronic illnesses subsequently died five days after the occurrence.)***

The aircraft sustained major damages to the starboard engine, starboard wing, and starboard main landing gear. The Air Traffic Controllers in the SYCJ/CJIA Control Tower and the ACC worked together to notify relevant persons and agencies.

It was reported that the '**emergency radio**', located in the Flight Information Centre (FIC), which was intended to enable quick and easy communication with the Airport, Force Control, Georgetown Public Hospital Corporation, Guyana Defence Force Air Corps, and the ARFFS, was malfunctioning. The investigators were informed that this radio was the only means by which ATC contacts the Airport Duty Officer. ***(This situation obtained for some period prior to the FJA 256 accident and remained unresolved up to the time of the occurrence.)*** There was some uncertainty as to who **'owned'** the radio, which resulted in conflicting statements regarding who was responsible for the maintenance of the radio.

The following persons and agencies were notified by Air Traffic Services (ATS):

(a) The ARFFS (CJIA);

(b) The Airport Duty Officer (CJIA);

(c) Georgetown Public Hospital Corporation (Ministry of Health);

(d) Senior Air Traffic Control Officer – Operations (GCAA);

(e) Director Air Navigation Services (GCAA);

(f) Manager Air Traffic Services (GCAA);

(g) Director General Civil Aviation (GCAA); and

(h) Director Aviation Safety Regulation (GCAA).

It was reported that when the Georgetown Public Hospital Corporation was called via the telephone, the person who answered seemed to be unaware of the role of that agency in an emergency of this nature. It was also reported that attempts to establish telephone contact with the Diamond Diagnostic Centre proved to be an exercise in futility.

The Air Traffic Controller in the CJIA Control Tower indicated that the aircraft executed what appeared to be a normal landing, touching down in line with the VOR, everything appeared normal at this point, but then the aircraft appeared to be moving faster than usual and then exited the runway.

The initial follow-up action taken by ATS:

(a) The Air Traffic Controller in the CJIA Control Tower was relieved from her position.

(b) Adjacent ATC Centres were notified via voice link that the CJIA was closed due to a disabled aircraft on the runway.

(c) At 08:13 UTC, NOTAM (A0091) was disseminated closing the CJIA to aircraft operations due to the position of the disabled aircraft.

(d) At 09:30 UTC, adjacent ATC Centres were informed that the CJIA was reopened with restrictions: Landings were restricted to RWY06, and departures were restricted to RWY24.

(e) At 12:51 UTC, NOTAM, A0091, was cancelled following a preliminary assessment of the situation regarding the position of the aircraft and how much of an obstacle it was in its present position.

(f) At 13:38 UTC, another NOTAM- A0093, was disseminated indicating the reopening of the CJIA to aircraft operations with restrictions. It advised that the disabled aircraft was approximately, three hundred and eighty-five meters, northeast of RWY24's Threshold, at a height of thirty feet above the Threshold.

1.6 AIRCRAFT INFORMATION

1.6.1 GENERAL

The paperwork for the aircraft was as follows:

(a) Technical log for dispatch of flight - 43,420:13 hours and 13,367 cycles.

(b) Line Number – 895.

(c) Type Certificate Number - A2NM.

(d) Production Certificate Number – 700.

(e) The date for first flight - October 7, 1999.

(f) The owner - Wings Aviation, 28 Old Rudnick Lane, Dover, DE 19901-4912.

Other Information:

Manufacturer	-	**BOEING AIRCRAFT COMPANY**
Year of Manufacture	-	**1999**
Aircraft Model Number	-	**757-23N**
Aircraft Serial Number	-	**30233**
Certificate of Registration	-	**FAA ISSUED – 11TH SEPTEMBER 2011, EXPIRING – 30TH SEPTEMBER 2020**
Certificate of Airworthiness	-	**ISSUED - 24TH NOVEMBER 2011**
Total Airframe Hours	-	**43,420:13HRS**
Maximum Take-off Weight	-	**113,852KGS (251,000LBS)**
Last Scheduled Inspection	-	**750 FH**
Time since last Inspection	-	**548:57HRS**
Next Inspection Due	-	**43,621:16HRS**
Port Engine Model	-	**ROLLS ROYCE RB 211-535E4**
Starboard Engine Model	-	**ROLLS ROYCE RB 211-535E4**
Fuel Type	-	**JET A1**

1.6.2 MAINTENANCE

1.6.2.1 RECORDS

Maintenance records examined by the accident investigation team indicated that there were no significant maintenance issues recorded in the aircraft Technical Log. ***(Note: Not all maintenance records of the aircraft were requested, only those deemed relevant were requested and examined.)*** The records examined indicated that all required and scheduled maintenance had been performed, and that all Airworthiness Directives had been complied with. All major repairs and alterations were documented, as necessary. No maintenance discrepancies were noted prior to the accident flight. The only maintenance item, other than checks, was for one of the three inertial reference systems, and on 6th November 2018, this had been deferred in accordance with the approved Minimum Equipment List for future resolution. The aeroplane's initial departure was delayed for twenty-one minutes due to a faulty slide light in the L1 door, this was rectified by ground maintenance and the aircraft was cleared for departure.

Interviews were held with the maintenance staff based in Guyana. Staffs interviewed appeared to be quite knowledgeable and showed a good understanding of the aircraft systems. They all considered that they had a good working relationship with each other and with their immediate supervisor who was based in Jamaica. The lead mechanic confirmed that a light check was done as part of the pre-take-off checks and all lights were working including the brakes source lights.

1.6.2.2 EXAMINATION OF AIRCRAFT PARTS BY MOOG UNDER THE SUPERVISION OF THE NTSB

After the accident, and to facilitate the investigation, three Autopilot Servos and an Elevator Feel Cylinder were removed from the aircraft and sent to MOOG Inc in East New York, USA, for examination under supervision of the NTSB.

THE AUTOPILOT SERVOS TEST

The three Autopilot Servos were identified as:

1. ***Autopilot Servo removed from Position – M271***

Moog Part Number	-	163100-107
Serial Number	-	2814
Year of Manufacture	-	1999

2. ***Autopilot Servo removed from Position – M272***

Moog Part Number	-	163100-107
Boeing Part Number	-	S25IN212-6
Serial Number	-	2944
Year of Manufacture	-	2000

3. ***Autopilot Servo removed from Position – M273***

Moog Part Number	-	163100-107
Boeing Part Number	-	S25IN212-6
Serial Number	-	2812
Year of Manufacture	-	1999

The three Autopilot Servos – Serial Numbers: 2812, 2814 and 2944 were examined using the Moog Component Maintenance Manual for the Autopilot Servo Revision 14 dated October 9, 2013, Chapter 22-12-02. The Servos were mounted onto the Moog 757 Hydraulic Test Stand and electric and hydraulic power were connected. For Serial Numbers: 2812 and 2944, the hydraulic connections to the servos were made using the attachment fittings as received on the units.

For Servo Serial Number: 2814, originally, the received attachment fittings were removed and later re-attached. Hydraulic pressure was then applied to each servo, from zero ('0') to 3,000psi in 500psi increments, allowing each unit to stabilize between each increment. After reaching a supply pressure of 3,000psi, the pressure was then increased to the manufacturer proof pressure of 4,500psi. Finally, the hydraulic back pressure of 1,500psi was applied to the return port of the unit. For each unit, no significant hydraulic leakage was noted with either the received fittings attached or removed.

For Servo Serial Number: 2944, a small leak was noted at the Moog attachment fitting to the Boeing NAS1762 elbow fitting on the return port during the back-pressure test, no leakage was noted during the normal operating condition tests.

Following the tests, the Boeing NAS1762 elbow fitting on the return port on each of the three servos were removed for dimensional checks. The fittings were submitted to Moog Material and Process Engineering Laboratory. The results were satisfactory.

THE ELEVATOR FEEL CYLINDER LEAKAGE TEST

Elevator Feel Assembly Cylinder:

Boeing Assembly Part Number	-	S25IN212-6
Serial Number	-	SHL-2620

The elevator feel cylinder was received with four attached flexible hydraulic hoses. The cylinder and the four attached hoses were attached to the Moog Large Body Test Stand. In a manner like the autopilot servo valves, hydraulic pressure was applied to each side of the cylinder – Supply '1' and Supply '2'. The pressure was increased to 2,100psi (the unit's operating pressure) and the cylinder's actuation arm cycled on either side. The previous day, with the cylinder attached to the Moog Utility Bench, the hydraulic pressure was increased to 3,000psi. In all cases neither the cylinder nor any of the attached hoses exhibited significant leaking.

POWER TRANSFER UNIT (PTU) PRESSURE MODULE FILTER

The Power Transfer Unit Pressure Module Filter was shipped from Moog Aircraft Group Facility and examined at the Boeing Equipment Quality Analysis (EQA) Laboratory in Seattle, Washington. The component was identified as:

Power Transfer Unit Pressure Module Filter:

Part Number	-	271N2040-2
Serial Number	-	1016A

A failed solenoid was identified by the testing. The failed solenoid was to be Computed Tomography (CT) scanned on 2/5/2020 by EQA.

DETAILS OF INVESTIGATION

GENERAL:

The component had been shipped from Moog Aircraft Group facility in East Aurora, New York to the Boeing EQA Laboratory in Seattle, Washington and placed into secured storage, pending arrival of the group. The component was removed from storage, the container opened, and the component removed and laid out for documentation and initial examination. Observations from the packaging and shipment:

- No damage to packaging.
- Images captured of all sides.
- PTU filter encased in foam.

EXTERNAL VISUAL EXAMINATION

The following observations were noted during the external visual examination of the component:

- No FME Caps noted on the inlet or outlet ports.
- Module Part Number: 271N2040–2, Serial Number: 1016A (Pre-Boeing Service Bulletin 757-29-0057, Dated February 8, 2001).
- Check Valve Part Number: 2790523-101, Serial Number: 13573.
- Outlet (indication) pressure switch (solenoid) - Part Number: 211C223-521, Serial Number: V01263.

- Date of Manufacturer (DOM) 97-03.
- Inlet (Control) Pressure Switch (Solenoid) - Part Number: 211C223-521, Serial Number: W01992, DOM 98-03.
- No suffix 'A' nor 'C' noted after the serial number (Pre-Eaton Service Bulletins 29-09-05-01, Dated January 15, 1999, and 29-09-05-01, Dated April 15, 2010).
- Inlet side mate with electrical connector (control solenoid) was cracked.
- Some minor circumferential cracks on the outer insulation material on the inlet side wiring harness (white sleeving/jacket).
- All lock wires appeared to be present and unremarkable.
- Solder sleeves appeared unremarkable with no evidence of discoloration or damage on both harnesses.
- No evidence of excessive fluid, or FOD at the rear connector grommet or the wire entry of both connectors.
- Multiple observations were done and noted on the control side electrical connector:
    - Cracked threaded connector nut.
    - Material present in crack valley.
    - Fluid and material present on the external switch body.
    - Control Solenoid body was gouged near the electrical connector.

MATERIAL SAMPLING FOR CHEMICAL ANALYSIS

Boeing Research and Technology (BRT) personnel were requested to take samples of material found on the fractured connector and outer external switch body. The following samples were taken:

- Sample 1 – Fluid at the base of the inlet port.
- Sample 2 – Material at the base of the inlet port.
- Sample 3 – Fluid at the base of the outlet port.
- Sample 4 – Material at the base of the outlet port.
- Sample 5 – Fluid present on the inlet fitting.
- Sample 6 - Material on the inlet switch body at the port end.
- Sample 7 – Material on the inlet switch body middle section.

- Sample 8 – Material present in the fracture valley on the inlet electrical connector.

COMPONENT MAINTENANCE MANUAL TEST AND DISASSEMBLY

The Boeing Component Maintenance Manual (CMM) Chapter 29-11-37 and 29-09-05 checks and inspections were accomplished on the PTU Filter Module and pressure switches, respectively. The component was connected to the Boeing EQA Laboratory Hydraulic Test Bench for the test. The results of the testing were as noted:

- Initial state of both switches (unpressurised) -
    - Inlet – Pins 2-3 closed (0.11 Ohms); and
    - Outlet – Pins 2-3 closed (0.1 Ohms) and pins 2-1 open.
- Performed step 7 in CMM 29-11-37 -
    - Two (2) meters connected to NO (normally open) and NC (normally closed) outlet (indication solenoid) switch contacts.
    - Switch actuated at 373psi.
    - Switch de-actuated at 200psi.
    - Switch re-actuated at 375psi.
    - Switch de-actuated at 216psi.
- One (1) meter connected to NC inlet (control solenoid) switch contacts:
    - Did not switch throughout the test (approx. 600K Ohms from pins 2-3).
    - Remained in the same condition throughout the test (approx. 600K Ohms).
    - Further analysis to isolate the fault.
- Removed electrical harness control solenoid:
    - Fluid present on the interfacial seal (yellow).
    - Pin 2-3 800k ohm (sb closed).
    - Pin 1-2 0.2 ohm (sb open).
    - No electrical anomalies were noted in the wire harness as continuity checks were performed.

- Disconnected electrical harness indication solenoid:
  - Fluid present on the interfacial seal (yellow).
  - No electrical anomalies were noted in the wire harness as continuity checks were performed.
- Removed both solenoids from the filter module:
  - No anomalies noted on the solenoids themselves.
  - Visual inspection of the internal cavities of the filter module showed no signs of debris.

1.6.2.3 EXAMINATION OF AIRCRAFT PARTS BY EATON UNDER THE SUPERVISION OF THE NTSB

After the accident, three Hydraulic Components were removed from the aircraft and sent to Eaton Fuel and Motion Control Systems (formerly Vickers) facility in Jackson, Mississippi, USA for examination under supervision of the NTSB.

HYDRAULIC COMPONENTS EXAMINATION FIELD NOTES

SUMMARY:

The group met virtually between January and December 2021, at the Eaton Fuel and Motion Control Systems facility in Jackson, Mississippi for the examination and disassembly of the following components:

1. ***Electric Motor Pump (EMP) - RH Position***

Part Number	-	623303
Serial Number	-	MX-495187
Modification Status	-	A-J Indicated

2. ***Power Transfer Unit (PTU)***

Part Number	-	MPHF3-1608D
Serial Number	-	MX-616453

3. Engine Driven Pump (EDP) - RH position

Part Number	-	350880-6
Serial Number	-	MX-531791
Modification Status	-	M-Y, AA-AE, AG Indicated

DETAILS OF INVESTIGATION

VISUAL EXAMINATION OF COMPONENTS

Prior to the start of the virtual examination, Eaton personnel removed the shipping container from storage, the container opened, and the components laid out for documentation and initial examination. The units were opened by Eaton personnel under FAA witness.

During the initial examination, the visual inspection determined that the Alternating Current (AC) variable displacement Electric Motor Pump (EMP) and the Power Transfer Unit were received without protective caps on the hydraulic ports; only the Engine Driven Pump (EDP) had its hydraulic ports covered by protective caps. Eaton personnel indicated that the unit had been preserved well.

Eaton policy is not to connect any hydraulic component received to test without proper hydraulic caps, to prevent debris or other contaminants from being introduced into the Easton's hydraulic supply system. Therefore, the EMP and Power Transfer Unit were ***only examined visually***.

Visual Examination of Right-Hand Electric (AC) Variable Displacement Electric Motor Pump (EMP)

The EMP was removed from its shipping container and visually examined. No evidence of physical damage was noted, and the unit appeared to be in a functional state. No indication of overheat was noted.

Visual Examination of Power Transfer Unit (PTU)

The PTU was removed from its shipping container and visually examined. No evidence of physical damage was noted, and the unit appeared to be in functional state. No indication of overheat was noted on the unit.

Visual and Initial Examination of the Engine Driven Pump (EDP)

The EDP was removed from its shipping container and visually examined. No evidence of physical damage was noted; the unit appeared to be in a functional state. The EDP was photographed to document its condition. The EDP's hydraulic ports were sealed with plugs. Eaton removed the hydraulic plugs and drained the fluid contents.

Eaton was able to collect hydraulic fluid from the Outlet (high pressure) Port but not enough to quantify the contamination level. However, the Eaton Materials Laboratory did a Visual Microscopic Analysis of the available sample and determined that the fluid was sufficiently uncontaminated so that a functional bench test could be performed on the unit. Abnormal visual findings included that the solenoid was loose and the lockwire was not intact; additionally, the lockwire method was poor and was not to the standards of an Eaton lockwire operation.

Examination of Right-Hand Engine Driven Pump (EDP) Acceptance Test Protocol and Further Examination

The EDP was connected to an Eaton hydraulic test bench for further functional testing. As part of the Eaton Acceptance Test Protocol (ATP), a proof pressure test was accomplished on the unit; the test applies hydraulic fluid at set pressures to measure the amount of unit leakage.

During the proof pressure test, there was no external leakage observed coming from the EDP and no external leakage observed at the loose solenoid interface. Because of the loose solenoid no further testing was performed. The solenoid was removed to determine if there was erosion of the solenoid O-Ring. The O-Ring was not pristine and did have some indications of wear. No source of a hydraulic leak was determined. No further examination was conducted.

1.6.3 MASS AND BALANCE

The aircraft approved maximum take-off weight was 251,000lbs (113,852kgs.) The Flight Manifest indicated that FJA256 departed with a weight of was 105,000kgs. The manifested take-off weight was therefore satisfactory. Centre of Gravity was within limits and Mass and Balance were determined to be satisfactory.

1.7 METEOROLOGICAL INFORMATION

The National Weather Watch Centre with responsibility for the Georgetown FIR is located at Hyde Park, Timehri, East Bank Demerara, Guyana, in close proximity to the CJIA. The Centre makes use of a wide range of products to determine the need for the issuance of the various warnings used to inform the aviation community of the presence of weather-related hazards. At the time of the emergency landing, the conditions at CJIA and in the FIR did not warrant the issuance of any such warnings. Below are a few meteorological products from just before the time of the accident to just after the accident.

SATELLITE IMAGE

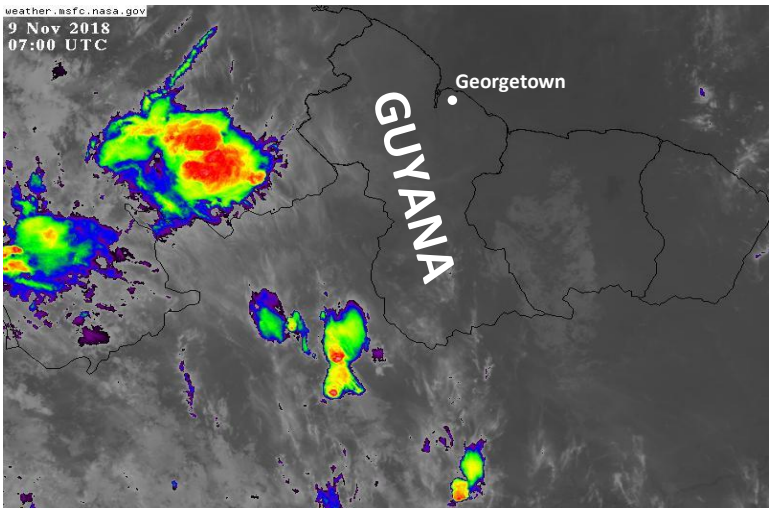


Figure 1: Infrared satellite image valid at 07:00 UTC 9th November 2018

This infrared satellite image valid 07:00 UTC 9th November 2018 indicated that there were no convective clouds within the Georgetown FIR at the time of the emergency landing, thus there was no need for the issuance of a convective SIGMET message in the Georgetown FIR.

RADAR IMAGE

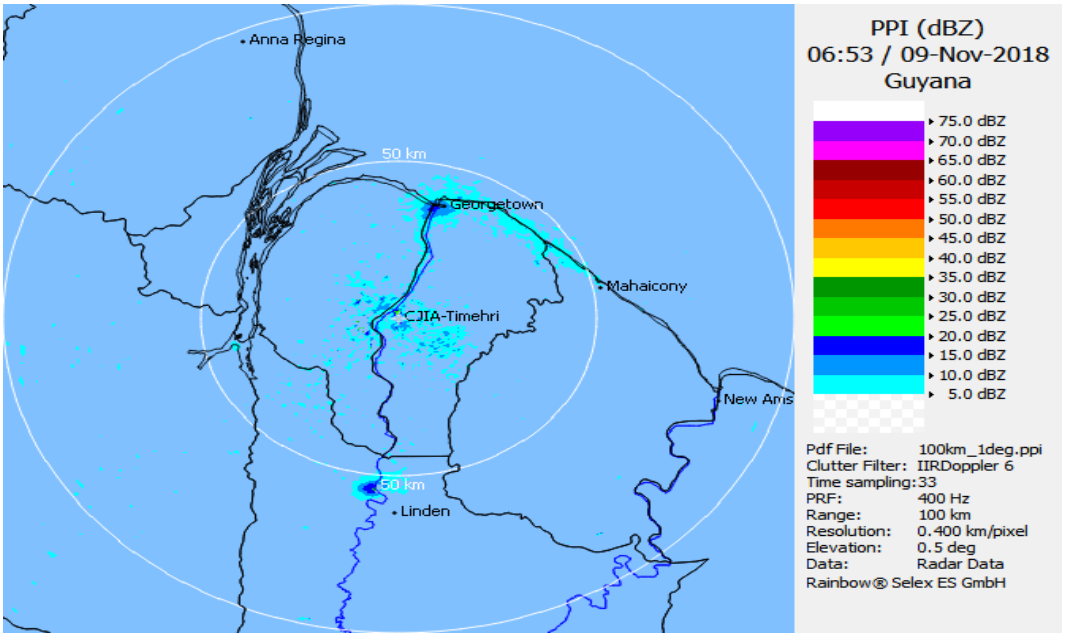


Figure 2: Radar generated Plan Position Indicator (PPI) Scan valid 06:53 UTC 9th November 2018.

The PPI image valid 06:53 UTC 9th November 2018 shows no meteorological target within a 100 Km radius of the CJIA.

ROSHEAR

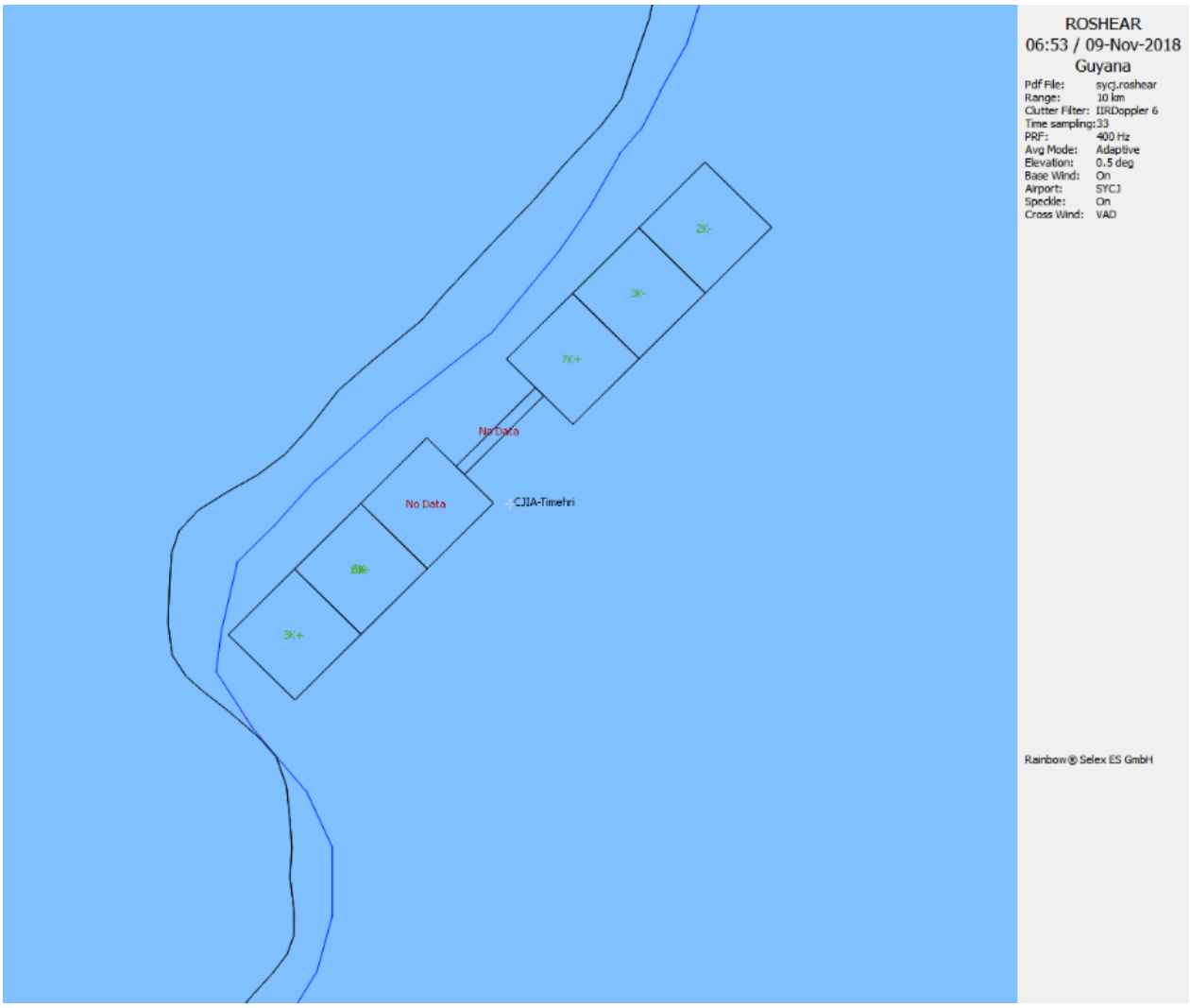


Figure 3: Radar generated Runway Oriented Shear (ROSHEAR) product valid 06:53 UTC 9th November 2018.

The ROSHEAR product showed Loss and Gain less than 10kt along the 3º path towards and RWY06 and RWY24. This data shows that there was no need for the issuance of a wind shear warning at the time of this scan. Similar scans before the emergency landing also show that the wind shear along the glide path of 3º, was not significant and hence did not warrant the issuance of a wind shear warning.

GUST FRONT

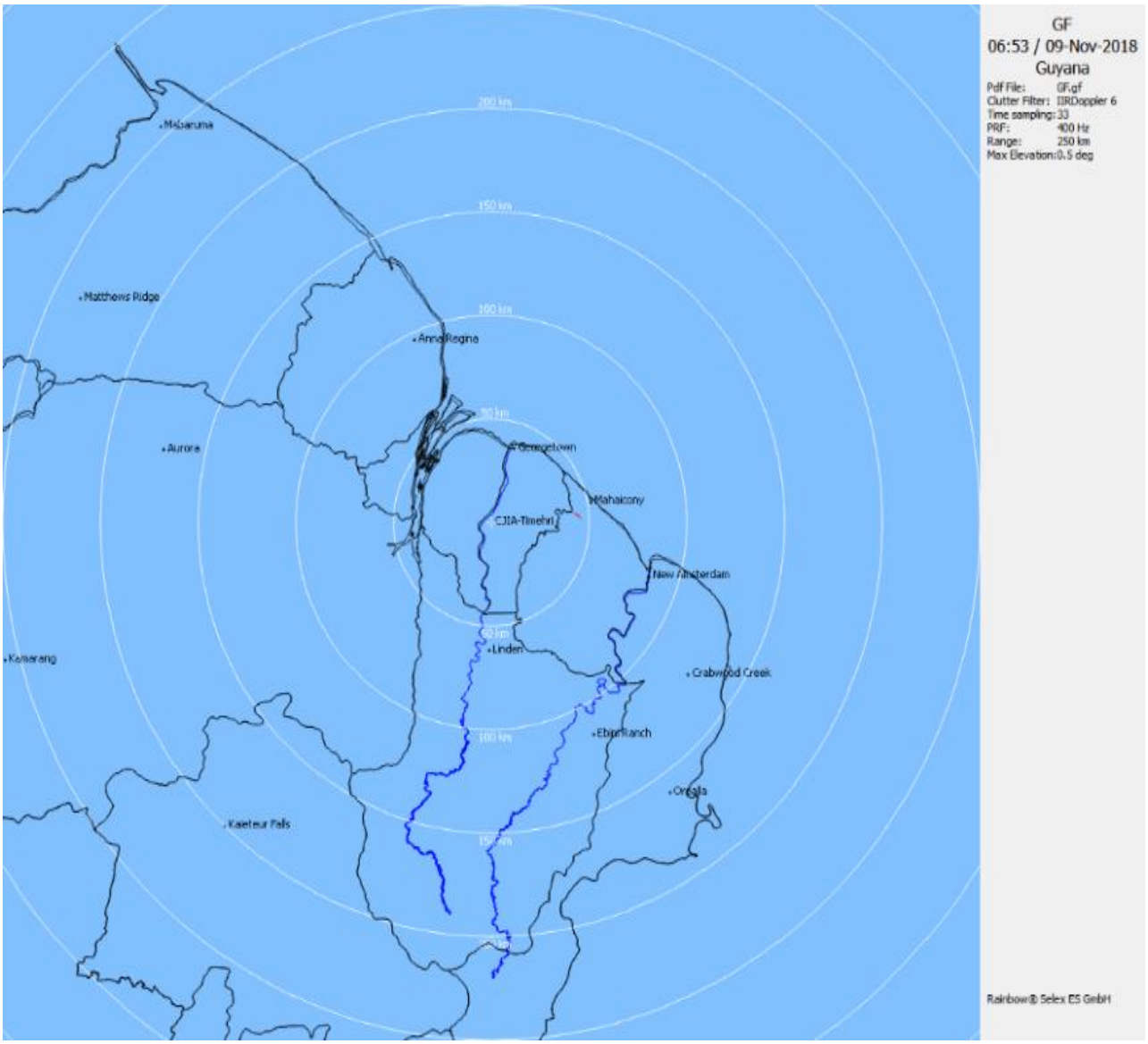
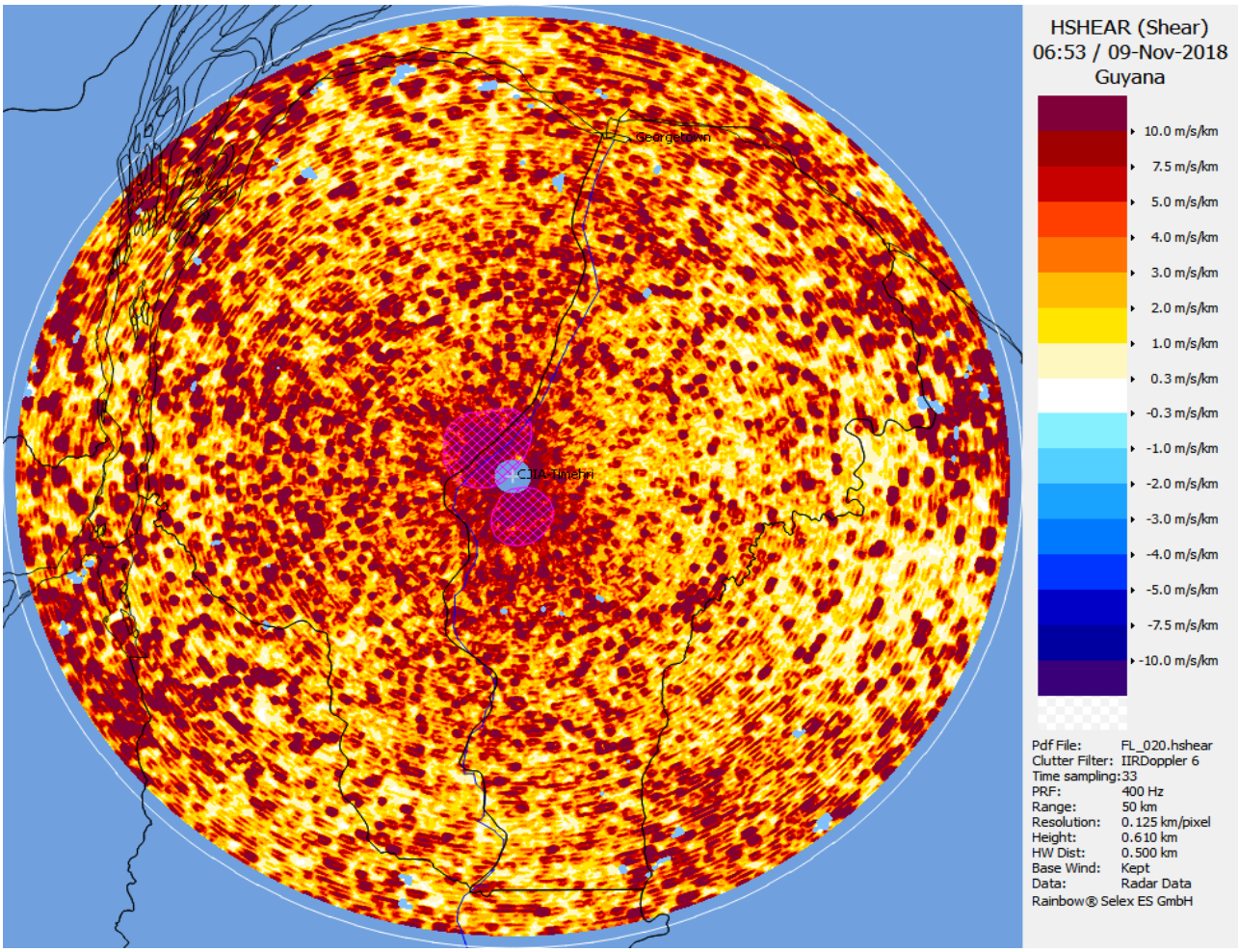


Figure 4: Radar generated Gust Front (GF) product valid 06:53 UTC 9th November 2018.

The Gust Front product showed no gust fronts at or near the aerodrome. The nearest and only gust front in the image is located 080º to the aerodrome and between 40Km and 50Km of same. In addition to this product, the METARs, PPI scan and Satellite image showed that there was no need for an aerodrome warning at the time of the emergency landing of the aircraft.

HORIZONTAL SHEAR



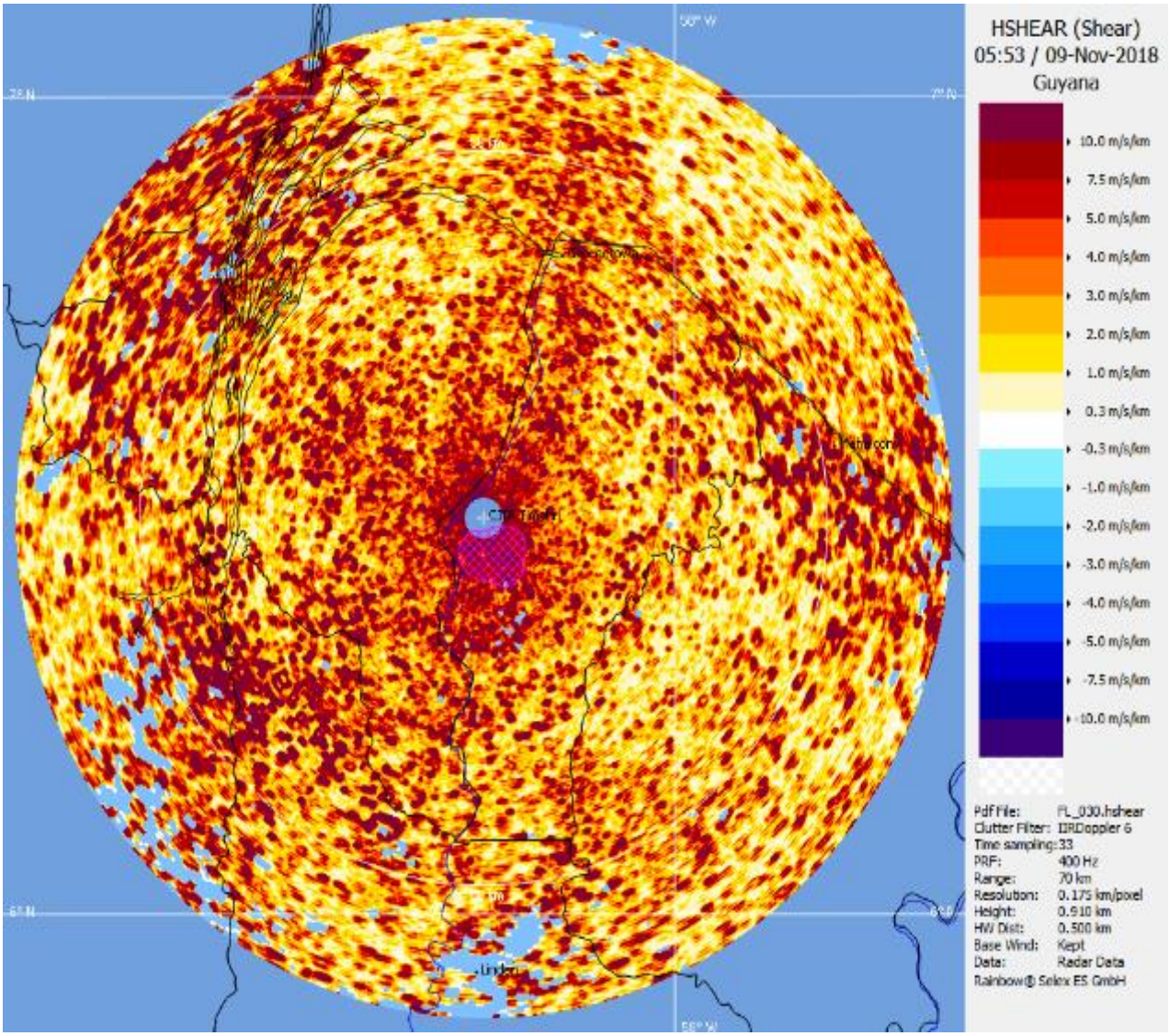


Figure 5: Radar generated Horizontal Shear (H-Shear) products valid 06:53 UTC 9th November 2018. A) FL020 and B) FL030.

The H-Shear product can be used to detect areas of shear at the different flight levels. This information is then used to infer areas with significant turbulence. According to the images in Figure 5, at the FL020 and FL030 horizontal wind shear was not significant within a 100km radius of the CJIA. Due to the lack of significant wind shear no AIRMETs were issued.

Meteorological Conditions reported at the time of the Emergency Landing:

METARs for SYCJ:

- SYCJ 090500Z VRB02KT CAVOK 23/22 Q1010 NOSIG.
- SYCJ 090600Z VRB02KT CAVOK 23/22 Q1010 NOSIG.
- SYCJ 090700Z VRB02KT CAVOK 23/22 Q1010 NOSIG.
- SYCJ 090800Z VRB02KT CAVOK 23/22 Q1009 NOSIG.

The meteorological reports for the CJIA are issued by the Aeronautical Meteorological Station which is located at the National Weather Watch Centre Hyde Park, Timehri, East Bank Demerara, Guyana. For both the 06:00 UTC and 07:00 UTC reports, the wind speed at the CJIA was reported as 2kts. As required for winds below 3kts, the wind direction was reported as variable. This was done in accordance with APP 4.1.5.2 (b) (2) of Annex III. In both messages, the next code used is Ceiling and Visibility Okay (CAVOK).

This code was used because of the conditions at the times of observation and in accordance with APP 2.2. Temperature and dewpoint at the aerodrome were coded as 23 ºC and 22 ºC, respectively, for both the 06:00 UTC and 07:00 UTC observations. These values of temperature and dewpoint give a Relative Humidity (RH) of about 97%.

Terminal Aerodrome Forecast (TAF) for the SYCJ:

TAF SYCJ 090500Z 0906/1006 VRB02KT 4000 BR FEW012 SCT038 BECMG 0911/0913 07012KT 9999 BKN020 PROB30 TEMPO 0915/0918 6000 SHRA FEW016CB BKN018***.***

At the time of the emergency landing the TAF that was valid was the 0906/1006 TAF. According to this TAF, between 090600UTC and 091100 UTC winds were expected to be 2kts. The same requirements apply to the direction as in the METAR. Visibility was expected to be about 4km due to the presence of mist in the aerodrome. Between 1 – 2 octaves of clouds with base at 1,200ft and 3 – 4 octaves of clouds with base at 3,800ft.

1.8 AIDS TO NAVIGATION

1.8.1 INSTRUMENT APPROACHES AT CJIA

CJIA is served by four instrument approaches, namely:

- CJIA VOR RWY06 (045/180 PT);
- CJIA VOR RWY06 (BASE TURN);
- CHEDDI JAGAN INTERNATIONAL RNAV (GPS) RWY06; and
- CHEDDI JAGAN INTERNATIONAL RNAV (GPS) RWY24.

All approaches were designed in accordance with ICAO Document 8168 – Procedures for Air Navigation Services. The instrument approach charts are published in the Guyana AIP.

1.8.2 SYCJ (CJIA) RNAV RWY06 APPROACH

For the return to land at SYCJ, the Captain opted to use the RNAV GPS Approach RWY06. This procedure aligns the aircraft on the extended centreline of RWY06 at position AKSIN, 11.2 nautical miles from the threshold at an altitude of 3,000ft AMSL. The aircraft will continue the approach to cross the Final Approach Fix at position OLVIK, located 5.2 nautical miles from the threshold, at 1,800ft. Thereafter, the aircraft will make a continuous descent on a 3º slope to a Minimum Decision Altitude of 380ft AMSL. After this, the approach and landing are completed by visual reference to the ground. If visual reference is not acquired when the aircraft reaches 380ft AMSL a missed approach procedure is carried out. The aircraft completed the approach sequence and touched down satisfactorily.

1.9 COMMUNICATIONS

No malfunctions between ATC and the aircraft radio communications systems were reported before or during the occurrence. At the time of the occurrence, the aircraft was in contact with the SYCJ Control Tower on VHF 118.3MHz.

1.10 AERODROME INFORMATION

1.10.1 GENERAL

The accident occurred at the CJIA, Timehri, East Bank Demerara, Guyana, South America, Position – North 6 29 56.149, West 058 15 15.67; Magnetic Variation – 16°W, Elevation – 96ft ASL. CJIA is located 39km south of the city of Georgetown on the Eastern Bank of the Demerara River.

CJIA (ICAO reference SYCJ) is operated by the Cheddi Jagan International Airport Corporation (CJIAC). The Airport is operated under the Cheddi Jagan International Airport Act: Chapter 52:01 of the Laws of Guyana and the Cheddi Jagan International Airport Order No. 20 of 2001. The Order establishes the airport as a public corporation. Among the functions of the Corporation is the provision of rescue and fire-fighting equipment and services at the Airport. The Order also requires the CJIAC, through its Chief Executive Officer to ensure that physical amenities meet the Standards as established by the Guyana Civil Aviation Authority, The International Civil Aviation Organisation, and any other International Agreements to which the Government of Guyana is a party.

CJIA operates on a twenty-four (24) hour basis, with Visual Flight Rules (VFR) and Instrument Flight Rules (IFR). VFR operations are during daylight hours, and IFR operations only during hours of darkness.

The Airport was closed after the accident and remained closed for six hours. There was no anticipated incoming traffic during this time. Following an assessment of the obstacle created by the crashed aircraft, the Airport was reopened with restrictions; landings were restricted to RWY06, and departures restricted to RWY24.

At sunrise, approximately three hours after the accident, the runway was inspected by representatives of the CJIA and the accident investigation team. The runway surface, lights and markings were found to be satisfactory and in keeping with ICAO Standards. No FOD was observed on the runway.

Construction was being done on the runway to extend its length. The area of the new construction was not approved for use and was appropriately marked with 'displaced runway threshold lighting' and a large white 'X' indicating closed runway. A displaced threshold runway end light was damaged, and a concrete block which held down the large 'X' was crushed.

1.10.2 CERTIFICATION

At the time of the accident, the CJIA was certified by the Guyana Civil Aviation Authority which provides oversight for safety and security regulation and compliance. The last certification inspection was conducted on 27th and 28th September 2018. The Certificate was valid from 16th October 2018 to 15th October 2019.

1.10.3 RUNWAY DESCRIPTION

RUNWAY 06

The following information regarding RWY06 was extracted from the Guyana Aeronautical Information Publication, and by observation:

- RWY06 was 2,270m (7,448ft) long and 46m (150ft) wide.
- Orientation was 061° magnetic 045º true.
- Take-Off Run Available (TORA), Take-Off Distance Available (TODA), Accelerate Stop Distance Available (ASDA); and Landing Distance Available (LDA) were all 2,270m (7448ft.).
- Information on the slope of runway was not provided. However, it was noted that the elevation of the threshold of RWY06 was ninety-six feet while the elevation at the end of the runway was seventy-one feet.
- Along the entire length of the runway there were transverse grooves providing improved friction characteristics for landing aircraft. These grooves also aid in drainage of the runway. On average, the grooves were 3/16" wide and 1/4" deep and the grooves' centrelines were 1½" apart.
- The runway was under construction at the time of the accident. It was being extended at both ends. RWY06 end had an extended portion consisting of 460m (1,508ft) of paved surface, plus an addition 250m (820ft) of sand. Thus, the complete length of the runway, including Blast Pad and RESA was 710m (2,329ft). At the time of the accident, this area was closed and was marked with the approved 'closed runway' marks - two white 'X' on the paved portion.

Note – The construction work was intended to provide a total length of 11,240ft.

RUNWAY 06 MARKING

Runway marking was in keeping with the standards established in ICAO Annex 14. Details are as described in the 5th Edition of the Guyana AIP. The following ***Marks*** were obtained from the 5th Edition of the Guyana AIP and confirmed by observation:

- Threshold Markings - a series of vertical bars marking the threshold;
- Runway Designation Markings - consisting of the runway number at the threshold;
- Touchdown Zone Markings - consisting of repeating series of vertical bars on either side of the centreline;
- Aiming Point Markings - at 1,500ft from the threshold;
- Centreline Markings - a dashed line along the entire length indicating the centreline of the runway; and
- The Runway Side Stripe Markings - a solid white stripe along both edges of the runway.

All runway markings contained reflective material.

RUNWAY 06 LIGHTING

Runway lighting was in keeping with the Standards established in ICAO Annex 14. The following information was obtained from the 5th Edition of the Guyana AIP and CJIA Corporation:

- The runway was equipped with red runway end lights, green threshold lights and white edge lights. The runway edge lights were spaced 60m apart.
- The runway was also equipped with a Precision Approach Path Indicator (PAPI) System. The PAPIs at CJIA consisted of four light units on the left side of the runway in the form of a horizontal bar. The aircraft would have been on the correct slope if the two units nearest the runway showed red and the two units furthest from the runway showed white; the aircraft was too high if all units showed white, and too low if all units showed red. The PAPIs were installed in accordance with ICAO specifications.
- At the time of the accident, there was no glide slope, and this was published in an AIC.

- The runway lights and PAPIs were adjustable and were operated and controlled from the Control Tower by the Air Traffic Controller. The intensity can be adjusted at the request of the pilot.

Note: Approach lighting was not provided due to the terrain and there was no centreline lighting.

CHEDDI JAGAN INTERNATIONAL AIRPORT'S RESPONSE

In keeping with (Guyana Aviation Requirements) GAR Part 12 - 'Aerodrome Certification', the CJIA has an Approved Aerodrome Manual. The 5th Edition of this Manual was approved in 2016 by the GCAA. Subpart 12.4.3 of the GAR requires that the Aerodrome Manual contain particulars of the Airport's emergency plan. Details of the Airport's emergency plan and other specifics were contained in a separate CJIA document - The Airport Emergency Response Plan. This document was approved by the GCAA in 2008. The particulars of the CJIA's Emergency Plan were stated in Part 4.3.0 of this Manual.

Section 2 of the CJIA's Emergency Plan details the actions of the various individuals and agencies in response to an aircraft accident on the Airport. Among other things, this document detailed the actions required by the Airport Emergency Committee, the Airport Duty Officer, the Manager Airport Operations, and Medical Director.

AIRPORT DUTY OFFICER (ADO) AND EMERGENCY OPERATION CENTRE (EOC)

The Airport Duty Officer received the emergency message from the CJIA Control Tower, and in accordance with a prepared checklist he attempted to call relevant persons and agencies. Initially, immediate contact was not established with all these persons and agencies, however, there was varying degree of success. Members of the Emergency Committee were notified by the ADO.

The investigation revealed that as various persons arrived at the airport, many proceeded via the Duty Officer's Office to the crash site instead of going to the Emergency Operations Centre. This is contrary to the provisions of the Airport Emergency Response Plan Part 2.4 - 'Action by Airport Emergency Committee'. (***At the time of the accident there was only one staff on duty.***) Eventually, some officials returned to the Airport Terminal Building from the crash site and opted to meet in the CJIA's Executive Lounge.

The investigators were informed by a CJIA official, that it would have been difficult to prevent the very senior persons from going to the crash site. It was opined that the CJIA needed to accommodate these individuals and consequently facilitated the actions of these individuals. This was viewed as unsafe and unacceptable.

The EOC was not immediately activated upon receipt of the emergency message. It was subsequently activated at a period convenient to the Airport Duty Officer. According to the Airport Emergency Plan, the EOC was located in the CJIA's Conference Room on the Mezzanine Floor, within the Passenger Check-in Area of the Departure Terminal. This information was incorrect at the time of the accident and should be amended accordingly.

The EOC was not in a state of readiness at the time of the accident, but was subsequently prepared by the ADO, with relevant checklists, name plates, and the relevant seating arrangements. Initially, it was reported that there were no radios. A subsequent report indicated that there was one radio and one telephone at the time of the accident. ***(It must be noted that the GCAA had repeatedly requested a list of equipment for the EOC from the CJIA, but this was never provided.)*** It was found that the EOC was in a room which serves a dual function but, primarily as a meeting/conference room. Thus, the EOC was not in a state of readiness.

AIRSIDE AND CRASH SITE ACTIVITY

According to the Section 2, Subsection 2.5.2 (i) and (ii) of the Airport Emergency Plan, the Manager Airport Operations shall proceed immediately to the accident site and establish a command post; he shall obtain a brief from the Officer-In-Charge of the ARFFS and assume the role of On-Scene Commander, among other things.

The aircraft returned to the CJIA at 06:53 UTC. The Manager Airport Operations received a call from the ADO at 07:15 UTC. The Manager arrived at the Airport at approximately 07:45 UTC. Upon his arrival he observed four Police Officers at the Screening Check Point. It was indicated that they took approximately one hour to arrive at the Airport. Consequently, the inner and outer cordons which should have been formed by the Police and Army around the crash site following the accident, were not formed in a timely manner. A contributing factor to the above situation could have been the order of priority for the call outs as indicated in the ADO Emergency Notification Checklist. ***(This should be reviewed to ensure that the persons and agencies that are needed to respond first, such as, first responders, are given priority.)***

ON-SCENE COMMANDER AND TRIAGE

The Manager Airport Operations proceeded to the crash site and obtained a briefing from the ARFFS Officer. All passengers were already evacuated, none required assistance, there was no fire, and a secondary sweep had already been conducted.

It was reported that personnel from the ARFFS were conducting assessments of the passengers. They were essentially assisted by the Airport and its Ground Staff in this task, and also doing a headcount and escorting the passengers away from the crash site. The passengers were escorted to the departure area of the terminal building. It was reported that two passengers were feeling unwell and subsequently left with an ambulance.

No medical personnel were on-scene at the time of the accident. It was found that the medical personnel (Port Health Officer) at the CJIA does not work night duty. This Officer should have been notified by the ADO of the emergency, and the Officer in turn should have notified the Chief Medical Officer (CMO). Investigators were informed that the CMO would then notify the hospitals of the emergency. It was not determined if, when, and how, this was done.

With the absence of the Port Health Officer at nights, the CJIA informed investigators that it would usually utilise the services of the Guyana Defence Force (GDF) Medex. It was reported that the Medex was not on the scene either.

It could not be ascertained whether other ambulances responded, other than the ambulance from the CJIA.

Emergency Radio Network

It was observed that there was uncertainty regarding the ownership and responsibility for maintenance of the emergency radios. It was posited that in the past the CJIA Control Tower owned their own set of emergency radios while the CJIAC owned its own set of emergency radios within the network consisting of the GDF, Force Control, GPHC, and ARFFS, but it was the Civil Aviation Department (not the same as the GCAA) that maintained the equipment. During the emergency, this network did not function as it should have and follow up investigations should be initiated to ascertain the status of the network and its functionality. Reasons for unserviceability or non-responsiveness should be determined and addressed.

1.11 FLIGHT RECORDERS

1.11.1 COCKPIT VOICE RECORDER

The Cockpit Voice Recorder on the accident aircraft was sent to the NTSB Vehicle Recorder Division Audio Laboratory for evaluation on 13th November 2018. The CVR was a Honeywell 6020 that records thirty minutes of analogue audio on a continuous loop in a four-channel format: one channel for each flight crew and one channel for the cockpit area microphone (CAM). When the CVR was deactivated or removed from the aeroplane, it retained only the most recent thirty minutes of CVR operation**.** The CVR did not sustain any heat or structural damage and the audio information was extracted from the recorder normally, without difficulty.

1.11.2 CVR AUDIO RECORDING DESCRIPTION

The thirty-minute recording consisted of four channels of useable audio information. Each channel's audio quality is indicated in the Table 3, below. For the half-hour portion of the CVR recording, each channel contained good quality audio information as defined by the following CVR Rating Scale.

TABLE 3: AUDIO QUALITY OF CVR CHANNELS

CHANNEL NUMBER	CONTENT/SOURCE	QUALITY
1	Jump Seat/PA	Excellent
2	First Officer	Excellent
3	Captain	Excellent
4	CAM	Excellent

On the CVR Quality Rating Scale, excellent quality is characterised as follows:

Virtually all the Crew Members' conversations could be accurately and easily understood. The transcript that was developed may indicate only one or two words that were not intelligible. Any loss in the transcript is usually attributed to simultaneous cockpit/radio transmissions that obscure each other.

1.11.3 DESCRIPTION OF AUDIO EVENTS

The recording and summary of events covered the descent, approach, landing, and accident events. Investigators from the GAAIU, NTSB, FAA, Boeing (Manufacturer), and Fly Jamaica Airways attended the CVR review in Washington, DC, USA. It was noted that the Flight Crew reported the loss of hydraulic pressure at 6:21hrs. Because this model CVR records only thirty minutes of analog audio, it was not possible to determine events in the cockpit before 6:23:35 from which time the recording was available.

1.11.4 TIMING AND CORRELATION – CVR AND FDR

Times stated on the summary is in Greenwich Mean Time (GMT). The VHF transmissions from the aircraft were correlated with the corresponding 'Key VHF' parameters recorded from the FDR. To convert from elapsed CVR time to GMT, 6 hours 23 minutes and 35 seconds were added.

1.11.5 REQUIRED DURATION OF CVR

ICAO Annex 6, Chapter 6, Standard No. 6.3.2.3.2 requires, "that with effect from 1 January 2016 all CVRs shall be capable of retaining the information recorded during at least the last two hours of their operation." This Standard has been implemented by both the United States FAA and Jamaica JCAA. However, the CVR on board the accident aircraft was only capable of thirty minutes of effective CVR operation.

1.11.6 FLIGHT DATA RECORDER INFORMATION

The FDR was a Solid-State Memory Flight Data Recorder. Information from FDR indicated that Flight Crew engaged the manual nose up pitch trim to adjust the horizontal stabilizer at 06:10:17[1] about eight seconds after take-off.

The Boeing 757 has three hydraulic systems; left, centre and right. The centre system is not associated with the brakes, nosewheel steering, or thrust reversers. A loss of left system hydraulic fluid developed within the following thirty seconds and the quantity diminished after about six minutes.

[1] These values are taken from plots, not digital data.

The quantity indicated that it was low after about four minutes, then stabilised at about 10%, slowly diminishing from that point. Left system hydraulic pressure was lost at about 06:29:50.[2] The indicated right system hydraulic quantity value fluctuated between about 100% and 130% for this and the previous six flights, depleting to zero ('0') quantity and having no pressure after the aeroplane departed the runway and when valid data from the right main landing gear ended. Post-accident inspection found numerous broken hydraulic lines in the right main landing gear area.

Regarding the higher than usual amount of hydraulic fluid in the right hydraulic system as discovered from the FDR readout. The Lead Mechanic at CJIA explained that it is not unusual for the right hydraulic system to show higher than normal fluid. This happens during usage of the brake, fluid from the left system leaks over to the right through the shuttle valve. He explained that there is a procedure in the manual that requires maintenance to transfer the fluid back from the right to the left system. The overfill is registered at 1.2. He further explained that the overfill situation only shows up on the maintenance page thus only maintenance sees this and would take the necessary action in keeping with Boeing procedures.

The hydraulic Power Transfer Unit became active about thirteen minutes after the left hydraulic quantity began to diminish. The PTU incorporates a hydraulic motor which is driven by the right hydraulic system to power a pump which can pressurise portions of the left hydraulic system. The hydraulic fluid is kept isolated within each left and right system without a crossflow capability.

The right hydraulic pressure slowly diminished until at about 06:37:00, when the CVR indicated that the right Electric Driven Pump (EDP) was switched on. At 06:39:50 an indication recorded that the right hydraulic system overheated, the Flight Crew reportedly turned off the EDP. At 06:46:20 the overheat condition that was indicated ended.

The PTU is equipped with two switches, one each for control and indication. This was reported by a Boeing representative to be set to change state at about 200-400 psi. In the event of low hydraulic pressure indicated in the left system, the control switch should shut the PTU off so that an unloaded pump is unable to depressurise the right.

[2] During inspection of the wreck, the APU and tail access doors were opened, and substantial amounts of hydraulic fluid poured out of each. Hydraulic hoses and actuators in the tail were found covered in hydraulic fluid, including the components associated with the pitch/stabilizer trim.

The FDR recorded that the PTU did not shut off and remained in operation until the aeroplane departed the runway when valid data ended for the right main landing gear and the right hydraulic pressure dropped to zero ('0').

The aeroplane utilises the left and right hydraulic systems to actuate the brakes, nosewheel steering, and thrust reversers for the respective sides of the aeroplane. In addition, the right hydraulic system provides a redundant braking source for the left brakes and the nosewheel steering. In the event there might be no pressure in either system, the left and right accumulators have a standpipe to supply a limited amount of braking fluid. The centre hydraulic system is only associated with the flight controls and is not associated with the brakes or thrust reversers. The aeroplane landed with the leading-edge slats extended and trailing edge flaps at 20° with no asymmetry. As the aeroplane nose rose into the flare during the five seconds prior to the landing (bogie tilt between 06:53:24 and 06:53:25), the right hydraulic system pressure diminished from about 2,950psi to 2,200psi. As soon as the aeroplane contacted the ground, the antiskid system design allowed the wheels to spin up, diverting some fluid to the 1,500psi return and the right hydraulic system pressure went to less than 750psi as the brakes were actuated four seconds after touchdown.[3]

Longitudinal deceleration associated with braking reached a peak of about 0.35G and ended about twenty-four seconds after touchdown, at 06:53:48, with the airspeed close to 60knots. Neither thrust reversers were deployed during the landing. The aeroplane departed the runway at 06:54:11. The roll angle and right main gear bogie tilt positions indicated that the right main gear separated at 06:54:13.

1.12 WRECKAGE AND IMPACT INFORMATION

On the day of the accident, a survey was conducted by a sworn Land Surveyor (Guyanese). The tyre marks were followed from the wreckage back to the initial ground contact, which was at 1,063ft from the threshold. Tyre transfer on the runway was seen up to about the 4,000-foot point from the threshold. From that point, the path slowly deviated to the right until a main landing gear tyre was damaged at a displaced threshold runway end light. The outboard left tyre path crossed the remnants of a crushed concrete block which held down a large white 'X' (closed runway marking). The No.1 Tyre (main, forward left) was subsequently found burst and evidence of a loose Tyre on the outboard left gear track could be followed from the 'X' to the aeroplane.

[3] The brake pressures are measured downstream of the metering valve.

From the 'X' to about 710ft, the right main gear track departed the runway and penetrated about thirteen inches into the dirt until the path came to a concrete obstruction at about 800ft from the 'X'. The concrete was a widened portion of the runway edge. The right main gear track disappeared for a short distance before becoming a wide deep single furrow, rather than the previous two separate tyre tracks. At 25ft along the path from the edge of the concrete was an initial contact point for the right engine small cowl fragments. At 30ft from the concrete the right nose tyre departed the widened section of runway and further away from the runway at 33ft into the field were two fragments of the outboard right slat. Two large cowl sections were found at 900ft from the 'X'. The left Tyre track of the left main landing gear reached the pavement at 1,000ft from the 'X'. The fuselage was 1,000ft from the 'X'.

There was a steep drop-off 30ft from the nose landing gear.

1.13 MEDICAL AND PATHOLOGICAL INFORMATION

1.13.1 MEDICAL REPORTS

None of the Crew Members displayed any signs of physical injury, thus, it was not necessary for them to visit a hospital. Arrangements were made for a Medical Technologist from the Eureka Medical Laboratory in Georgetown to travel to CJIA to carry out routine blood and urine toxicology screening for the presence of psychoactive/psychotropic substances, including alcohol and narcotics. This laboratory is certified and approved by the Guyana National Bureau of Standards. Both Flight Crew were tested for the prohibited substances (Marijuana and Cocaine, included), which returned negative results. Blood Alcohol tests were within acceptable limits. The Cabin Crew were also tested, and all returned negative results.

1.14 FIRE

There were reports of smoke in the cabin, there was no sign of damage caused by fire in the cabin. The Airport Rescue and Fire Fighting Service reported that the smoke originated from the undercarriage of the aircraft.

1.15 SURVIVAL ASPECTS

1.15.1 NOTIFICATION OF ACCIDENT

When the Flight Crew advised Air Traffic Control about the loss of hydraulic fluid and the decision to return to SYCJ, the ATCO immediately cleared the aircraft to return to the Airport and activated the local standby emergency by notifying the ARFFS. Thus, the ARFFS was able to respond immediately to the accident site. The Duty Air Traffic Controller reported that the landing appeared to be normal. But the landing roll was not. The aircraft sped down the runway and came to a stop beyond the end of the usable portion and perpendicular to the runway.

Based on dialogue with the Flight Crew, the Duty Air Traffic Controller did not expect an emergency landing. However, before the aircraft landed, in addition to the ARFFS, the Duty Air Traffic Controller had notified the Airport Duty Officer of the pending return of the flight.

The Air Traffic Control Tower daily log sheet showed that reports of the occurrence were made to senior GCAA staff.

1.15.2 ACTIONS BY THE AERODROME FIRE AND RESCUE SERVICE

The ARFFS provided twenty-hour service in three shifts at the CJIA and usually have eight staff on duty for each shift. Eight staff were on duty at the time of the accident, because of the location of the crash site, the staff level was adequate for this occurrence, however it may not have been sufficient under different circumstances. Several firemen reside in the vicinity of the CJIA and therefore could be called out if necessary. The Station Officer of the ARFFS stated that he was advised by the Fireman on Watch Duty that the Fly Jamaica Airways aeroplane was returning to the Airport due to a hydraulic problem and the CJIA Control Tower had requested the Fire Tender to be on standby. As a result, he returned to the Fire Station and gave two Fire Crew instructions to be ready to respond to an emergency.

The two appliances (Fire Tenders) were positioned as instructed by the CJIA Control Tower in front of the Fire Station near to Taxiway 'C'. The Firemen observed the aircraft landing and were able to go into action immediately. The Station Officer instructed that the appliances be positioned on the right and left sides of the aircraft so that the extinguishing agent (foam) could be focused on the right and left main undercarriages simultaneously, as smoke was seen emanating from them.

The Firefighters were in position in less than one minute. The Firefighters observed the slides being deployed and passengers exiting the aircraft via the slides. The Station Officer instructed some of the Firemen to assist the passengers who were coming off and to gather them in a safe area. As the exit flow of the passengers eased, he and some other Firemen entered the aircraft to look and seek out any passengers that might have been trapped inside. They entered the aircraft via the slide at the L3 door and searched the aircraft from rear to front. At the time, the interior lighting was dim but there was enough visibility for them to conduct the search.

Approximately three minutes later due to a sudden build-up of smoke that was coming from the wheels and engines into the cabin, he ordered all Firefighters off the aircraft. He ordered the application of foam to the areas where the smoke was coming from. When the smoke died down, he re-entered the aircraft to continue the search. During this search he encountered several unauthorised Firemen, whom he did not immediately recognise because it was dark in the aircraft. He then instructed and ensured that all Firemen exited the aircraft.

He said that a little later he was approached by the Manager Airport Operations, who asked him if all were accounted for. He could not verify this but told him that the aircraft was clear. The Pilots also approached him and asked if it was safe to go on board the aircraft to retrieve their personal belongings. He instructed another Fireman to assist the Pilots. He then handed over command of the scene to the Manager Airport Operations.

Shortly after, the Station Officer was advised by the Pilots that someone had tampered with their bags and two cell phones and other items were missing. He made enquiries and was able to summon the previously unrecognised Firemen back to the site and informed the Commissioner of Police who was also on site, of the situation. The Firemen were arrested and subsequently charged.

Apart from the Station Officer, four other on-duty Firemen were interviewed. The Officer who was stationed in the Fire Station Control Room stated that radio communication between the ARFFS and ATS was malfunctioning. Communication was supplemented by telephone. This was a normal occurrence which was recorded in the Station's logbook and reported to the CJIA Control Tower. The ARFFS said that the radios are owned and maintained by the CJIA Control Tower.

ARFFS Training

Lack of training specific to aerodrome activities is a major concern. It was stated that apart from the annual mass casualty exercise, no training or guidance was provided by the airport. In-house training for routine fire service activities was being done regularly. Training equipment such as diagrams of 'cut out' areas for aircraft were old. None were available for new larger type of aircraft. The aerodrome plan was not up to date. All firemen had received limited first aid training. They did not participate in the triage exercise during this occurrence.

1.15.3 ACTIONS BY THE FLIGHT CREW

The Flight Crew reported that, all the time during the return flight, they were anticipating a normal landing and were therefore caught by surprise by the subsequent failure of the right hydraulic system. In fact, they did not become aware of the total failure until after touching down, thus, the first emergency call was made twenty-four seconds before the aircraft came to a stop. At this time, the Captain called "**BRACE, BRACE, BRACE**". Thirteen seconds later, when the engines were shut down, the Captain shouted "**EVACUATE, EVACUATE, EVACUATE**". The Flight Crew were the last two persons to exit the aircraft.

1.15.4 ACTIONS BY THE CABIN CREW

(L1, L2, L3, and L4, and R1, R2, R3 and R4 refers to the left and right-side passenger doors, respectively.) The following was extracted from the CVR:

Three seconds after the Captain's emergency calls of "**BRACE, BRACE, BRACE**". The Cabin Crew started to shout the emergency instructions repeatedly; "**EMERGENCY, EMERGENCY, EMERGENCY, STAY DOWN, STAY SEATED**". After the aircraft stopped and the Captain called "**EVACUATE, EVACUATE, EVACUATE**", the Cabin Crew instructed passengers to open their seat belts. All Cabin Crew reported taking up their assigned positions. They all reported that the aircraft emergency lighting including the ground proximity lighting was effective.

The Purser was responsible for the L1 door. Despite strenuous effort she could not open the door, so she blocked it and redirected passengers to use other exits. The Purser said that she noted a little congestion at the L2 door, but it cleared quickly. The No.2 Cabin Crew was seated at the L4 door at the back of the aircraft. She was responsible for one lift-off-passenger, eleven wheelchair passengers and two children, but she did not assist any passengers off the aircraft.

She attempted to open her door but only managed to push it a little ajar. When she realised this, she blocked the exit and redirected passengers to the L3 door. after her section was cleared of passengers, she collected the survival kit, the first aid kit, a flashlight, and a portable ELT. She could not release the clip to free the megaphone. She exited the aircraft through the L3 door.

The Cabin Crew designated as No.3 was responsible for the L2 and R2 doors. The passengers who were seated in this area were briefed as required prior to take-off. A lift-off-passenger was also briefed. She considered opening the R2 door but decided against doing this because some oxygen masks and overhead panels had dropped down with the impact and blocked the access. she noted that several overhead luggage compartments had also opened due to the impact. She also mentioned that she noted the attitude of the aircraft, (right side up) and decided against opening that door. She opened the L2 door and called to passengers to use this exit. She was responsible for several wheelchair passengers and one lift-off-passenger, whom she got off the aircraft with help from a male passenger. After her section was cleared, she gave the Purser the thumbs up sign and left the aircraft with a survival kit, a first aid kit and a flashlight via the L2 door.

The Cabin Crew designated as No.4 was responsible for the R4 door. She was only able to open this door a little. This was the same situation as occurred with the 4L door. She blocked this door and redirected passengers to the L2 door. She also assisted in clearing passengers who were crowded at the L2 door. After the passengers got off the aircraft, she went to the front of the aircraft and checked to ensure that all passengers had deplaned, and the Flight Crew were okay. She left the aircraft via the slide at the R3 door with a first aid kit and a flashlight. She could not release the megaphone clip.

The Cabin Crew designated as No.6 was responsible for the R1 door. She opened her door and guided the passengers in the evacuation. She left the aircraft with a megaphone which she used on the ground to assemble the passengers away from the aircraft. The passengers who exited from this door ended up outside the fence, as the nose of the aircraft had penetrated the fence. When the rescue personnel arrived, they cut a hole in the fence and the passengers walked through back towards the airport.

All the Cabin Crew confirmed that they had completed full refresher training in March 2018, at the PANAM Training Academy in Miami, USA. The training included opening doors, slide deployment, etc.

1.16 PASSENGERS

1.16.1 GENERAL

Most of the one hundred and twenty passengers were Canadian citizens who were outbound to Canada on the accident flight. They subsequently departed Guyana at a later date for Canada. As a result, the Guyana Aircraft Accident and Incident Investigation Unit (GAAIU) requested assistance from the Transportation Safety Board (TSB) of Canada to contact the passengers and collate whatever information was available from them. The GAAIU forwarded the passenger manifest and available passenger contact details, to the TSB. The manifest contained the details of one hundred and fifteen passengers. The breakdown of data collection is given in Tables 4 and 5, below.

Table 4: Passengers available for contact by the TSB

PASSENGER CONTACT DETAILS	NO. OF PASSENGERS
Total Passengers on Manifest	115
Non-Canadian Nationals	10
Canadian Nationals	105
Deceased Passengers	1
Passengers with insufficient or incorrect contact information	20
Passengers available for contact by TSB	84

Table 5: Method of Contact and Responses

TSB CONTACT METHOD	PASSENGERS CONTACTED	PASSENGERS RESPONDED
Emailed questionnaire	30	2
Mailed Questionnaire	30	7
Telephoned Passenger	24	8
Total Passenger	**84**	**17**
Other (2 children under 5 years)		2
Total Adult Passengers		15

Of the eighty-four passengers contacted, the TSB only received responses from seventeen passengers. Of the thirty questionnaires emailed, only two persons responded. Of the thirty questionnaires mailed via the post office, only seven persons responded. Of the twenty-four persons telephoned, only eight answered the telephone or returned the call. Of the passengers that responded, some replied as a group, for example, one questionnaire contained information for two adults travelling together or one telephone interview for five members of the family travelling together. The TSB telephoned the next of kin of the deceased passenger twice but neither call was returned.

Of the seventeen passenger responses, one was a child aged four years, and one was an infant aged nine months. Therefore, safety observations were based on **fifteen adult responses**. Of the data received for the fifteen passengers, information quality and quantity were variable.

1.16.2 DECEASED PASSENGER

The GAAIU also unsuccessfully attempted to contact the next of kin of the deceased. However, a Medical Report was received from the Guyana Public Hospital Corporation (GPHC) which indicated that this passenger was admitted to the hospital five days after the accident. The report stated that this passenger was eighty-six years old and had a previous medical history of high blood pressure (hypertension), high cholesterol, and a cardiovascular accident in January 2018. She had been admitted and managed at a private hospital for a Cerebral Vascular Accident (CVA) or a brain attack before being referred to GPHC for further management of her condition. The referral also stated that she had a Glasgow Coma Scale (GCS) of 10/15; she also had a Computerised Tomography Scan (CTS) that showed she had Patient-Controlled Analgesia (PCA) infarct with bilateral mandibular shaft fracture. When she was first examined, she was unconscious, but responding to painful stimuli and her GCS was 7/10. She was admitted to hospital for further monitoring. Her condition was worse than the previous day. She died that day (five days after the accident) at 13.45pm Guyana local time.

1.16.3 OPERATIONAL DECISIONS

Eight of the fifteen adult passengers who were contacted reported that, prior to take-off, the Cabin Crew experienced difficulties closing one of the main passenger doors and that the Cabin Crew announced that this difficulty was related to hydraulics. Passengers also reported that, following take-off, the Cabin Crew announced the aircraft would be returning to SYCJ as there was a wider hydraulics issue.

Prior to landing, the aircraft appeared to experience difficulties with the flaps and, on landing, difficulties with the brakes. At some point in this sequence, the nose wheel and the right-hand landing gear collapsed. Passengers reported experiencing a heavy and fast landing, a loud bang or explosion and a subsequent runway departure.

All fifteen adult passengers reported that, neither prior to or during this landing sequence, did the Flight Crew or Cabin Crew issued any emergency landing information or commands to 'brace.' However, it was noted from the CVR readout that both the Flight Crew and Cabin Crew made emergency calls after the landing. With the limited data available to the TSB, it could not determine the details concerning the diagnosis of the initial pre-flight door closing difficulties, the subsequent decision to take-off, the decision to return to SYCJ, or the decision not to issue any passenger emergency commands, either, prior to the landing impact or prior to the runway excursion.

1.16.4 IMPACT FORCES AND PASSENGER MOVEMENT

For FJA256, the aircraft experienced a harder than usual landing (vertical impact force). The aircraft then proceeded into soft sand and mud terrain with a damaged centre nose wheel and right-hand main landing gear. Passengers contacted by the TSB reported a rapid deceleration (horizontal impact force). Two of the most significant variables on how an occupant will cope with impact forces that are transferred through the cabin, is how well the occupant is ***restrained and braced***. This B757-200 had one hundred and ninety-eight forward facing passenger seats distributed across thirty-five rows. Each row is identified by a number 1 to 35 and each seat by a letter A to F. Seats A, B and C were on the port side and D, E and F on the starboard side. Passenger seats were equipped with a standard two-point lap belt. All fifteen adult passengers reported being restrained by their safety belt at the time of the occurrence, that these belts remained secure throughout the occurrence and were easily removable prior to evacuation. It was also noted that the child aged four years was also restrained by the seat belt but that the infant aged nine months, was unrestrained on their parent's lap.

As passengers were not issued a brace command prior to the landing impact sequence and as most passengers were only secured around their waist with a lap belt, some of the passengers experienced uncontrolled body movements during the impact sequence. Three of these passengers sustained minor injuries.

1.16.5 SURVIVABLE SPACE

During an aircraft impact sequence, the internal survivable space should remain safe and large enough to reduce the probability of injury and to facilitate the subsequent evacuation.

Seven of the passengers reported that, during the landing and excursion sequence, parts of the cabin collapsed. However, some reported this was overhead cabin lighting and some reported it was the ceiling itself. Some also reported that the over-head luggage containers opened, and luggage fell onto the aisle. The collapse of the aircraft structure appeared to cause minor passenger injuries and produced a trip hazard that subsequently affected the evacuation process.

1.16.6 PASSENGER READINESS

Pre-flight - passengers on large commercial aircraft typically receive safety information through pre-flight safety briefings, demonstrations, and the aircraft's safety-features card. Safety information includes location of emergency equipment, location and use of exits, and procedures to follow, such as how to brace effectively. Passengers are provided safety information to improve their readiness and survival during an emergency. However, passengers typically pay little attention to pre-flight safety information and instead, tend to rely more on information provided by crew at the time of the emergency.

In the event of an ***anticipated emergency***, and where time and circumstances permit, Crew on large commercial aircraft typically provide passengers with an additional relevant emergency briefing, such as how and when to 'brace.' However, although many passengers rely on this additional emergency briefing at the time of the emergency, if the emergency is ***not anticipated*** by the Cabin Crew, or the Cabin Crew become incapacitated, passengers may not receive any further emergency-related information.

The TSB did not have access to the standard Fly Jamaica pre-flight safety briefing and demonstration, the safety-features card or the information provided by the Crew at the time of the emergency.

However, of the fifteen adult passengers that the TSB had obtained information from, the following information was noted:

Most passengers reported observing a pre-flight safety briefing and over half reported reading the safety-features card. All reported wearing their seat belt as a result of a seat belt command and/or the lit seat-belt sign. However, all passengers confirmed there was no pre-impact brace command or any warning of an impending emergency landing. As a result, none of the passengers were expecting a heavy landing and none were initially braced.

1.16.7 CABIN ENVIRONMENT

Of the passengers contacted by the TSB, five reported that, following the impact, there were lights on inside the cabin during the evacuation, although passengers could not determine if this was normal or emergency lighting. Two passengers reported that, subsequently, the cabin became filled with white smoke, and this affected their visibility during the evacuation. The TSB could not determine from the passenger data, as to where this white smoke originated.

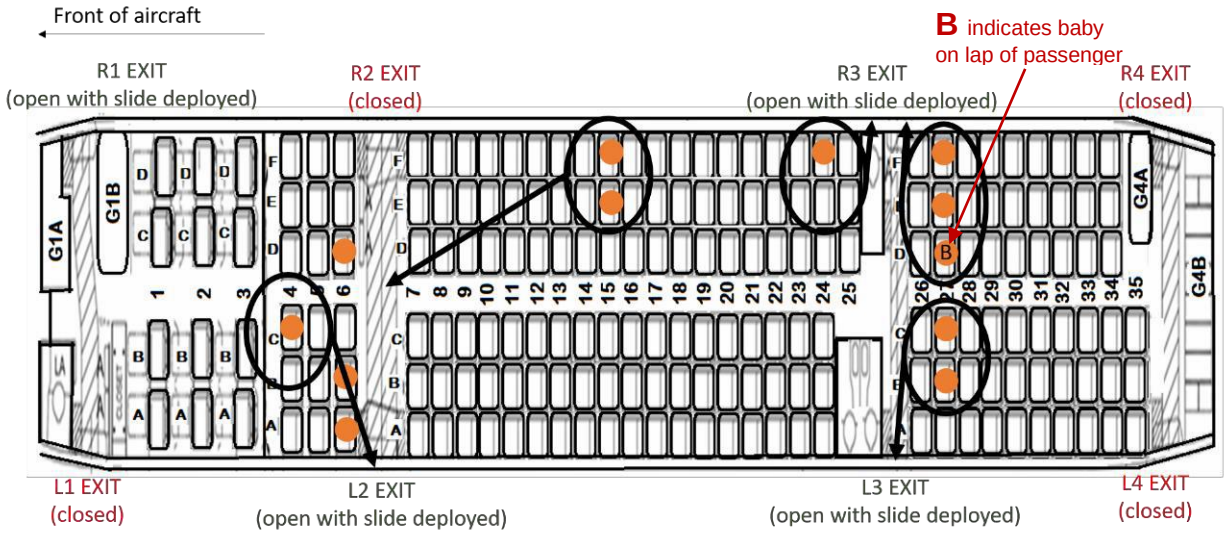
1.16.8 EVACUATION AND USE OF EXITS

Of the fifteen adult passengers, eight passengers contacted by the TSB reported that once the aircraft came to a standstill, the Crew issued commands to evacuate. However, one reported these commands were unclear and one reported not receiving any commands. Two of the passengers reported the commands came from the flight-deck, not from the Cabin Crew.

The aircraft has eight cabin exits, that is, four exits on the left side and four on the right side. The left-side exits are designated L1 to L4 and the right-side exits are designated R1 to R4. L1 and R1 are at the front of the aircraft, L2 and R2 are in front of the wings, L3 and R3 are behind the wings and L4 and R4 are at the rear of the aircraft.

Figure 5 below, illustrates the aircraft layout and exit locations, including the open exits, as observed in post-occurrence images. Of the passenger information available, exact seat allocation was obtained for fourteen of the seventeen passengers. The seat allocation and evacuation routes are also indicated in Figure 5.

FIGURE 5: SEAT INFORMATION FOR 14 PASSENGERS. B INDICATES A BABY ON THE LAP OF A PARENT



Although there were six Cabin Crew on-board, passengers who provided information to the TSB only referenced one Crew Member at the L2 exit and one Crew Member at the L3 exit. Some passengers reported having opened the exits themselves and one mentioned there was no Crew Member attending their evacuation slide.

1.16.9 PASSENGERS WITH SPECIAL NEEDS

One passenger reported that there were approximately twelve people on the flight who used wheelchairs. None of those passengers were among the passengers who provided information to the TSB. It was noted by passengers that, after the initial passenger evacuation, it took the Crew several minutes more to evacuate the remaining wheelchair-bound passengers. With the limited information available, it could not be determined how the passengers who used wheelchairs were evacuated, including from which exit and how long this process took.

1.16.10 PASSENGER INJURIES

Ten of the passengers contacted by the TSB reported having been injured during the occurrence, with most receiving their injuries either on impact or when evacuating via the evacuation slide. Of those who were injured, all injuries were limited to minor to severe bruising. Although none of the injured passengers received medical treatment on the day of the accident, seven injuries were bad enough to require medical treatment in the days following the accident. A summary of injuries is given in Table 6, below.

Table 6: Summary of Passenger Injuries (bruising)

METHOD OF INJURY	INJURY TYPE	NUMBER OF INJURIES	INJURIES TREATED DURING OCCURRENCE	INJURIES TREATED IN THE FOLLOWING DAYS/WEEKS
IMPACT (FALLING CEILING)	HEAD	1	0	1
IMPACT (IMPACT FORCE)	BACK	1	0	1
IMPACT (IMPACT FORCE)	CHEST	1	0	1
IMPACT (SEAT BELT)	STOMACH	1	0	1
EVACUATION (SLIDE)	BACK/SHOULDER	3	0	1
EVACUATION (SLIDE)	LEG/FOOT	2	0	0
EVACUATION (SLIDE)	ARM/HAND	1	0	0
OPENING DOOR	SHOULDER	1	0	1
UNKNOWN	BACK	1	0	0
UNKNOWN	RIBS	1	0	1

As the next of kin of the deceased passenger did not contact the TSB, the TSB were not able to determine the deceased injuries or her cause of death.

1.16.11 SLIDE MANAGEMENT AND SLIDE ANGLE

Of the six passengers who reported having received evacuation slide related injuries, all had exited the aircraft on the left-hand side of the aircraft. Media images show that the aircraft was leaning to the right after the impact, due to the right-hand engine and landing gear having collapsed. As a result, the evacuation slides on each side of the aircraft were deployed at different vertical angles. In particular, the slides on the left-hand side were steeper than normal. As a result, passengers would have moved faster than normal down these slides. With the limited information available, the TSB could not determine if those injuries sustained by passengers evacuating on the left-hand slides occurred as a result of crowding (from more passengers having exited the left side of the aircraft than the right) or from the steeper vertical angle of the slides on the left side.

1.16.12 Post-Crash Factors

The occurrence took place at approximately 02:00hrs Guyana local time and therefore it was dark outside when the passengers were evacuated. The terrain was sand and mud, which was difficult to walk in. The aircraft was positioned at the end of the runway, which was some distance from the Airport Terminal. All passengers reported difficulties in transiting from the aircraft to the Airport Terminal. Although some passengers were taken by shuttle (bus) to the Airport Terminal, most were left to walk on their own and in the dark using their own cell phones as flashlights. Of those who walked, many complained of fatigue, being scared, and having injuries that became more painful due to walking.

Of those passengers contacted by TSB, eight passengers mentioned that once in the Airport Terminal, they were left for several hours with minimal information, medical treatment, and food. Passengers observed Crew Members attempting to perform a head count, but it seemed that some passengers had left the airport without giving notice. With the limited information available to the TSB, the sequence, timing and number and type of personnel involved with the rescue could not be determined. However, passengers contacted by the TSB reported that the Fire Service were on-site.

1.16.13 Safety Equipment

None of the passengers contacted by the TSB mentioned the use of any safety or emergency equipment during the sequence of the occurrence. However, one passenger reported that some of the Cabin Crew were using their flashlights once outside the aircraft but that these flashlights were ineffective. The passenger reported that the Cabin Crew were repeatedly hitting the flashlights to try to get a usable luminance level. Instead, passengers used their own cellphone flashlights to find their way back to the Airport Terminal.

1.17 Organisation and Management

1.17.1 Fly Jamaica Airways - General

Fly Jamaica Airways is a privately owned Jamaican based aircraft operator which operated international flights between Jamaica and Guyana, United States of America, and Canada. The Airline was certified by the Jamaica Civil Aviation Authority (JCAA) in September 2012 and commenced operation in February 2013. It had approval to operate a B757 and B767 aircraft. The company's Accountable Manager was the major shareholder of the company.

1.17.2 FLY JAMAICA AIRWAYS – OPERATIONS MANUAL

The operations manual was subdivided into four parts. As follows:

- Part A – General/Basic; this is the Operations Policy Manual or Flight Operations Manual.
- Part B – Aeroplane Operating Matters (Aeroplane Operations Manual).
- Part C – Route and Airport Instructions and Information.
- Part D – Training.

Part A, Chapter 1 lists the named post holders, including the Accountable Manager. The Director of Operations reported to the Accountable Manager, and he had overall responsibility for development of the company's policy, giving full recognition to the need for safe and efficient operations. Other senior management staff included the Director of Maintenance, the Chief Pilot, and the Director of Quality Assurance. The Director of Operations (also held the position of Chief Pilot), and both the Director of Maintenance and the Director of Quality Assurance reported to him. The Director of Maintenance reported to the Director of Operations because the company did not have a separate AMO. It used an Equivalent Maintenance System which allows for a separate department under the AOC. The Director of Quality Assurance reported to the Director of Operations but also had direct access to the Accountable Manager. Other named post holders included the Director of Safety and Compliance and the Manager of In-flight Services.

Part A, Chapter 3 of the Manual, examines in detail the Safety Management System (SMS) to be used in the company. The Accountable Manager had ultimate responsibility for safety activities in the company and had full and final responsibility for the safety system. The roles of senior managers and general staff were detailed. It was stated that all managers must be up to date with safety issues and understand the principles, procedures, and tools of the SMS. The expectations of a just and positive safety culture within the organisation were adumbrated.

1.17.3 STAFF INTERVIEWS

1.17.3.1 INTERVIEW WITH SENIOR FJA OPERATIONS STAFF

Due to time constraints, it was agreed that interviews with the Director of Operations and the Assistant Chief Pilot would be done together. The Assistant Chief Pilot also functioned as Check Pilot, Trainer, and Senior Pilot. He was previously employed in military aviation then went to general aviation and subsequently to the airline aviation. He had more than twenty-five years' airline experience prior to joining FJA. He opined that FJA has a similar environment to other international airlines that he worked with. He expected that there would be similar structure and standard of discipline. He subsequently resigned from the position of Assistant Chief Pilot and reverted to Check Pilot and Training Captain. He reported to the Chief Pilot, who in turn reported to the Director of Operations. As Assistant Chief Pilot, Check Pilot and Training Captain, he tried to keep above the fray and did his best to ensure that the operations section was not adversely affected by non-technical (external) influences. He stated that the pilots operated professionally, as expected, in keeping with established standards. They had to fly serviceable aircraft, keep required records, maintain the integrity of the flight, maintain rest and duty periods, etc. The same professionalism was maintained in simulator and other training. The pilots had no option but to operate professionally, so he could not verify anything out of the norm.

He noted that the JCAA could have been more helpful in ensuring that standards were maintained in the company. He recalled instances where pilots were call to the JCAA and these summonses would simply be ignored. He was not aware that any punitive action was taken against these pilots by the JCAA. He also recalled being held accountable unfairly by the JCAA for a flight being dispatched full when he was neither on the flight nor was the accountable person. He said that he was attempting to develop a working relationship with the Chief Pilot, but the accident put an end to this attempt.

The Director of Operations expressed concern that the Chief Pilot was not based in Jamaica, and this sometimes was inconvenient to other pilots who were required to fill this gap. Up to the time of the accident the Chief Pilot did not provide a satisfactory reason for this. Notwithstanding this, the Director of Operations noted that the Chief Pilot was carrying a full workload as a flying pilot. At one point he was the only line Training Captain. So, although he was not actually based in Jamaica, he was carrying a full load within the approved Flight and Duty Time Limitations.

However, the Director of Operations felt that because the Chief Pilot (CP) was not domiciled in Jamaica, there was a problem with managing his time and carrying out his responsibilities as Chief Pilot. The Director of Operations noted that in the absence of the Chief Pilot, he was often required to deal with issues affecting pilots. With the JCAA's involvement, the Check Pilot/Training Captain was appointed to the position of Assistant Chief Pilot and was assigned the same functions as Chief Pilot. This was deemed to be unacceptable by the investigation team.

(Note: JCAA comments on the Draft Final Report regarding the investigation team's observation that the Assistant Chief Pilot was assigned the same functions as Chief Pilot, are as follows: "JCAA believes that this adjustment was acceptable and was done to re-enforce the functions of the Chief Pilot who was not readily available at base.")

The Director of Operations showed that he was aware and quite knowledgeable about Safety Management Systems in aviation, however it is apparent that he did not get the necessary support from the Accountable Manager to make the concept workable within the Airline. Several other senior management staff also expressed concerns about the attitude of the Accountable Manager. They identified several breaches of accepted policies and procedures that were considered to be standard in an airline operation. These included incidents of poor (non-standard) recruitment and hiring policies and staff relationships, undermining senior management, abuse of staff, etc. However, it was apparent that most of the staff were hopeful that the situation would be turned around for the company and there would be a positive outcome. On occasion, the Accountable Manager gave cause for hope, but this mood did not prevail, and this only contributed to the general uncertainty among workers. It was noted that the company had three hundred and fifty employees whose livelihood depended on the profitability of the company.

Neither the Accountable Manager nor the Director of Operations had ever heard of undocumented maintenance being done on the aircraft.

1.17.3.2 INTERVIEW WITH FJA DIRECTOR OF MAINTENANCE

The Director of Maintenance stated that he was employed with FJA since 2012 as the Director of Maintenance and Maintenance Controller. He explained that the company's AOC allowed for an Equivalent Maintenance System under the JCAA Regulations. The procedures for the EMS were contained in the company's Maintenance Control Manual (MCM), approved by the JCAA.

Although there was an approved system on paper, it was apparent that the system was not effectively implemented and there was much circumventing in this area. He had concerns about some maintenance practices in the company and resigned in March 2014. He was asked to resume in 2015, when he was appointed as the Systems Engineer. In December 2016 he was asked to once more be the Director of Maintenance. He accepted this position reluctantly as he still had some concerns. In this position he had overall responsibility for the maintenance department.

His major concerns were with the three maintenance chiefs, one each stationed in Guyana, Jamaica, and New York, respectively. He said that he did try to make a difference in the maintenance activities in the company, but despite his position, he was sometimes excluded from the decision-making process in this area. He cited several examples of this. He believes that the relationship between the maintenance chiefs and the Accountable Manager may have allowed them to get away with doing 'wrong things.' Particularly in Guyana's case, he had noted issues that were not documented and therefore could not be traced. He had also experienced some amount of push back whenever he tried to give advice or share his knowledge with staff in Guyana. There were three qualified persons in Guyana. They had completed the full training course for both the Boeing 757 and the Boeing 767, but only one of them submitted his applications for approval. He was granted approval for the Boeing 767 based on his continued improvement. He failed his interview for the Boeing 757 approval and was required to return for a re-assessment. It was felt that personnel in Guyana lacked depth. They were asked basic questions that they could not answer, and it was apparent that the Guyana team took offence at being asked these questions. This was even though he was mandated in the MCM to carry out on-the-job training and to interview persons who were prospective authorised signatories, with a view to giving them full authority to sign off the aircraft airworthiness releases, etc. He had the impression that the Guyana staff did not consider him to be their immediate supervisor, as they could bypass him and go directly to the Accountable Manager. He cited a situation involving a defective APU, he became involved towards the end, after he became aware of an email that was being sent to the manufacturer before any inhouse trouble shooting was done. He found this objectionable because there was a process to be followed which was ignored. The Accountable Manager was involved in this incorrect process, when it was brought to his attention, the Accountable Manager did not offer satisfactory redress. It was felt that this was a reflection on how the company was managed. Generally, there was a lack of trust. Maintenance in the USA was contracted out to Swissport.

He also expressed concern about the failure of Flight Crew to log defects in the technical log. He noted that the Cabin Crew were not allowed to record cabin defects unless approved by the Captain, and in any case, the Purser was the only Cabin Crew authorised to write in the cabin log sheet. This procedure required Cabin Crew to make a note of defects, and these were taken to the Captain who would assess the defect and determine and authorise if it should be entered in the cabin log. This was not an approved (written) procedure.

He felt that the Cabin Crew were intimidated and could not use the cabin logs effectively. It was explained that defects were not actioned from the cabin sheet but from the technical log, but because things were not always recorded on the technical log, maintenance were not always fully aware of some deficiencies. He also recalled instances of mechanics writing up defects which may have occurred during flight and should have been written up by Flight Crew. He took these concerns directly to the Director of Operations and the Accountable Manager in an attempt to rectify some of the problems internally, rather than complaining to the JCAA, but progress in this area was slow and ineffective.

(Note: JCAA comments on the Draft Final Report: "JCAA stated that the correct procedure is to take concerns through the chain of command of an organisation. The JCAA as an outside regulator is the last step in the event of ineffective action.")

He was also suspicious about spares being ordered when there was no worksheet to support this. The JCAA raised a reported instance of hydraulic fluid leaking from the right wheel well, the report indicated that a brake isolation shut-off valve was leaking at the union, which was tightened and then reported as being within limits as per the Aircraft Maintenance Manual (AMM). Nevertheless, it was stated that an O-Ring was required and ordered as a replacement. This occurred on 31st October 2018. It was stated that from this date to the date of the accident, nine days later, four pints of hydraulic fluid was added.

He was asked to explain the FDR finding of excess hydraulic fuel quantity for six previous flights, while there was no record to show that this was ever recorded as a defect, and neither was there any record of fluid uplift/replenishment in the technical log or anywhere else. He pointed out that this aircraft is old and is parked on the ramp for long periods. He noted that before the very first flight of this aircraft, hydraulic lines had ruptured due to aging. It was explained that hydraulic lines may have been long on the shelf, before being installed on the aircraft just before the expiration of its shelf life. However, no records were available to verify this.

It was recalled that a significant quantity of hydraulic fluid was observed pouring out when the rear compartment door (tail door) was opened at the crash site. It could not be determined exactly where the leak was or how the fluid got there, but it was acknowledged that internal lines may have been ruptured during the accident. It was noted that the aging of the aircraft itself was determined by the manufacturer, and the accident aircraft was almost at its life limit.

He was asked to explain the operation of the Minimum Equipment List (MEL). He agreed that generally flights were properly dispatched in accordance with the MEL, but this was not always strictly adhered to. It was noted that failure to follow the correct procedures could affect the dispatch of the aircraft. He was further convinced that there was need for a cultural change in the company and just two weeks before the accident he had expressed concerns to another management staff about the direction in which the company was heading. He reiterated that these concerns were discussed with both the Director of Operations and the Accountable Manager, but the situation remained unchanged.

The role of quality control and quality assurance was raised, it was noted that these areas were affected by inadequate staffing and limited training. Generally, the company was affected by both quantity and quality of staff. The shortage of staff also affected line maintenance, resulting in a challenge to get the work done in a timely manner to keep the aircraft operating on its flight schedule. The company suffered constantly from staff attrition. Qualified persons were difficult to recruit, attempts were being made to organise training.

1.17.3.3 INTERVIEW WITH FJA QUALITY ASSURANCE MANAGER

The Quality Assurance Manager explained that the Director of Operations was his immediate Reporting Officer, but for safety issues he reports directly to the Accountable Manager. He was on the same reporting level with the Director of Maintenance. This was in accordance with the company's operations manual. He stated that he was not adversely affected by the existing reporting lines as he had direct access to the Accountable Manager.

The Quality Assurance Manager said that he always strived to maintain an acceptable standard of quality assurance at FJA. He noted that physical day-to-day work on the aircraft was usually good. However, and unfortunately, he was not getting the expected responses from the company pertaining to corrective actions on audit queries that should have come from the company maintenance section. His complaint to higher management was usually disregarded, and for the first time in his aviation career he was forced to complain to the regulatory authority, the JCAA, in 2017.

He had also approached the FAA but did not get the desired responses from them. He thought that higher management was not providing the requisite support to ensure that the correct responses were obtained from maintenance. He felt that he had a good relationship with the JCAA and was comfortable reporting his concerns to the Authority. In explaining the relationship between maintenance quality assurance and operations quality assurance, he agreed that the process, from the entry of a defect in the technical log to its resolution, worked. Flight Crew were required to enter defects in the technical log and automatically the system allows for it to be handled through the MEL or one of the other approved deferral practices in place.

He agreed that generally flights were properly dispatched in accordance with the MEL, but he did recall instances where violations occurred. He did advise both the Accountable Manager and the Director of Operations when these breaches occurred and that there could be trouble with the JCAA if they found out. He confirmed that defects were not always recorded in the technical log by the Flight Crew. Sometimes maintenance would be given verbal notification with the expectation that maintenance would write up the defect and take corrective action. He agreed that this was not acceptable, as it put maintenance in a position where they had to write up defects that occurred in flight. Despite this, if maintenance was aware of a defect, they will take the necessary action. He had spoken to the Chief Pilot about this on several occasions. The Quality Assurance Manager felt that the existing structure could have worked well if the Director of Operations had received the requisite support from the Accountable Manager.

1.17.3.4 INTERVIEW WITH FJA CHIEF PILOT

The Chief Pilot stated that he carried out his duties professionally as detailed in the company's Operations Manual. He pointed out that operations were largely in keeping with the Jamaica Civil Aviation Regulations (JCAR) as the company's Air Operator Certificate (AOC) was issued by the JCAA. The FAA was involved only because the aircraft was registered in the United States of America. He stated that he did have accommodation in Jamaica, but even when he was away from Base due to his flying activities, he was always available via phone. Management and Pilots were free to contact him at any time. He said that he agreed with the appointment of a Deputy Chief Pilot as he felt that the individual so appointed would have made a positive contribution to the company. He did not see the appointee as a threat to him or his position but rather as an asset. He had the final say and final responsibility for any operational decisions in the company. He pointed out that he had never received any adverse comments or warnings from management and staff of the company or the JCAA.

He also noted that the position of Chief Pilot is not necessarily a desk job. It is quite normal for the Chief Pilot to fly regularly, including conducting flight checks, training, etc.

He explained that it is normal for all Pilots to cover all systems and emergency training over a three-year period. He confirmed that the accident Flight Crew would have covered training in the hydraulics system. He noted that they had complied with the Quick Reference Handbook (QRH) during the occurrence, as required. He felt that the Flight Crew did what was expected of them. The aircraft did not float, the touchdown was right on point. However, bearing in mind that the right Electrical Motor Pump failed right on touchdown, at a critical time, when it was unexpected and when the Flight Crew was totally unprepared for it, there was not much that the Flight Crew could have done.

The Chief Pilot also noted that at this time it would be normal for the flying Pilot's attention to be on directional control and listening for the speed brake call. When the non-flying pilot called "no speed brake", the flying pilot was able to respond immediately by activating the speed brake and reverse interlock was activated. He agreed that when the brake source light came on, the only available source of braking left was accumulator (emergency) braking. However, ***it was apparent*** that neither of the two Pilots may have noticed this light in a timely manner, probably because they were both concentrating on the outside the aircraft. From the Co-pilot's statement it was believed that he belatedly noticed the light and reached for the switch, but this may have happened too late to be effective. The Chief Pilot further noted that illumination of the light was not a memory item, thus the Flight Crew could not be expected to respond to it without first referring to the QRH, because a procedure must be followed, thus the Flight Crew cannot be faulted for not pressing the switch. He agreed that the message of the light was clear, but it was noted that Pilots operate in a disciplined environment, and it was not acceptable to take action that was not detailed in the QRH, as there was no guarantee that situation would have been any different, (whether better or worse), if the light had been seen and used. It was noted that use of the light by the Flight Crew was not covered in their procedures, so they had no guidance on its use at this critical point in time, therefore it should not be considered as the cause of the accident.

The Chief Pilot stated that he had full confidence in the available maintenance provided for the aircraft. He had full confidence in the company's Director of Quality, who along with the JCAA, did not slack up on the company. He felt that the lapse with the CVR should not be considered as an indication of a trend of poor maintenance in the company.

About the excess fluid in the right hydraulic system for the last six prior flights, (as showed on the FDR readout), he agreed that this was a maintenance issue, but he was aware that there was a possibility for fluid to move from one system to another, but this was only on the ground.

It was noted that the right hydraulic system failure that occurred at touchdown was only revealed by the FDR. The Chief Pilot stated that despite this failure, there were several indications that brakes, possibly accumulator, were still available and used after touchdown, he noted that the aircraft slowed to 60kts after touchdown. He also noted that the Captain may have come off the brakes in anticipation of exiting the runway at Taxiway 'Charlie', which may have accounted for depletion of the accumulator, when he attempted to use it again. Further the brakes were smoking, indicating that the brakes were used.

The Chief Pilot said that he maintained a strictly professional relationship with the Accountable Manager. He never found it necessary to make any compromise when standing up for what he believed to be right. He gave the Pilots one hundred percent support when they made decisions based on safety of the operations. He always recognised that he was ultimately responsible for company operational matters, and he strived to operate in accordance with the law. He was not aware of any internal operational safety investigations being conducted by the company. During the early days of the company, there was an excellent relationship between the company and JCAA. After the departure of the Primary Operations Inspector (POI), the JCAA had some difficulty recruiting adequately qualified flight operations staff and the relationship deteriorated until the JCAA was able to recruit the current incumbent. He conceded that from the time between the departure of the POI and the arrival of the current incumbent, the company may have fallen into some bad habits, but the new FOI was working diligently to pull the company back into shape.

He stated that the accident Captain was known to be very thorough and professional and was well respected among his fellow Pilots. The Co-Pilot was very professional, and he took his role very seriously. The decision to turn back to SYCJ was one that was made by the Flight Crew and could not be faulted, as they would have had the information to make that decision. He put it down to a bad day and any Pilot could have been affected similarly or worse. He felt that the outcome was fortunate as it could have been much worse or even catastrophic.

1.17.3.5 INTERVIEW WITH FJA GUYANA STATION MANAGER

The FJA Guyana Station Manager said that he was not on duty when the accident occurred, but as the senior person in Guyana he was kept updated as events unfolded even prior to the event. He was advised of the initial departure delay due to the defective slide light; he was advised when the Pilots indicated that the aircraft would be returning to CJIA due to the loss of hydraulic fluid. He was advised when the aircraft ran off the runway and he made his way to the airport immediately. He estimated that he reached the CJIA about twenty minutes after the accident. While driving to the airport, he was giving instructions/advice to the Duty Station Manager. These instructions included, carrying out a head count and using the passenger manifest to ensure that all passengers were accounted for; making arrangements for injured passengers and crew to be taken to the nearest hospitals; arranging for transportation and hotel accommodation for passengers who needed it.

The Station Manager said that he had fourteen years' experience as an Airline Counter Supervisor with Caribbean Airlines Limited (CAL) before joining FJA. He had received emergency training from CAL. He was also actively involved in an actual aircraft emergency when a CAL aircraft ran off the runway at CJIA nine years earlier. It was largely based on this experience that he was able to provide guidance to the Duty Manager. He considered himself to be the senior FJA representative at the airport and in Guyana that night. He knew that there was an FJA emergency procedures manual, but he had never been given emergency training by FJA. His reactions were based on training he had received during his previous employment with CAL and from his involvement in the CAL accident. When he got to the airport, he reported to the FJA Office where he had brief discussions with the staff on duty. He collected the Flight Manifest and other documents related to dispatch of the flight. He then made his way to the crash site to ensure that all passengers and Crew Members were off the aircraft. He said that the FJA staff did spoke to the passengers after the accident and had adequately explained the situation to them.

However, it was noted that following reports that passengers were milling round in the area, GAAIU personnel along with a Minister of Government considered it necessary to speak with the passengers because it was apparent that the passengers were not receiving adequate feedback from FJA. The Station Manager insisted that FJA staff were in area and did speak to the passengers, but he did not speak to the passengers himself and could not say who from FJA had spoken to the passengers.

It was agreed that there would be some amount of confusion among the passengers. He felt that when senior officials appeared on the scene, the passengers would naturally tend to cluster around them and in the process would not pay attention to the FJA Staff. However, when the GAAIU staff and the Minister spoke to the passengers some amount of time had elapsed and it was apparent from this intervention, that the passengers were not satisfied with the information provided by FJA. It was also noted that the GAAIU personnel did approach the FJA staff before speaking to the passengers, but the staff in the office seemed to be very perturbed and could not provide any response to the queries made by the GAAIU personnel. It was noted that training is the backbone of airline procedures and operations.

It was agreed that the airport had a vital role to play in this especially based on its previous experience with CAL. The airport still does not have a defined area to keep the passengers safe and separate from the public, nor to provide them any sustenance following a traumatic experience.

The Station Manager said that there was an FJA emergency manual in the office, but he could not recall receiving any emergency training from FJA management that would have prepared staff to handle the occurrence. He did recall that FJA provided periodic training from a policy and procedures manual that would cover actions to be taken in event of delays, passengers' injury, or sickness, provision/assignment of hotels as necessary, etc. He noted that this training was monitored by the JCAA.

From the passenger manifest, the aircraft take-off weight for the accident flight was 105,000kgs.

1.17.3.6 Interview with FJA Accountable Manager

The Accountable Manager understood that his role as Accountable Manager made him responsible for general operations of the company, especially the financial viability of the company. He was responsible for ensuring that financing was available to guarantee that safety in the company was not adversely affected by lack of or insufficient finances. He was also ultimately responsible for ensuring that all aspects necessary for safety, security and quality control of the company were allowed to function effectively and in keeping with regulations as laid out by the JCAA and the FAA. The company received its certification in September 2012 and started operation in February 2013.

He was not aware of any problems among his staff. He was asked to explain the appointment of the Deputy Chief Pilot with the same duties as the Chief Pilot. He said that he never had a problem with his Chief Pilot, he acknowledged that the Chief Pilot was very busy because in addition to doing line flying, he also functioned as Training and Check Pilot. He said that the appointment of a Deputy Chief Pilot with the same duties as Chief Pilot was in recognition of this. Further there were occasions when there was the immediate need for issues to be resolved and the Deputy Chief Pilot could do this in the Chief Pilot's absence. He felt that there was no bias in favour of his Guyanese staff. He believed that all staff were treated fairly, and they were all expected to maintain acceptable standards in keeping with normal airline operations. He also refuted claims that the Guyanese maintenance staff could bypass their immediate reporting officer and take things directly to him for resolution. He thought this was 'loose talk.' The maintenance headquarters was in Kingston, Jamaica. He stated that the communication between Kingston and Georgetown was normal in keeping with regular airline standards, he was not aware of any conflict between the two bases.

Communication between the bases was by phone, facsimile, and email. Service Bulletins (SB), Airworthiness Directives (AD) and other maintenance obligations were sent from Kingston to Georgetown, regularly and as necessary. All the maintenance bases were adequately equipped with spares and equipment. He noted that the maintenance section of the company was quite large, comprising a Director of Maintenance, Director of Quality, Chief Engineer, Maintenance Planning and Maintenance Control. He said that instructions were issued from Kingston to the outlying bases which were expected to comply, and to report back on progress made on the assigned tasks. He said that Guyana was well staffed so there was no reason for tasks not being done. He opined that if this situation had existed, it would have been revealed before now during inspections by the JCAA. The Accountable Manager refuted claims that the Guyanese maintenance staff could bypass their immediate reporting officer and take things directly to him for resolution.

He said that the company had a satisfactory relationship with both the JCAA and the FAA. As far as he was aware the company was never required to carry out any safety investigations in relation to violations cited by either the JCAA or the FAA.

He agreed that being the Accountable Manager was an onerous task, but his flying did not adversely affect his ability to function as Accountable Manager. In fact, the ability to fly enhanced his ability to function as Accountable Manager, because it allowed him to observe issues first-hand at various locations and to resolve issues on the spot.

He in fact enjoyed flying and found it to be therapeutic. He was not in Guyana when the accident happened. He flew from Jamaica and arrived in Guyana the next night. He did not have any discussion with either of the two Pilots as to the cause of the accident, because he was upset. So, he delegated his Chief Pilot and Director of Operations to have discussions with the Pilots. Their reports did not reveal anything significant as the Pilots did not say much. He saw the MOR they submitted and felt that they were probably advised by their union or lawyer. He felt that it would have been fruitless to attempt to get anything else from them at the time. He also said that he was aware that the Pilots were being given support from the International Federation of Air Line Pilots' Associations (IFALPA) and the Trinidad and Tobago (T&T) Pilots Association.

The Accountable Manager was asked to share his opinion of the accident Pilots. He said that the Captain was a new hire who previously flew at Air Jamaica and Saudi Arabia. When he came to FJA he had about 14,000hrs flying experience. He applied for a job and received training and was subsequently checked out and appointed as Captain. The Accountable Manager said that he did not have an opinion about the reputation, attitude, or style of the accident Captain. He said that he was not involved in training or checking the Captain, this was done by his training team. He had only flown once with this Pilot, and they were both on a line check. The decision to employ him was based strictly on the results of his training and assessments and recommendations made by his trainers and checkers.

Senior management for FJA were based in Jamaica, however, FJA Guyana Station Manager was at CJIA on the night of the accident.

1.18 ADDITIONAL INFORMATION

1.18.1 VISIT WITH THE JCAA

Efforts by the Accident Investigation Team to visit with the Jamaica Civil Aviation Authority were initially hampered. After several delays, the Team was eventually facilitated and visited Jamaica from 17th to 20th September 2019. Despite the passage of time the Team was well received by the JCAA.

Following a review of documentation provided by the JCAA, it was noted that when Fly Jamaica Airways was certified, the JCAA had two Flight Operations Inspector, four Airworthiness Inspectors and one Cabin Safety Inspector. This number of technical staff was considered adequate for the certification process as Fly Jamaica Airways was the only locally based international airline operating in Jamaica at the time.

The Flight Operations Inspector, who was the Principal Operations Inspector responsible for the certification process of FJA was no longer employed with the JCAA at the time of the accident. However, another POI was employed in June 2017. Several significant issues were raised by the Airworthiness Inspectorate of the JCAA. These included:

(a) Dissatisfaction with the completion of the five-phase process for issue of an AOC. Specifically, they expressed the opinion that the Demonstration and Inspection Phases were not properly completed and there were too many inconsistencies. Consequently, the Airworthiness Inspectorate did not participate in the AOC presentation Ceremony.

As a matter of fact, the Airworthiness Inspectors registered their dissatisfaction and disappointment, and were surprised when the AOC was issued to FJA, even though they raised several concerns.

(b) Findings from audits and surveillance activities revealed that JCAA records indicated poor record keeping practices by Fly Jamaica Airways. The following was also observed:

(i) Poor record keeping may have resulted in maintenance defects not being recorded at times. Thus, it was difficult to ascertain the maintenance integrity of the aircraft and particularly the hydraulic system;

(ii) On some occasions, Pilots did not write up defects but would report them verbally to mechanics;

(iii) Mechanics would clear defects without making an entry of the rectification in the statutory logbooks; and

(iv) There were records of aircraft parts being ordered but there were no records of any defect that required those parts. This led to further speculation that defects were not being recorded.

(c) The Airworthiness Inspectors also expressed concern about the safety culture at FJA and believed that this could have, in a general sense, resulted in unsafe practices.

(d) They also believed that management interference had an adverse effect on maintenance and safety practices generally.

The JCAA also provided records of audits, surveillance and correspondence exchanged between the JCAA and FJA.

1.18.2 POST EVACUATION ISSUES

(a) The GAAIU and a team of Senior Officers from the GCAA arrived at the accident site at approximately 08:15 UTC. The wreckage was examined. Discussions were held with the Crew, Airport Management, Fly Jamaica Ticketing Staff and the Aerodrome Rescue and Fire Fighting Services. The Airport management had arranged for site security for the wreckage to be provided by the Guyana Police Service and the Guyana Defence Force.

(b) Fly Jamaica Staff and Airport Staff indicated that they had provided limited transportation for passengers and Crew from the accident site to the Airport Terminal. But they could not account as to how many persons were provided with transportation.

(c) Several passengers reported walking from the aircraft to the Airport Terminal. However, it was difficult to traverse on foot from the accident site to the Airport Terminal since it was dark, the distance was far, and the terrain was muddy and sandy.

(d) The GAAIU and the Minister responsible for Civil Aviation spoke to several passengers who were waiting in the arrival area of the Airport Terminal. The passengers were calm and were awaiting information from Fly Jamaica Airways. Unfortunately, up to this time, it was apparent that no FJA senior management staff had spoken to the passengers. The ticketing and supervisory staff were unable to advise the passengers on the way forward, but they had arranged transportation and accommodation in Georgetown for passengers who needed this. It was explained to the passengers that the airline was responsible for their wellbeing and would be expected to arrange for their departure from Guyana. It was also explained to the passengers that their baggage could not be released to them immediately, but after going through necessary formalities it would be handed over to FJA who would be responsible for ensuring that the baggage was forwarded to their respective owners.

(e) The Airport had not identified an isolated area where the affected passengers could be made comfortable while they waited for information. There was no arrangement for the passengers to be served with refreshments, nor were they given any medical attention while they waited.

(f) No Port Health or other medical services were available at the Airport at the time of the accident. The Chief Medical Officer subsequently arrived and aided the passengers.

(g) After the cargo was off loaded, it was handed over to customs for routine inspection and then handed back to Fly Jamaica Airways for distribution to passengers.

2. ANALYSIS

2.1 THE AIRCRAFT

2.1.1 GENERAL

a) The aircraft was nearing the end of its airframe life limit as was determined by the manufacturer.

b) Contrary to ICAO Standard which requires this type of aircraft (large, passenger aircraft) to be equipped with a CVR that is capable of retaining at least the last two hours of recorded information, the CVR on the accident aircraft only had a capacity of half hour. As a result, recording of events that occurred earlier was not available. So, it was difficult to determine the earlier sequence of events.

c) With regard to the broken hydraulic lines, it was noted that these lines have a shelf-life when in storage, but once the lines are installed, they can continue in use as the shelf-life restriction is no longer in effect. However, there were no records available to track how long these items were held in storage before being installed on the aircraft.

d) The multiple systems failures and the lapse with the CVR were considered to be indicative of a trend of poor maintenance in the company.

e) Review of the aircraft records raises the question of adequacy of record keeping within the company. The purchase of spares to address undocumented defects was most unusual and gives cause for concern.

f) The airport emergency radio network was not working at the time of the occurrence.

2.1.2 EMERGENCY EQUIPMENT

a) There was no report of the ELT being activated.

b) The Cabin Crew reported that they accessed various pieces of emergency equipment.

c) The dislodging of the oxygen masks, dislocation of ceiling panels and opening of the overhead baggage bins along the right side of the cabin was noted, this was attributed to the impact during landing.

d) It was noted that some Cabin Crew reported that they were unable to release the clips that held the megaphones in place.

e) It was reported that the flashlights used by the Cabin Crew were malfunctioning and Cabin Crew were observed hitting them to get some level of luminance.

f) The aircraft's emergency lights were functional during the emergency.

2.1.3 EMERGENCY EXITS

1. It was noted that the original departure of the aircraft was delayed due to a malfunction of the L1 door slide light. The Cabin Crew reported being unable to open this door during the evacuation.
2. The Cabin Crew assigned to doors R4 and L4 (the two rear-most exits) reported that despite their best efforts, they only managed to push these doors ajar, consequently the slides associated with these doors did not deploy. It was not determined what prevented these doors from opening properly.

2.1.4 SUMMARY OF EVENTS/CONSEQUENCES

a) During departure, the Left Hydraulic System pressure was lost, due to a leak of unknown origin, and the flight crew shut off the Left EDP and Left ACMP, per Boeing's QRH.

b) Loss of Left Hydraulic System pressure resulted in loss of the Alternate Brake Function.

c) The PTU turned on automatically, when the left system pressure was lost, but the PTU could not pressurise the Left Hydraulic System, due to the system's fluid loss. By system design, the PTU should have subsequently shut off, but did not due to a latent failure of the PTU Control Circuit Pressure Switch. This resulted in the PTU running in a No-Load condition. There is no scheduled maintenance task to check for a latent failure of the PTU Control Circuit Pressure Switch. Boeing SB 757-29-0056 recommends installation of an enhanced pressure switch.

d) The PTU continued to run in a No-Load condition, which caused the Right Hydraulic System fluid temperature to increase. The increasing Right Hydraulic System fluid temperature eventually exceeded the set point of the right ACMP's overheat switch and a R ELEC HYD OVHT EICAS message was enunciated to the flight crew; however, the Right Hydraulic System fluid temperature remained below the set point of the Right EDP overheat switch. The flight crew turned off the right ACMP, per Boeing's QRH.

e) Turning OFF the Right system ACMP resulted in loss of the Reserve Brake Function.

f) At right engine power settings above flight idle, the EDP rotational speed was sufficient to provide an EDP output flow rate that was adequate to meet the aircraft systems demand on the right EDP, including the unexpected demand from the PTU operating in a No-Load condition. When the right engine power setting was reduced to flight idle, during flare and shortly before touchdown, the EDP output flow rate was no longer adequate to meet the aircraft systems demand on the right EDP, due to the unexpected demand from the PTU operating in a No-Load condition. This resulted in the loss of Right Hydraulic System pressure. Subsequent lab evaluations of the right EDP and the PTU found they operated within design parameters. Those lab evaluations took place at Eaton, at the direction of the NTSB.

g) Loss of Right Hydraulic System pressure resulted in loss of the Normal Brake Function, just prior to touchdown.

h) The airplane touched down with no Left or Right Hydraulic System pressure and the right ACMP was turned off. Therefore, the left and right thrust reversers, the ground spoiler panels, nose wheel steering, Normal Brakes, Alternate Brakes, and Reserve Brakes were not functional during rollout. Only brake system accumulator pressure was available for braking.

i) Brake Pedal pumping resulted in the loss of accumulator braking, before the aircraft was stopped, and the airplane departed the runway surface.

2.2 FLIGHT CREW

a) The Captain and First Officer were certified in accordance with both the JCAA and the FAA Regulations. There was no evidence of any pre-existing medical or behavioural conditions which might have adversely affected the Flight Crew's performance during the accident flight.

b) The flight and duty times for both Flight Crew were within accepted limits.

c) The Flight Crew had flown the route together on previous occasions and were familiar with each other and also with the route.

d) From conversations recorded on the CVR, the discussion between the Flight Crew was quite professional. The required briefings were done including:

   (i) briefing for the weather, the approach procedure for a RNAV-GPS approach and procedures for the possibility of a missed approach; and

   (ii) they considered the available landing distance at SYCJ, taking full consideration of the aircraft weight.

e) The Chief Pilot and the Deputy Chief Pilot both said that both Flight Crew were usually very professional.

2.3 THE COMPANY (FJA)

2.3.1 STAFFING GENERAL

a) The qualifications of the senior management staff were impressive. However, although well qualified and seemingly quite knowledgeable, it was apparent that these individuals were suppressed by the attitude of the Accountable Manager. They were appointed to positions but were not allowed to function effectively. From discussions, it became obvious that these staff were aware that several things were going wrong with the company and tried unsuccessfully to correct them. They generally expressed the hope that the situation would get better and operations at the company would improve.

b) Several senior staff indicated that they, individually and collectively, unsuccessfully attempted to hold interventions with the Accountable Manager to highlight problem areas in the company. He failed to heed advice given to him by them. They felt that he did not acknowledge the basic concepts of SMS.

He should have supported his management staff and actively supported and used the core principles of SMS to re-enforce values, establish expected behaviours, policies, and procedures, establish expected ways of thinking and most importantly, invest resources in the company. When articulating and re-enforcing values, it is necessary to disincentivise unacceptable behaviours; people must be held accountable for their behaviour, similarly acceptable behaviour should be incentivised by recognition. He should have been leading the entire company on a mission to seek continuous development and improvement for all its staff and the company.

2.3.2 OPERATIONS STAFF

Some senior staff expressed concerns about the availability of the Chief Pilot who was not resident in Jamaica and was away from Base most of the time. They expressed the opinion that because he was not co-located with other Pilots at the company's head office in Jamaica, meant that he was not available to manage his team and to deal with issues that may have affected the other Pilots. These senior staff also noted that the Chief Pilot was doing a lot of flying, including, Check and Training Captain duties, which takes up most of his time thus not allowing him to perform his administrative duties of Chief Pilot. This also made it difficult to track his flight and duty times limitations. With involvement of the JCAA, the company appointed a Senior Pilot as Assistant Chief Pilot, who was also doing duty as Check and Training Captain. He was assigned the same duties as the Chief Pilot. This was not a satisfactory solution.

2.3.3 MAINTENANCE

Although the procedures for the EMS were explicit in the approved MCM and gave the Director of Maintenance authority over several levels of line maintenance staff. The Director of Maintenance found it difficult to function effectively because the line staff were able to bypass him and go directly to the Accountable Manager. This encouraged junior staff to be disrespectful to the Director of Maintenance and his efforts to enforce adequate maintenance procedures were undermined. However, these views were disputed by the maintenance staff in Guyana and also by the Accountable Officer.

The Quality Assurance Manager carried out regular company audits, but he did not always get the desired response from maintenance or from higher management. It was these unsatisfactory responses that forced him to approach the JCAA to resolve several issues.

Both the Director of Maintenance and the Quality Assurance Manager agreed that the company was lacking in both quantity and quality of maintenance staff. Large airlines should have both a quality assurance system and quality control system. Both systems were not up to the required strength in FJA. Quality control polices in the maintenance system should capture problems before they occur by means of inspections. While quality assurance has an audit plan and will capture a problem after the fact by checking records, stores, etc. It is believed that the weaknesses in both areas was largely due to staffing constraints. Both managers indicated that attempts were being made to correct this by adding suitable staff. The lack of adequate staffing had also been noted in a JCAA Audit report.

2.4 THE JAMAICA CIVIL AVIATION AUTHORITY (JCAA)

It is believed that the JCAA may have lost some control of FJA. It is believed that a shortage of suitably qualified staff may have contributed to the failure of JCAA to exercise adequate authority over FJA at a critical time in its development.

2.5 AIR TRAFFIC SERVICES – GUYANA

a) It was obvious that the Air Traffic Controllers on duty were not aware of the Flight Crew's workload during the various phases of flight. Awareness of how busy and hectic the cockpit environment becomes during an emergency would ensure that Air Traffic Controllers do not, unnecessarily, disturb or interrupt the Flight Crew to obtain non-essential information.

b) Apart from simulated crash exercises, which are conducted by the CJIA, the Air Traffic Services management should conduct regular exercises to keep the various emergency services up to date about their roles and functions in event of an emergency.

2.6 SEQUENCE OF EVENTS

Using a combination of information gathered from the CVR, FDR and interviews, it was determined that the left hydraulic system failed, this influenced the decision made by the Flight Crew to return to SYCJ. Subsequently the right electrical hydraulic pump overheated, and this was turned off, the pump eventually cooled, but there was no requirement for this pump to be turned back on. With a failed left hydraulic system, the aircraft would not have alternate brakes, no left reverse thrust and no nose wheel steering. The numbers computed by the Flight Crew were within the operational limits of the aircraft and confirmed that the aircraft could land safely at SYCJ. The computations considered that only brakes would be used to stop the aircraft. Any other stopping mechanisms such as reverse thrust, or deployment of spoilers were considered to be extra assets.

The landing was briefed to be done with 20° flaps, no doubt taking into consideration the possibility of an overshoot or a balked landing. With the 20° flaps, the Captain correctly briefed for a fast landing and maximum manual braking. However, on touchdown the right hydraulic pressure dropped to zero psi, indicating failure of the right hydraulic system. At this point the emphasis should have been only on stopping the aircraft, the pilot attempted to use right reverse thrust to do this, but it was not available due to the failure of both hydraulic systems.

At this point of the flight, it was apparent that the Captain gave up all hope, he said that he felt like a 'passenger on the aircraft'. He did not see the brake source light. If the switch located just below the brake source light was activated immediate braking would have been available, even with a total hydraulic failure, and may have stopped the aircraft on the runway and prevent the excursion. However, it was noted that this possibility was not briefed during the entire process, which suggested that this method of stopping the aircraft was never considered since this switch was not required to be operated in this phase of flight (according to the checklist).

The CVR data indicated that during the flight there was excellent coordination between the Flight Crew. However, the totally unexpected failure of the right hydraulic system at a crucial time, just at touchdown as indicated by the FDR, would have taken the Flight Crew by surprise. The suddenness of this occurrence may have affected the Flight Crew's ability to react.

It is believed that the Flight Crew's mind set for maximum manual braking, may have contributed to loss of situational awareness after the aircraft touched down.

3. CONCLUSION

3.1 MAJOR CAUSE

Loss of hydraulic fluid, failure of the pressure switch and subsequent total failure of the hydraulic system (firstly the left and subsequently the right) which affected the deployment of some spoilers, thrust reversers and efficacy of the main brakes caused the aircraft to continue the landing roll at a high-speed resulting in an overrun and excursion and severe damage to the aircraft.

3.2 CONTRIBUTING FACTORS

a) Flight Crew lost main brakes after 'pumping the brakes' several times which bled off main brake pressure, and their failure to use accumulator brake that was available at the time to stop the aircraft after losing the main brakes.

b) Setting the flaps to 20^{o} instead of landing flap configuration. This resulted in a higher landing speed and roll and with the combination of loss of main brake pressure due to "pumping" the brakes rather than applying and holding the brakes made it difficult to stop the aircraft on the runway.

c) Maintenance deficiencies and inadequate maintenance actions regarding the hydraulic system. Leaking hydraulic system. FDR readings indicated a trend of hydraulic system difficulties, more so, during the previous 6 flights before the accident. These maintenance lapses may have led to further deterioration and loss of the hydraulic systems.

d) Poor FJA maintenance quality assurance and quality control may have led to the maintenance deficiencies which may have contributed to the ineffective resolution of the hydraulic system leakages and other hydraulic system maintenance issues indicated by the FDR.

e) FJA management's lackadaisical attitude and bypassing recommendations from the Director of Maintenance and Quality Assurance Manager may have led to bad culture, unsafe practices and may have furthered improper maintenance.

(e) Management's interference may have had an adverse effect on maintenance and safety practices generally.

f) The soft mud and loose sand in the overrun area contributed to damage to the aircraft during the excursion.

4. RECOMMENDATIONS

FLIGHT CREW

a) Under circumstances when there is a hydraulic or other system failure(s) which could affect the aircraft performance, or operation of critical system(s), the Flight Crew should be prepared and declare an emergency since there is the potential of a disaster or catastrophe. They should take into consideration a worst-case scenario when met with this kind of situation, especially on commercial flights with large volume of passengers.

b) Under similar circumstances, Flight Crew should advise Cabin Crew to initiate the emergency drill and prepare passengers for an emergency landing.

CABIN CREW

c) Cabin Crew must initiate the emergency drill and prepare and brief passengers for an emergency landing under this and similar circumstances.

d) Cabin Crew should be prepared for any outcome after an aircraft accident.

AIRLINE (FJA)

e) Noncompliance with Boeing Service Bulletin SB 757-29-0056. Failure of the pressure switch is a known occurrence and the subject of, which recommends installation of an enhanced pressure switch.

f) Airlines must not compromise maintenance and safety. They must encourage a just culture, adequate SMS and not interfere in, or encourage maintenance shortcuts which can lead to deficiencies. Management and staff should be able to perform their duties in accordance with the approved manuals and without interference from management.

g) Airline operations staff and station managers must be trained to handle aircraft emergencies and be able to properly brief passengers after an accident or serious incident, able to gather them in a safe area, carry out a head count and ensure all passengers and crew are accounted for.

h) Airlines should ensure that aircraft emergency equipment is serviceable and there is adequate quantity for use during an emergency.

MAINTENANCE

i) Maintenance must never be compromised for any reason. Maintenance must be scheduled and carried out as required by the approved maintenance manual and check sheets.

j) For aging and old aircraft there should be a Reliability Programme which must be adhered to at all times. Leaking and age decaying hydraulic hoses should be replaced to enhance and guarantee integrity of the hydraulic system.

AIRPORT RESCUE AND FIRE FIGHTING SYSTEM - ARFFS

k) ARFFS should be prepared for aircraft emergencies at all times and staff should be trained to handle all types of aircraft and airport emergencies at the aerodrome.

l) Communication devices at the ARFFS offices and on its equipment must always be fully functional and in appropriate quantities.

m) ARFFS should have frequent or at least regular emergency drills to prepare them for any eventuality and emergency.

n) ARFFS staff must be properly trained in first response approaches, procedures and first aid.

PORT HEALTH

o) All International Airports should have a functional Port Health that is adequately staffed with qualified medical personnel and there must be always adequately trained personnel present at the airport and at their station.

p) Port Health must also be in a state of readiness to take care of casualties and injured persons should there be an accident or serious incident. They must be able to administer first aid and treat the injured until they are taken to a hospital for further assessment and treatment.

AIRPORT

q) Airports should conduct regular inspections to ensure that Airlines, ARFFS and other entities at the Airport are fully prepared for an aircraft accident, or serious incident and any other aviation related emergencies on the aerodrome.

r) Communication devices at Airports, including the different Sectors that are required to participate during an emergency must be fully functional and their devices and equipment are always serviceable. Reasons for unserviceability or non-responsiveness of airport emergency radio network should be determined and addressed and personnel should be given timely and adequate training, including, initial, recurrent, on-the-job, and specialised training, as necessary.

s) All International Airports should have a functional Port Health that is adequately staffed with qualified medical personnel and there must be always adequately trained personnel present at the airport and at their station to handle any aircraft emergency.

t) Airport staff must be trained to handle an aircraft emergency and be able to properly brief passengers after an accident or serious incident.

u) Airports must have adequate shuttle busses or other such transportation to move passengers to a safe place, most likely, in the terminal building or a designated area, where they can be briefed and comforted and counted. ***Passengers should not have to walk from the crash site at an airport to the terminal***.

v) Airports should have proper and adequate space (a designated area) to comfortably accommodate passengers after a crash or serious incident, have Port Health facilities to assess any injury, carry out first aid and make arrangements to transport the injured to a hospital and make hotel arrangements for those passengers who need accommodations.

HOSPITAL & MEDICAL FACILITIES

w) Hospitals and medical facilities that are required to provide medical emergency services to an aircraft accident must be aware of the role of that agency in an emergency of this nature.

CIVIL AVIATION AUTHORITY

x) The JCAA and the GCAA must ensure that there is regular and adequate oversight, including ramp inspections of aircraft, operational and maintenance audits.

y) The JCAA and the GCAA must ensure that they have at all times adequately trained and qualified Inspectors to carry out its oversight functions and monitor Airline operations under their jurisdiction, and if necessary, increase their oversight frequencies when Airlines shows signs of non-adherence and breaches of regulatory requirements.

z) The JCAA and the GCAA should ensure that CVRs, FDRs and emergency and safety equipment meet and comply with the latest regulatory requirements.

aa) The JCAA should ensure that all required areas of the 5-Phase System for approval and certification of an Air Operator (and other entities requiring certification) are not compromised and are fully met before the Certificate is issued. There must be coordination amongst the various Inspectorates involved in the process and where concerns are highlighted by any Inspector or Inspectorate involved in the process, it must be given consideration and all concerns/issues must be resolved amicably before the Certificate is issued.

bb) The GCAA should ensure that all local regulatory requirements are met, and that the AOC was carried out in accordance with the regulatory 5-phase process by the State of the Operator before it issues a Foreign Operations Specifications to a foreign air operator.

cc) The JCAA and GCAA must ensure that all recommendations under a) to aa) above and any other recommendations contained in this Report are taken into consideration and implemented in a timely manner.

--END--