SERIOUS INCIDENT REPORT 1/2017

ACCIDENT INVESTIGATION DIVISION

Civil Aviation Department
The Government of
Hong Kong Special Administrative Region

Report on the Serious Incident to Gulfstream Aerospace G550
Registration B-8256 Operated by
Hanergy Jet Company Limited
During the Approach into
Hong Kong International Airport, Hong Kong
on 13 January 2015

Hong Kong
June 2017

In accordance with Annex 13 to the Convention on International Civil Aviation, the sole objective of this investigation is the prevention of aircraft serious incidents or accidents. It is not the purpose of this activity to apportion blame or liability.

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GLOSSARY OF ABBREVIATIONS USED IN THIS REPORT

AP	Autopilot
AMSL	Above Mean Sea Level
ATC	Air Traffic Control
CAAC	Civil Aviation Administration of China
CCAR	China Civil Aviation Regulations
CAD	Civil Aviation Department
CAS	Crew Alerting System
CAST	Center of Aviation Safety Technology
CMC	Central Maintenance Computer
CRM	Crew Resources Management
CVR	Cockpit Voice Recorder
DFDR	Digital Flight Data Recorder
FHDB	Fault History Database
ft	feet
ft/min	feet per minute
GAC	Gulfstream Aerospace Corporation
GPWS	Ground Proximity Warning System
G-V	Gulfstream G-V series aircraft types including G550
HHG	Hanergy Jet Company Limited
hPa	hectopascal (equivalent unit to mb)
IFR	Instrument Flight Rules
ILS	Instrument Landing System
kg	kilogram(s)
km	kilometre(s)
kt	knot(s)
m	metre(s)
nm	nautical mile(s)
NTSB	National Transportation Safety Board
PF	Pilot Flying
PFD	Primary Flight Display
PM	Pilot Monitoring
QAR	Quick Access Recorder
QNH	Pressure setting to indicate elevation above mean sea level
RA	Radio Altitude
UTC	Co-ordinated Universal Time

VFR	Visual Flight Rules
VHHH	Hong Kong International Airport
ZBAA	Beijing Capital International Airport

ACCIDENT INVESTIGATION DIVISION

CIVIL AVIATION DEPARTMENT

Serious Incident Report 1/2017

Registered Owner:	Hanergy Jet Company Limited
Operator:	Hanergy Jet Company Limited
Aircraft Type:	Gulfstream Aerospace GV-SP (G550)
Nationality:	Chinese
Registration:	B-8256
Place of Incident:	About 11 nautical miles south-west of Hong Kong International Airport
Date and Time:	13 January 2015 at 0237 hours (1037 hours Hong Kong local time)
	Remarks: All times in this report are in UTC. *Hong Kong time is UTC+8 hours*

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SYNOPSIS

On 13 January 2015, a Hanergy Jet Company Limited (HHG) G550 aircraft, registration mark B-8256, operated from Beijing Capital International Airport (ZBAA) to Hong Kong International Airport (VHHH) with flight number HHG305. The flight was a company ferry flight.

The pilot-in-command was the 'Pilot Flying' (PF) in the left-hand seat while the co-pilot was the 'Pilot Monitoring' (PM) in the right-hand seat. Another company captain was at the observer seat in the flight deck during the approach. When HHG305 was about 11 nautical miles (nm) southwest of the VHHH, the Air Traffic Control (ATC) issued a clearance for it to descend to 2,000 feet (ft) above mean sea level (AMSL) and to intercept the instrument landing system (ILS) of Runway 07L.

At 0237 hours, when the aircraft was about 1 nm to intercept the localizer of the ILS for Runway 07L, it began to lose height quickly from around 2,000 ft AMSL to about 500 ft AMSL at its lowest when it was about 7 nm to Runway 07L. The Ground Proximity Warning System (GPWS) warning on board the aircraft was triggered in the process. The aircraft then carried out a missed approach and landed uneventfully on its second approach. There was no injury or damage to the aircraft involved, and the surrounding air traffic was not affected.

The Civil Aviation Department (CAD) was informed of the occurrence on 13 January 2015 via occurrence report from Hong Kong ATC. The occurrence was subsequently classified as a serious incident and an investigation was instituted in accordance with the International Civil Aviation Organisation (ICAO) Annex 13. The fundamental purpose of this investigation is to determine the circumstances and causes of the incident with a view to the preservation of life and the avoidance of similar incident in future; it is not the purpose to apportion blame or liability.

The Civil Aviation Administration of China (CAAC), representing the State of Registry and the State of the Operator, and the National Transportation Safety Board (NTSB) of the United States, representing the State of Design and the State of Manufacture of the aircraft involved, have appointed Accredited Representatives to take part in the investigation. HHG and Gulfstream Aerospace Corporation (GAC) also participated in the investigation as the corresponding adviser of CAAC and NTSB respectively.

The following causal factors were identified:-

1) It is probable that during the critical phase of approach, pilot's inadvertent input was applied to the elevator trim switch causing the Autopilot to disengage and the pitch trim to move to full nose-down limit. The trim balance on the aircraft's pitch was upset leading to a nose-down pitch moment.

2) The pilots at the control did not recognise the Autopilot disengagement and pitch trim status through the flight control response or the Flight Control Synoptic display in a timely manner. Vital time was lost in comprehending the situation which resulted in an excessive rate of descent.

3) Necessary recovery actions by the pilots were hindered due to ineffective Crew Resources Management, which consequentially escalated the height loss situation.

The Investigation Team has made two safety recommendations.

1. FACTUAL INFORMATION

1.1. History of the flight

1.1.1. On 13 January 2015, a HHG G550 aircraft (the "Aircraft"), registration B-8256 with flight number HHG305, was operated on a company ferry flight from ZBAA to VHHH. The flight departed ZBAA at 2300 hours on 12 January 2015. The flight was uneventful until approach to VHHH.

1.1.2. At 0235 hours on 13 January 2015, the aircraft was about 11 nm southwest of the VHHH. It was cleared by the ATC to descend to 2,000 ft AMSL and to intercept the ILS of Runway 07L.

1.1.3. At 0237 hours on 13 January 2015, the aircraft was levelling at approximately 2,000 ft AMSL with both Autopilot (AP) and Autothrottle (AT) engaged and was heading 040 to intercept ILS 07L at about 9.3 nm from VHHH. Subsequently the AP was disengaged with the pitch trim moved and reached full nose-down position. According to the Digital Flight Data Recorder (DFDR) readout, the aircraft pitch angle dropped significantly and began to lose altitude quickly with vertical speed peaked at 3,801 feet per minute (ft/min). The Ground Proximity Warning System (GPWS) alerts and warnings were triggered at 1,583 ft Radio Altitude (RA) and 692 ft RA respectively.

1.1.4. PF stated in the interview that during the event he had major difficulties in raising the aircraft pitch angle to arrest the loss of altitude as the control wheel was unusually heavy to pull. Apart from the PM's effort in pulling the control wheel on his side, the relief pilot from the observer's seat also leaned forward and tried to help by pulling the control wheel on the PF side as well as advancing the thrust levers. They eventually managed to pull the control wheel sufficiently to regain control of the aircraft attitude.

1.1.5. According to the DFDR data, the aircraft radio altimeter had registered the lowest of 499 ft RA at about 7 nm to Runway 07L. It also recorded a time frame of 48 seconds from the disengagement of the AP until the aircraft recovered positive rate of climb during the go-around manoeuvre. ATC vectored the aircraft for another approach and it landed uneventfully on its second approach onto Runway 07L.

1.1.6. After the aircraft landed in VHHH, flight crew reported in the aircraft Flight Log Book potential operational problem with the horizontal stabilisers. Maintenance actions were then carried out on the ground including visual checks on the horizontal stabilisers, elevators and flaps with no abnormalities found. Functional checks of the horizontal stabilisers and elevators were also conducted by the engineer and found satisfactory.

1.1.7. The aircraft then departed VHHH at 0625 hours after the incident, returning to ZBAA and was reported to have landed at 0945 hours, without event.

1.2. Injuries to Persons

There was no injury to any person.

1.3. Damage to Aircraft

There was no damage to the aircraft.

1.4. Other Damage

There was no damage resulted from the incident.

1.5. Personnel Information

1.5.1. Pilot in Command, Captain

Sex / Age	:	Male / Aged 48
Licence	:	Airline Transport Pilot's Licence issued by CAAC, perpetual with no expiry date
Aircraft ratings	:	B-737, B-747, B-777, G-V (G550)
Date of first issue of aircraft rating on type	:	15 September 2012
Date of last proficiency check on type	:	29 September 2014 valid till 28 March 2015
Date of last line check on type	:	17 September 2014 valid till 16 September 2015

ICAO Language Proficiency	:	Level 4 valid till 29 August 2016
Medical Certificate	:	Class 1 valid till 16 December 2015
Limitation	:	Near vision correction Part CCAR-121 inhibited

Flying Experience:

Total all types (Hours:Mins)	:	13 619 hours
Total on type (Hours:Mins)	:	283 hours
Total in last 90 days (Hours:Mins)	:	61 hours
Total in last 30 days (Hours:Mins)	:	23 hours
Total in last 7 days	:	0 hour

Duty Time:

Day up to the incident flight	:	4 hours 30 minutes
Day prior to incident	:	0 hour

Last Flown	:	1 January 2015

1.5.2. Co-Pilot, First Officer

Sex / Age	:	Male / Aged 29
Licence	:	Commercial Pilot's Licence issued by CAAC, perpetual with no expiry date
Aircraft ratings	:	B-737, B-747, G-V (G550)
Date of first issue of aircraft rating on type	:	2 September 2014

Date of last proficiency check on type	:	2 September 2014 valid till 1 March 2015
Date of last line check on type	:	4 September 2014 valid till 3 September 2015
ICAO Language Proficiency	:	Level 4 valid till 1 November 2016
Medical Certificate	:	Class 1 valid till 15 May 2015
Limitation	:	Nil

Flying Experience:

Total all types (Hours:Mins)	:	1 810 hours
Total on type (Hours:Mins)	:	143 hours
Total in last 90 days (Hours:Mins)	:	109 hours
Total in last 30 days (Hours:Mins)	:	41 hours
Total in last 7 days	:	0 hour

Duty Time:

Day up to the incident flight	:	4 hours 30 minutes
Day prior to incident	:	0 hour
Last Flown	:	1 January 2015

1.5.3. Relief Pilot, Captain

Sex / Age	:	Male / Aged 47
Licence	:	Airline Transport Pilot's Licence issued by CAAC, perpetual with no expiry date
Aircraft ratings	:	B-777, G-V (G550)

Date of first issue of aircraft rating on type	:	15 September 2012
Date of last proficiency check on type	:	20 October 2014 valid till 19 April 2015
Date of last line check on type	:	18 September 2014 valid till 17 September 2015
ICAO Language Proficiency	:	Level 4 valid till 13 September 2016
Medical Certificate	:	Class 1 valid till 21 March 2015
Limitation	:	Part CCAR-121 inhibited

Flying Experience:

Total all types (Hours:Mins)	:	14 200 hours
Total on type (Hours:Mins)	:	508 hours
Total in last 90 days (Hours:Mins)	:	165 hours
Total in last 30 days (Hours:Mins)	:	68 hours
Total in last 7 days	:	18 hours

Duty Time:

Day up to the incident flight	:	4 hours 30 minutes
Day prior to incident	:	0 hour

Last Flown	:	11 January 2015

1.5.4. Flight Attendant

Sex / Age	:	Female / Aged 26
Flight Attendant Training Certificate	:	G-V (G550)
Medical Certificate	:	Class 4a valid till 12 May 2015
Limitation	:	Corrective lenses to be worn

1.5.5. Crew Training and Qualification

1.5.5.1. Both the pilot in command and the relief pilot completed the G550 conversion course and were checked out to fly the G550 in Captain's capacity in September 2012. After one year of flying, they underwent a line training course and qualified as line instructors on the G550 at the end of November 2013. They possessed the proper licences, qualifications, recency and medical certificates for their assigned duties.

1.5.5.2. The initial rating of the co-pilot was conducted on Boeing B-737 in October 2008 and then Boeing B-747 in the capacity of co-pilot. After completing a G550 conversion course, he was checked out to fly the G550 in September 2014.

1.6. Aircraft Information

1.6.1. Aircraft

Aircraft manufacturer	:	Gulfstream Aerospace Corporation
Model	:	GV-SP (G550)
Serial number	:	5348
Year of Construction	:	2011
Nationality / Registration Mark	:	China / B-8256
Name of the owner	:	Minsheng Taihui (Tianjin) Aviation Leasing CO., LTD
Name of the operator	:	Hanergy Jet Company Limited
Certificate of Airworthiness	:	Transport Category (Passenger) issued on 24 October 2012
Re-issued (annually) on	:	15 September 2014
Certificate of Registration	:	Hanergy Jet Company Limited
Issued on	:	29 October 2013
Maximum Take-off Weight	:	41 277 kg
Total airframe hours:	:	524.5 hours

1.6.2. Engine

Manufacturer	:	Rolls-Royce
Engine Type	:	Turbo-fan engine
Model	:	BR710

1.6.3. Airworthiness and Maintenance

The aircraft records indicated that the aircraft had no outstanding flight control defect prior to the incident flight from ZBAA to VHHH.

1.6.4. Weight and Balance

The flight document records indicated that the calculated aircraft's weight and balance was within the operating envelope for the incident flight from ZBAA to VHHH.

1.6.5. Central Maintenance Computer (CMC) System

The CMC is an onboard central maintenance computer system integrated into the aircraft system for collecting and analysing maintenance information. The CMC system collects, consolidates, and reports aircraft component fault data in order to aid flight crew and maintenance personnel for the maintenance procedures. During flight, the data processing system controls the collection of fault data, generating associated fault and maintenance messages which are then stored in the fault history.

In the G550 aircraft, should there be any fault messages from major system components, including AP, manual electric trim and flight controls, they are logged into the fault history database (FHDB) of the CMC system.

1.6.6. AP System

The AP system operates the flight controls of the aircraft to hold attitude and heading or to follow Flight Director command to maintain a smooth flight path.

For the AP pitch control system, engagement of the AP activates the AP pitch trim function provided the pitch angle is not more than ± 20°. With pitch angles between ±20° and no pitch modes active, the AP engages in the flight path angle hold (pitch hold). This system holds the aircraft at, or returns it to, a commanded altitude and pitch angle. The AP pitch control system also compensates for external influences such as wind, turbulence, and temperature along with aircraft changes such as fuel usage to maintain commanded pitch attitude.

The AP system can be disengaged “normally” or “abnormally” under specific default conditions together with respective annunciations and aural alerts.

In the case of “normal” AP disengagement, referred to as a “manual” disconnect in the GAC Operating Manual, annunciation and aural alert would be triggered. There is a single low/high/low chime and the AP annunciator on the Primary Flight Display (PFD) which blinks amber for 2.5 seconds and goes away automatically.

In the case of “abnormal” AP disengagement, referred to as an

"automatic" disconnect in the GAC Operating Manual, annunciation and aural alert would be triggered. There is a single low/high/low chime and the AP annunciator on the PFD which blinks red and would have to be cancelled manually by flight crew using the AP quick disengagement switch.

1.6.7. Pitch (Elevator) Trim System

The G550 pitch trim system uses two elevator trim tabs which are manually or electrically controlled, mechanically actuated control surfaces located on the trailing edges of both the left and right elevators. To control the pitch trim of the aircraft, the elevator trim tabs move opposite to the elevators, causing the nose of the aircraft to pitch up or down in accordance with the elevator trailing edge movement. When the tab trailing edge moves down, the elevator trailing edge moves up and vice versa. For manual trim control, it is initiated by turning the elevator trim control wheels on the pedestal in the direction of desired aircraft pitch. A system of cables and pulleys transmits the motion to the elevator trim tab actuators located in the left and right elevators.

For electrical trim control, it is initiated by the elevator trim switch (see **Figure 1** below) on each control wheel. The elevator trim servo and bracket in the tail compartment move the elevator trim tabs in the desired direction when either elevator trim switch commands a change in trim tab position. It is important to note that the elevator trim switch is a "dual/split-switches" which must

be both moved in unison for trim. If the split switches are held and the trim is allowed to reach the electric pitch trim limits (+21° and -7°), this will result in an "Elevator Trim Up Limit" or "Elevator Trim Down Limit" message annunciated depending on the direction of travel that was commanded.

Aircraft pitch trim should be appropriately balanced at all phases of flight, managed either manually by the pilot's input or automatically by the AP system. An undesirable condition upsetting the pitch trim balance due to uncommanded electric trim inputs is known as "runaway pitch trim".

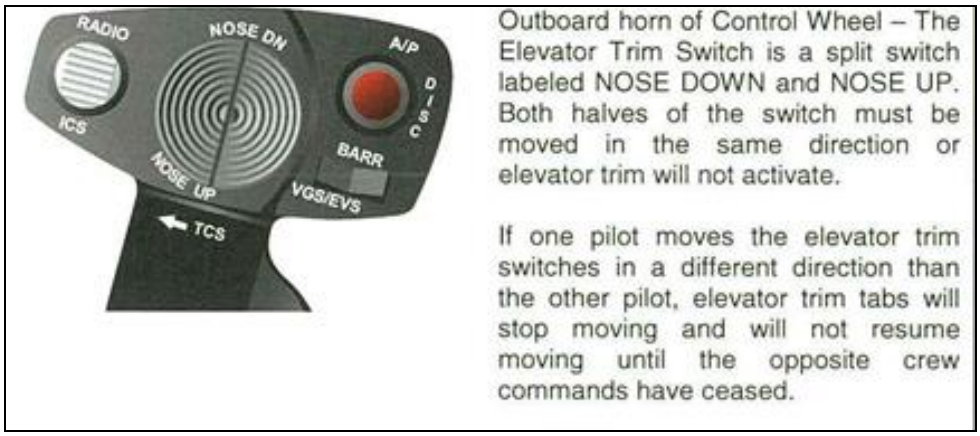


Figure 1 - The Elevator Trim Switch on the control wheel

1.7. Meteorological Information

1.7.1. The Aviation Weather Report for VHHH at 0230 hours indicated that the wind was from 340 degree at 11 kt. The visibility was 6 km in light rain, with few clouds at 800 ft and scattered clouds at 1,800 ft. Temperature was 13 degrees Celsius and dew point at 11 degrees Celsius. QNH was 1023 hectopascal (hPa). Visibility could be temporarily reduced to 4,000 m in light rain or mist.

1.7.2. After the incident, Hong Kong Observatory provided a summary of the weather at the time of incident. In summary, the weather over the area of concern near the incident time was covered by a broad layer of stratiform clouds (height of cloud base 800 ft) under the influence of a winter monsoon. Winds were generally from the North of about 10 kts on the surface while about 20 kts over the Lantau Peak. No low level windshear or turbulence warning was issued within the vicinity 10 minutes before and after the time of incident. Visibility was about 5,000 m along Runway 07L.

1.8. Aids to Navigation

1.8.1. There was no report of malfunction on any navigational aids along the approach route of HHG305.

1.9. Communications

1.9.1. The aircraft was equipped with VHF radio communication systems. All VHF radios were serviceable. All communications between Hong Kong ATC and the crew were recorded by Voice Recording System in the ATC System.

1.10. Aerodrome Information

1.10.1. Destination Aerodrome

Aerodrome Code	:	VHHH
Airport Name	:	Hong Kong International Airport
Airport Address	:	Chek Lap Kok, Lantau Island
Airport Authority	:	Airport Authority Hong Kong
Air Navigation Services	:	Approach Control, Area Control, Aerodrome Control, Ground Movement Control, Zone Control, Flight Information Service, Clearance Delivery Control, Automatic Terminal Information Services
Type of Traffic Permitted	:	IFR/VFR
Coordinates	:	22° 18’ 32” N, 113° 54’ 53” E
Elevation	:	28 ft
Runway Length	:	3 800 m
Runway Width	:	60 m
Stopway	:	Nil
Runway End Safety Area	:	240 m x 150 m

Azimuth	:	07L / 25R, 07R / 25L
Category for Rescue and Fire Fighting Services	:	CAT 10

1.11. Flight Recorders

The aircraft concerned was installed with a Cockpit Voice Recorder (CVR) and a DFDR with recording durations of 2 hours and 140 hours respectively. Both recorders were intact and undamaged in the incident. The DFDR data was available and retrieved for analysis, but the CVR data had been over-written due to its continuous operation during the subsequent return flight to ZBAA. Furthermore, records from Quick Access Recorder (QAR) and the ATC Voice Recording System were also retrieved for the purpose of the investigation.

1.12. Medical and Pathological Information

No evidence of any pre-existing medical or physical condition of the crew.

1.13. Fire

There was no fire.

1.14. Organisational and Management Information

1.14.1. Hanergy Jet Company Limited

HHG, whose principal base of operation is in Beijing, China, holds an Air Operator's Certificate issued by the CAAC to operate as an air carrier and conduct unscheduled passenger flight operations in accordance with applicable laws, rules, regulations, standards and the approved operations specifications.

1.15. Investigation Process

Soon after the serious incident had been reported to the Accident Investigation Division of CAD, an investigation team was dispatched to Beijing to meet CAAC, Center of Aviation Safety Technology (CAST) and HHG personnel. With the aircraft remained in ZBAA, evidence collection as well as crew interviews were conducted. Individual statements were taken, reviewed and accepted by the crew. Retrieved QAR and DFDR data were subsequently analysed with the assistance from CAST and NTSB.

2. ANALYSIS

2.1. The Incident Aircraft

2.1.1. Maintenance History

Routine line maintenance inspection was performed at ZBAA before the incident flight to VHHH and with no abnormality recorded. After the aircraft landed in VHHH, visual and functional checks on the horizontal stabilisers, elevators and flaps were performed in accordance with the Aircraft Maintenance Manual and again with no abnormality found.

A further review of the aircraft maintenance records, three months prior to and after the incident, indicated the aircraft had no flight control and/or AP system defect nor any reported flight control problem.

2.1.2. Autopilot Disengagement

The G550 AP can be disengaged either in “normal” or “abnormal” mode.

GAC advised that several conditions would result in “normal” AP disengagement. These include:

- either pilot’s AP quick disengagement switches are pressed;
- the elevator trim switch is activated by either pilot; or

- the pilot presses the AP push-button while AP is already engaged.

"Normal" AP disengagement would result in a flashing amber "AP" annunciation on the PFD in front of both PF and PM that would extinguish automatically after a few seconds, as well as an aural chime which would be cut off automatically.

Conditions that would result in "abnormal" AP disengagement include:

- a stall warning is detected and activated;
- a loss of either aileron or elevator AP servos;
- an excessive force is applied to the control wheel large enough to override the AP servos; or
- a trim runaway.

"Abnormal" AP disengagement would result in a flashing red "AP" annunciation on the PFD and an aural chime which would not automatically extinguish and cut off respectively. From the DFDR data there was no record of "abnormal" AP disengagement during the incident.

The various conditions leading to AP "normal" and "abnormal" disengagements were elaborated in the system manual as well as the aircraft type training.

2.1.3. Runaway Pitch Trim

According to GAC, a runaway pitch trim situation would be detected and resulting in an “abnormal” AP disengagement annunciating an “AP Fail” message. From the DFDR record, there was no “abnormal” AP disengagement or “AP Fail” message.

In addition, the CMC would have logged “AP Fail” and/or “Elevator Trim Fail” message(s) in the FHDB. However, no such specific fault message was identified in the post flight CMC report.

Based on the fact that no “AP Fail” and/or “Elevator Trim Fail” message and no “abnormal” AP disengagement was recorded, runaway pitch trim scenario was eliminated.

2.1.4. Nose-down Trim Input

According to the DFDR data there was a “normal” AP disengagement at approximately the same time as the nose-down trim input was recorded. The nose-down trim input continued until it reached its limit triggering the “Elevator Trim Down Limit” message.

According to GAC, it was possible that manual input of the “elevator trim switch” might have led to the “normal” AP disengagement and eventually triggered the “Elevator Trim Down Limit” message.

2.1.5. Weight and balance

Loading conditions calculated for the flight was in order. The mass and the centre of gravity were within the prescribed limits. It is considered not a contributing factor to the incident.

2.2. Flight Data Analysis

2.2.1. With the assistance of CAAC and CAST, the raw data of the DFDR was downloaded and preserved for the investigation. Technical support in decoding the DFDR data was provided by NTSB.

The significant DFDR parameters were selected and shown in the summary table below:-

DFDR Parameter	**Remarks** ***(Primary source, i.e. No. 1 or Left System is selected when applicable)***	**Unit / Status**
Altitude Radio-1	Radio Altitude	Feet
Altitude Press-L	Pressure Altitude	Feet
AP-1 Eng	Autopilot engagement	ON/OFF
Pitch	Pitch angle	Degree
Roll	Roll angle	Degree
Trim Input Pitch	The consolidated trim input feedback signal for the aircraft's overall pitch trim control	Degree
Elevator Trim	Tab position of Elevator Trim (output)	Degree
Vertical Speed	The vertical speed of the aircraft which is derived from the DFDR Pressure Altitude data	Feet Per Minute

Note: The DFDR parameters above were plotted in Appendix 1.

2.2.2. According to the DFDR data, the aircraft began to pitch down and lose height quickly when the parameters "Trim Input Pitch" and "Elevator Trim" were moving synchronously from 4.6° and 4.7° to -6.7° and -7.6° respectively. It indicates that the aircraft's pitch trim output was working accordingly with respect to its input, indicating that the serviceability of the pitch trim system was in order at that time.

2.2.3. "Trim Input Pitch" feedback signal is generated either from the AP commands or manual inputs. Manual inputs could be achieved through engaging the manual electric trim (from the elevator trim switch) or mechanical trim (from the trim wheel). According to DFDR data, the "Trim Input Pitch" kept moving towards to nose-down limit even after the "normal" disengagement of AP. Based on this, the possibility of having the full nose-down pitch trim commanded by the AP was ruled out leaving manual inputs as the only probable source.

2.2.4. The flight data analysis reinforced the advice made by GAC (Para. 2.1.4 refers) that manual trim action by the pilot might have led to the AP disengagement and eventually the nose-down trim limit situation.

2.3. Flight Operations

2.3.1. Pitch Trim Movement and Autopilot Disengagement

2.3.1.1 *Aircraft System*

During the incident, the AP had a "normal" disengagement and the pitch trim moved to the full nose-down limit. The aircraft trim balance was upset resulting in a nose-down moment. Referring to the engineering analysis (Para. 2.1.1 – 2.1.4 refer), there was no evidence that the AP disengagement or the aircraft pitch trim movement was induced by the aircraft systems.

2.3.1.2 *Weather*

According to weather information (Para 1.7 refers), there was no indication of low level windshear or turbulence. Data from the DFDR also revealed that the aircraft had been steadily maintaining 2,000 ft before the pitch trim movement and the AP disengagement (Appendix 1 refers). There was no evidence to suggest that weather was a contributing factor to the incident.

2.3.1.3 *Probable Explanation*

Crew interviews revealed that the PF could not recall when the AP was disengaged until prompted by the PM, nor could he recall the status of the aircraft pitch trim despite the visual annunciation and the aural chime, an AP disengagement scenario which he was trained of. However, with no logical explanation to substantiate the aircraft system, "weight and balance" or the weather as the

cause of AP disengagement and the aircraft pitch trim movement, as analysed in paragraphs 2.1.5, 2.2 and 2.3.1 above, the most plausible reason would be that the AP "normal" disengagement and the full nose-down pitch trim were caused by pilot's input to either the elevator trim switch or the manual trim wheel.

In view of the fact that there was no further "abnormal" AP disengagement and pitch trim movement during the go-around and the second approach and landing, it was unlikely that the pilot's input on the "normal trim control" during the event was intentional.

Furthermore, considering the more convenient location of the elevator trim switch (i.e. on the control wheel) and the difficulty in providing continuous unintentional input on the manual trim wheel, it was more likely that the elevator trim switch was inadvertently activated by the pilot, causing the AP disengagement and pitch trim movement. This was also consistent with the deduction made by GAC as mentioned in paragraph 2.1.4.

2.3.2. Situational Awareness

When the AP was disengaged, in this incident "normal" disengagement, there would be a status change annunciation flashing in amber colour on the PFD as well as a specific aural chime to remind the pilots.

According to crew interview statements, PF could not recall the

AP disengagement until prompted by the PM.

Similarly, real-time aircraft pitch trim information should have been displayed in the Flight Control Synoptic in front of the pilot. PF could not recall the status of the aircraft pitch trim or any change of trim movement.

PF also stated that he had major difficulty in pulling the unusually heavy control wheel in order to pitch the aircraft nose-up, confirming the aircraft's pitch trim was significantly imbalanced towards aircraft nose-down. However, there was no evidence to suggest that any one of the pilots in the flight deck had doubt on the pitch trim setting.

Both the PM and the relief pilot commented that the PF was not pulling the control wheel effective enough and seemed to be fixated on it with little response during the incident.

In view of the above, it appeared that both the PF and PM did not have sufficient situational awareness on the aircraft status and the information provided by the system synoptic displayed in the flight deck. The aircraft might be able to be recovered sooner and at a higher altitude if the pilots identified the pitch trim setting during early recovery stage.

2.3.3. Crew Resources Management (CRM)

According to interview statements, PF showed little response despite the co-pilot and the relief pilot had made numerous attempts to prompt him to respond to the imminent situation. The crew communication during the incident seemed to be ineffective and there was a lack of coordination amongst the flight crew to resolve the situation in a timely manner during such critical phase. It took 48 seconds for the aircraft to recover positive rate of climb from AP disengagement. A prolonged period of time was taken before the crew could recognise situation and take necessary recovery actions.

3. CONCLUSION

3.1. Findings

3.1.1. HHG305 was a company ferry flight operated by HHG from ZBAA to VHHH.

3.1.2. The aircraft had a valid Certificate of Airworthiness and at that time, relevant documents showed that the aircraft was properly maintained.

3.1.3. Records also showed that there was no outstanding flight control defects with the aircraft prior to the departure from ZBAA that would have contributed to the incident.

3.1.4. The aircraft was released for service per requirements when dispatched for the flight.

3.1.5. The mass and the centre of gravity of the aircraft were within the prescribed limits.

3.1.6. Evidence gathered suggests that weather was not a contributing factor to the incident.

3.1.7. There was no aircraft system malfunction and loading anomalies that caused the AP disengagement and the pitch trim movement. There was no further abnormal situation encountered after the recovery manoeuvre.

3.1.8. It was probable that pilot's inadvertent input to the elevator trim switch disengaged the AP and moved the pitch trim to full down limit during the approach.

3.1.9. The aircraft quickly lost significant height at low altitude with rate of descent peaked at 3801 ft/min.

3.1.10. It was recorded that the aircraft was at its lowest altitude of 499 ft RA when the aircraft was 7 nm from VHHH.

3.1.11. CRM amongst the flight crew was ineffective during the recovery action. It took 48 seconds for the aircraft to recover positive rate of climb from AP disengagement. The pilots then carried out a go-around manoeuvre. The aircraft landed uneventfully from a second approach.

3.1.12. Post-flight serviceability and functional tests of the aircraft were conducted and found satisfactory.

3.1.13. The aircraft soon departed VHHH and returned to ZBAA without event.

3.1.14. Data pertaining to the incident from DFDR and QAR were successfully retrieved. However the CVR data was overwritten due to its continuous operation during the subsequent flight returning to ZBAA.

3.2. Causal Factors

3.2.1. Trim Movement and Autopilot Disengagement

It is probable that during the critical phase of approach, pilot's inadvertent input was applied to the elevator trim switch causing the AP to disengage and the pitch trim to move to full nose-down limit. The trim balance on the aircraft's pitch was upset leading to a nose-down pitch moment.

3.2.2. Insufficient Situational Awareness

The pilots at the control did not recognise the AP disengagement and pitch trim status through the flight control response or the Flight Control Synoptic display in a timely manner. Vital time was lost in comprehending the situation which resulted in an excessive rate of descent.

3.2.3. Ineffective Crew Resource Management

Necessary recovery actions by the pilots were hindered due to ineffective CRM, which consequentially escalated the height loss situation.

4. SAFETY RECOMMENDATIONS

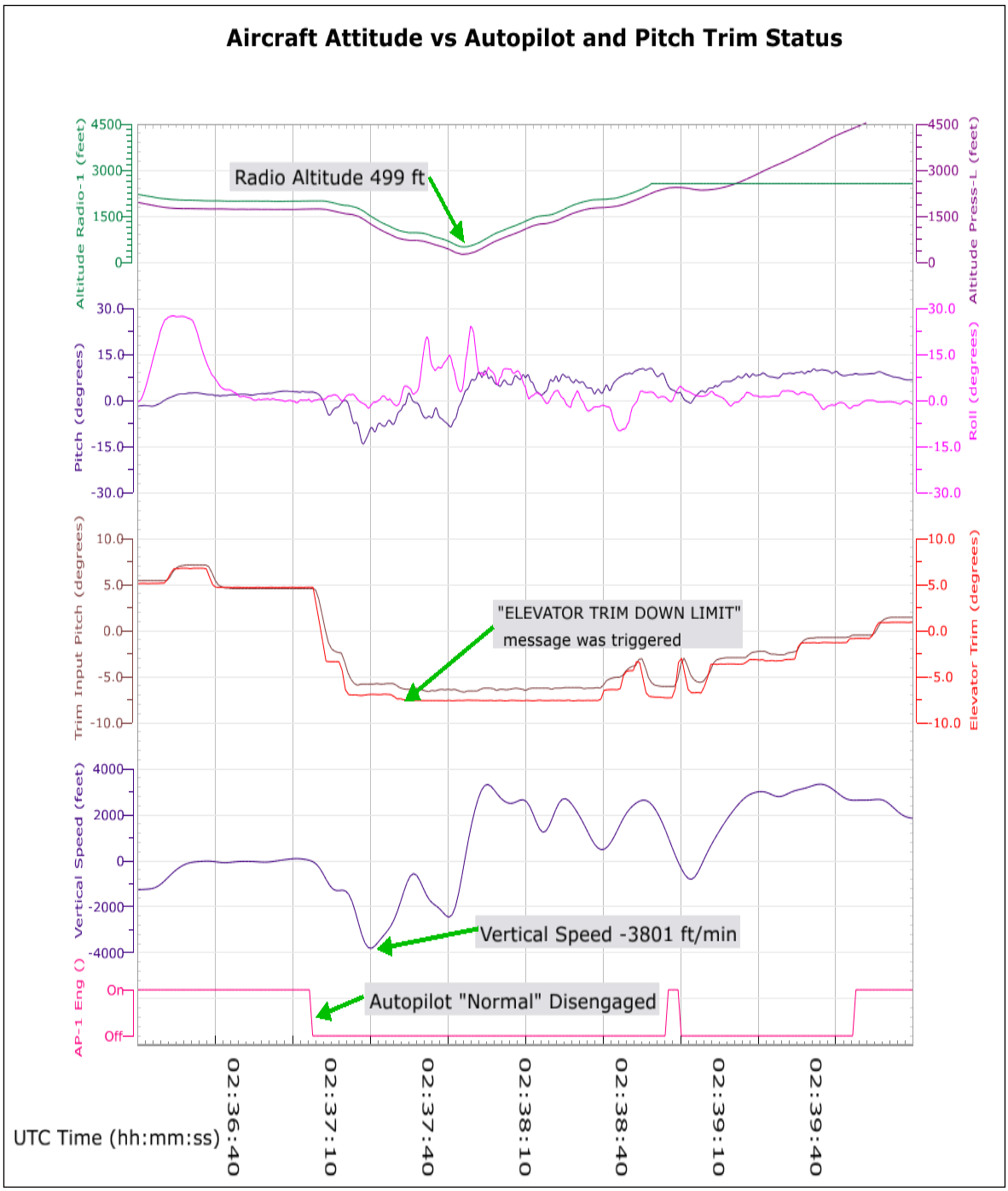
4.1. Safety Recommendation 2017-1

It is recommended that HHG should review and strengthen flight crew training on situational awareness, monitoring of aircraft status with particular emphasis on the AP and pitch trim systems, their effects on flight control, and avoidance of inadvertent input to any aircraft systems. (Para 2.3.1 and 2.3.2 refer)

4.2. Safety Recommendation 2017-2

It is recommended that HHG should review and enhance its CRM training to ensure more effective communications and coordination in the flight deck for the handling of abnormal situations. (Para 2.3.3 refers)

Appendix 1


Aircraft Attitude vs Autopilot and Pitch Trim Status
Altitude Radio-1 (feet)
Altitude Press-L (feet)
Pitch (degrees)
Roll (degrees)
Trim Input Pitch (degrees)
Elevator Trim (degrees)
Vertical Speed (feet)
AP-1 Eng ()
Radio Altitude 499 ft
"ELEVATOR TRIM DOWN LIMIT"
message was triggered
Vertical Speed -3801 ft/min
Autopilot "Normal" Disengaged
On
Off
UTC Time (hh:mm:ss)
02:36:40
02:37:10
02:37:40
02:38:10
02:38:40
02:39:10
02:39:40