FINAL REPORT

LEARJET 35A, REGISTRATION RP-C5354
RUNWAY OVERRUN ACCIDENT
AT SINGAPORE SELETAR AIRPORT
ON 21 AUGUST 2007

AIB/AAI/CAS.043

Air Accident Investigation Bureau of Singapore
Ministry of Transport
Singapore

5 October 2011

The Air Accident Investigation Bureau of Singapore

The Air Accident Investigation Bureau (AAIB) is the air accidents and incidents investigation authority in Singapore responsible to the Ministry of Transport. Its mission is to promote aviation safety through the conduct of independent and objective investigations into air accidents and incidents.

The AAIB conducts the investigations in accordance with the Singapore Air Navigation (Investigation of Accidents and Incidents) Order 2003 and Annex 13 to the Convention on International Civil Aviation, which governs how member States of the International Civil Aviation Organization (ICAO) conduct aircraft accident investigations internationally.

In carrying out the investigations, the AAIB will adhere to ICAO's stated objective, which is as follows:

> *"The sole objective of the investigation of an accident or incident shall be the prevention of accidents and incidents. It is not the purpose of this activity to apportion blame or liability."*

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GLOSSARY ABBREVIATIONS

ATPL	Airline Transport Pilot Licence
CVR	Cockpit Voice Recorder
FDR	Flight Data Recorder
PF	Pilot Flying
PIC	Pilot-in-command
PNF	Pilot-Not-Flying

SYNOPSIS

At 0230 hours (local time) on 21 August 2007, a Learjet 35A aircraft, registration RP-C5354, landed at the Singapore Seletar Airport. During the landing, the pilot flying flared the aircraft early which resulted in the aircraft landing beyond the normal touchdown area. The crew could not stop the aircraft before the end of the runway. Aware that there was a water channel beyond the end of the runway, the crew decided to veer the aircraft onto the grass area just before the end of the runway. The aircraft came to a stop on the grass area at the intersection of Runway 03 and Taxiway W1. The nose wheel of the aircraft broke when it hit an electrical box. The passengers and crew members were not injured.

The occurrence was classified as an accident by the Air Accident Investigation Bureau of Singapore.

AIRCRAFT DETAILS

LEARJET 35A

Aircraft type	: Learjet 35A
Operator	: Pacific East Asia Cargo Airlines, Inc
Registration	: RP-C5354
Number and type of engines	: Two TFE731-2-2B
Place	: Grass verge at the intersection of Runway 03 and Taxiway W1, Seletar Airport
Date & Time (Local time)	: 21 August 2007 at 0230 hours
Type of flight	: Non-scheduled, revenue
Persons on Board	: Crew - two Passengers - five
Point of Departure	: Medan, Indonesia
Destination	: Singapore

1 FACTUAL INFORMATION

All times used in this report are Singapore times. Singapore time is eight hours ahead of Coordinated Universal Time (UTC).

1.1 History of the flight

1.1.1 At 0230 hours on 21 August 2007, a Learjet 35A aircraft arrived at Seletar Airport from Medan, Indonesia. The Learjet 35A was operating a non-scheduled revenue flight for medivac purposes. There were five passengers and two flight crew members on board. The Pilot-in-command (PIC) was sitting in the right hand seat and was the Pilot-Not-Flying (PNF). Another pilot was sitting in the left hand seat, he was the Pilot-Flying (PF).

1.1.2 On approaching Seletar Airport, the aircraft was cleared for an approach to Runway 21. By the time the aircraft became visual with Runway 21, it was too high to conduct the approach and the flight crew requested to fly overhead for a circuit to land.

1.1.3 The air traffic controller then offered the flight crew the option to join the downwind leg[1] for Runway 03. The flight crew accepted the option and attempted to land on Runway 03.

1.1.4 However, while manoeuvring to land on Runway 03, the flight crew assessed that they were too high. They decided to conduct a missed approach for another landing onto Runway 03.

1.1.5 While the aircraft was approaching Runway 03, the PF flared[2] the aircraft early in such a way that it floated. The PIC who was the PNF told the PF not to let the aircraft float and to land as soon as possible. The PF reacted accordingly. The aircraft landed long on the runway, beyond the touchdown zone markings.

1.1.6 After touchdown, the PF maintained the aircraft on the runway centreline but felt the aircraft was going too fast. He applied full manual braking. Both the PNF and PF could not recall deploying the spoilers during the landing roll. The investigating team found during their post-accident inspection of the aircraft that the spoiler switch was in the off position. According to the PIC, the spoilers were not deployed because the flight crew was preoccupied with the function of stopping the aircraft with only the manual brakes.

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[1] The downwind leg is a course flown parallel to the landing runway, but in a direction opposite to the intended landing direction.

[2] A manoeuvre carried out just before touchdown to reduce the rate of descent, so that the aircraft settles on the runway smoothly and with the least amount of vertical speed.

1.1.7 The aircraft was approaching the runway end and the flight crew decided to veer the aircraft to the left towards the grass area and tried to stop the aircraft on the grass area as they were aware of a water channel beyond the end of Runway 03.

1.1.8 The nose wheel was found on the grass in close proximity to the aircraft. There were no gouges or markings on the paved runway surface. This suggests that the nose gear broke after the aircraft had left the paved runway surface (see **Figure 1**).

Figure 1. Aircraft nose wheel broken from its axle

1.1.9 The aircraft came to a stop at the intersection of Runway 03 and Taxiway W1 (see **Figures 2** and **3**).

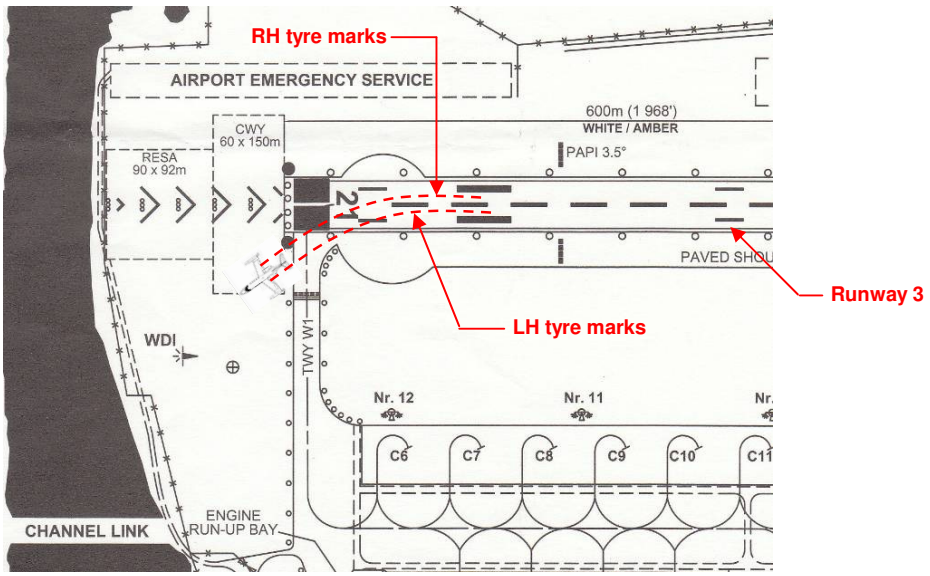

Figure 2. Aircraft path off Runway 3 to the grass verge

Figure 3. Aircraft on grass verge

1.2 Injuries to persons

1.2.1 All five passengers and two crew members evacuated safely. There was no injury.

1.3 Damage to aircraft

1.3.1 There was no fire. The aircraft suffered damage to the nose gear, nose gear doors, radome, nose lower structure, pilots' windshield. The nose, forward and aft fuselage of the aircraft had signs of wrinkled deformation. There were also crack marks on the ventral fin and the vertical stabiliser (see **Figure 4**).

Figure 4. Nose gear collapsed

1.4 **Other damage**

1.4.1 Two aerodrome runway edge lights and an electrical box at the edge of the runway were damaged.

1.5 **Personnel Information**

1.5.1 Pilot in Left Hand Seat (PF)

Age	:	41
Licence	:	Airline Transport Pilot Licence (ATPL) issued by the Philippines Air Transportation Office (ATO)
Aircraft ratings	:	B737-200 Temporary Airman Certificate – Issued to "build up time/transition for additional rating on Learjet 35/36 aircraft, renewal of ATPL and checkride."
Total flying experience	:	4444.92 hours
Flying experience on type	:	39.85 hours
Licence expiry date	:	31 August 2007
Last medical check	:	1 June 2007

1.5.2 Pilot in Right Hand Seat (PIC/PNF)

Age	:	58
Licence	:	ATPL issued by the Philippines ATO, validated based on USA FAA Temporary Airman Certificate
Aircraft ratings	:	Learjet 35A
Total flying experience	:	8790.75 hours
Flying experience on type	:	43.23 hours
Licence expiry date	:	31 October 2007
Last medical check	:	3 April 2007

1.5.3 The PIC was the PNF. He did not have a flight instructor rating. He had only obtained his Learjet 35A rating on 26 July 2007 and he was aware that he was not exercising any instructor role during the flight. The investigators were unable to obtain a reply from the operator as to whether it knew that the PIC did not have a Learjet 35 instructor rating.

1.5.4 The operator knew that the PF had only a Temporary Airman Certificate. However, according to the PIC, he did not know that the PF had only a Temporary Airman Certificate. He told the investigators that he was aware that the operator had hired the PF for a future command position, that when the PF reported for the flight he was dressed as a captain, and that when he asked the PF, the PF presented himself as having flight experience on a Boeing 737 aircraft and as a captain on a

Beechcraft aircraft. The PIC, basing on this information by the PF, chose[3] to occupy the right hand seat and offered the left hand seat to the PF so that the PF could start gaining experience for his future command appointment.

1.5.5 When the PF's ATPL (with a rating on the Boeing 737 aircraft) expired on 30 June 2007, he was issued with a Philippine Air Transportation Office (ATO) Temporary Airman Certificate (covering the period from 24 July 2007 to 31 August 2007) to enable him to build up flight time/transition for additional rating on the Learjet 35A aircraft at a later stage and after passing the necessary check flight. The Temporary Airman Certificate did not allow the PF to perform duty as a pilot-in-command or as a co-pilot. It only allowed him to accomplish his training on the left hand seat of a Learjet 35A that is not on a commercial or revenue flight, provided he is accompanied by a Learjet 35A rated flight instructor. The PF apparently was not aware of these restrictions associated with his Temporary Airman Certificate. The PIC was even not aware that the PF had only a Temporary Airman Certificate. The PF had completed a Learjet 35A ground and simulator course on 12 August 2007 and had accumulated a total of 39.85 hours on Learjet 35A, all without a flight instructor present. At the time of the accident, the PF had yet to be checked out on Learjet 35A by a Philippine ATO.

1.5.6 According to the operator, both pilots were duly licensed to fly as Learjet 35A crew members and they were authorised by the operator to fly together on international or regional routes.

1.6 Aircraft information

1.6.1 The aircraft involved in the accident had a valid Certificate of Airworthiness.

1.6.2 The following was clarified by the Philippine ATO (the regulatory authority):

(a) The aircraft was registered under the General Aviation (GA) category.

(b) GA category aircraft operated under the Philippine ATO AO No. 91 as primary category aircraft.

[3] According to the Philippines ATO's Administrative Order (AO) No. 91 ("General Flight and Operating Rule") under which the aircraft was operating, the PIC of the aircraft was the final authority to the operation. AO No. 91 stated with regard to the powers of the pilot-in-command:

91.3 Responsibility and authority of the pilot-in-command:
(a) The pilot-in-command of an aircraft is directly responsible for, and is the final authority to the operation of that aircraft.

(c) Primary category aircraft were not meant to be used for revenue flights, as stated in Section 91.325[4] of the AO No. 91.

(d) GA category aircraft were not subject to regular oversight audits by the ATO's airworthiness inspectors. However, operators were required to keep maintenance and inspections records and to present these records to the ATO when requested.

1.7 Meteorological Information

1.7.1 The accident occurred at night. The air traffic controller reported that the wind was light and variable around the time of the accident. There was no precipitation.

1.8 Aids to navigation

1.8.1 The navigation aids at Seletar Airport were working normally at the time of the accident.

1.9 Communications

1.9.1 The aircraft was in contact with Seletar Tower. The communications between the ATC and the flight crew were normal.

1.10 Flight recorders

1.10.1 The details of the aircraft's cockpit voice recorder (CVR) and flight data recorder (FDR) are as follows:

CVR:
Model: Fairchild
Part number: A100A
Serial number: 1275

FDR:
Model: Fairchild F800
Part number: 17M903-282
Serial Number: 06080

1.10.2 The CVR and FDR were removed from the aircraft by the investigators.

1.10.3 The CVR was downloaded and read out in the AAIB recorder laboratory.

[4] AO No. 91 stated:

Section 91.325 Primary category aircraft: Operation limitations
(a) No person may operate a primary category aircraft carrying persons or property for compensation or hire.

1.10.4 The FDR data was downloaded and approximately 9.5 megabytes of raw data for 25 hours of flight were obtained. However, the operator could not provide the parameter allocation and conversion equation documentation for the accident aircraft to enable the investigation team to convert the raw data to meaningful engineering units. The FDR had been fitted to the aircraft prior to the operator's acquiring the aircraft. The aircraft manufacturer also could not provide the parameter allocation and conversion equation documentation as the FDR was not fitted to the aircraft by the aircraft manufacturer. Without the parameter allocation and conversion equation documentation, the investigators attempted to decode the raw data assuming an industry standard format, but to no avail. Thus, the FDR's functionality could not be determined. It is noted that there is no record of FDR functionality check since at least 15 July 2005.

1.10.5 The investigation team assessed that, as the testimonies from the flight crew members were consistent with the events of the accident, it was not necessary to pursue the recovery of the FDR parameters.

1.11 Medical/Toxicological Information

1.11.1 The flight crew was sent for medical/toxicological examinations. The examination results were normal.

1.12 Tests and Research

1.12.1 The aircraft was towed to a hangar after the accident. The following checks were carried out by the investigation team:

(a) The hydraulic fluid level of the normal brake system was found to be normal.

(b) The accumulator pressure of the emergency brake system was found to be normal.

(c) The normal and emergency brake systems were found to be operating correctly.

1.13 Additional Information

1.13.1 The international Civil Aviation Organisation (ICAO) introduced a standard in Annex 6 to the Convention on International Civil Aviation entailing a requirement for air operators to implement a safety management system (SMS) by 1 January 2009. At the time of the accident, the operator concerned did not have a SMS in place, nor was it a requirement of the Philippines ATO for its air operators to have a SMS in place.

1.13.2 According to the Philippine ATO, it conducted surveillance audit of the operator every two months and safety audit every six months.

1.13.3 The investigation team has probed into areas concerning the operator's flight and safety oversight operations. The investigation team has written to the operator to ask for information on, among others, the following:

- Does the operator have a safety department responsible for the safety oversight process for the flight operations and flight crew qualifications?
- How did the operator determine that the two pilots were duly licensed to fly as flight crew members of the aircraft?
- The PNF was the PIC. How did he determine that the PF was eligible to sit on the left hand seat? Does the operator have standard operating procedures (SOP) against which the PIC may check to determine if another flight crew member was allowed to sit on the left hand seat?
- Did the operator know that PF's temporary Airman Certificate did not allow the PF to perform duty as a pilot-in-command or as a co-pilot, and only allowed the PF to accomplish his training on the left hand seat of a Learjet 35A that was not on a commercial or revenue flight, provided he is accompanied by a Learjet 35A rated flight instructor?
- How has the operator improved the oversight processes after the accident?

However, repeated attempts by the investigation team to contact the operator to gather the information were not successful.

1.13.4 On 4 March 2008, the Philippine ATO was restructured and became the Civil Aviation Authority of the Philippines (CAAP).

1.13.5 According to the CAAP, the air operating certificate (AOC) of the operator has been suspended since 19 March 2010. The AOC was suspended as the operator did not meet some newly introduced Philippine civil aviation regulations.

2 DISCUSSION

The aircraft's brake system operated normally and was not a factor in the accident. There is no evidence to suggest any aircraft system malfunction that could be a factor in the accident. The investigation team focused on the following:

(a) Aircraft handling
(b) Flight recorder readout
(c) Safety Management

2.1 Aircraft handling

2.1.1 The aircraft landed on its second attempt. The first attempt was aborted as the aircraft was high. Even on the second attempt, the aircraft landed long. All these could be a reflection of the inexperience of the pilots, who had only low hours on Learjet 35A, notwithstanding the fact that they had flown more complex aircraft before[5].

2.2 Flight recorder readout

2.2.1 The investigation team was able to download the FDR raw data. The investigation team needed the flight recorder parameter allocation and conversion equation documentation to interpret the FDR raw data. However, the operator was not able to provide the relevant documentation. This was not in line with ICAO standards and recommended practices.

2.2.2 Chapter 6.3.12 of Part I of Annex 6[6] to the Convention on International Civil Aviation requires that operational checks and evaluation of recordings from the FDR system shall be conducted to ensure the continued serviceability if the recorders. Paragraph 1.3.4 of Attachment D to Annex 6 requires that the parameter allocation and conversion equation documentation, which will enable accident investigation authorities to read out the FDR raw data in engineering units, should be maintained by the operator. Paragraph 3.4 of Attachment D implies that inspections of the FDR system should be conducted annually. In this regard, it would appear that the operator did not satisfy the above-mentioned requirements in Annex 6 and its Attachment D.

[5] The PIC had flown McDonnell Douglas DC-10 and the PF Boeing 737 aircraft before.
[6] Eighth edition July 2001. Current edition July 2010.

2.3 Safety management

2.3.1 The investigation revealed the following:

- The aircraft was used for revenue flight at the time of the accident whereas, as a GA category aircraft operating under the Philippine ATO AO No. 91, it was not supposed to be used for such flight.
- The PF was not qualified to fly the aircraft for revenue flight and had been building up flying hours on Learjet 35A without an instructor, as was required.
- The operator somehow determined that the two pilots were duly licensed to fly as flight crew members of the aircraft and authorised them to fly together on international or regional routes.

2.3.2 What the investigation had found, as indicated in paragraph 2.2.1, and the unanswered questions identified in paragraph 1.13.3 suggest a profound lack of quality of the operator's flight and safety oversight operations. The operator appeared not to know the Philippine ATO's regulations or, if the operator did know, not to have a system to ensure compliance with the regulations. A proper implementation of a safety management system by the operator would presumably prevent such a situation.

3 SAFETY RECOMMENDATIONS

3.1 The operating certificate of the operator has been suspended by the CAAP. In view of this, this report is not making any specific safety recommendation to the operator.

3.2 However, it is recommended that, before any lifting of the suspension of the operator's operating certificate, the CAAP ensure that the operator has implemented, among others, a robust safety management system. [AAIB Recommendation R-2011-003]

3.3 It is further recommended that the CAAP ensure that the Philippine air operators have the necessary parameter allocation and conversion equation documentation for all their aircraft so that the documentation can be provided to accident investigation authorities, when needed, for the readout of FDR raw data in engineering units. [AAIB Recommendation R-2011-004]