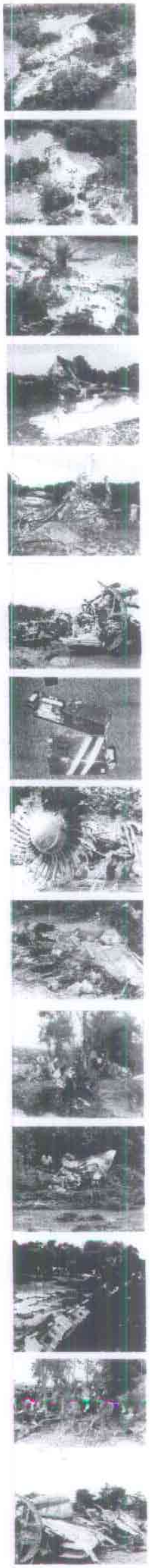

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AIRCRAFT ACCIDENT INVESTIGATION COMMITTEE
MINISTRY OF TRANSPORT AND COMMUNICATIONS
THAILAND

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AIRCRAFT ACCIDENT INVESTIGATION REPORT

THAI AIRWAYS INTERNATIONAL COMPANY LIMITED
AIRBUS A310-204, HS-TIA

SURAT THANI AIRPORT
THAILAND

11 DECEMBER 1998

The investigation process of Aircraft Accident Investigation Committee follows the procedures in **ICAO ANNEX 13 AIRCRAFT ACCIDENT AND INCIDENT INVESTIGATION** which the 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.

Contents

Synopsis

On 11 December 1998 at about 17:54 hours, AIRBUS A310-204 belonging to Thai Airways International Public Company Limited, of nationality and registration HS-TIA, departed on flight TG 261 from Bangkok International Airport to Surat Thani Airport. The pilot had requested Surat Thani air traffic control for approach to land on runway 22. After trying for three approaches, the aircraft crashed 700 metres south of Surat Thani Airport at about 19:08 hours destroying itself completely. From 146 crew and passengers on board: 101 died, 35 were seriously injured and 10 suffered minor injuries.

All times in the report are local time

1. Factual Information

1.1 History of the Flight

On 11 December 1998 at approximately 17:54 hours, AIRBUS A310-204, belonging to Thai Airways International Public Company Limited, of nationality and registration HS-TIA departed on a passenger scheduled flight TG 261 en route on airways G458 at flight level 310 from Bangkok International Airport to Surat Thani Airport. There were 14 crew and 132 passengers on board.

At 18:26 hours, the co-pilot first established contact with Surat Thani approach controller while the aircraft was 70 nautical miles away from Surat Thani Airport, Surat Thani approach controller gave instructions to execute instrument approach procedures expecting the aid of VOR/DME would be used. At runway 22, surface wind was calm with the visibility of 1,500 metres, light rain, and cloud base at 1,800 feet. Temperature and dewpoint were 24/22 degrees Celsius respectively.

At 18:39 hours, the co-pilot contacted Surat Thani aerodrome controller and reported over the intermediate fix (IF). The controller informed him that the precision approach path indicators (PAPI) on the right side of runway 22 were unserviceable while the lefts were in use. The distance between each runway edge light was 120 metres. The distance between each runway end light and runway threshold light was 6 metres and the pilot should be aware that there was an obstacle at 400 metres from runway 22 threshold.

At 18:41 hours, the co-pilot reported passing final approach fix (FAF). The aerodrome controller informed the pilot that the aircraft was not in sight, yet ;however, it was clear to land on runway 22. The surface wind was blowing from 310 degrees at a velocity of 5 knots so the pilots should be careful of the slippery runway.

At 18:42 hours, the co-pilot reported that the runway was in sight and later on the aerodrome controller also had the aircraft in sight. The pilot decided to go-around. The aerodrome controller asked the pilot about the distance where the runway could be seen. The co-pilot replied that it could be seen at 3 nautical miles and requested for the second approach. The aerodrome controller requested for FAF report. Having been reported the FAF by the co-pilot, the aerodrome controller reported back that the aircraft could not be seen ; however , it was clear to land on runway 22. The aerodrome controller asked if the runway could be seen and received the 'no' reply from co-pilot. Then, the pilot made a go-around and requested for the third approach. Aerodrome controller requested for FAF report from heading inbound and informed the pilot that the visibility was 1,000 metres with light rain at the airport. Also, it was clear to land on runway 22. The surface wind was blowing from 290 degrees at a velocity of 3 knots and the pilot should be careful with the slippery runway. The co-pilot acknowledged at the time of 19:05:43 hours and after that the contact was lost.

1.2 **Injuries to Persons**

Injuries	Crew	Passengers	Other
Fatal	11	90	-
Serious	3	32	-
Minor/Non	-/-	10/-	-

1.3 **Damage to Aircraft**

The aircraft was completely destroyed.

1.4 **Other Damage**

None

1.5 **Personnel Information**

1.5.1 The pilot held required documents and flying credentials detailed as follows:

1.5.1.1 Air Transport Pilot's License No. D-0368 issued by the Department of Aviation (DOA) of Thailand on 24 October 1991 which was last extended on 23 May 1998 to be valid until 22 May 1999. The license carries the following ratings

- Single & multi-engine land
- A300 B4 (Cruise Only)
- Co-pilot for B747-200/300
- Co-pilot for B747-400
- Pilot for AIRBUS A300-600/A310

1.5.1.2 Medical Certificate Class 1 issued by Institute of Aviation Medicine Directorate of Medical Services, Air Support Command, on 4 November 1998 and valid until 3 May 1999 with the following limitations:

- Corrective lenses for distant vision are required for flying duty

1.5.1.3 Flying Credentials

Total flight time	10,167:15 hours
Flight time on B747-200/300/400	6,086:28 hours
Flight time on AIRBUS A300-600/A310	3,088:57 hours
Flight time on other types of aircraft	991:50 hours
Flight time on AIRBUS A300-600/A310 for the last 90 days	227:01 hours
Flight time on other types of aircraft for the last 90 days	- hours
Flight time on AIRBUS A300-600/A310 for the last 30 days	108:44 hours
Flight time on other types of aircraft for the last 30 days	- hours
Flight time on AIRBUS A300-600/A310 for the last 24 hours	1:10 hours
Duty time for the last 24 hours	2:40 hours
Rest period before duty	20:05 hours

1.5.2 The co-pilot held required documents and flying credentials detailed as follows:

1.5.2.1 Air Transport Pilot's License No. D-0824 issued by the DOA on 7 August 1998 and valid until 6 August 1999. The license carried the following ratings:

- Single & multi-engine land
- Co-pilot for AIRBUS A300 B4
- Co-pilot for AIRBUS A300-600/A310

1.5.2.2 Medical Certificate Class 1 issued by Institute of Aviation Medicine Directorate of Medical Services, RTAF on 24 February 1998 and valid until 23 February 1999

1.5.2.3 Flying Credentials

Total flight time	2,839:18 hours
Flight time on AIRBUS A300-B4	1,605:33 hours
Flight time on AIRBUS A300-600/A310	983:45 hours
Flight time on other types of aircraft	250:00 hours
Flight time on AIRBUS A300-600/A310 for the last 90 days	277:46 hours
Flight time on other types of aircraft for the last 90 days	- hours
Flight time on AIRBUS A300-600/A310 for the last 30 days	83:44 hours
Flight time on other types of aircraft for the last 30 days	- hours
Flight time on AIRBUS A300-600/A310 for the last 24 hours	- hours
Duty time for the last 24 hours	- hours
Rest period before duty	44:55 hours

1.6 **Aircraft Information**

1.6.1 **Aircraft Data**

1.6.1.1 **Aircraft**

1.6.1.1.1 Aircraft type : AIRBUS A310-204

1.6.1.1.2 Serial No. 415

1.6.1.1.3 Aircraft Nationality and Registration: HS-TIA

Standard Airworthiness Certificate No. 108/2541 valid from 1 April 1998 until 31 March 1999

1.6.1.1.4 Manufactured in April 1986 with the time since new of 23,028 hours; 22,031 flights on 11 December 1998

1.6.1.1.5 Undergone scheduled inspection detailed as follows:

- A-check (every 350 hour): Most recently on 15 October 1998, while having the time since new of 22,754 hours; 21,737 flights
- C-check (every 15 month): Most recently on 7 January 1998, while having the time since new of 21,959 hours; 20,873 flights
- D-check (every 12,000 hour or every 4 year): Most

recently on 22 July 1998, while having the time since new of 22,407 hours; 21,335 flights

1.6.1.1.6 Time since last scheduled maintenance (A-check): 274 hours; 294 flights

1.6.1.2 **Engine**

1.6.1.2.1 Left Engine

1.6.1.2.1.1 Engine Type: General Electric CF6-80C2A2

1.6.1.2.1.2 Serial No: 690337

1.6.1.2.1.3 Time since new: 21,224 hours; 10,445 flights (on 11 December 1998)

1.6.1.2.1.4 Undergone major repair module A-F, minor repair module G, while having the time since new of 18,887 hours; 7,980 flights on 27 December 1996

1.6.1.2.1.5 Time since last overhaul 2,337 hours; 2,475 flights

1.6.1.2.2 Right Engine

1.6.1.2.2.1 Engine Type: General Electric CF6-80C2A2

1.6.1.2.2.2 Serial No: 690107

1.6.1.2.2.3 Time since new: 19,537 hours; 10,692 flights (on 11 December 1998)

1.6.1.2.2.4 Undergone major repair module A-F, minor repair module G, while having the time since new of 17,087 hours; 8,096 flights on 6 December 1996

1.6.1.2.2.5 Time since last overhaul 2,450 hours; 2,596 flights

1.6.2 **Weight and Balance**

Aircraft type A-310 is medium ranged aircraft of approximately 3,500 nautical miles or approximately 6,300 kilometers. The maximum takeoff weight is 142 tons. The weight of aircraft at the time of accident was approximately 102 tons. The calculated centre of gravity position based on DFDR data of the aircraft during the third approach is between 28 and 30 %. (The maximum permissible landing weight is 122 tons and the centre of gravity position is between 18-35% Mean Aerodynamic Chord; MAC)

From the loadsheet, the take off fuel was 15.7 tons. However, at the time of accident, the fuel quantity was 9.9 tons.

1.6.3 **Fuel and Oil**

The aircraft was filled with JET A-1 and ESSO TURBO OIL 2380 (MIL-L-23699) permissible to use for the aircraft.

1.7 **Meteorological Information**

1.7.1 Weather forecast for 11 December 1998 during 13:00-22:00 hours: variable surface wind at a velocity of 8 knots with the visibility of 7,000 metres; rain showers, with three to four octas of low cloud at 1,800 feet and overcast at 11,000 feet.

Forecast for temporary weather period during 13:00-22:00 hours: variable surface wind at a velocity of 15 knots, gusting to 25 knots with the visibility of 1,500 metres; rain showers, with one to three octas of low cloud at 1,200 feet, broken cloud at 2,000 feet and overcast at 11,000 feet.

1.7.2 Weather report for Surat Thani Airport at 19:00 hours: surface wind was blowing from 340 degree at 4 knots with the visibility of 1,500 metres; rain shower with broken low cloud at 1,800 feet, broken cloud at 12,000 feet, overcast at 30,000 feet; temperature and dewpoint were 24/23 degrees Celsius. Atmospheric pressure above mean sea level was 1,009 millibar.

1.7.3 Weather report at the time of accident: surface wind was blowing from 290 degrees at 3 knots with the visibility of 1,000 metres; rain showers.

1.8 **Air Navigation Facilities**

1.8.1 Instrument Landing System (ILS)

The DOA issued Notice to Airmen (NOTAM) on 30 January 1997 stating that the ILS could not be operated during 30 January 1997 until 30 April 1997 **(detailed in Appendix 1)** due to the renovation of Surat Thani Airport. The NOTAMs were continuously released, and the last of which was on 1 December 1998 stating that the ILS would not be in operation during 1 December 1998 until 25 January 1999 (**detailed in Appendix 2**).

1.8.2 Precision Approach Path Indicator (PAPI)

The DOA issued NOTAM on 30 November 1998 stating that the PAPI on the left side of runway 04 and the right side of runway 22 would not be operated during 30 November 1998 until 30 December 1998 (**detailed in Appendix 3**). The latest periodic check on 18 November 1998 found that the PAPI on the left side of runway 22 was operative. (**detailed in Appendix 4**).

According to International Civil Aviation Organization (ICAO) Annex 14, the system shall be located on the left side of the runway unless it is physically impracticable to do so (**detailed in Appendix 5**).

1.8.3 Non-Directional Radio Beacon (NDB)

The DOA issued NOTAM on 16 November 1998 stating that the NDB was not in operation during 16 November 1998 until 25 January 1999 due to the relocation (**detailed in Appendix 6**).

1.8.4 Doppler Very High Frequency Omnidirectional Radio Range/Distance Measuring Equipment (DVOR/DME)

The latest check by the DOA on 10 September 1998 found that the DVOR/DME were operative. (**detailed in Appendix 7**).

After the accident, the DOA rechecked the DVOR/DME on 14-17 December 1998 and found that they were operative. (**detailed in Appendix 8**).

1.9 Communications

Radio communication between aerodrome controller at Surat Thani Airport and the pilots was normal.

1.10 Aerodrome Information

1.10.1 Surat Thani Airport is located at latitude 9 degrees 8 minutes North, and longitude 99 degrees 8 minutes 25 seconds East. The runway 04/22 is 45 metres wide, 2,500 metres long and has an asphaltic concrete surface. The aerodrome elevation is 19 feet (6 metres) above mean sea-level.

The highest obstacle at the airport is 121 metres antenna at latitude 9 degrees 7 minutes 50 seconds North and longitude 99 degrees 21 minutes 30 seconds East.

1.10.2 Runway edge lights and runway end lights/Runway threshold lights

- Runway edge lights are usually operated with 2 circuits. The distance between each light is 60 metres. However, due to the renovation of the airport at the time of accident, there was only 1 operative circuit, and this caused the distance between each light to be 120 metres.

According to International Civil Aviation Organization (ICAO) Annex 14, the light shall be uniformly spaced in rows at intervals of not more than 60 metres for an instrument runway, and at intervals of not more than 100 metres for a non-instrument runway.

- Runway end lights/Runway threshold lights are usually operated with 2 circuits. The distance between each light is 3 metres. However, due to the renovation of the airport at the time of accident, there was only 1 operative circuit, and this caused the distance between each light to be 6 metres.

The DOA issued NOTAM on 16 November 1998 stating that the distance between runway edge lights would be 120 metres while the distance between runway end lights/runway threshold lights would be 6 metres during 16 November 1998 until 16 December 1998 due to only 1 operative circuit. (**detailed in Appendix 9**).

1.10.3 Approach lights and sequenced flashing white lights

The DOA issued NOTAM on 14 September 1998 stating that the approach lights and sequenced flashing white lights could not be operated during 14 September 1998 until 30 December 1998 (**detailed in Appendix 10**).

According to ICAO Annex 14, a simple approach lighting system shall be provided to serve a non-precision approach runway, except when the runway is used only in conditions of good visibility or sufficient guidance is provided by other visual aids.

1.11 **Flight Recorders**

Digital Flight Data Recorder (DFDR) and Cockpit Voice Recorder (CVR) were brought to be read at National Transportation Safety Board (NTSB), U.S.A. by Aircraft Accident Investigation Committee of the Kingdom of Thailand.

1.11.1 DFDR, part number 980-4700-001 serial number 1849 with 161 parameters recording unit, was manufactured by Allied Signal Commercial Avionics System. It was installed in the aft section of the aircraft. The DFDR was removed from the aircraft on the second day after the accident. It was noted that the outer case was deformed. However, the information and data contained within remained intact. **(detailed in Appendix 11)**

1.11.2 CVR, part number 93-A100-80 Model A100A serial number 50599, plastic tape type with 4 recorded channels, was manufactured by Loral. It was installed in the aft section near the DFDR. The CVR was removed from the aircraft on the second day after the accident. The outer case of the CVR was dented and deformed. However, the data was audible and can be analysed **(detailed in Appendix 12)**.

1.12 **Wreckage and Impact Information**

The site of the accident was at latitude 9 degrees 7 minutes 42 seconds North and longitude 99 degrees 8 minutes 17 seconds East. There were wreckages scattered around within 100 metres in the wood with flooded water of 50-100 centimetres deep. The site was at 440 metres, 174 degrees from Surat Thani Tower. **(detailed in Appendix 13)**

1.13 **Medical and Pathological Information**

1.13.1 The bodies of both crew were found at the night of 11 December 1998 and brought to be kept at a rescue foundation in Surat Thani at the temperature of 26-30 degrees Celsius. The pathological examination showed that both crew were killed instantly.

1.13.2 Pathology Department Bhumibol Adulyadej Hospital, Directorate of Medical Services, Air Support Command, RTAF did the autopsy 24 hours after both pilots died. The report is as follows:

1.13.2.1 Findings on the body of the pilot

- Bruise on the right shoulder and upper abdomen
- A deep wound inside the skull
- Multiple fractures
- Internal organs exhibited heavy damage and laceration

1.13.2.2 Findings on the body of the co-pilot

- Contusion on the chest
- Multiple fractures
- Internal organs exhibited heavy damage and laceration

1.13.2.3 No alcohol, tranquilizer, sedative or illegal drug was found on both bodies.

1.13.3 Survivor Injuries

1.13.3.1 There are 132 passengers and 14 crew on board. After the accident, 42 passengers and 3 crew survived and were treated at a nearby hospital.

1.13.3.2 35 passengers had multiple fractures, severe injuries and been admitted to the hospital. As regard to the doctor's diagnosis, the recovery time for the most severe injured took between 2 months to 1 year. The 10 remaining survivors had mild injury and did not need to be treated in the hospital.

1.13.4 The cause of death

- 50 passengers died as a result of burns
- 37 passengers died as a result of blunt trauma to the head
- 14 passengers died as a result of other severe injuries

(detailed in Appendix 14)

1.14 **Fire**

After the crash, there were fire on the left wing and the aft section of the aircraft. However, there was no evidence of pre-impact fire.

1.15 **Survival Aspects**

After the accident, Surat Thani Airport sent the fire engines to the scene using the possible route. However, as there was no access to the scene for a sizeable vehicle, the necessary equipment was, therefore, brought by Surat Thani Airport officials-on-foot who were the first troop at the scene. The scene was difficult to be reached as it was covered with tree and flooded water of 50-100 centimetres high. There was no light and it had been raining all the time. Later on, the troop from the RTAF joined the troop of rescue foundation, Royal Thai Army and Police in rescuing the casualty until 3:00 hours on 12 December 1998. When they left the scene, the search began again at approximately 7:00 hours, and was ceased on 15 December 1998 at 17:30 hours.

1.16 **Test and Research**

None

1.17 **Organization Information (Thai Airways International Public Company Limited)**

1.17.1 The Department responsible for NOTAM

1.17.1.1 Dispatch Service Department (OW) is responsible for distributing NOTAM to pilots, according to Flight Operations Manual (FOM) 1.2.12 page 2 paragraph 3.1.2. The information is also recorded in the computer so that the pilots will be informed of the relevant detail accordingly.

1.17.1.2 Operation Control and Planning Department (OP) is responsible for analysing the information on the NOTAM, which will affect the company's operation and regulation, according to FOM 1.2.1 page 6 paragraph 1.3, in order to amend or improve the flight plan accordingly.

1.17.2 The Department responsible for approach chart

1.17.2.1 Route & Aircraft Document Division (OB-R) is responsible for amending manuals and document as well as updating approach chart issued by Jeppesen, a private institution which gathers information from Aeronautical Information Publication (AIP) of various countries for commercial. (FOM 1.2.2 page 10 paragraph 2 and FOM 4.1.1 page 1 paragraph 1)

1.17.2.2 Flight Standard Department (OO) had amended and improved approach chart of VOR/DME runway 22 of Surat Thani Airport in order to be used in place of approach chart published in AIP.

1.18 Additional Information

1.18.1 FOM: Item No.3 Flight Procedures/3.1 Flight Performance/3.1.8 Letdown and Approach

The procedures in page 11 paragraph 5.3: Go-around on Approaches without Glidepath Reference **(detailed in Appendix 15)** described as follows:

The approach shall be abandoned and a go-around commenced if:

- The official visibility is below the applicable Company minima at the Outer Marker (OM) or equivalent position, or at 1,000 feet Above Ground Level (AGL) if no OM
- Not stabilized at 500 feet AGL
- When reaching Missed Approach Point (MAP), the pilot is unable to complete the landing by using visual guidance
- Visual guidance is lost after passing Minimum Descent Altitude (MDA).

The approach must not be continued at MDA to a position closer to the runway unless the pilot is able to descend visually at normal sink rate.

The procedures in page 11 paragraph 5.6: Second Approach **(detailed in Appendix 15)** described as follows:

If a go-around has been made, another approach shall only be commenced if the P-i-C has reason to believe that a second approach will lead to a successful landing.

More than two approaches shall only be made if there is any indication that the conditions have considerably improved, giving greater probability of a successful landing.

1.18.2 FOM: Item No.3 Flight Procedures/3.1 Flight Performance/3.1.10 Landing

The procedure in page 1 paragraph 2: Requirements for Night Landing **(detailed in Appendix 16)** described as follows:

When performing night landings the following aids must be installed and functioning:

1) Glidepath reference, which may consist of:
   - An Instrument Landing System (ILS) /Precision Approach Radar (PAR), or
   - Approach lights with at least one crossbar or a centerline consisting of barrets, or
   - Visual Approach Slope Indicator (VASI) or Precision Approach Path Indicator (PAPI) (a VASI consisting of one light unit in each bar is considered satisfactory for this purpose)
2) Runway edge lights

Note: threshold and runway end lights are strongly recommended to be available

1.18.3 Instrument Approach Chart

The pilots used Instrument Approach Chart VOR/DME of runway 22 of Surat Thani Airport issued by Thai Airways International Public Company Limited in order to compare and amend the existed approach chart. The chart appeared to be 11 degrees difference **(detailed in Appendix 17)**. The pilots also used Instrument Approach Chart VOR/DME of runway 22 of AIP issued by the DOA **(detailed in Appendix 18)**.

No.	Difference	AIP (DOA)	Thai Airways International Public Company Limited
1	IF	On radial 024 degrees of Surat Thani VOR at 11 DME	On Radial 035 degrees of Surat Thani VOR at 11 DME
2	FAF	On radial 024 degrees of Surat Thani VOR at 6 DME	On Radial 035 degrees of Surat Thani VOR at 6 DME
3	Track to VOR Surat Thani	204 degrees	215 degrees
4	Obstacle Clearance Altitude (OCA/H)	470 (451) feet	424 (405) feet
5	Minimum Descent Altitude (MDA/H)	Not determined	430 (411) feet
6	MAP	At Surat Thani VOR/DME	On Radial 035 degrees of Surat Thani VOR at 1.2 DME

No.	Difference	AIP (DOA)	Thai Airways International Public Company Limited
7	Missed Approach Procedure	At Surat Thani VOR climb on radial 190 degrees at 1,500 feet turn left and climb to FAF or as advised	Climb directly to Surat Thani VOR then turn left and climb on radial 190 degrees at 2,000 feet then turn left to 6 DME or as advised
8	Visibility	No minimum visibility limit	Minimum visibility limit at 2,200 metres

1.18.4 Periodic Flight Training (PFT)

1.18.4.1 From the record of the pilot's last recurrent or PFT on 8 March 1998 **(detailed in Appendix 19)**, the instructor commented as follows:

- Type of approach and details must be briefed to confirm pilot flying and pilot not flying duties before commencing approach especially in bad weather condition.
- Must be on track as soon as possible during non-precision approach, otherwise visual contact will be difficult.
- Otherwise good PFT

1.18.4.2 No proven record showed that the instructor performed the additional NDB training more to increase the pilot's expertise on non-precision approach.

1.18.5 The go-around causing large-airplane upsets (unusual attitude)

The aircraft type was A-310 manufactured by AIRBUS Industrie. It was a medium range aircraft of 3,500 nautical miles or approximately 6,300 kilometres. The maximum takeoff weight is 142 tons and the maximum permissible landing weight is 122 tons. The takeoff weight of flight TG 261 on 11 December 1998 was 107 tons and the landing weight of the first landing was approximately 102.4 tons while it was approximately 102 tons on the accident flight.

The A-310 aircraft is mounted with 2 engines of turbo fan manufactured by General Electric model CF6-80C2A2, the thrust of which is 52,000 pounds each, located under swept back wings. When go lever is triggered in go-around mode, autothrottle system will move the throttle at the rate of 8 degrees per second (whereas in other modes will move the throttle at the rate of 3 degrees per second) in order to spin up the engine to get "go-around N1 limit" which the system will calculate by using velocity, height and total air temperature but not the total weight of the aircraft. According to the aerodynamic principles, the thrust will produce a nose-up pitching moment.

When autopilot is operated, the system will adjust the pitch attitude to be in envelope or at the angle of approximately 18 degrees. However, if using manual control and the pilots are not well prepared or at loss of situation awareness, the pilots might not be able to control the pitch attitude to be within flight envelope. As a result of achieving the maximum thrust quickly when the aircraft weight is light, the aircraft can enter into airplane upset condition.

As large airplane manufacturers; AIRBUS and BOEING, were aware of aerodynamic principles of large airplane upsets in the aircraft which does not have electronic flight control, commonly known as Fly-by-Wire , they developed and produced training aid such as document, video and CD ROM which have been distributed to every user of AIRBUS and BOEING aircraft in order to be used for initial upset recovery training and recurrent training. In this regard, AIRBUS Industrie has also distributed the training aid to Thai Airways International Public Company Limited with the letter reference number AI/ST-Fn° 945.7507/98-CM/AB dated 1 February 1998 **(detailed in Appendix 20).**

Flight Safety Information November 1998 Vol. 82 No. 6, circulated in Thai Airways International Public Company Limited, published Aerodynamic Principle of Large-Airplane Upset and Recovery Techniques, a courtesy of AERO Magazine No. 3 with permission of the BOEING Company **(detailed in Appendix 21).**

Flight Operation Department of Thai Airways International Public Company Limited issued Inter-Office Communication to call AIRBUS: A300-600/A310 pilots for extra semi auto go-around training in simulator at the beginning of February 1999 **(detailed in Appendix 22).**

1.18.6 Pitch trim systems are composed of pitch trim 1 and pitch trim 2 systems. In normal operation, pitch trim 1 is in operating mode while pitch trim 2 is in standby mode. **(detailed in Appendix 23)**

The main pitch trim devices are as followed:

- pitch trim lever
- flight augmentation computer (FAC)
- trim rocking levers
- electric servo motor

Engagement conditions of pitch trim 1 or pitch trim 2 are as follows :

- pitch trim lever 1 (2) - manually ON position
- 115V, 26VAC, 28VDC available
- Servo motor 1 (2) OK
- Air data computer 1 (2) operative (if flaps retracted)
- At least 2 of 3 angle of attack probes operative (if slats retracted)
- Internal Monitoring of the FAC

If the above conditions are properly operated, pitch trim 1 or pitch trim 2 will be engaged and pitch trim lever is held in ON position. Should any pitch trim engagement conditions be lost, the systems will disengage and the corresponding pitch trim lever will trip to OFF.

The other 2 conditions which can trip the system are :

- Pilot uses Pitch trim control wheel directly.

- The two switches of trim rocking lever on control column are in opposite position.

The pitch trim system operates the THS, depending on the calculation and operation of the FAC . It can be divided into 4 functions as follows:

- electric trim - by using rocking levers on control column

- autotrim - by using autopilot

- Mach/V_c trim- which trims the aircraft nose up to keep a neutral static stability at high speed.

- Incidence Trim function is to provide a nose down command as soon as the AOA is too high. It can be divided into 2 types as follows :

- Standard Incidence Trim is to enable the longitudinal stability augmentation by sending the nose down command when the aircraft AOA signal exceeds a predetermined threshold.
- Anti Stall Trim is to assist the stall recovery through a nose down command that is activated when the AOA is about to create the stall condition.

1.18.7 Stall Warning Operation

Stall warning will give cricket warning and stick shake warning when true angle of attack exceeds 10 degrees in case the slat extends less than 15 degrees and when true angle of attack exceeds 17.5 degrees in case the slat extends 15 degrees or more respectively.

1.18.8 Flight Path Chart

1.18.8.1 From radar record of Surat Thani Airport, the approach flight path chart was done. It can be concluded that there were three approaches after passing FAF. The aircraft was on the left side of VOR course 215 degrees **(detailed in Appendix 24).**

1.18.8.2 It can be concluded from the DFDR information that all three approaches had been done after passing FAF. The aircraft was on the left side of VOR course 215 degrees **(detailed in Appendix 25).**

1.18.9 Crew Resource Management (CRM)

The meaning of CRM is to make use of existing aviation resources such as equipment, information, human and procedures for the safety and effectiveness of flight operation. They are related to principles of development , communication skills, decision making skills, good leadership and followership skills, stress and fatigue management abilities including the abilities to work as a team for problem solving while flying.

1.18.9.1 The First Approach

When the co-pilot had the first contact with Surat Thani Tower, he was informed that PAPI light on the right side was out-of-service whereas the left one was operating normally. The interval of runway edge light was increased to 120 metres caused by one electrical circuit was out of service. However, after receiving such information, there was no record of the discussion between the pilot and the co-pilot with regard to the reduced visibility. (It is possible that they may discuss this matter before descending which was beyond the period that CVR can record.)

1.18.9.2 The Second Approach

After the go-around had been made, Surat Thani Tower asked for the distance where the pilot saw the runway. The pilot told the co-pilot that he had seen three miles and the co-pilot repeated that to the Surat Thani Tower. Later on, the pilot said that they were off to the left of the course which was the reason why they could not land at the first time. The co-pilot agreed and added that it might be because the wind and rain were moving toward the airfield.

While the teardrop was flown to the FAF, the co-pilot asked the pilot whether he wanted to ask if it was raining at the airfield. The pilot, however, would like the co-pilot to ask about the visibility. Nevertheless, the co-pilot asked Surat Thani Tower if it was raining over the field and was informed that there was light rain.

Having passed the FAF and received landing clearance, the pilot said to the co-pilot that the aircraft was not on the radial and commented that it was difficult to land if the aircraft was not on the radial like this. Though the co-pilot said, "gear down, flaps full, radial coming", the pilot still said it was difficult to land. Both pilots could not see the runway until it appeared on the right and, therefore, could not land. The pilot decided to go-around again. The co-pilot acknowledged and set altitude of autopilot at 2,000 feet.

1.18.9.3 The Third Approach

After the go-around, the pilot intended to make the third approach by bringing the aircraft to intercept at 11 miles from VOR and commented that the second approach was not in line with the runway because the aircraft was not on the VOR course. The co-pilot said he was uncertain whether the light he saw was a light from a boat or from the runway. So he did not inform the pilot because he was afraid of making him misunderstanding.

Surat Thani Tower asked if TG 261 would like to make the approach again. The pilot decided to make the third approach, so the co-pilot informed Surat Thani Tower accordingly. Later on, the pilot made the announcement to the passengers that they were unable to land but they would try again. However, if it was not possible, they would proceed to Bangkok. Then he emphasized to the co-pilot that they would go to Bangkok. The co-pilot acknowledged and confirmed the minimum fuel.

The pilot discussed about the second approach with the co-pilot that he saw the runway on the right and it was very close. The pilot repeated to make sure that the runway heading was 225. The co-pilot said the runway heading was actually 225 but VOR track was 215.

The aircraft passed FAF outbound to 12 DME from Surat Thani VOR then was brought to FAF again. At that moment, the pilot requested the co-pilot to inform Thai Airways International Public Company Limited operation (Surat Thani) that if they could not land, they would proceed to Bangkok. Surat Thani Tower reported that the visibility observed by tower now reduced to 1,000 metres. The co-pilot confirmed the visibility and asked if it was raining at the airfield. Surat Thani Tower confirmed the visibility and also said there was light rain over the airfield. After receiving the weather condition and visibility, both the pilot and co-pilot sounded worried. The pilot said "one thousand metres…..unable" but did not state his decision. At the same time, the co-pilot reported the FAF and Surat Thani Tower stated that it was clear to land on runway 22. The pilot decided to make another approach by saying that "Clear to land. We'll try again. If we can't….." followed by the request to select gear down and flap full.

After the co-pilot said, "flaps full", the pilot said the aircraft was on VOR course and the co-pilot acknowledged. The pilot asked whether the co-pilot could see the airfield. The co-pilot said "altitude hold, pre-set to two thousand …. and asked if it was on the right side" The pilot said they could not land. After the co-pilot acknowledged, the pilot ordered to go-around and the co-pilot responsed "go-around, trigger go levers, ….." . After a while, the pilot said, "too close, cannot land". Thereafter the co-pilot was calling out procedures until the stick shaker sounded.

1.18.10 Mobile Phone Signal Transmission

The reports on the mobile phone signal transmission from Total Access Communication Company Limited and Advances Info Service Public Company Limited, the country-wide mobile phone network providers, showed no signal transmission around the area of Surat Thani Airport during the time of the accident **(detailed in Appendix 26)**

1.19 **Useful or Effective Investigation Techniques**

None

2. Analysis

2.1 Both the pilot and co-pilot had valid licenses and other required credentials issued by the DOA.

2.2 Both the pilot and co-pilot were medically fit and had been issued Class I Medical Certificate by Institute of Aviation Medicine, Directorate of Medical Services, RTAF.

2.3 Both air traffic controllers on duty had valid licenses of Aerodrome Control and Approach Control (Surat Thani Airport) issued by the DOA.

2.4 Both air traffic controllers on duty were medically fit and had been issued Class III Medical Certificate by Institute of Aviation Medicine, Directorate of Medical Services, RTAF.

2.5 The aircraft had undergone inspection schedule and had a valid airworthiness certificate. From the information obtained from DFDR and CVR, there was no airframe or engine malfunction except stall warning and pitch trim systems as described in the Flight Crew Operating Manual (FCOM) and Aircraft Maintenance Manual (AMM).

2.6 Surat Thani Airport was under renovation. The runway was being extended to the south. Since 16 November 1998, the distance between each runway edge light was 120 metres as there was 1 circuit operative instead of the usual 2 circuits with the distance between each light of 60 metres. It might be the reason that made it difficult for the pilot to see the airport especially when the visibility was low.

2.7 The effect of mobile phone signal transmission

2.7.1 At present, though there are several studies on the effect of electronic devices especially mobile phone signal transmission, no evidence showed that it could interfere navigation, communication equipment and the operation of aircraft systems.

2.7.2. Some responsible organizations such as Federal Aviation Administration (FAA) of the U.S.A. or Civil Aviation Authority (CAA) of the U.K. have not set the strict prohibit on mobile phone usage on board.

2.7.3 From CVR, during the time of accident, both pilots did not discuss about the malfunction of navigation aids such as invalid flag or failure flag warnings.

2.7.4 From DFDR, the flight control systems, both primary and secondary, functioned normally during the three approaches and go-arounds until the time of accident.

2.7.5 The information received from Total Access Communication Company Limited and Advanced Info Service Public Company Limited showed that there was no mobile phone signal transmission during the time of accident.

2.8 According to FOM 1.2.1 page 6 paragraph 1.3, OP is responsible for assessing what might affect flight operation and company regulation. However, according to FOM, there is no indication with regard to the unit under OP who analyses the information from NOTAM for flight operation effect assessment. In this particular case, there was the announcement of runway light condition in NOTAM. However, there should be a responsible unit to inform authorized people of the unsuitable condition to operate the night flight in order that the amendment would be proposed.

2.9 OB-R is responsible for providing and updating approach charts used on board Thai Airways International Public Company Limited aircraft basing upon Jeppesen (referred to paragraph 1.17.2.1). From CVR at 19:00:19 hours, the track set was 204 degrees. However, the pilot used 215 degrees track which was in the chart provided in cockpit by Flight Route Facility Department (OB) (as shown on low-right corner of Appendix 14, referred to in paragraph 1.18.3). Thai Airways International Public Company Limited prepared the chart for piloting according to the resolution of the instrument approach procedure meeting on 12 February 1998. Meanwhile, Thai Airways International Public Company Limited has also sent a copy to Surat Thani Tower for actual operation.

2.10 As a result of wide body aircraft, engines under swept back wings and light weight at the time of accident, increasing thrust would create a nose-up pitching moment which could easily lead to upset position. However, the manufacturers were aware of this problem. Therefore, they developed and created training material such as video and CD ROM which were delivered to the airlines using AIRBUS and BOEING, for recovery training. In this regard, AIRBUS Industrie sent document to Thai Airways International Public Company Limited on 1st February 1998.

Moreover, Thai Airways International Public Company Limited had published an article entitled "AERODYNAMIC PRINCIPLES OF LARGE-AIRPLANE UPSET" in the "Flight Safety Information" in November 1998. Following that, the pilots in this fleet were trained in simulators in February 1999. The maximum use of engine power and the light weight during a go-around caused a sudden nose-up pitching moment. However, had the pilots been trained in the simulators, they would have known the unique feature of the aircraft and how to prevent the aircraft from entering the upset condition.

2.11 From the last recurrent or PFT on 8 March 1998, there was non-precision approach with NDB training. His instructor commented that the aircraft had to be on track as soon as possible during his non-precision approach, otherwise the visual contact would be difficult. However, there was no written evidence that the instructor asked the pilot to perform NDB again in order to gain more expertise.

2.12 The pilot saw the airport on the right side in every approach because the VOR station which Surat Thani Airport used as an approach aid was on the left side of runway 22 not in the middle of the runway (track 225 degrees). Track 215 degrees to the VOR passes runway 22 centre line at 4,800 metres from the threshold. Therefore, when the pilot used track 215 degrees at the visibility of less than 2,000 metres, the pilot was able to see the airfield only when the aircraft had already passed runway 22 centre line. As a result, when the pilot was able to see the airfield, it was on the right hand side in every approach. For track 204 degrees, the aircraft will pass runway 22 centre line at 1,800 metres from the threshold. The pilot might be able to see the airfield before the aircraft passed the runway centre line. It can be inferred that it was difficult for the pilot to see the airfield and successfully approach Surat Thani Airport using track 215 degrees when the visibility fell to less than 2,000 metres.

2.13 When approaching the airport, the pilot went too far left of the track all 3 times. The pilot was not able to adjust the direction of the aircraft to maintain VOR course. Additionally, the pilot was not familiar with non-precision approach as shown in his last PFT record (**detailed in Appendix 19**).

2.14 The weather forecast at Surat Thani Airport during 13:00-22:00 hours which the pilot received from Thai Airways International Public Company Limited's Dispatcher indicated that there might be temporarily variable surface wind with a visibility of 1,500 metres with rain showers. The visibility reported when the aircraft was 70 nautical miles away from the airport was still at 1,500 metres. Though the last visibility report before the accident was at 1,000 metres which was less than the minimum visibility, the pilot decided to approach 3 times.

2.15 The Pitch Trim system Analysis of TG 261

The information from DFDR

- No record of both pitch trim systems tripped throughout the flight

- The anti stall trim function of the pitch trim system came into operation at approximately 19:08:03 hours (when the true angle of attack was 17.7 degrees) which caused the THS to move from –4.6 degrees to –0.7 degrees and then back to –4.6 degrees at approximately 19:08:14 hours and was consistent with threshold limit described in AMM (16 degrees to 21 degrees depending on phase advance term)

- There was no evidence that the pilot used manual trim control wheel. The information received from CVR at 19:07:59 hours indicated that the pilot said "…trim" which was not able to clarify that it was "manual trim" or "it was not (or "mun-mai" in Thai) trim" as it sounded like he talked to himself. Also, the pilot neither repeated nor gave the corrective action order to the co-pilot when the pitch attitude is more than 23 degrees nose up. Moreover , the pilot did not use pitch trim control wheel as pitch trim lever was still at "on" position and there was no pitch trim fault in DFDR.

There was not enough information to support that the pitch trim system functioned efficiently described as follows:

According to the FCOM and AMM, it stated that when the information on angle of attack is not valid, pitch trim system will be automatically released and THS will remain at the last position.

2.16 Stall Warning System Analysis

Information on DFDR

Time	Indicated Angle of Attack	True Angle of Attack	Stall
19:08:03	27 degrees	15.67 degrees	No
	30 degrees	**17.67 degrees**	
19:08:04	35 degrees	21.04 degrees	No
	38 degrees	23.05 degrees	
Time	**Indicated Angle of Attack**	**True Angle of Attack**	**Stall**
19:08:05	42 degrees	**25.73 degrees**	**Yes**
	46 degrees	28.42 degrees	
19:08:06	49 degrees	30.43 degrees	Yes

The equation to calculate the true angle of attack in case the flap extends more than or equal to 15 degrees and the indicated angle of attack is more than or equal to 26 degrees is

$$\text{True angle of attack} \quad \frac{\text{indicated angle of attack}}{1.49} - 2.45 \text{ degrees}$$

The first stall warning was at 19:08:05 hours. From CVR record at 19:08:05 hours, there was the sound of stall warning continuously for 5 seconds which was consistent with the DFDR record above which could indicate that the system generated the warning when the true angle of attack was 25.73 degrees which was not consistent with the threshold limit of 17.5 degrees as described in the FCOM and AMM.

2.17 The chronological incidents before the approaches as in the records of DFDR, CVR and Surat Thani Tower have been deduced as follows:

2.17.1 At the first approach, when the aircraft was 70 nautical miles away from Surat Thani Airport, the co-pilot contacted approach controller for weather report. The controller reported that the surface wind was calm with the visibility of 1,500 metres, light rain and cloud base at 1,800 feet. Temperature and dew point were 24/22 degrees Celsius respectively.

2.17.2 While executing the first instrument approach with the aid of VOR/DME at runway 22, the co-pilot reported that the airport was in sight. The autopilot was disconnected at 696 feet. Later on, the pilot considered that he was unable to land, so the pilot decided to go-around again. During this time, the pilot noticed and said that there was a high rate of climb. The co-pilot said it might have been because they were very light. At the first go-around, the pilot showed no sign of fatigue, and the acceleration of engine power was gradually increased (70% N1 – 102% N1 in 23 seconds), which resulted in the low pitching up moment. The pilot still had awareness and could cope with the situation.

2.17.3 In executing the second instrument approach with the aid of VOR/DME at runway 22, the autopilot was used. When the co-pilot reported FAF, the air traffic controller was unable to see the aircraft. Later on, when the traffic controller could see the aircraft and asked the pilot to state the intention, the co-pilot answered that he could not see the runway. From the record, the conversation between the pilot and co-pilot was on the confusion about whether the lights seen were those of the airfield. It can be analyzed that as it was raining at that time and the runway edge lights were operated with 1 circuit causing the distance between each light to be 120 metres, then the pilot decided to go-around using autopilot and autothrottle.

2.17.4 In executing the third instrument approach with the aid of VOR/DME at runway 22, the air traffic controller informed the pilot that the visibility observed was approximately 1,000 metres. Both pilots acknowledged and were concerned about the reduction of visibility since the pilot said "one thousand metres unable". However, the decision was not made. Later on, the co-pilot reported FAF. The air traffic controller then said "clear to land runway 22". The pilot decided to approach again and said "clear to land. We'll try again. If we can't…." the air traffic controller's words "clear to land" might stimulate the pilot's decision to land again. While approaching and maintaining the height as in MDA, the pilots said "Can you see?" which showed his attempt to find the airfield. After a while, there was a sound of "cavalry charge" similar to autopilot disconnection. (It cannot be proved that who disconnected it as there was no call out and the procedure in AOM does not indicate.) The pilot was flying manually but could not see the airfield until it was too close. The pilot emphasized "cannot land" twice. He, then, decided to go-around using trigger go levers (autothrottle). The engine spun up rapidly (from 59% N1 - 102% N1 in 8 seconds). Additionally, the pitching moment around the lateral axis of the aircraft also strongly increased. (This was consistent with the explanation received after the accident from the flight attendant that the pilots had pulled up harshly.) At the beginning of the go-around, the pitch attitude was continuously increasing. According to DFDR, the pilot applied elevator with the angle of maximum +4.56 degrees for 2-3 seconds to lower the pitch attitude when it was 18 degrees which reduced, at small amount, the rate of the increasing pitch while there was no movement of the stabilizer. Until the pitch attitude reached approximately 40 degrees, the pilot, once again, applied the elevator with the angle of +7.74 degrees for 5 - 6 seconds which resulted in decreasing of pitch attitude to 32 - 33 degrees then increasing to 47 - 48 degrees thereafter when he discontinued applying the elevator and at that time the aircraft speed was less than 100 knots. From the record, the pilot said "too close, cannot land" which showed that the pilot was at a loss of situation awareness and did not recognize the abnormal position of the aircraft until the aircraft entered a stall and could not recover. The reasons for the pilot's loss of situation awareness were as follows:

2.17.4.1 The pilot paid attention to the approach as he had not been able to land for 3 times. Also, he was concerned about bringing the aircraft back to flight schedule which was shown during the third approach when the pilot said "we fly back…if not in time, the aircraft won't make it to Chiang Mai"

2.17.4.2 The rapid increase of pitch situation occurred as a result of the use of engine power during the third go-around which was different from the two previous ones. According to the DFDR, when the co-pilot said "trigger go levers" during the go-around, the power of engine increased from 59% N1 – 102% N1 in 8 seconds. It produced a nose-up pitching moment which led to an upset position. However, being familiar with the pitch during the first two go-arounds, the pilot, therefore, did not prepare to enter into the upset position for the third go-around.

2.17.4.3 The pilot suffered from the accumulation of stress as a result of two go-arounds and not being able to land. Moreover, the low visibility also increased the high workload which caused less efficiency and channelized attention. Such factors resulted in various human errors and omission. The previous reaction was used as a decision standard (negative transfer). In this case, the danger did not happen during the first two go-arounds, therefore, the pilot was not aware of different procedures in the third one.

2.17.5 According to the CRM

2.17.5.1 The judgment of the risks, which could occur during the flight did not include the followings :

2.17.5.1.1 The information on the distance between runway edge lights which was 120 metres instead of 60 metres, the less intense of lights affecting the visibility, and also the visibility which was less than the standard set by Thai Airways International Public Company Limited during the third approach.

2.17.5.1.2 The aircraft information according to the characteristic: The A-310 has a high tendency of pitching up moment while using autothrottle by trigger go levers during the go-around.

2.17.5.2 The pilot's aeronautical decision making was not efficient enough as the visibility information and the aircraft specific control information were not brought into consideration for safety operation.

2.17.5.3 The pilot had a personal character of speaking in a soft tone of voice which might sometimes cause a communication problem. The co-pilot misunderstood the meaning (The co-pilot asked if the pilot wanted him to ask about the rain at the airfield. The pilot replied that he wanted him to ask about the visibility. However, the co-pilot might not be able to hear it clearly, he, therefore, asked the Surat Thani Tower if it was raining at the airfield).

2.17.5.4 According to CVR, there was no record that the pilot had a briefing before the second and the third approach at Surat Thani Airport after the go-around especially in the third approach when the visibility decreased to 1,000 metres. Though there is no regulation that a briefing must be made again, the pilots, from CRM perspective, should have performed an approach briefing and assign the responsibilities including those on the instrument approach and the call out.

3. Conclusions

3.1 **Findings**

3.1.1 The pilot and the co-pilot had valid airline transport pilot's licenses as well as class I medical certificate.

3.1.2 Both air traffic controllers at Surat Thani Airport had valid air traffic control's licenses as well as class III medical certificate.

3.1.3 Airframe, engines and other aircraft systems were maintained in accordance with the procedures and regulation set forth by the DOA of Thailand and had valid certificate of airworthiness.

3.1.4 From the information obtained from DFDR and CVR, it was found that the engines functioned normally. However, the pitch trim system might not function properly. While the information on the angle of attack was not valid, the pitch trim should have tripped but according to the DFDR, none of the information indicated that the pitch trim had tripped.

3.1.5 From the information obtained from DFDR and CVR, the stall warning system functioned when the AOA was 25.73 degrees instead of 17.5 degrees as described in the FCOM and AMM.

3.1.6 The conditions obstructing the airfield visibility

3.1.6.1 At the time of accident, the visibility was at 1,000 metres with light rain.

3.1.6.2 At the time of accident, there was no approach light while the runway lights were partially inoperative as announced in the NOTAM.

3.1.6.3 The pilot used approach chart issued by Thai Airways International Public Company Limited for trial. Following such an approach chart, the aircraft will intercept the runway centre line at the further distance than following the chart issued by the DOA. Therefore, with low visibility, the airfield was even more difficult to see.

3.1.6.4 The pilot could not maintain the VOR course as set forth in the chart. The aircraft flew left of VOR course every approach.

3.1.7 As two go-arounds had been made in the low visibility , the pilot suffered from the accumulation of stress and channelized attention. Therefore, during the third go-around, the use of engines was at maximum power especially when the aircraft's weight was light would cause large amount of pitching up moment , moreover , the pilot was at the loss of situation awareness as he paid attention to searching the airfield rather than monitoring the flight instruments. This made the aircraft nose up until the aircraft entered into the upset condition.

3.1.8 The pilot was not trained on large airplane upset condition recovery.

3.1.9 Thai Airways International Public Company Limited's FOM did not specify the responsible unit for studying information in NOTAM which might affect the flight safety and reporting to the management.

3.1.10 The flight instructor was lack of strictness in PFT for the pilot.

3.2 Probable Causes

After careful consideration, the Aircraft Accident Investigation Committee of the Kingdom of Thailand ultimately came to the conclusion that the accident occurred because the aircraft entered into stall condition which might be caused by the followings:

3.2.1 The pilot attempted to approach the airport in lower than minimum visibility with rain.

3.2.2 The pilot could not maintain the VOR course as set forth in the approach chart. The aircraft flew left of VOR course on every approach.

3.2.3 The pilots suffered from the accumulation of stress and were not aware of the situation until the aircraft entered into the upset condition.

3.2.4 The pilots had not been informed of the document concerning the wide-body airplane upset recovery provided by AIRBUS Industrie for using in pilot training.

3.2.5 The lighting system and approach chart did not facilitate the low visibility approach.

3.2.6 Stall warning and pitch trim systems might not fully function as described in the FCOM and AMM.

4. Safety Recommendations

4.1 Pilots should strictly follow all procedures set forth in the flight operation manuals.

4.2 The operator should be strict in evaluation and test of the flying training following the standards and procedures.

4.3 When receiving NOTAMs which affect the flight operation, it is important that the operator stresses to notify to the pilots to use them as the essential factor for the flight operation in each route .

4.4 Any flight safety documents that the operator has already assured for its safety should be certified by the authority.

4.5 The operator should inform pilots about all the flight safety documents for their proper use and correct action.

4.6 Aviation personnel must attend CRM training on Human Factors Training Manual ICAO DOC. 9683-AN/950.

4.7 Pilots should undergo airplane upset recovery training.

Appendix

Appendix 1

ZCZC BAA043 300304

GG VTBAYOYX

300301 VTBDYNYX

(C0294 / 97 NOTAMN

Q) VTBB / QISAS / I / NBO / A / 000 / 999 /0908N09908E050 /

A) VTSB B) 9701300300 C) 9704300500

E) RWY 22 ILS U/S)

Appendix 2

ZCZC BAA266 010832

GG VTBAYOYX

GG VTBAYOYX VTBANPPX

010827 VTBDYNYX

(C3510 / 98 NOTAMN

Q) VTBB / QISAS / I / NBO / A / 000 / 999 / 0907N09907E050

A) VTSB B) 9812010827 C) 9901251000

E) RWY 22 ILS U/S)

Appendix 3

ZCZC BAA098 300512

GG VTBAYOYX

GG VTBAYOYX VTBANPPX

300508 VTBDYNYX

(C3491 / 98 NOTAMR C3227 / C3227 / 98

Q) VTBB / QLPAS / IV / BO / A / 000 / 999 / 0908N09908E005

A) VTSB B) 9811300508 C) 9812301430

E) RWY 04 LEFT SIDE PAPI U/S)

ZCZC BAA102 300517

GG VTBAYOYX

GG VTBAYOYX VTBANPPX

300513 VTBDYNYX

(C3493 / 98 NOTAMR C3225 / C3225 / 98

Q) VTBB / QLPAS / IV / BO / A / 000 / 999 / 0909N09908E005

A) VTSB B) 9811300513 C) 9812301430

E) RWY 22 RIGHT SIDE PAPI U/S)

Appendix 4

FACILITIES FLIGHT INSPECTION BRANCH
AIR NAVIGATION FACILITIES DIVISION.
DEPARTMENT OF AVIATION

FLIGHT INSPECTION REPORT - VISUAL AIDS			Reports Identification Symbol ANFD/FIO-001
1. STATION SURAT PAPI	2. LOCATION IDENT. VTSB	3. DATE/DATES OF INSPECTION November 18, 1998	

4. TYPE OF INSPECTION						5. COMMON SYSTEM	
	SITE EVALUATION	X	PERIODIC		SPECIAL		YES
	COMMISSIONING		SURVEILLANCE		INCOMPLETE		NO

6. OWNER					OTHER (INDICATE ACTUAL OWNER)
	X	DOA		USAF	
		RTAF		INTERNATIONAL	

7. FACILITY INSPECTED		ALS		REIL	X	PAPI	8. RUNWAY SERVED 22

9. ITEMS TO BE CHECKED	SAT.	UNSAT.	9. ITEMS TO BE CHECKED (Cont.)	SAT.	UNSAT.
INTENSITY	X				
GLIDE SLOPE ANGLE (PAPI)	X				
COINCIDENCE (PAR/ILS/PAPI)	N/A				
ANGULAR COVERAGE	X				
OBSTRUCTION CLEARANCE (PAPI)	X				
STANDBY POWER	N/C			YES	NO
RUNWAY LIGHTS			ALL LIGHTS OPERATIVE		
SEQUENCE FLASHERS			PHOTOGRAPHS MADE		
FOCUS AND ADJUSTMENTS					
COLOR FILTERS					

10. DISCREPANCIES AND/OR REMARKS — CORRECTED: YES / NO

1. This is a periodic check of SURAT PAPI served runway 22.
2. Glide slope angle is 2.98 degree.
3. Light intensity, angular coverage and obstruction clearance found satisfactory.
4. Facility performance classified as "Unrestricted".
5. Next periodic check is due on November 18, 1999. (Overdue on January 16, 2000).

FACILITY CLASSIFICATION		FLIGHT INSPECTOR
X	UNRESTRICTED	[signature] CHINDA.

Appendix 5

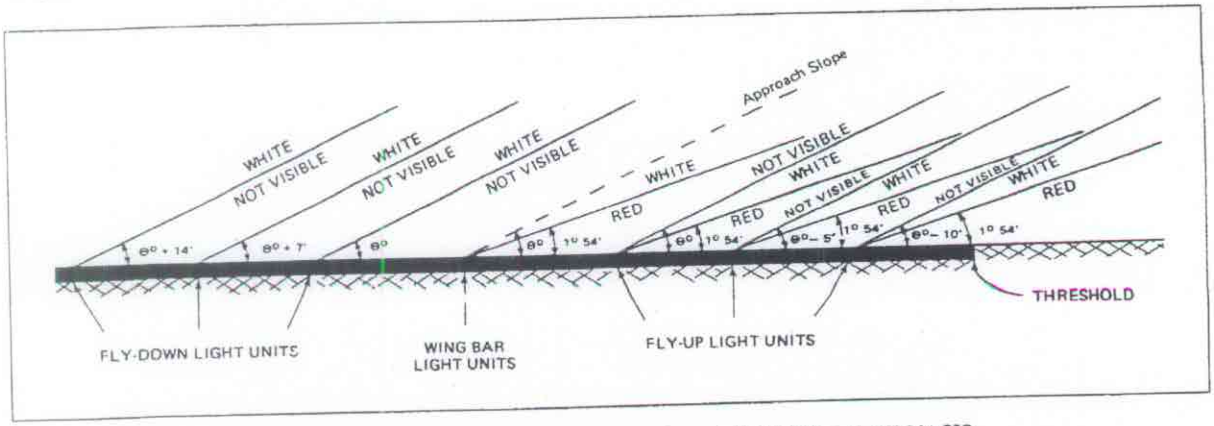

Figure 5-14. Light beams and elevation settings of T-VASIS and AT-VASIS

5.3.5.20 The elevation of the beams of the wing bar light units on both sides of the runway shall be the same. The elevation of the top of the beam of the fly-up light unit nearest to each wing bar, and that of the bottom of the beam of the fly-down light unit nearest to each wing bar, shall be equal and shall correspond to the approach slope. The cut-off angle of the top of the beams of successive fly-up light units shall decrease by 5′ of arc in angle of elevation at each successive unit away from the wing bar. The cut-in angle of the bottom of the beam of the fly-down light units shall increase by 7′ of arc at each successive unit away from the wing bar (see Figure 5-14).

5.3.5.21 The elevation setting of the top of the red light beams of the wing bar and fly-up light units shall be such that, during an approach, the pilot of an aeroplane to whom the wing bar and three fly-up light units are visible would clear all objects in the approach area by a safe margin if any such light did not appear red.

5.3.5.22 The azimuth spread of the light beam shall be suitably restricted where an object located outside the obstacle protection surface of the system, but within the lateral limits of its light beam, is found to extend above the plane of the obstacle protection surface and an aeronautical study indicates that the object could adversely affect the safety of operations. The extent of the restriction shall be such that the object remains outside the confines of the light beam.

Note.— See 5.3.5.41 to 5.3.5.45 concerning the related obstacle protection surface.

PAPI and APAPI

Description

5.3.5.23 The PAPI system shall consist of a wing bar of 4 sharp transition multi-lamp (or paired single lamp) units equally spaced. The system shall be located on the left side of the runway unless it is physically impracticable to do so.

Note.— Where a runway is used by aircraft requiring visual roll guidance which is not provided by other external means, then a second wing bar may be provided on the opposite side of the runway.

5.3.5.24 The APAPI system shall consist of a wing bar of 2 sharp transition multi-lamp (or paired single lamp) units. The system shall be located on the left side of the runway unless it is physically impracticable to do so.

Note.— Where a runway is used by aircraft requiring visual roll guidance which is not provided by other external means, then a second wing bar may be provided on the opposite side of the runway.

5.3.5.25 The wing bar of a PAPI shall be constructed and arranged in such a manner that a pilot making an approach will:

a) when on or close to the approach slope, see the two units nearest the runway as red and the two units farthest from the runway as white;

b) when above the approach slope, see the one unit nearest the runway as red and the three units farthest from the runway as white; and when further above the approach slope, see all the units as white; and

c) when below the approach slope, see the three units nearest the runway as red and the unit farthest from the runway as white; and when further below the approach slope, see all the units as red.

5.3.5.26 The wing bar of an APAPI shall be constructed and arranged in such a manner that a pilot making an approach will:

Appendix 6

ZCZC BAA104 160603

GG VTBAYOYX

GG VTBAYOYX VTBANPPX

160600 VTBDYNYX

(C3360 / 98 NOTAMN

Q) VTBB / QNBAS / IV / BO / AE / 000 / 999 / 0907N09908E100

A) VTSB B) 9811160600 C) 9901250400

E) 338 KHZ NDB U/S DUE TO RELOCATE)

Appendix 7

FACILITIES FLIGHT INSPECTION BRANCH
AIR NAVIGATION FACILITIES DIVISION
DEPARTMENT OF AVIATION

Reports Identification Symbol AN:TD/FIO-004

FLIGHT INSPECTION REPORT – VOR, VORTAC, TACAN, VOT

1. STATION	2. LOCATION IDENT	3. DATE/DATES OF INSPECTION
SURAT DVOR/DME	STN	September 10, 1998

4. TYPE OF INSPECTION

SITE EVALUATION		PERIODIC	X	SPECIAL	
COMMISSIONING		SURVEILLANCE		INCOMPLETE	

5. COMMON SYSTEM: YES / NO

6. OWNER				OTHER (INDICATE ACTUAL OWNER)
X	DOA		USAF	
	RTAF		INTERNATIONAL	

7. FACILITY/COMPONENT INSPECTED: X DVOR | VORTAC | TACAN | VOT | X DME

8. RADIAL DATA

FACILITY SERVICE DESIGNATION	DVOR	DVOR	DVOR	DVOR	DVOR	DVOR	DVOR	DVOR		
RADIAL USE	MON	MON	W-10	W-10	–	–	–	–		
AZIMUTH	200	200	017	017	151	151	319	319		
TRANSMITTER(S)	1	2	1	2	1	2	1	2		
MSL ALTITUDE (In hundreds)	20	20	20	20	20	20	20	20		
DISTANCE (Nautical miles) FROM	4.3	7.9	3.9	7.2	7.6	4	7.2	9.9		
DISTANCE (Nautical miles) TO	7.5	9.8	6.9	9.4	10.6	7.2	3.3	7.8		
SENSITIVITY	–	–	–	–	–	–	–	–		
ROUGHNESS	O	O	O	O	O	O	O	O		
SCALLOPING	O	O	O	O	O	O	O	O		
BENDS	O	O	O	O	O	O	O	O		
POLARIZATION	–	–	–	–	–	–	–	–		
ALIGNMENT ERROR	-0.1	-0.1	+1.2	+1.4	-0.1	+0.4	+0.4	+0.7		
TRANSMITTER DIFFERENCE	0.0	0.0	0.2	0.2	0.5	0.5	0.3	0.3		
SIGNAL STRENGTH	80+	40+	71+	40+	28+	50+	80+	28+		
INTERFERENCE	O	O	O	O	O	O	O	O		

9. GENERAL	SAT.	UNSAT.
STANDBY POWER	–	–
VOICE	N/A	
IDENTIFICATION	X	
DME ACCURACY	X	
DME COVERAGE	X	

10. MONITORS

LAST DATE INSPECTED: September 10, 1998

			TX	ALIGNMENT	ALARM +	ALARM –
DVOR	REFERENCE RADIAL	200	1	-0.1	+0.9	-0.8
DVOR	CHECK POINT					
TACAN	REFERENCE RADIAL					
TACAN	CHECK POINT					

11. DISCREPANCIES AND/OR REMARKS — CORRECTED: YES / NO

SEE ATTACHMENT

FACILITY CLASSIFICATION: X UNRESTRICTED

FLIGHT INSPECTOR: [signature] [signature] [signature]

Appendix 8

MEMO

From: Air Navigation Facilities Division, Facilities Flight Inspection Unit

Ref: 0409/0097

Subject: Flight Inspection Report

To: Director General through Deputy Director General (Administration)

Due to the accident in which an aircraft of Thai Airways International Public Company Limited at Surat Thani Airport on 11 December 1999, Facilities Flight Inspection Unit rechecked the DVOR/DEM during 14-17 December 1998. The results were as follows:

1. DVOR/DME Number 2, operated on the day of accident, were operated within the in-tolerance error.
2. The chart of VOR/DME Runway 22 Instrument Approach Procedure, rechecked on 15 December 1998, was able to be used to enter runway 22 threshold.

Tawat Payakvichirn

Director of Air Navigation Facilities Division

Appendix 9

ZCZC PRN045 161133

GG VTBAYOYX

GG VTBAYOYX VTBANPPX

161130 VTBDYNYX

(C3364 / 98 NOTAMR C3362 / 98

Q) VTBB / QLELX / IV / NBO / A / 000 / 999 /

A) VTSB B) 9811161130 C) 9812161430

E) DUE TO RWY 04 / 22 LGT FAC OPR INTERVAL OF ELECTRICAL CIRCUIT AS FLW :

1. REDL INTERVAL OF 120 M
2. THR LGT AND RENL INTERVAL OF 6 M)

Appendix 10

ZCZC BAA076 140441
GG VTBAYOYX
GG VTBAYOYX VTBANPPX
140428 VTBDYNYX
(C2744 / 98 NOTAMR C1860 / 98
Q) VTBB / QLAAS / IV / NBO / A / 000 / 999 /
A) VTSB B) 9809140428 C) 9812300930
E) RWY 22 ALS U/S)

ZCZC BAA077 140442
GG VTBAYOYX
GG VTBAYOYX VTBANPPX
140430 VTBDYNYX
(C2745 / 98 NOTAMR C1861 / 98
Q) VTBB / QLFAS / I / BO / A / 000 / 999 /
A) VTSB B) 9809140430 C) 9812300930
E) RWY 22 SEQUENCED FLG LGT U/S)

Appendix 8

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Tawat Payakvichirn
Director of Air Navigation Facilities Division

Appendix 9

ZCZC PRN045 161133

GG VTBAYOYX

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161130 VTBDYNYX

(C3364 / 98 NOTAMR C3362 / 98

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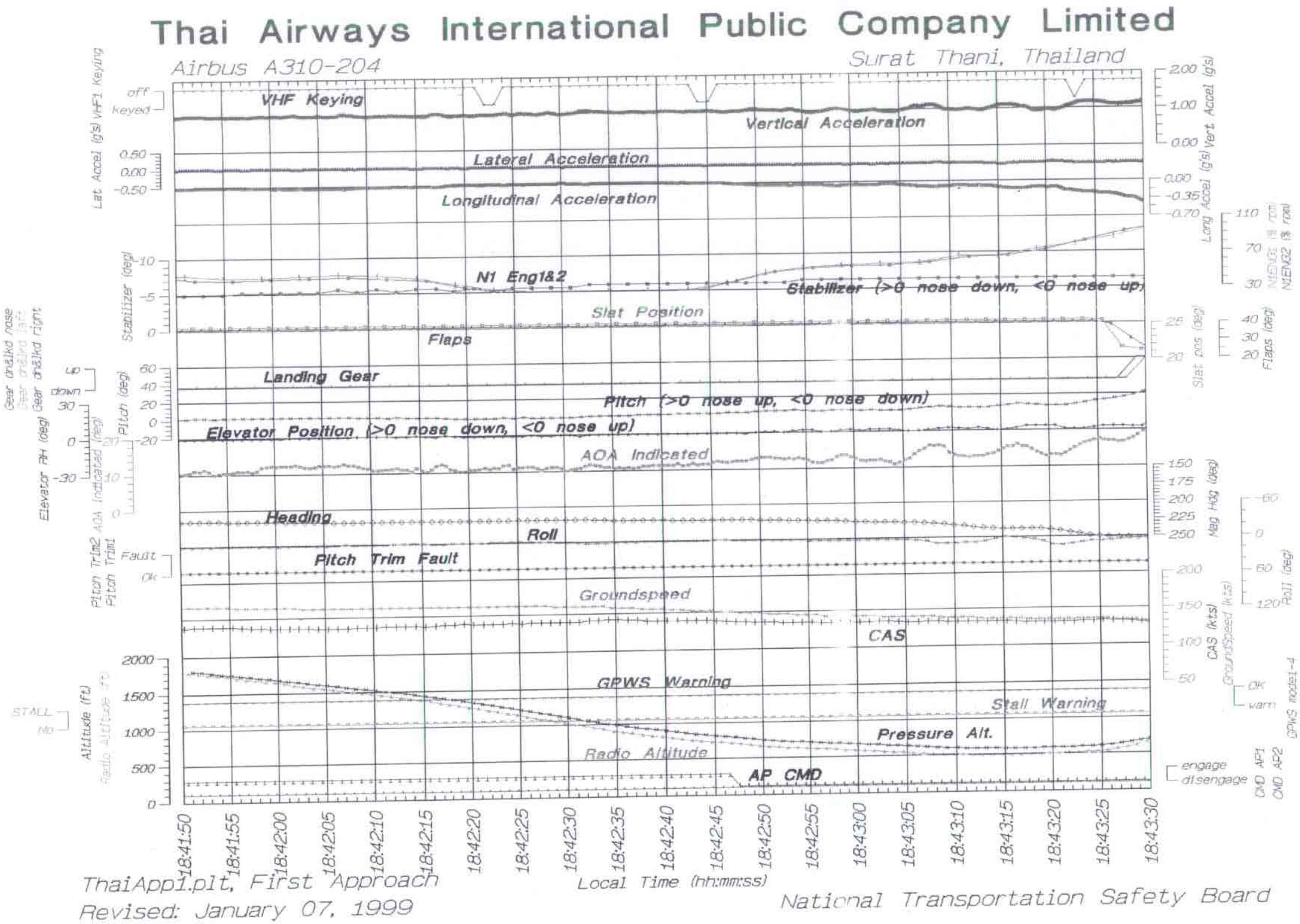
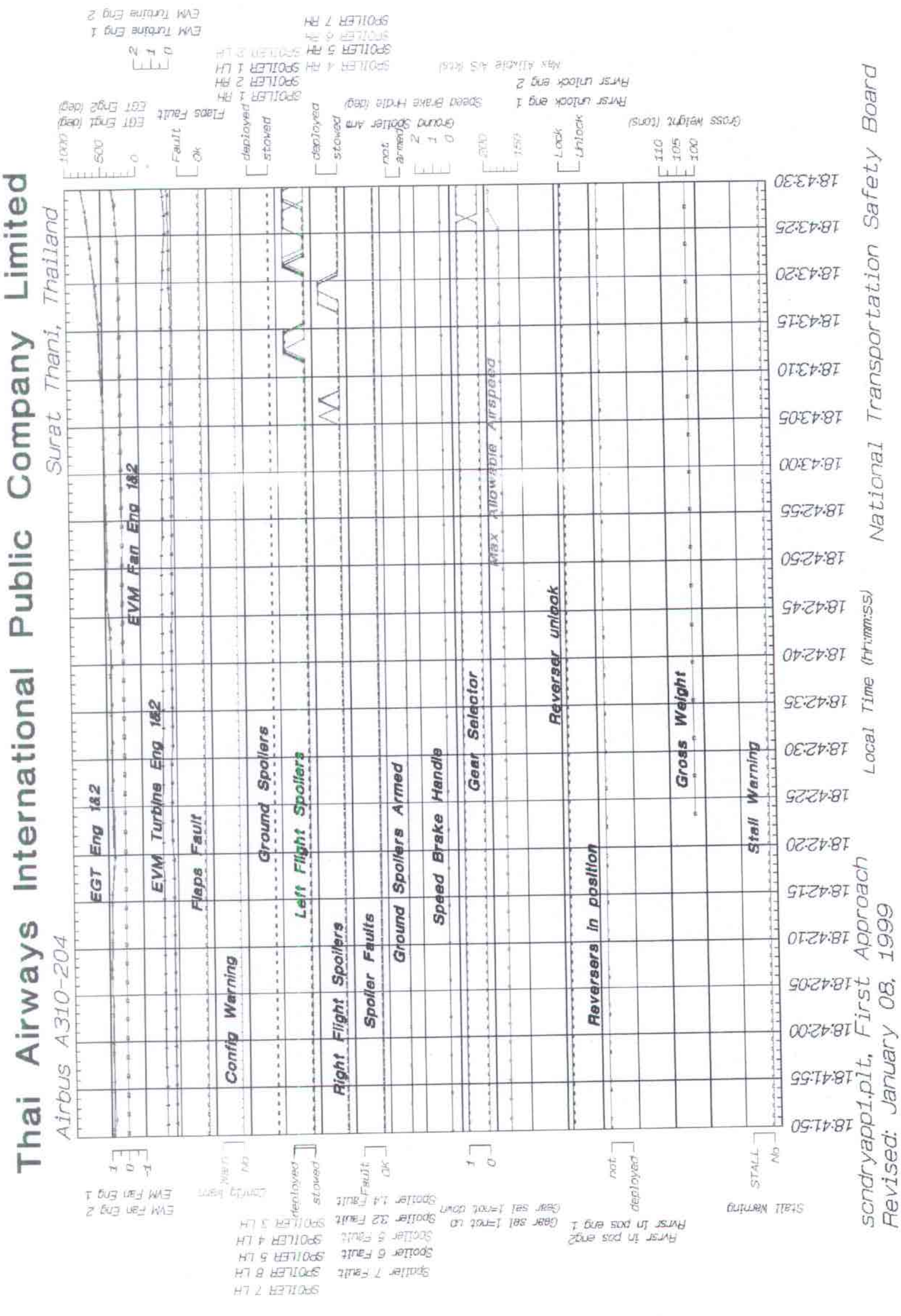
Q) VTBB / QLFAS / I / BO / A / 000 / 999 /

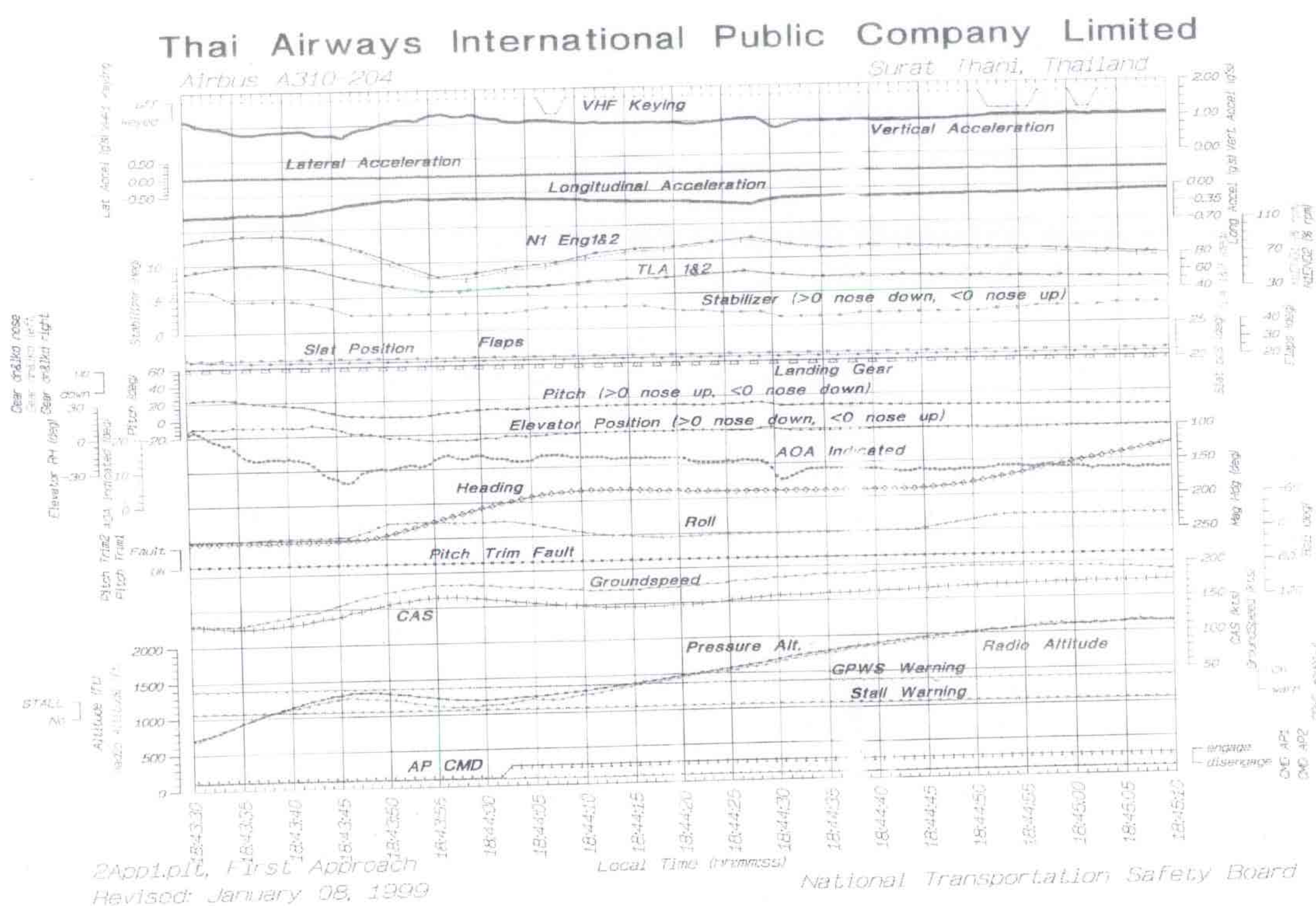
A) VTSB B) 9809140430 C) 9812300930

E) RWY 22 SEQUENCED FLG LGT U/S)

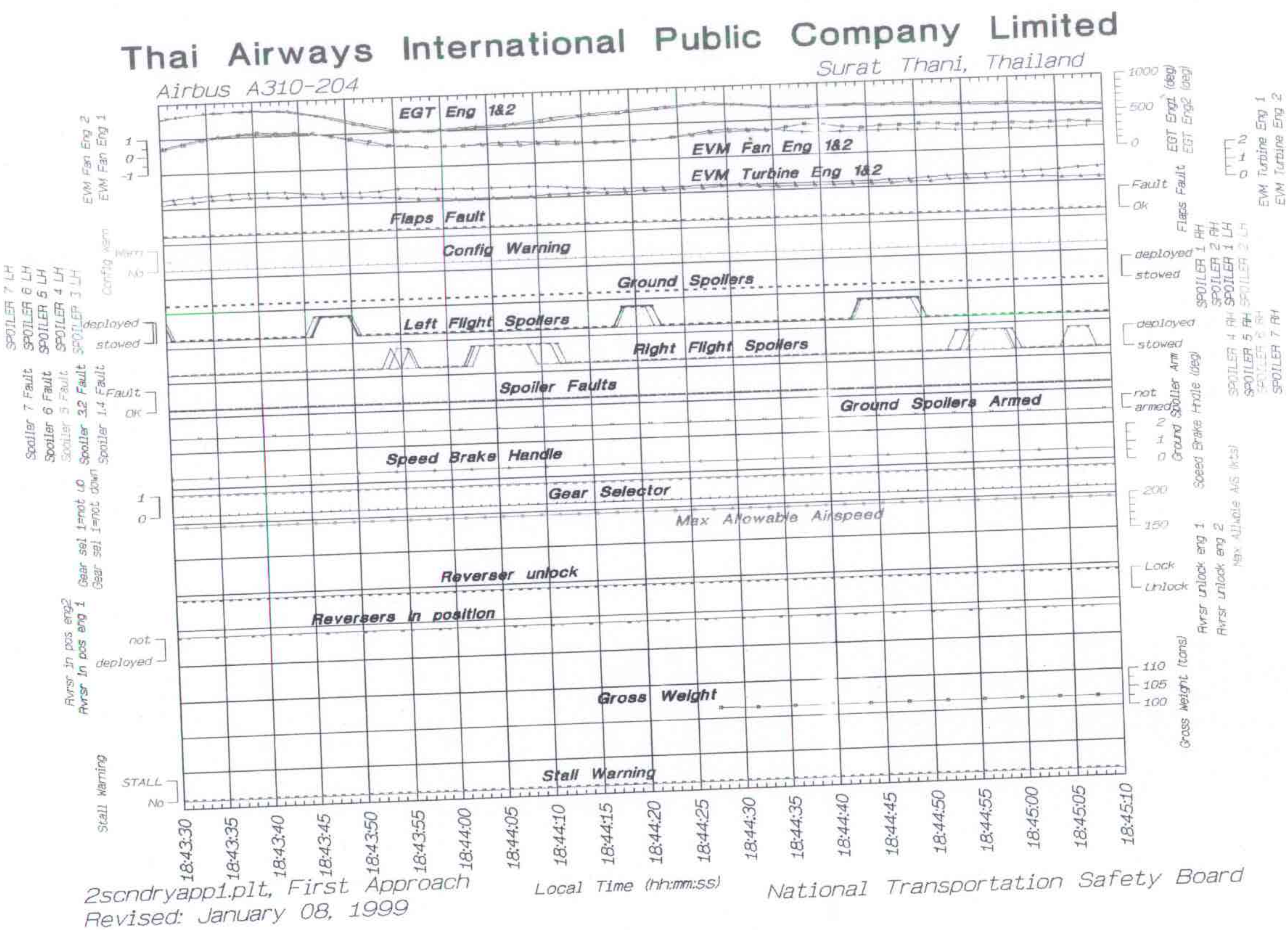
Appendix 11

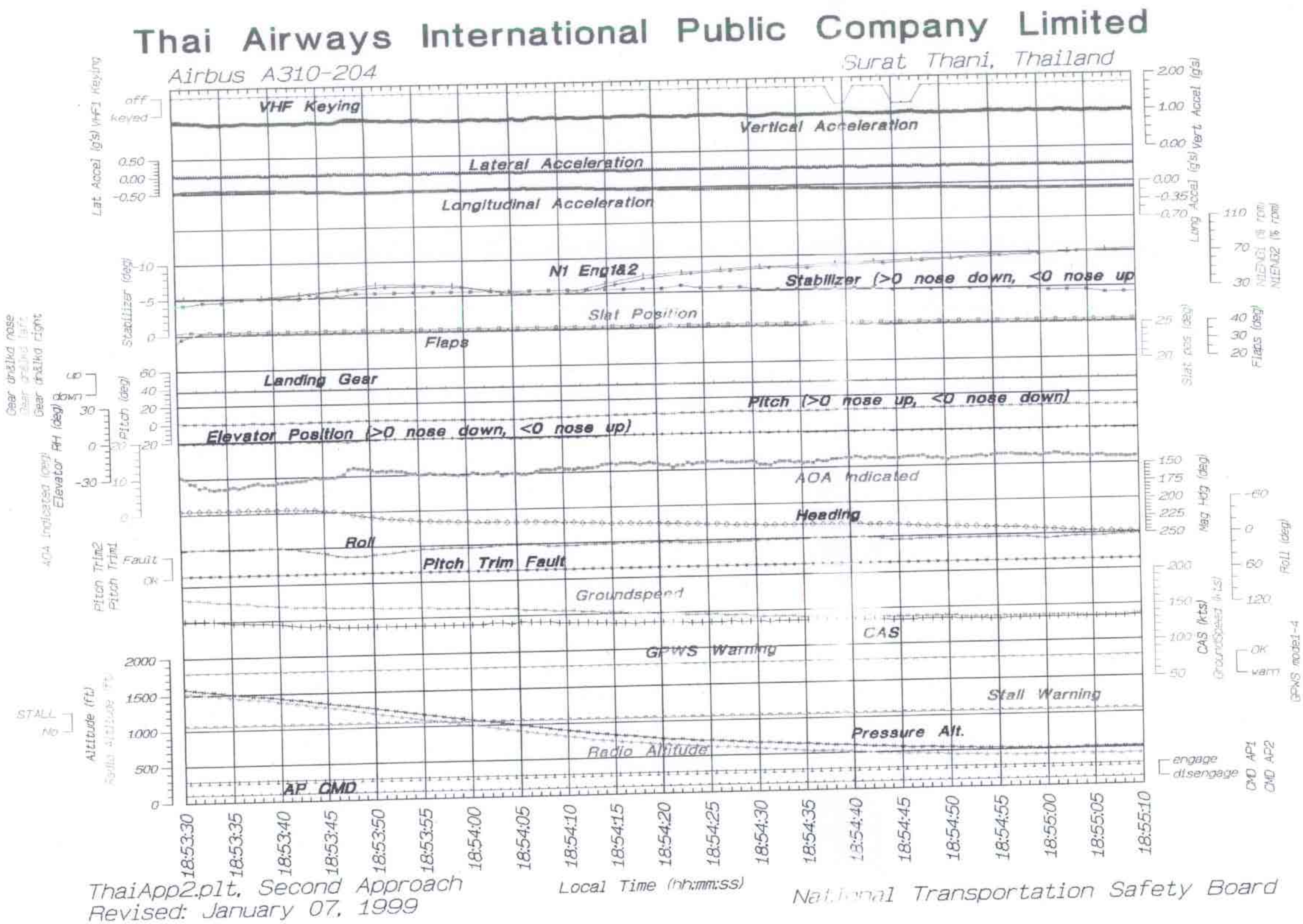

Thai Airways International Public Company Limited
Airbus A310-204
Surat Thani, Thailand
VHF Keying
Vertical Acceleration
Lateral Acceleration
Longitudinal Acceleration
N1 Eng1&2
Stabilizer (>0 nose down, <0 nose up)
Slat Position
Flaps
Landing Gear
Pitch (>0 nose up, <0 nose down)
Elevator Position (>0 nose down, <0 nose up)
AOA Indicated
Heading
Roll
Pitch Trim Fault
Groundspeed
CAS
GPWS Warning
Stall Warning
Pressure Alt.
Radio Altitude
AP CMD
Lat Accel (g's) VHF1 Keying
Stabilizer (deg)
Pitch (deg)
Elevator RH (deg)
AOA Indicated (deg)
Gear dn&lkd nose
Gear dn&lkd left
Gear dn&lkd right
Pitch Trim2
Pitch Trim1
Altitude (ft)
Radio Altitude (ft)
Vert Accel (g's)
Long Accel (g's)
N1ENG1 (% rpm)
N1ENG2 (% rpm)
Slat pos (deg)
Flaps (deg)
Mag Hdg (deg)
Roll (deg)
CAS (kts)
GroundSpeed (kts)
GPWS mode1-4
CMD AP1
CMD AP2
engage
disengage
off
keyed
up
down
Fault
Ok
STALL
No
warn
18:41:50
18:41:55
18:42:00
18:42:05
18:42:10
18:42:15
18:42:20
18:42:25
18:42:30
18:42:35
18:42:40
18:42:45
18:42:50
18:42:55
18:43:00
18:43:05
18:43:10
18:43:15
18:43:20
18:43:25
18:43:30
Local Time (hh:mm:ss)
ThaiAppl.plt, First Approach
Revised: January 07, 1999
National Transportation Safety Board

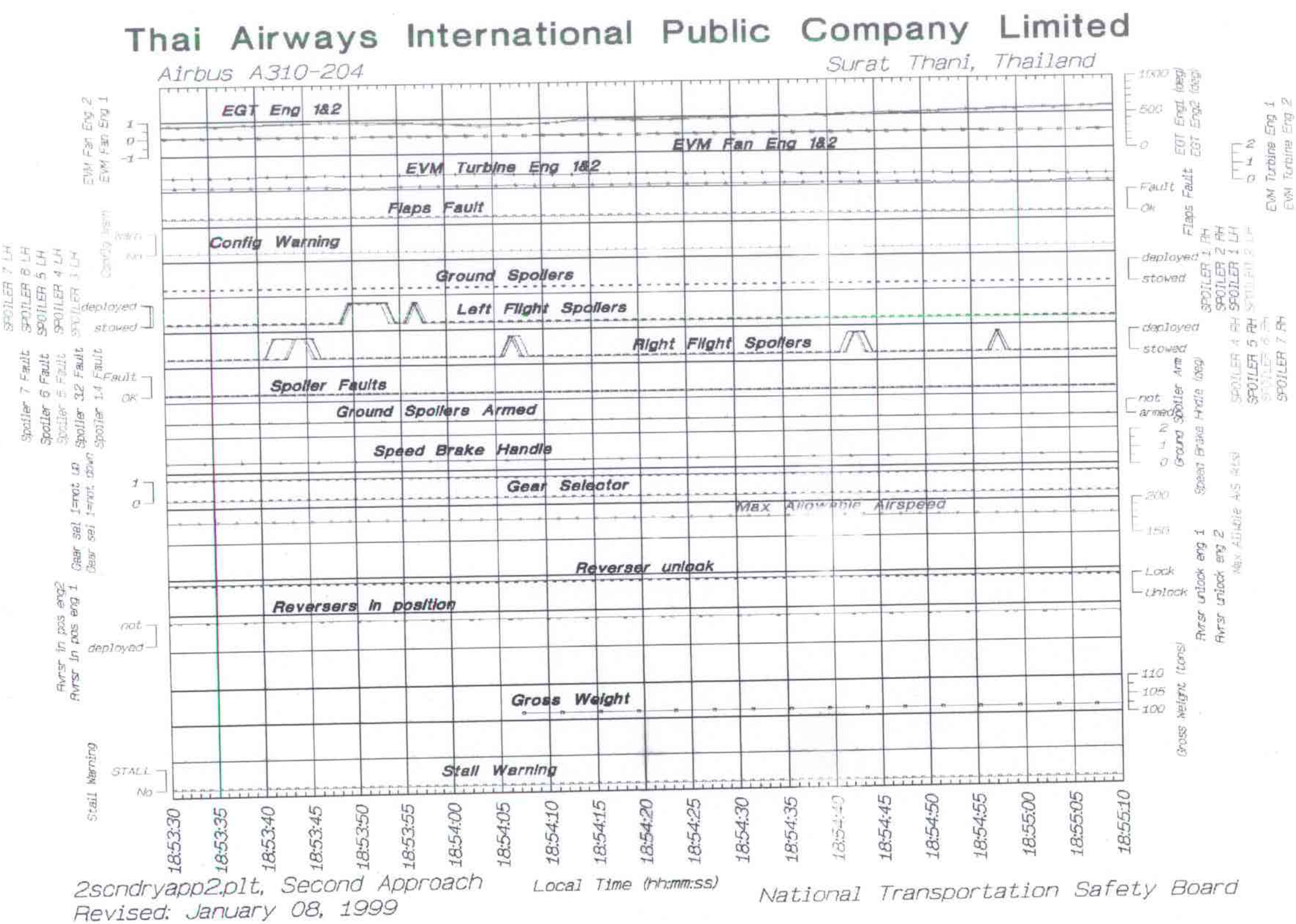

Thai Airways International Public Company Limited
Airbus A310-204
Surat Thani, Thailand
EGT Eng 1&2
EVM Fan Eng 1&2
EVM Turbine Eng 1&2
Flaps Fault
Config Warning
Ground Spoilers
Left Flight Spoilers
Right Flight Spoilers
Spoiler Faults
Ground Spoilers Armed
Speed Brake Handle
Gear Selector
Max Allowable Airspeed
Reversers in position
Reverser unlock
Gross Weight
Stall Warning
18:41:50
18:41:55
18:42:00
18:42:05
18:42:10
18:42:15
18:42:20
18:42:25
18:42:30
18:42:35
18:42:40
18:42:45
18:42:50
18:42:55
18:43:00
18:43:05
18:43:10
18:43:15
18:43:20
18:43:25
18:43:30
Local Time (hh:mm:ss)
scndryapp1.plt, First Approach
Revised: January 08, 1999
National Transportation Safety Board

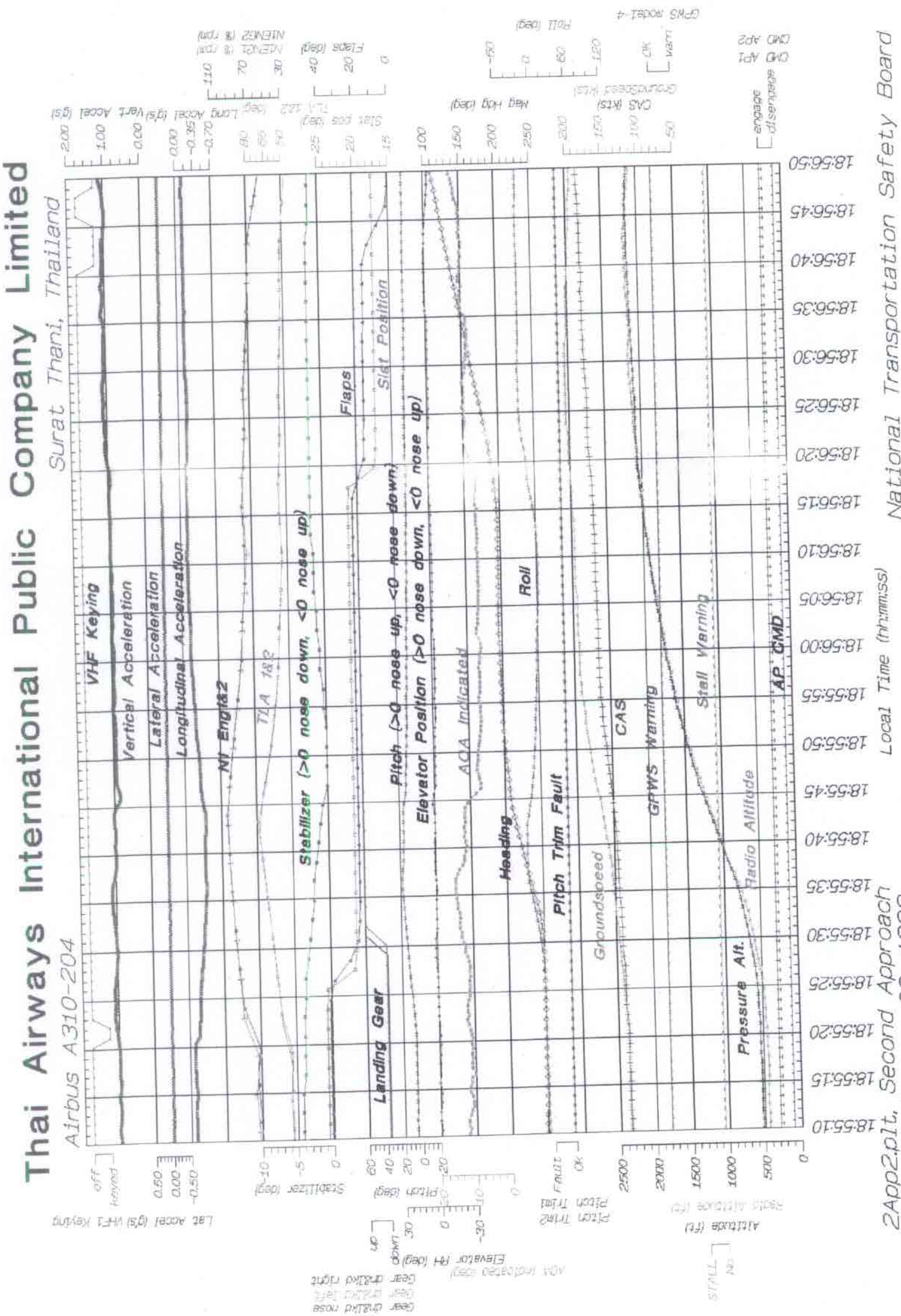


Thai Airways International Public Company Limited
Airbus A310-204
Surat Thani, Thailand
VHF Keying
Vertical Acceleration
Lateral Acceleration
Longitudinal Acceleration
N1 Eng1&2
TLA 1&2
Stabilizer (>0 nose down, <0 nose up)
Slat Position
Flaps
Landing Gear
Pitch (>0 nose up, <0 nose down)
Elevator Position (>0 nose down, <0 nose up)
Heading
Roll
Pitch Trim Fault
Groundspeed
CAS
Pressure Alt.
Radio Altitude
GPWS Warning
Stall Warning
AP CMD
18:43:30
18:43:35
18:43:40
18:43:45
18:43:50
18:43:55
18:44:00
18:44:05
18:44:10
18:44:15
18:44:20
18:44:25
18:44:30
18:44:35
18:44:40
18:44:45
18:44:50
18:44:55
18:45:00
18:45:05
18:45:10
Local Time (hh:mm:ss)
2App1.plt, First Approach
Revised: January 08, 1999
National Transportation Safety Board

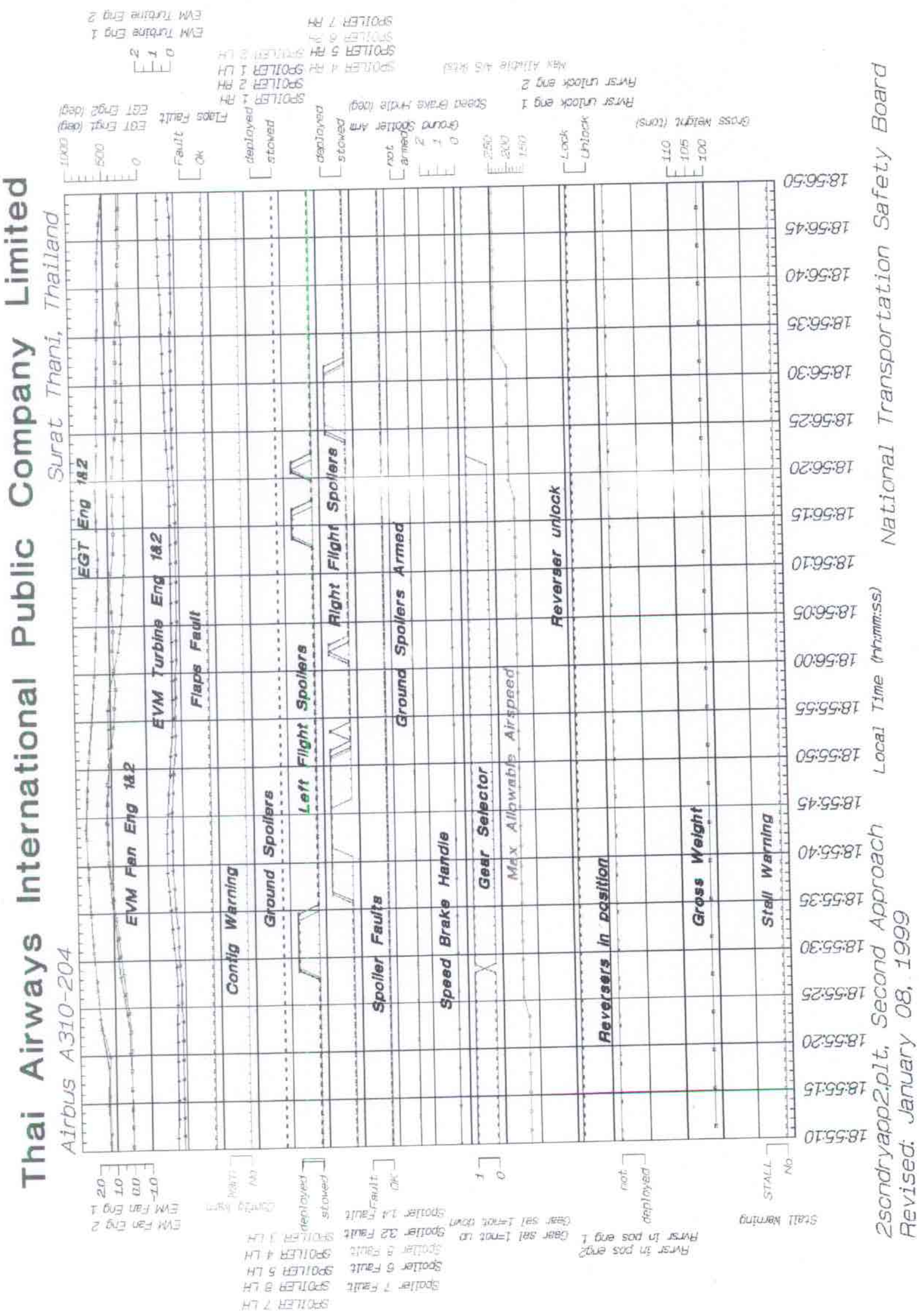

Thai Airways International Public Company Limited
Airbus A310-204
Surat Thani, Thailand
EGT Eng 1&2
EVM Fan Eng 1&2
EVM Turbine Eng 1&2
Flaps Fault
Config Warning
Ground Spoilers
Left Flight Spoilers
Right Flight Spoilers
Spoiler Faults
Ground Spoilers Armed
Speed Brake Handle
Gear Selector
Max Allowable Airspeed
Reverser unlock
Reversers in position
Gross Weight
Stall Warning
EVM Fan Eng 2
EVM Fan Eng 1
SPOILER 7 LH
SPOILER 6 LH
SPOILER 5 LH
SPOILER 4 LH
SPOILER 3 LH
Spoiler 7 Fault
Spoiler 6 Fault
Spoiler 5 Fault
Spoiler 32 Fault
Spoiler 14 Fault
Gear sel 1=not up
Gear sel 1=not down
Rvrsr in pos eng2
Rvrsr in pos eng 1
Stall Warning
EGT Eng1 (deg)
EGT Eng2 (deg)
EVM Turbine Eng 1
EVM Turbine Eng 2
Flaps Fault
SPOILER 1 RH
SPOILER 2 RH
SPOILER 1 LH
SPOILER 2 LH
SPOILER 4 RH
SPOILER 5 RH
SPOILER 6 RH
SPOILER 7 RH
Ground Spoiler Arm
Speed Brake Hndle (deg)
Max Allwble A/S (kts)
Rvrsr unlock eng 1
Rvrsr unlock eng 2
Gross Weight (tons)
18:43:30
18:43:35
18:43:40
18:43:45
18:43:50
18:43:55
18:44:00
18:44:05
18:44:10
18:44:15
18:44:20
18:44:25
18:44:30
18:44:35
18:44:40
18:44:45
18:44:50
18:44:55
18:45:00
18:45:05
18:45:10
Local Time (hh:mm:ss)
2scndryapp1.plt, First Approach
Revised: January 08, 1999
National Transportation Safety Board


Thai Airways International Public Company Limited
Airbus A310-204
Surat Thani, Thailand
VHF Keying
Vertical Acceleration
Lateral Acceleration
Longitudinal Acceleration
N1 Eng1&2
Stabilizer (>0 nose down, <0 nose up
Slat Position
Flaps
Landing Gear
Pitch (>0 nose up, <0 nose down)
Elevator Position (>0 nose down, <0 nose up)
AOA Indicated
Heading
Roll
Pitch Trim Fault
Groundspeed
CAS
GPWS Warning
Stall Warning
Pressure Alt.
Radio Altitude
AP CMD
Local Time (hh:mm:ss)
ThaiApp2.plt, Second Approach
Revised: January 07, 1999
National Transportation Safety Board

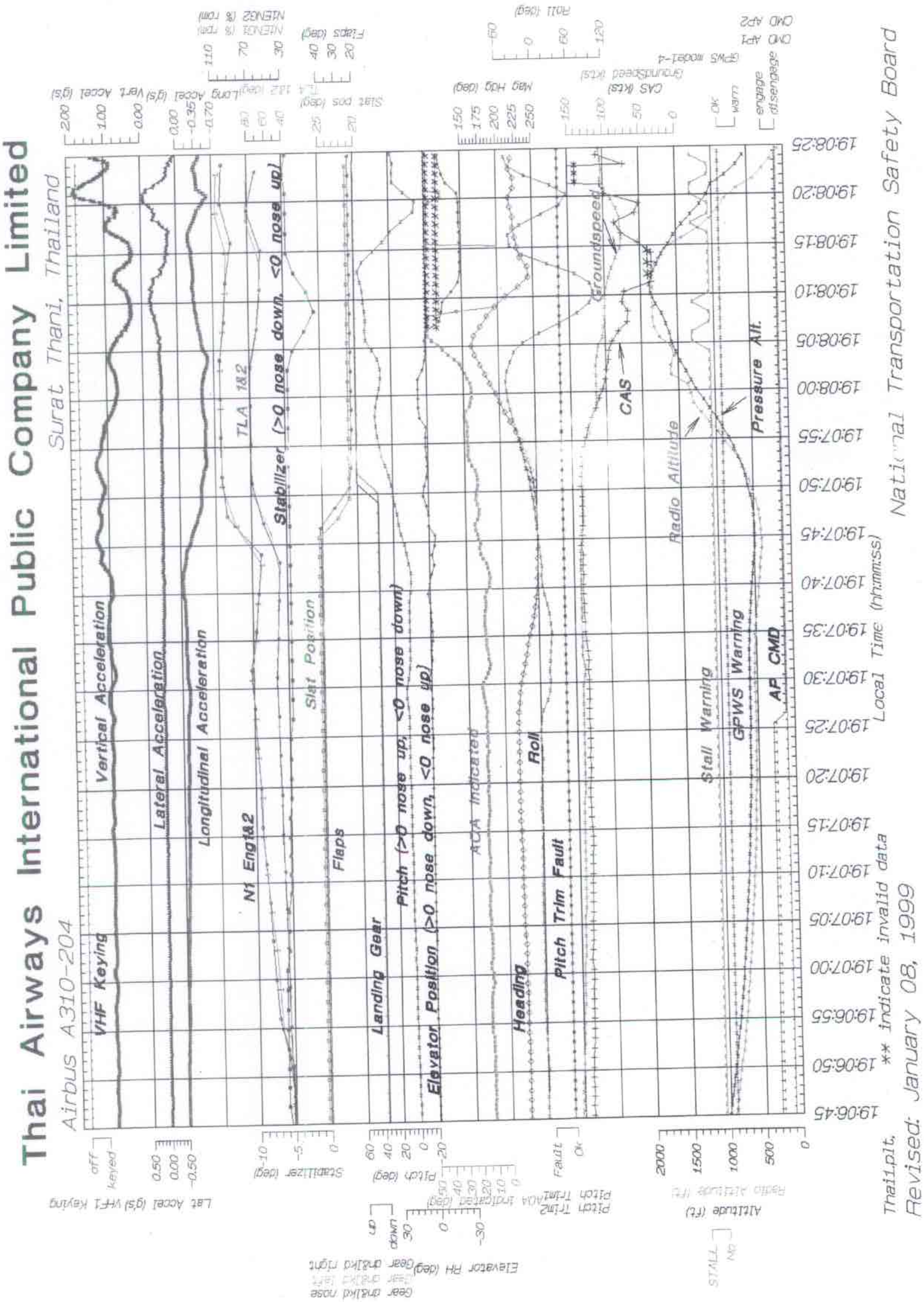

Thai Airways International Public Company Limited
Airbus A310-204
Surat Thani, Thailand
EGT Eng 1&2
EVM Fan Eng 1&2
EVM Turbine Eng 1&2
Flaps Fault
Config Warning
Ground Spoilers
Left Flight Spoilers
Right Flight Spoilers
Spoiler Faults
Ground Spoilers Armed
Speed Brake Handle
Gear Selector
Max Allowable Airspeed
Reverser unlock
Reversers in position
Gross Weight
Stall Warning
EVM Fan Eng 2
EVM Fan Eng 1
SPOILER 7 LH
SPOILER 6 LH
SPOILER 5 LH
SPOILER 4 LH
SPOILER 3 LH
deployed
stowed
Spoiler 7 Fault
Spoiler 6 Fault
Spoiler 5 Fault
Spoiler 32 Fault
Spoiler 14 Fault
Fault
OK
Gear sel 1=not up
Gear sel 1=not down
Rvrsr in pos eng2
Rvrsr in pos eng 1
not
deployed
Stall Warning
STALL
No
1000
500
0
EGT Engl (deg)
EGT Eng2 (deg)
Flaps Fault
Ok
EVM Turbine Eng 1
EVM Turbine Eng 2
SPOILER 1 RH
SPOILER 2 RH
SPOILER 1 LH
SPOILER 4 RH
SPOILER 5 RH
SPOILER 7 RH
not
armed
Ground Spoiler Arm
Speed Brake Hndle (deg)
200
150
Lock
Unlock
Rvrsr unlock eng 1
Rvrsr unlock eng 2
110
105
100
Gross Weight (tons)
18:53:30
18:53:35
18:53:40
18:53:45
18:53:50
18:53:55
18:54:00
18:54:05
18:54:10
18:54:15
18:54:20
18:54:25
18:54:30
18:54:35
18:54:40
18:54:45
18:54:50
18:54:55
18:55:00
18:55:05
18:55:10
Local Time (hh:mm:ss)
2scndryapp2.plt, Second Approach
Revised: January 08, 1999
National Transportation Safety Board

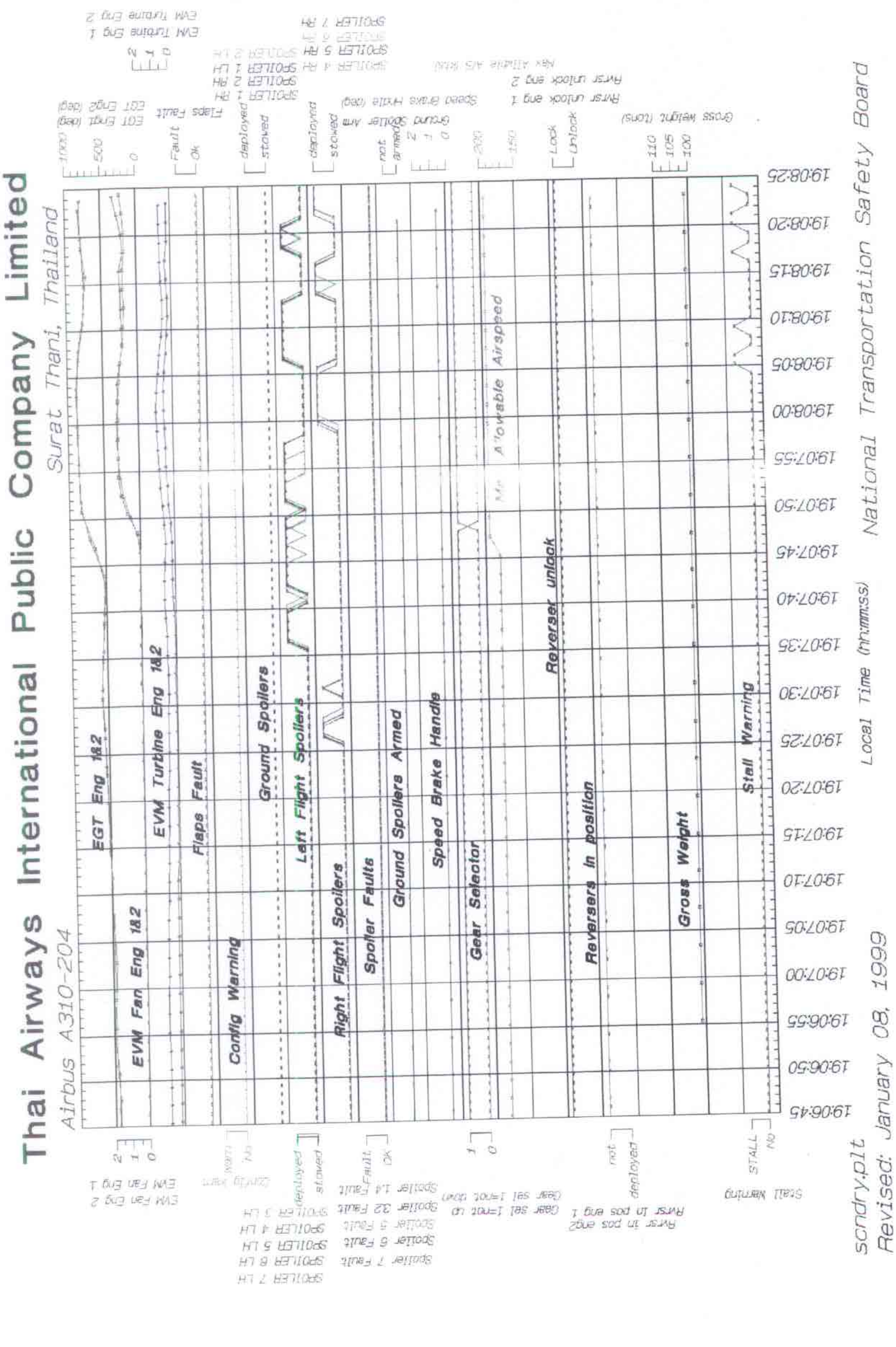


Thai Airways International Public Company Limited
Airbus A310-204
Surat Thani, Thailand
VHF Keying
Vertical Acceleration
Lateral Acceleration
Longitudinal Acceleration
N1 Eng1&2
TLA 1&2
Stabilizer (>0 nose down, <0 nose up)
Flaps
Slat Position
Landing Gear
Pitch (>0 nose up, <0 nose down)
Elevator Position (>0 nose down, <0 nose up)
AOA Indicated
Heading
Roll
Pitch Trim Fault
Groundspeed
CAS
GPWS Warning
Stall Warning
Pressure Alt.
Radio Altitude
AP CMD
Local Time (hh:mm:ss)
National Transportation Safety Board
2App2.plt, Second Approach
Revised: January 08, 1999



Thai Airways International Public Company Limited
Airbus A310-204
Surat Thani, Thailand
EVM Fan Eng 1&2
EGT Eng 1&2
EVM Turbine Eng 1&2
Flaps Fault
Config Warning
Ground Spoilers
Left Flight Spoilers
Right Flight Spoilers
Spoiler Faults
Ground Spoilers Armed
Speed Brake Handle
Gear Selector
Max Allowable Airspeed
Reverser unlock
Reversers in position
Gross Weight
Stall Warning
18:55:10
18:55:15
18:55:20
18:55:25
18:55:30
18:55:35
18:55:40
18:55:45
18:55:50
18:55:55
18:56:00
18:56:05
18:56:10
18:56:15
18:56:20
18:56:25
18:56:30
18:56:35
18:56:40
18:56:45
18:56:50
Local Time (hh:mm:ss)
2scndryapp2.plt, Second Approach
Revised: January 08, 1999
National Transportation Safety Board


Thai Airways International Public Company Limited
Airbus A310-204
Surat Thani, Thailand
VHF Keying
Vertical Acceleration
Lateral Acceleration
Longitudinal Acceleration
N1 Eng1&2
TLA 1&2
Stabilizer (>0 nose down, <0 nose up)
Flaps
Slat Position
Landing Gear
Pitch (>0 nose up, <0 nose down)
Elevator Position (>0 nose down, <0 nose up)
AOA Indicated
Heading
Roll
Pitch Trim Fault
Groundspeed
CAS
Radio Altitude
Stall Warning
GPWS Warning
Pressure Alt.
AP CMD
Local Time (hh:mm:ss)
** indicate invalid data
Thai1.plt
Revised: January 08, 1999
National Transportation Safety Board


Thai Airways International Public Company Limited
Airbus A310-204
Surat Thani, Thailand
EGT Eng 1&2
EVM Fan Eng 1&2
EVM Turbine Eng 1&2
Flaps Fault
Config Warning
Ground Spoilers
Left Flight Spoilers
Right Flight Spoilers
Spoiler Faults
Ground Spoilers Armed
Speed Brake Handle
Gear Selector
Max Allowable Airspeed
Reverser unlock
Reversers in position
Gross Weight
Stall Warning
19:06:45
19:06:50
19:06:55
19:07:00
19:07:05
19:07:10
19:07:15
19:07:20
19:07:25
19:07:30
19:07:35
19:07:40
19:07:45
19:07:50
19:07:55
19:08:00
19:08:05
19:08:10
19:08:15
19:08:20
19:08:25
Local Time (hh:mm:ss)
National Transportation Safety Board
scndry.plt
Revised: January 08, 1999

Appendix 12

INTRA-COCKPIT COMMUNICATION		AIR-GROUND COMMUNICATION	
TIME & SOURCE	**CONTENT**	**TIME & SOURCE**	**CONTENT**
1837:18 {00:00} **START of RECORDING START of TRANSCRIPT**			
1837:50 **CAM-1**	{00:32} speed brake in flaps fifteen.		
1837:52 **CAM-2**	{00:34} speed brake in flaps fifteen, selected.		
CAM	sound of click [similar to flap handle being moved.		
1838:01 **CAM-2**	{00:43} flaps fifteen speed one five two.		
1838:20 **CAM-1**	{01:02} eleven DME.		
1838:22 **CAM-2**	{01:04} sir ..... pre level.		
1838:34 **CAM-1**	{01:16} flaps twenty.		
1838:36 **CAM-2**	{01:18} flaps twenty selected....... flaps twenty speed one forty two.		
1838:53 **CAM-1**	{01:35} eleven miles, sir.		
		1838:54 **RDO-2**	{01:36} Thai two six one, intermediate fix.
		1838:57 **APR**	{01:39} Thai two six one continue approach, contact Surat Tower one two two decimal seven. goodbye.
		RDO-2	one two two seven, Thai two six one, goodbye.

INTRA-COCKPIT COMMUNICATION		AIR-GROUND COMMUNICATION	
TIME & SOURCE	**CONTENT**	**TIME & SOURCE**	**CONTENT**
		1839:11 **RDO-2**	{01:53} Surat tower, Thai two six one intermediate fix runway two two.
		1839:16 **TWR**	{01:58} Thai two six one final approach fix, QNH one zero zero nine.
		1839:22 **RDO-2**	{02:04} report final approach fix one zero zero nine, Thai 261.
		1839:28 **TWR**	{02:10} Thai two six one negative Papi light. right side of runway two two. Left side is OK and runway edge light interval one hundred twenty meters threshold and runway end light interval six meters caution barrier four hundred meters from threshold runway two two.
		1839:44 **RDO-2**	{02:26} Thai two six one, thank you.
1839:46 **CAM-1**	{02:28} gear down.		
1839:48 **CAM**	{02:30} [sound of two clicks similar to gear handle being moved]		
1839:53 **CAM-2**	{02:35} altitude capture, speed select.		
1839:55 **CAM-1**	{02:37} six miles two thousand, right.		
1839:56 **CAM-2**	{02:38} sir.		
1840:02 **PA-3**	{02:44} ladies and gentlemen please adjust		
1840:05 **PA-2**	{02:47} cabin crew prepare for take.... prepare for landing.		

INTRA-COCKPIT COMMUNICATION		AIR-GROUND COMMUNICATION	
TIME & SOURCE	CONTENT	TIME & SOURCE	CONTENT
1840:08 **CAM-2**	{02:50} altitude capture speed select .		
1840:16 **PA-3**	{02:58} [sound of music] ..... ladies and gentlemen...		
1840:14 **CAM-1**	{02:56} flaps full.		
1840:15 **CAM**	{02:57} [sound of click similar to flap handle being moved]		
1840:20 **CAM-2**	{03:02} flaps full selected approach speed one three two. cabin crew notified. ignition cont relight. gear?		
CAM-1	down and check.		
CAM-2	down and check..... spoiler?		
1840:28 **CAM**	{03:10} [sound similar to windshield wipers at slow speed starts and continues]		
1840:36 **CAM-1**	{03:18} armed.		
1840:37 **CAM-2**	{03:19} anti-skid, check. auto brakes?		
1840:39 **CAM-1**	{03:21} auto brake, low.		
1840:43 **CAM-2**	{03:25} low selected. checklist to landing clearance, sir.		
1841:08 **CAM-1**	{03:50} vertical speed.		

INTRA-COCKPIT COMMUNICATION		AIR-GROUND COMMUNICATION	
TIME & SOURCE	CONTENT	TIME & SOURCE	CONTENT
1841:09 **CAM-2**	{03:51} ******		
		1841:12 **RDO-2**	{03:54} Thia two sixty one final approach fix.
		1841:16 **TWR**	{03:58} Thai two six one, Surat not in sight. check wheel, clear to land runway two two. surface wind thre one zero degrees at five.
		1841:23 **RDO-2**	{04:05} clear to land runway two two, Thai two six one.
CAM-1	clear to land.		
		1841:29 **TWR**	{04:11} two six one caution runway wet.
1841:27 **CAM-1**	{04:09} clear to land.		
		1841:31 **RDO-2**	{04:13} two six one.
1841:43 **CAM**	{04:25} [sound of windshield wipers no longer heard]		
1841:58 **CAM-1**	{04:40} gear down.		
1841:59 **CAM-2**	{04:41} landing clearance receive, sir. checklist completed.		
		1842:15 **TWR**	{04:57} Thai two six one runway in sight?.
		1842:17 **RDO-2**	{04:59} not yet, negative two six one.

INTRA-COCKPIT COMMUNICATION		AIR-GROUND COMMUNICATION	
TIME & SOURCE	**CONTENT**	**TIME & SOURCE**	**CONTENT**
		1842:20 **TWR**	{05:02} roger.
1842:29 **CAM-2**	{05:11} altitude capture, speed select.		
		1842:39 **RDO-2**	{05:21} runway in sight, Thai two six one.
		1842:42 **TWR**	{05:24} two six one Surat in sight now.
1842:44 **CAM**	{05:26} [sound of "cavalry charge" similar to autopilot disconnect]		
1842:45 **CAM-1**	{05:27} runway heading set.		
1842:47 **CAM-2**	{05:29} pull up two thousand set sir. two thousand set.		
1842:50 **CAM-1**	{05:32} correct.		
1843:00 **CAM-1**	{05:42} is that the right one?		
1843:01 **CAM-4**	{05:43} plus hundred.		
1843:02 **CAM-?**	{05:44} right, right. right hand side.		
1843:05 **CAM-1**	{05:47} where?		
1843:10 **CAM-1**	{05:52} *****.		
1843:15	{05:57}		

INTRA-COCKPIT COMMUNICATION		AIR-GROUND COMMUNICATION	
TIME & SOURCE	**CONTENT**	**TIME & SOURCE**	**CONTENT**
CAM-1	OK, OK, that's right, go around		
1843:17 **CAM-2**	{05:59} go around, sir.		
		1843:19 **RDO-2**	{06:01} Thai two six one go around.
1843:20 **CAM**	{06:02} [sound similar to increase in engine RPM]		
		1843:22 **TWR**	{06:04} Thai two six one roger.
1843:23 **CAM-1**	{06:05} flaps twenty.		
1843:24 **CAM-2**	{06:06} flaps fifteen, gear up. [said at same time as previous comment]		
1843:26 **CAM**	{06:08} [sound of two clicks similar to landing gear and flap handle movement]		
1843:37 **CAM**	{06:19} [C-cord alert, similar to altitude alert signal]		
1843:37 **CAM-2**	{06:19} over VOR, then left turn one nine zero.		
1843:43 **CAM**	{06:25} [sound similar to decrease in engine RPM]		
1843:46 **CAM-2**	{06:28} altitude capture, speed select.		
1843:48 **CAM-1**	{06:30} ****.		

INTRA-COCKPIT COMMUNICATION		AIR-GROUND COMMUNICATION	
TIME & SOURCE	CONTENT	TIME & SOURCE	CONTENT
1843:49 **CAM-2**	{06:31} sir. vertical speed. right now we are in vertical speed.		
1843:56 **CAM-1**	{06:38} select sir.		
		1843:59 **TWR**	{06:41} Thai two sixty one, about how far out were you when you saw the runway?
1844:02 **CAM-1**	{06:44} I saw three miles.		
		1844:03 **RDO-2**	{06:45} three miles ma'am, standby for a moment.
		1844:06 **TWR**	{06:48} roger.
1844:07 **CAM-2**	{06:49} vertical speed, heading hold, sir. continue climb to two thousand.		
1844:23 **CAM-2**	{07:05} over the VOR turn left one nine zero radial.		
1844:26 **CAM-1**	{07:08} when we pass, turn left.		
1844:32 **CAM-2**	{07:14} altitude capture speed select.		
1844:43 **CAM-1**	{07:25} left turn direct to.....		
		1844:45 **TWR**	{07:27} Thai two six one what's your intentions.
1844:48 **CAM-1**	{07:30} left turn six DME final runway two two. right now we are		

INTRA-COCKPIT COMMUNICATION		AIR-GROUND COMMUNICATION	
TIME & SOURCE	**CONTENT**	**TIME & SOURCE**	**CONTENT**
	maintaining two thousand ma'am.		
		1844:55 **TWR**	{07:37} roger that, report final approach fix.
		1844:56 **RDO-2**	{07:38} report again final approach, Thai two six one.
1845:06 **CAM-1**	{07:48} missed approach checklist.		
1845:07 **CAM-2**	{07:49} yes. missed approach checklist.		
1845:21 **CAM-2**	{08:03} nav aids......		
1845:21 **PA-1**	{08:03} [first in Thai and then English] Ladies and gentlemen due to raining at the airport and low visibility we have to uh, try to land again at Surat and expect to land in about ten minutes, thank you.		
1845:54 **CAM-2**	{08:36} nav aids.		
1845:55 **CAM-1**	{08:37} flaps.		
1845:55 **CAM-2**	{08:37} set and check flaps fifteen OK.		
1845:59 **CAM**	{08:41} [sound of click similar to flap handle movement]		
1846:01 **CAM-2**	{08:43} flaps fifteen selected.... spoiler?		
1846:06 **CAM-1**	{08:48} disarm .		

INTRA-COCKPIT COMMUNICATION		AIR-GROUND COMMUNICATION	
TIME & SOURCE	CONTENT	TIME & SOURCE	CONTENT
1846:10 **CAM-2**	{08:52} altitude hold, sir.		
1846:20 **CAM-1**	{09:02} approach six DME then do teardrop.		
1846:22 **CAM-2**	{09:04} correct.... then left turn.		
1846:30 **CAM-1**	{09:12} too close and we were off to the left, weren't we?		
1846:35 **CAM-2**	{09:17} sir we will make a teardrop and then try again, right? no hold.		
1846:47 **CAM-2**	{09:29} right now flap fifteen sir.		
1846:50 **CAM-1**	{09:32} flaps up ***. flaps up and keep the slats.		
1846:56 **CAM**	{09:38} [sound of clicks similar to flap handle movement]		
1846:56 **CAM-2**	{09:38} flaps up, sir.		
1847:11 **CAM-1**	{09:53} high rate of climb.		
1847:15 **CAM-2**	{09:57} it might be because we are very light.		
1847:18 **CAM-1**	{10:00} ******.		
1847:22 **CAM-2**	{10:04} the wind .... rain was moving to the airfield. this airfield ***.		

INTRA-COCKPIT COMMUNICATION TIME & SOURCE	INTRA-COCKPIT COMMUNICATION CONTENT	AIR-GROUND COMMUNICATION TIME & SOURCE	AIR-GROUND COMMUNICATION CONTENT
1847:38 **CAM-2**	{10:20} report again final approach fix.		
1847:49 **CAM-1**	{10:31} when over turn right first.		
1847:51 **CAM-2**	{10:33} roger. turn right first then turn left inbound.		
1847:56 **CAM-1**	{10:38} turn left inbound.		
		1848:14 **TWR**	{10:56} Thai two six one request position now.
		1848:17 **RDO-2**	{10:59} position two DME to final approach fix ma'am outbound. after final approach fix I will make a teardrop left turn inbound to the final approach fix again ma'am.
		1848:30 **TWR**	{11:12} roger that. report final fix heading inbound.
		1848:33 **RDO-2**	{11:15} report final approach when heading inbound, Thai two six one.
1849:22 **CAM-2**	{12:04} do you want me to ask if it is raining at the airfield or not?		
1849:26 **CAM-1**	{12:08} ask the visibility.		
		1849:28 **RDO-2**	{12:10} tower from two six one, is it raining over the field right now?
		1849:32 **TWR**	{12:14} there is light rain.

INTRA-COCKPIT COMMUNICATION		AIR-GROUND COMMUNICATION	
TIME & SOURCE	CONTENT	TIME & SOURCE	CONTENT
		1849:34 **RDO-2**	{12:16} thank you ma'am, two six one.
1850:20 **CAM-?**	{13:02} ****.		
1850:42 **CAM-2**	{13:24} would you like me to set runway heading?		
1850:45 **CAM-1**	{13:27} two two five.		
1851:00 **PA-2**	{13:42} cabin crew prepare for landing.		
1851:10 **CAM-1**	{13:52} do we have the runway input already?		
1851:13 **CAM-2**	{13:55} yes, aaah.... VOR, no, no runway.		
1851:37 **CAM**	{14:19} [sound similar to windshield wiper at slow speed]		
1851:48 **CAM-1**	{14:30} six DME, two thousand.		
1851:49 **CAM-2**	{14:31} roger.		
1852:13 **CAM-1**	{14:55} speed brake in, flaps... twenty.		
1852:15 **CAM**	{14:57} [sound of clicks similar to flap handle movement]		
1852:15 **CAM-2**	{14:57} speed brake in, flap twenty selected.		
1852:22	{15:04}		

INTRA-COCKPIT COMMUNICATION		AIR-GROUND COMMUNICATION	
TIME & SOURCE	**CONTENT**	**TIME & SOURCE**	**CONTENT**
CAM-1	two two five **. go ahead and report.		
1852:22 **CAM-2**	{15:04} OK.		
		1852:34 **RDO-2**	{15:16} Thai two six one final approach fix runway two two.
1852:37 **CAM-1**	{15:19} gear down ****.		
1852:38 **CAM**	{15:20} [sound of clicks similar to movement of landing gear handle]		
		1852:38 **TWR**	{15:20} Thai two six one, Surat. not in sight. check wheels. clear to land runway two two. surface wind two nine zero degrees at five.
		1852:45 **RDO-2**	{15:27} cleared to land runway two two, Thai two six one.
1852:53 **CAM-2**	{15:35} flaps fifteen, speed .... ignition?		
1853:00 **CAM**	{15:42} [sound similar to windshield wiper at high speed]		
1852:59 **CAM-1**	{15:41} cont relight.		
1853:00 **CAM-2**	{15:42} cont relight..... gear?		
1853:01 **CAM-1**	{15:43} down and check.		
1853:02 **CAM-2**	{15:44} down and check, spoiler?		

INTRA-COCKPIT COMMUNICATION		AIR-GROUND COMMUNICATION	
TIME & SOURCE	CONTENT	TIME & SOURCE	CONTENT
1853:04 **CAM-1**	{15:46} armed.		
1853:05 **CAM-2**	{15:47} anti-skid checked. auto-brake?		
1853:07 **CAM-1**	{15:49} low.		
1853:08 **CAM-2**	{15:50} low?		
1853:08 **CAM-1**	{15:50} low.		
1853:09 **CAM-2**	{15:51} low, landing clearance?		
1853:11 **CAM-1**	{15:53} received.		
1853:12 **CAM-2**	{15:54} received.		
1853:13 **CAM-1**	{15:55} the aircraft is not on the radial... do you see?		
1853:14 **CAM-2**	{15:56} it is not on the radial.		
1853:19 **CAM-1**	{16:01} it is difficult to land if the aircraft is not on the radial like this. flaps full.		
1853:23 **CAM**	{16:05} [sound of clicks similar to flap handle movement]		
1853:25 **CAM-2**	{16:07} gear down, flaps full. radial coming.		

INTRA-COCKPIT COMMUNICATION		AIR-GROUND COMMUNICATION	
TIME & SOURCE	**CONTENT**	**TIME & SOURCE**	**CONTENT**
1853:38 **CAM-1**	{16:20} **** it is difficult to land.		
1853:45 **CAM-1**	{16:27} four hundred thirty.		
1853:46 **CAM-2**	{16:28} roger.		
1854:10 **CAM-2**	{16:52} altitude capture, speed select.		
1854:15 **CAM**	{16:57} [sound similar to windshield wipers in high speed continues]		
1854:30 **CAM-2**	{17:12} vertical speed, speed select.		
		1854:33 **TWR**	{17:15} Thai two six one Surat, in sight.
1854:34 **CAM-4**	{17:16} plus hundred.		
		1854:37 **RDO-2**	{17:19} go ahead Thai two six one.
		1854:39 **TWR**	{17:21} Thai two six one Surat, in sight. Thai two six one say your intentions?
		1854:43 **RDO-2**	{17:25} I haven't got the runway. standby for a moment.
		1854:46 **TWR**	{17:28} roger that.
1854:49 **CAM-4**	{17:31} minimum, minimum.		

INTRA-COCKPIT COMMUNICATION		AIR-GROUND COMMUNICATION	
TIME & SOURCE	**CONTENT**	**TIME & SOURCE**	**CONTENT**
1854:51 **CAM-1**	{17:33} on the right side, is that right?		
1854:54 **CAM-2**	{17:36} I'm not sure. intermittent red lights.		
1855:00 **CAM-1**	{17:42} ****.		
1855:02 **CAM-2**	{17:44} left side of runway....		
1855:05 **CAM-1**	{17:47} let's go around instead.		
1855:09 **CAM-1**	{17:51} is that it? we passed it already, right?		
1855:12 **CAM-4**	{17:54} minimum.		
1855:14 **CAM-2**	{17:56} go around. altitude set two thousand.		
1855:15 **CAM-1**	{17:57} OK.		
1855:19 **CAM**	{18:01} [sound similar to increase in engine RPM]		
		1855:19 **RDO-2**	{18:01} Thai two six one go around.
		1855:22 **TWR**	{18:04} two six one, roger.
1855:23 **CAM-1**	{18:05} ***.		
1855:24	{18:06}		

INTRA-COCKPIT COMMUNICATION		AIR-GROUND COMMUNICATION	
TIME & SOURCE	CONTENT	TIME & SOURCE	CONTENT
CAM-2	flaps twenty, positive rate, gear up, OK. gear up.		
1855:29 **CAM-1**	{18:11} over the VOR, then turn left.		
1855:30 **CAM-2**	{18:12} roger.		
1855:31 **CAM-1**	{18:13} OK.... *** select.		
1855:32 **CAM-2**	{18:14} select.		
1855:39 **CAM-1**	{18:21} OK, we'll try again. I'll bring it to eleven miles.		
1855:42 **CAM-2**	{18:24} we will start.... altitude capture, speed select.		
1855:46 **CAM-1**	{18:28} two miles then we'll turn left again.		
1855:48 **CAM-2**	{18:30} roger.		
1855:54 **CAM-1**	{18:36} the approach is not in line with the runway. course is not aligned.		
1855:58 **CAM-2**	{18:40} I'm afraid to point because I'm not sure.... which light it is, possibly a light from a boat. some sort of light. [this airport is near a seaport] if I point incorrectly we might descend to low. ****.		
1856:05 **CAM-1**	{18:47} light ****.		
1856:14	{18:56}		

INTRA-COCKPIT COMMUNICATION		AIR-GROUND COMMUNICATION	
TIME & SOURCE	CONTENT	TIME & SOURCE	CONTENT
CAM-1	flaps fifteen first then.		
1856:15 **CAM-2**	{18:57} flaps fifteen confirmed.		
1856:16 **CAM**	{18:58} [sound of clicks similar to flap handle movement]		
1856:18 **CAM-1**	{19:00} turn left again.		
1856:20 **CAM-2**	{19:02} altitude capture, speed select...... altitude hold.		
1856:29 **CAM-1**	{19:11} flaps up.		
1856:31 **CAM-2**	{19:13} flaps up sir.		
1856:32 **CAM**	{19:14} [sound of click similar to flap handle movement]		
1856:31 **CAM-1**	{19:13} keep the slats out.		
		1856:34 **TWR**	{19:16} Thai two six one, confirm that you are joining the final again?
1856:38 **CAM-1**	{19:20} request try again.		
		1856:39 **RDO-2**	{19:21} yes ma'am, we will try again by joining the final once more and will report.....
		1856:45 **TWR**	{19:27} roger, report final approach fix.

INTRA-COCKPIT COMMUNICATION		AIR-GROUND COMMUNICATION	
TIME & SOURCE	**CONTENT**	**TIME & SOURCE**	**CONTENT**
		1856:47 **RDO-2**	{19:29} report final approach fix. thank you ma'am, Thai two six one.
1856:55 **CAM**	{19:37} [sound similar to windshield wiper no longer heard]		
1856:59 **CAM-2**	{19:41} after pull up checklist sir? nav aids, set and checked, spoil-ers?		
1857:06 **CAM**	{19:48} [sound of click similar to spoiler handle movement]		
1857:07 **CAM-1**	{19:49} disarmed.		
1857:11 **CAM-2**	{19:53} *******.		
1857:09 **CAM-1**	{19:51} the last time was a little bit too close. we will extend it further.		
1857:29 **CAM-1**	{20:11} I'll tell the passengers a little bit.		
1857:30 **CAM-2**	{20:12} roger.		
1857:30 **PA-1**	{20:12} [first in Thai and then in English] Ladies and gentlemen we are unable to land. we have to try again but if another landing uh, cannot accomplish we proceed to Bangkok., thank you.		
1857:56 **CAM-1**	{20:38} *** and we go to Bangkok.		
1857:57 **CAM-2**	{20:39} roger. ***point four.		
1858:00	{20:42}		

INTRA-COCKPIT COMMUNICATION		AIR-GROUND COMMUNICATION	
TIME & SOURCE	**CONTENT**	**TIME & SOURCE**	**CONTENT**
CAM-1	what was ***, six point nine?		
1858:00 **CAM-2**	{20:42} yes **** six point nine.		
1858:01 **CAM-1**	{20:43} is that right?		
1858:04 **CAM-2**	{20:46} right.... minimum fuel six point nine. thirty nautical miles di-agonal three three zero.		
1858:29 **CAM-2**	{21:11} *** when the runway is on the right and we are approaching from the left at low altitude the tower, the terminal buildings are on the left of the runway here then we have to turn hard right....		
1858:39 **CAM-1**	{21:21} we can't turn in time because it's too close.		
1858:40 **CAM-2**	{21:22} yes.		
1858:42 **CAM-1**	{21:24} the one on the right screen [right window], wasn't it?		
1858:44 **CAM-2**	{21:26} yes.		
1858:53 **CAM-1**	{21:35} when we see it it's too close. we'll set up further.		
1859:30 **CAM-1**	{22:12} we fly back **** if not in time the aircraft won't make it to Chiang Mai [sound of chuckle].		
1859:36 **CAM-2**	{22:18} yes.		

INTRA-COCKPIT COMMUNICATION		AIR-GROUND COMMUNICATION	
TIME & SOURCE	CONTENT	TIME & SOURCE	CONTENT
1859:38 **CAM-1**	{22:20} *****.		
1900:18 **CAM-1**	{23:00} two what? two two five, right?		
1900:19 **CAM-2**	{23:01} uh, runway heading is two two five. but track to VOR two one five.		
1900:34 **CAM-2**	{23:16} over final approach fix.		
1900:42 **CAM-1**	{23:24} six DME.		
		1900:45 **TWR**	{23:27} Thai two six one request position.
		1900:49 **RDO-2**	{23:31} now over final approach fix outbound ma'am, Thai two six one.
		1900:54 **TWR**	{23:36} Thai two six one report final approach fix heading inbound.
		1900:58 **RDO-2**	{23:40} report again final approach fix heading inbound Thai two six one.
1901:05 **CAM-1**	{23:47} ****.		
1901:10 **CAM-2**	{23:52} yes.		
1902:21 **CAM-1**	{25:03} it's too close.		
1902:54	{25:36}		

INTRA-COCKPIT COMMUNICATION		AIR-GROUND COMMUNICATION	
TIME & SOURCE	CONTENT	TIME & SOURCE	CONTENT
CAM-1	****.		
1903:07 **CAM-1**	{25:49} speed brake in, flaps fifteen.		
1903:08 **CAM-2**	{25:50} speed brake in, flaps fifteen. selected.		
1903:09 **CAM**	{25:51} [sound of click similar to flap handle movement]		
1903:17 **CAM-2**	{25:59} flaps fifteen, speed one five one..... one two DME.		
1903:41 **PA-2**	{26:23} cabin crew prepare for landing.		
1903:45 **CAM-2**	{26:27} cabin crew notified.... checklist completed to landing gear.		
1903:57 **CAM-1**	{26:39} please ask ah, if we are unable to land, ask operations ah, ask Thai operations if we are unable to land we would like to proceed to Bangkok.		
1904:08 **CAM-2**	{26:50} if we can't land, we will proceed to Bangkok.		
1904:12 **CAM-1**	{26:54} go ahead and ask.		
		1904:15 **RDO-2**	{26:57} Thai Surat, Thai two six one.
		1904:18 **CUT**	{27:00} Thai two six one Surat, go ahead.
1904:18 **CAM-1**	{27:00} twenty.		

INTRA-COCKPIT COMMUNICATION TIME & SOURCE	CONTENT	AIR-GROUND COMMUNICATION TIME & SOURCE	CONTENT
		1904:23 **RDO-2**	{27:05} Thai two six one we'll try again one more time. if we can't land, Captain would like to discuss about going back to Bangkok.
		1904:33 **CUT**	{27:15} OK, sir. will try to land. If unable to land will proceed to Bangkok sir. copy that sir.
		1904:40 **RDO-2**	{27:22} thank you very much.
1904:43 **CAM-2**	{27:25} flaps twenty.		
		1905:01 **TWR**	{27:43} Thai two six one, now visibility observed by tower approximately one thousand meters, sir.
1905:06 **CAM-2**	{27:48} uh ho.		
		1905:08 **RDO-2**	{27:50} copy that. reduced to one thousand meters, is that right?
		1905:12 **TWR**	{27:54} that's right.
1905:15 **CAM-1**	{27:57} one thousand meters unable.		
		1905:23 **RDO-2**	{28:05} is it raining at the airfield.
		1905:27 **TWR**	{28:09} light rain over the airport still.
1905:30 **RDO-2**	{28:12} thank you very much two six one final approach fix runway two two ma'am.		

INTRA-COCKPIT COMMUNICATION		AIR-GROUND COMMUNICATION	
TIME & SOURCE	**CONTENT**	**TIME & SOURCE**	**CONTENT**
		1905:35 **TWR**	{28:17} Thai two six one check wheels cleared to land runway two two. surface wind two niner zero degrees at three. caution runway wet.
1905:38 **CAM-1**	{28:20} gear down.		
1905:39 **CAM**	{28:21} [sound of clicks similar to gear handle being moved]		
		1905:43 **RDO-2**	{28:25} clear to land, runway two two, Thai two six one.
1905:46 **CAM-1**	{28:28} clear to land. we'll try again if we can't		
1905:53 **CAM-2**	{28:35} ignition?		
1905:54 **CAM-1**	{28:36} cont relight.		
1905:55 **CAM-2**	{28:37} cont relight. gear?		
1905:57 **CAM-1**	{28:39} down and check.		
1905:58 **CAM-2**	{28:40} down and check., spoilers?		
1905:59 **CAM-1**	{28:41} arm.		
1905:59 **CAM-2**	{28:41} anti-skid checked. auto brake.		
1906:02 **CAM-1**	{28:44} low.		

INTRA-COCKPIT COMMUNICATION		AIR-GROUND COMMUNICATION	
TIME & SOURCE	CONTENT	TIME & SOURCE	CONTENT
1906:02 **CAM-2**	{28:44} low.		
1906:03 **CAM-1**	{28:45} flaps full.		
1906:04 **CAM**	{28:46} [sound of click similar to flap handle movement]		
1906:04 **CAM-2**	{28:46} flaps full, selected. flaps full selected, approach speed one three two.		
1906:13 **CAM-1**	{28:55} right now we are on course, VOR on course.		
1906:16 **CAM-2**	{28:58} we are on course right now.		
1906:18 **CAM-1**	{29:00} vertical speed.		
1906:21 **CAM-2**	{29:03} selected. gear down, flaps full, spoiler armed.		
1906:42 **CAM-?**	{29:24} ****.		
1906:45 **CAM-2**	{29:27} altitude capture, speed select.		
1907:13 **CAM**	{29:55} [sound similar to windshield wiper]		
1907:16 **CAM-1**	{29:58} can you see?		
1907:20 **CAM-4**	{30:02} plus hundred.		

INTRA-COCKPIT COMMUNICATION		AIR-GROUND COMMUNICATION	
TIME & SOURCE	CONTENT	TIME & SOURCE	CONTENT
1907:21 **CAM-2**	{30:03} altitude hold pre-set to two thousand..... is that on the right side?		
1907:26 **CAM-4**	{30:08} [sound of "cavalry charge" similar auto-pilot disconnect]		
1907:30 **CAM-2**	{30:12} runway heading set.		
1907:30 **CAM-4**	{30:12} plus hundred.		
1907:33 **CAM-1**	{30:15} oh, we can't make it.		
1907:41 **CAM-4**	{30:23} minimum.		
1907:42 **CAM-1**	{30:24} cannot land.		
1907:43 **CAM-2**	{30:25} affirmative.		
1907:45 **CAM-1**	{30:27} go around.		
1907:45 **CAM-2**	{30:27} go around, trigger go lever, flaps twenty, positive rate.		
1907:46 **CAM**	{30:28} [sound similar to increase in engine RPM]		
1907:48 **CAM**	{30:30} [sound of several clicks]		
1907:48 **CAM-1**	{30:30} gear up, gear up.		

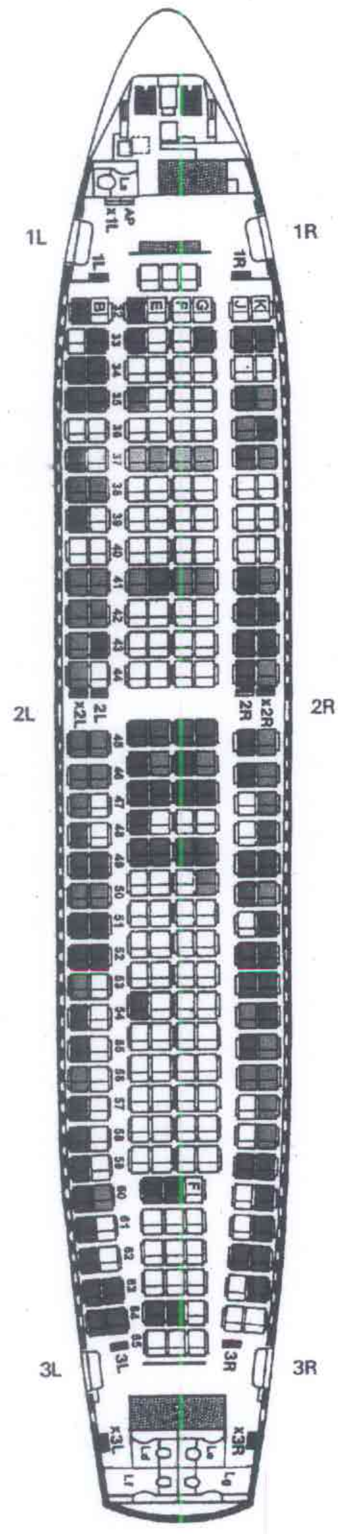
INTRA-COCKPIT COMMUNICATION		AIR-GROUND COMMUNICATION	
TIME & SOURCE	CONTENT	TIME & SOURCE	CONTENT
1907:49 **CAM-2**	{30:31} gear up.		
1907:52 **CAM-1**	{30:34} left heading, OK?		
1907:53 **CAM-2**	{30:35} yes.		
1907:56 **CAM-1**	{30:38} too close, cannot land.		
1907:59 **CAM-1**	{30:41} ** ... ("manual" or possibly "it doesn't") trim.		
1908:02 **CAM**	{30:44} [sound of "C-chord" similar to altitude alert]		
1908:02 **CAM-2**	{30:44} check.		
1908:04 **CAM-2**	{30:46} climb power.		
1908:05 **CAM**	{30:47} [sound of "cricket" similar to stall warning starts and continues for five seconds. sound similar to stick shaker sounds during same time interval]		
1908:12 **CAM-2**	{30:54} Exclamation…		
1908:13 **CAM**	{30:55} [sound of single chime similar to ECAM caution]		
1908:14 **CAM-2**	{30:56} Exclamation…		
1908:15	{30:57}		

INTRA-COCKPIT COMMUNICATION		AIR-GROUND COMMUNICATION	
TIME & SOURCE	**CONTENT**	**TIME & SOURCE**	**CONTENT**
CAM	[sound of "C-chord" similar to altitude alert]		
1908:18 **CAM-2**	{31:00} full power.		
1908:20 **CAM**	{31:02} [sound similar to GPWS warning for less than one second]		
1908:22 **CAM-4**	{31:04} plus hundred.		
1908:23 **CAM-4**	{31:05} minimum		
1908:24 **CAM-4**	{31:06} one hundred		
CAM-?	***.		
1908:25	{31:07}		

END of RECORDING
END of TRANSCRIPT

Appendix 14

Typical Cabin Layout



Total injurious passengers and crew members are 45

Total fatal passengers and crew members are 101

Appendix 15

- At CAT I minima on CAT II approach, requirements for CAT II are not fulfilled and visual guidance not obtained
- At minimum plus 100 ft on CAT II approaches, requirements for CAT II are not fulfilled
- On CAT III approaches, if requirements not fulfilled at 1000 ft AGL
- At CAT II/CAT III minimum, if crosswind measured on ground exceeds 10 kt.

5.3. GO-AROUND ON APPROACHES WITHOUT GLIDEPATH REFERENCE

The approach shall be abandoned and a go-around commenced if:

- The official visibility is below the applicable Company minima at the Outer Marker or equivalent position, or at 1000 ft AGL if no OM
- Not stabilized at 500 ft AGL
- When reaching MAP, the pilot is unable to complete the landing by using visual guidance
- Visual guidance is lost after passing MDA.

The approach must not be continued at MDA to a position closer to the runway unless the pilot is able to descend visually at normal sink rate.

5.4. GO-AROUND ON INSTRUMENT APPROACHES FOR CIRCLING

The approach shall be abandoned and a pullup commenced if:

- The official visibility or ceiling/vertical visibility is below the applicable Company minima at outer marker or equivalent position.
- No contact when reaching an estimated position from which a normal or special circling pattern can be followed.

5.5. GO-AROUND ON VISUAL APPROACHES OR THE VISUAL PART OF CIRCLING APPROACHES

The approach shall be abandoned and a go-around commenced if:

- The official visibility is below the applicable Company minima.
- The approach is not stabilized at 500 ft AGL.
- At any time during a visual approach or after establishing visual for a circling approach, required visual guidance is lost.

If visual reference is lost while circling to land from an instrument approach, the missed approach specified for the initial instrument approach procedure must be followed. It is expected that the pilot will make an initial climbing turn toward the landing runway and overhead the aerodrome where he will establish the aircraft climbing on the missed approach track.

For runways where specific missed approach procedure has been established to be followed in case of an abandoned circling approach, that specific procedure must be performed.

5.6. SECOND APPROACH

If a go-around has been made, another approach shall only be commenced if the P-i-C has reasons to believe that a second approach will lead to a successful landing.

More than two approaches shall only be made if there is any indication that the conditions have considerably improved, giving greater probability of a successful landing.

6. DEFINITIONS AND SUMMARY OF APPROACHES

6.1. DEFINITIONS

6.1.1. Precision Approach

An approach that the pilots continuously perceive both lateral and glidepath guidances (ILS, PAR).

6.1.2. Non-Precision Approach

An approach that the pilots perceive only lateral guidance.

6.1.3. Automatic Approach

An approach utilizing aircraft autopilot to capture and to hold the ILS localizer and glidepath.

6.1.4. Semi-Automatic Approach

An approach utilizing aircraft autopilot to maintain heading and/or rate of descent.

6.1.5. Automatic Landing

The autopilot is utilized to capture and hold the ILS localizer and glidepath down to touchdown and including rollout.

Appendix 16

1. CHOICE OF RUNWAY

The runway which gives the best safety margin under prevailing conditions shall normally be used with due regard to other factors, e.g., ATC requirements, etc.

An effort shall always be made to attain a runway with good braking conditions even if this may cause a delay in landing due to awaiting measurement of braking conditions or sanding of runway.

Landing should normally not be made on runways with width less than that specified in the respective AOM.

For runway width requirement in connection with snow, see FOM 3.3.1.

The landing weight must always be checked against Gross Weight Chart and due regard must be paid to runway conditions, e.g. braking action, etc. See also FOM 2.4.1 with regard to runways not given in Gross Weight Chart.

2. REQUIREMENTS FOR NIGHT LANDING

When performing night landings the following aids must be installed and functioning:

- Glidepath reference, which may consist of:
  - An ILS glidepath/PAR, or
  - Approach lights with at least one crossbar or a centerline consisting of barrets, or
  - VASI or PAPI
    (A VASI consisting of one light unit in each bar is considered satisfactory for this purpose.)
- Runway edge lights.

Note
Threshold and RW end lights are strongly recommended to be available.

3. GROUND FOG, BLOWING SNOW OR BLOWING SAND

Precipitation or drifting snow/sand in crosswind conditions may create a false impression of the direction of aircraft movement and thus the pilots may get an impression of no drift, though in fact there is a considerable drift present.

There is no definite rule as to how to handle the problem, but here are some recommended procedures:

- Make yourself aware of the existing situation
- Do not use landing lights
- Look well in front of the aircraft during touchdown and landing roll. Use runway lights for reference.

See also the respective AOM.

4. USE OF LANDING LIGHTS

When landing in reduced visibility, the use of landing lights may cause reduced forward visibility due to the blinding effect and may also lead to disorientation. In case of precipitation and crosswind, false impressions of drift can occur as stated in 3. above. The use of landing lights during landing in the above mentioned conditions is therefore not recommended.

5. HEIGHT OVER RUNWAY THRESHOLD

In normal landing, the height over the runway threshold shall be about 50 ft with reference to gear clearance above the runway.

If guided by an approved ILS glidepath, the wheel height over the threshold may be lower than 50 ft as dictated by the vertical distance between the airborne GP antenna and the landing gear and the restrictions in FOM 2.4.4 and FOM 3.2.13.

However, when downdrafts are expected due to terrain or turbulent air, the height margin over threshold should be increased whenever possible.

6. RUNWAY ALIGNMENT

Every effort shall be made to ensure a landing along the runway centerline as this gives the best margin for correction in case of unforeseen alignment difficulties after touchdown.

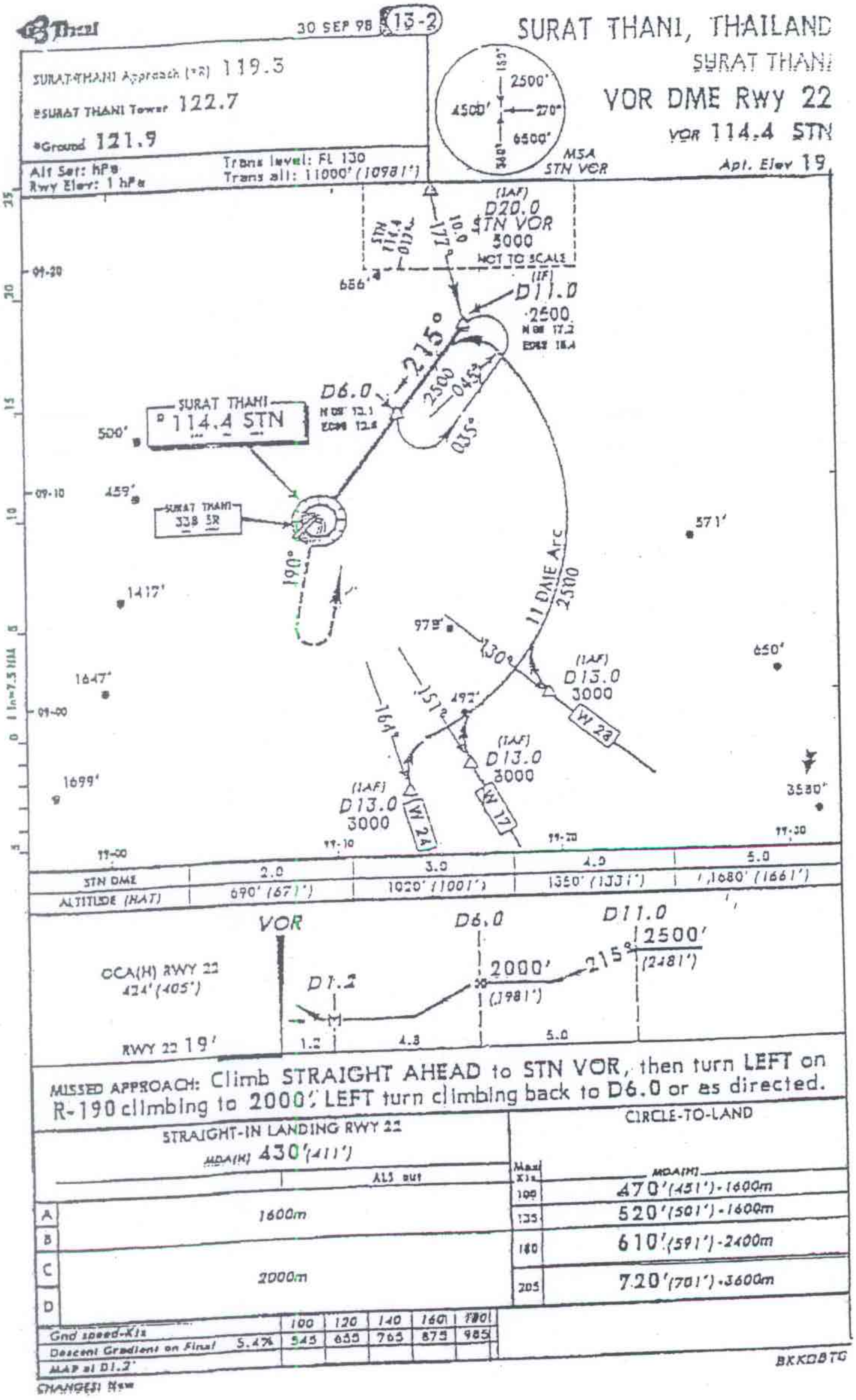
7. REVERSING

A full-stop landing must be completed if engine reversing has been initiated.

For reversing procedures, see the respective AOM.

oOo

Appendix 17


30 SEP 98 13-2
SURAT THANI, THAILAND
SURAT THANI
VOR DME Rwy 22
VOR 114.4 STN
Apt. Elev 19
SURAT-THANI Approach 119.3
*SURAT THANI Tower 122.7
*Ground 121.9
Alt Set: hPa
Rwy Elev: 1 hPa
Trans level: FL 130
Trans alt: 11000' (10981')
2500'
4500'
270°
6500'
MSA STN VOR
(IAF) D20.0 STN VOR 3000
NOT TO SCALE
(IF) D11.0
2500
215°
D6.0
2500
045°
035°
SURAT THANI
114.4 STN
SURAT THANI
338 SR
190°
11 DME Arc 2500
130°
(IAF) D13.0 3000
W 23
151°
(IAF) D13.0 3000
W 17
164°
(IAF) D13.0 3000
W 24
STN DME 2.0 3.0 4.0 5.0
ALTITUDE (HAT) 690' (671') 1020' (1001') 1350' (1331') 1680' (1661')
VOR
D6.0
D11.0
2500' (2481')
215°
2000' (1981')
OCA(H) RWY 22 424' (405')
D1.2
RWY 22 19'
1.2 4.8 5.0
MISSED APPROACH: Climb STRAIGHT AHEAD to STN VOR, then turn LEFT on R-190 climbing to 2000', LEFT turn climbing back to D6.0 or as directed.
STRAIGHT-IN LANDING RWY 22
MDA(H) 430' (411')
ALS out
A B 1600m
C D 2000m
CIRCLE-TO-LAND
Max Kts MDA(H)
100 470' (451') - 1600m
135 520' (501') - 1600m
180 610' (591') - 2400m
205 720' (701') - 3600m
Gnd speed-Kts 100 120 140 160 180
Descent Gradient on Final 5.4% 545 655 765 875 985
MAP at D1.2
BKKDBTG
CHANGES: New

Appendix 18

AIP
THAILAND

VTSB AD 2-15
1 APR 97

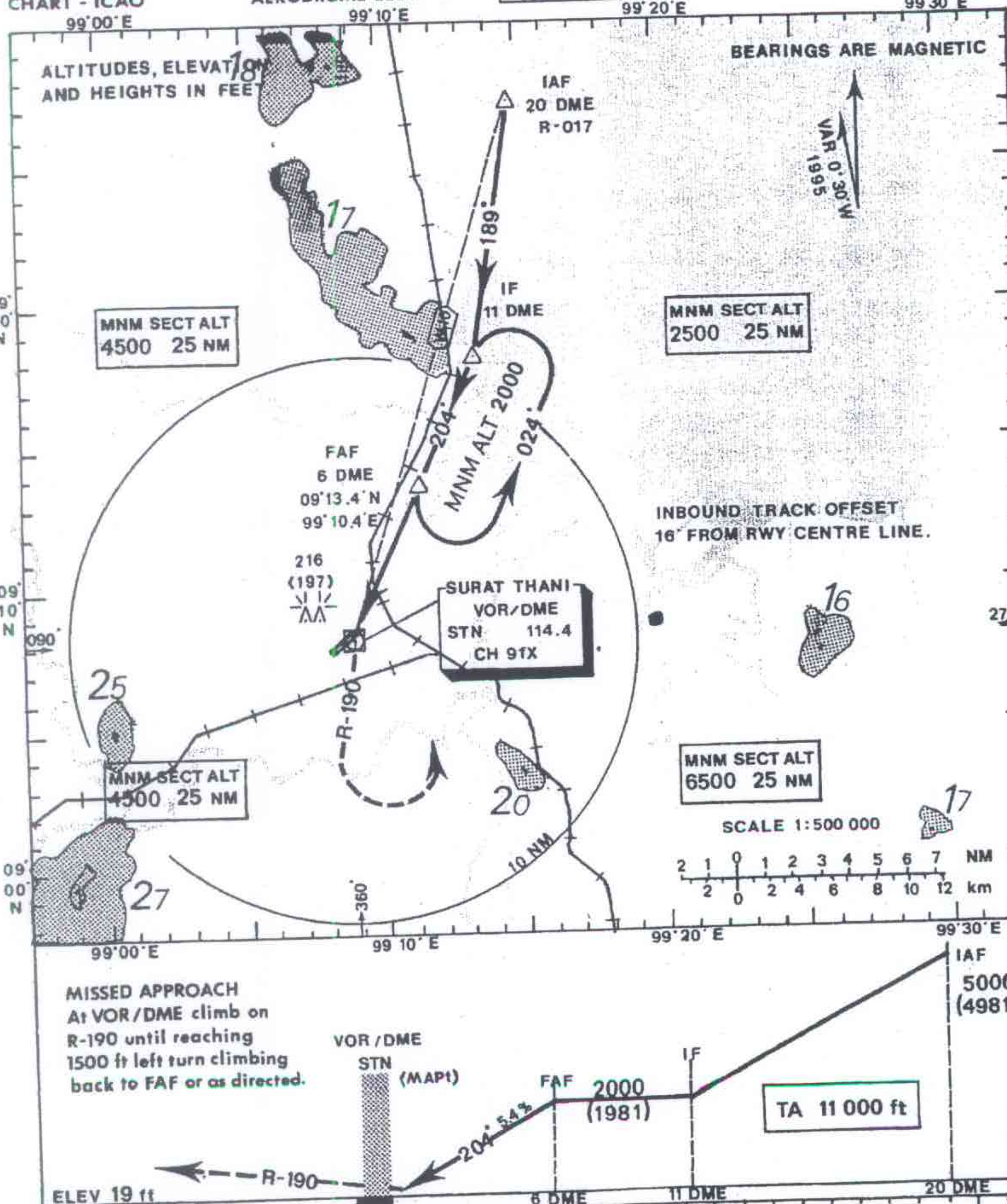
INSTRUMENT APPROACH CHART - ICAO

AERODROME ELEV 19 ft
HEIGHTS RELATED TO AERODROME ELEV

TWR 122.7
APP 119.3

SURAT THANI/Surat Thani

VOR/DME
RWY 22



OCA/H	A	B	C	D
Straight-in Approach	470 (451)			
Circling	510 (491)		670 (651)	720 (701)

Distance		2 DME		3 DME	4 DME	5 DME
Altitude		690		1020	1350	1680
Speed	Knots	100	120	140	160	180
Rate of descent	ft:min	545	655	765	875	985

Appendix 19

HAI AIRWAYS INTERNATIONAL — A300-600 F/S WITH VISUAL SYSTEM PST

CAPTAIN/COPILOT	PERS.NO.	DATE:	INSTRUCTOR
FC.	6636	8 MAR, 95	FC.

TECHNICAL: AIR COND & PRESS SYSTEM; APU SYSTEM; AUTO FLT SYSTEM; ELECTRICAL SYSTEM; FIRE PROTECTION SYSTEM; FLT CONTROLS SYSTEM; FUEL SYSTEM; HYDRAULIC SYSTEM; ______ SYSTEM

OPERATION 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 30 31 32 33 34 35 36 37 38 39 40 41 42 43 44 45 46 47 48 49 50 51 52 53 54 55 56 57 58 59 60

EMERGENCY 1 2 [illegible] 4 [illegible] [illegible] 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 30

SYMBOLS: O = CORRECT, / = PARTLY INCORRECT, X = INCORRECT

[/] PASSED [ ] NOT PASSED

HAVE REVISED FOM/AOM/RM7 [ ] YES [ ] NO

	REMARKS
1. BEFORE TAKEOFF PROCEDURE AD: a. CHECKLIST b. ENGINE STARTING (MALF) — HOT START	/
2. TAKEOFF (165T, 25 KT X WIND) TO FL 310 RAPID DECOMPRESSION AND DUAL HYD FAILURE a. BRIEFING c. STATIC T/O PROCEDURE b. CHECKLIST d. DEPARTURE PROCEDURE	/
3. ILS APPROACH & LANDING WITH REDUCED FLAPS, (SLATS) a. BRIEFING c. A/C HANDLING b. CHECKLIST d. APPROACH PROCEDURE AS PF [/] PNF [ ]	Fly down to [illegible]
4. TAKEOFF (WINDSHEAR) TO FL 30 BOTH ENGINE FLAMEOUT AND RELIGHT a. BRIEFING c. WINDSHEAR PROCEDURE b. CHECHLIST d. ROTATION	Maintain 260 KTS
5. NPA APPROACH, LOSS OF BOTH GENERATOR (RECOVERED) USE FPV & GO AROUND WITH ENGINE FAILURE AND LOSS OF AUTOPILOT a. VOR [ ] NDB [/] c. GOAROUND PROCEDURE b. BASIC INSTRUMENTS d. CLEAN UP PROCEDURE AS PF [/] PNF [ ]	KEEP ON TRACK AS SOON AS POSSIBLE - MAINTAIN MDA
6. 1 ENG. ILS APP AND L/D (MAX. XWIND) (HSI) a. A/C HANDLING b. LANDING TECHNIC	/
7. TAKEOFF (165 T) ENG. FAILURE AT V1 - a. DECISION b. ABORT PROCEDURE	Good
8. TAKEOFF (165T) ENG. FAILURE AT V1 + (165 T) a. DECISION c. DIRECTIONAL CONTROL b. POWER CONTROL d. CLEAN UP PROCEDURE	/

9. 1 ENG ILS APP AND GO AROUND (0/0) (165T) a. CHECKLIST c. GO AROUND PROCEDURE b. CHECK TGA d. CLEAN UP PROCEDURE	✓
10. 1 ENG ILS APP AND LANDING a. APPROACH PROCEDURE b. LANDING TECHNIC	GOOD.
11. TAKEOFF (140T) AUTOMATIC APP. AND L/D CAT II (VIS 300M) AUTOLAND a. BRIEFING c. CALL OUT PROCEDURE b. CAT II PROCEDURE d. LANDING ROLL AS PF [✓] PNF [ ]	✓
12. TAKEOFF (140 T) JAM ELEVATORS ILS APP AND LANDING a. ROTATION c. A/C HANDLING b. PROCEDURE d. L/D TECHNIC AS PF [ ] PNF [✓]	✓
13. CAPTAIN PERFORM PF ON [✓] T/O AND L/D FROM RH SEAT [ ] MAX X- WIND L/D AT HKG	✓
14. PILOT IN CAPACITY a. PROCEDURE c. CHECKLIST b. A/C HANDLING d. AFTER LANDING	✓
15. ON GROUND EMERGENCY AS PF [ ] PNF [✓]	✓

COMMENTS:
- TYPE OF APPROACH AND DETAILS MUST BE BRIEFED TO CONFIRM PF AND PNF DUTIES BEFORE COMMENCING APPROACH ESPECIALLY IN BAD W/X
- MUST BE ON TRACK AS SOON AS POSSIBLE DURING NON-PRECISION APC, OTHERWISE VISUAL CONTACT WILL BE DIFFICULT.
- OTHERWISE GOOD PFT

TRAINING COMPLETED [✓] NOT COMPLETED [ ]

P/S SIGN	AS 1/P	AS 2/P	TOTAL	P/I SIGN
(signature)	2 H — M	2 H — M	4 H — M	(signature)

BO/NP/kc. 09SEP97

Appendix 20

1 ROND POINT MAURICE BELLONTE
31707 BLAGNAC CEDEX FRANCE
TELEPHONE 05 61 93 33 33
TEL. INTERNATIONAL + 33 5 61 93 33 33
TELEX AIRBU 530526 F

AIRBUS INDUSTRIE

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Alan CADMAN
THABKK

Capt. Ampole Ploymekha
Director Flight Safety
& Aviation Affairs Dept.
THAI AIRWAYS INTERNATIONAL
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BANGKOK
THAILANDE

Express
Tel. : 00.662.545.2666

Blagnac, February 1st, 1998
AI/ST-F n° 945.7507/98 - CM/AB

Gentlemen,

We are providing you this Airplane Upset Recovery Training Aid as part of an industrie effort to reduce loss of control accidents and incidents. This aid was developed by an industrie team during a two-year effort of researching and building a consensus among many aviation experts.

It was in response to increasing interest by the NTSB in aircraft loss of control accidents which, together with CFIT, cause a large proportion of accidents.

This training aid, already presented during our 10th Performance & Operations Conference in SAN FRANCISCO last October is aimed at preventing loss of control accidents on conventional aircraft. It is not aimed at Protected Fly-by-Wire aircraft. There is no need for this type of continuation training on protected aircraft, although a general knowledge of the principle involved is useful for every pilot.

You may reproduce portions or the total training aid to fulfil your internal requirements. It is recommended distributing section two "Pilot Guide to Airplane Upset Recovery to your pilots".

The video was produced in two parts with the intent that both parts be used for initial upset recovery training and part two would be used for recurrent training.

We encourage you to use this training aid to ensure your pilots participate in an effective airplane upset recovery training program.

Yours Faithfully,

Christian MONTEIL
Deputy Vice President
Training and Flight Operations Support

GROUPEMENT D'INTERET
ECONOMIQUE REGI
PAR L'ORDONNANCE N° 67821
DU 23 SEPTEMBRE 1967
302609607 R.C.S. TOULOUSE

Appendix 21

EDITORIAL & PRINTING OFFICE

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SUBSCRIPTIONS

Complimentary subscriptions distributed to THAI pilots and management personnel related to commercial airline activities.

The contents of this publication are not intended to supersede the Company regulations, technical order or any Government regulations unless so stated.

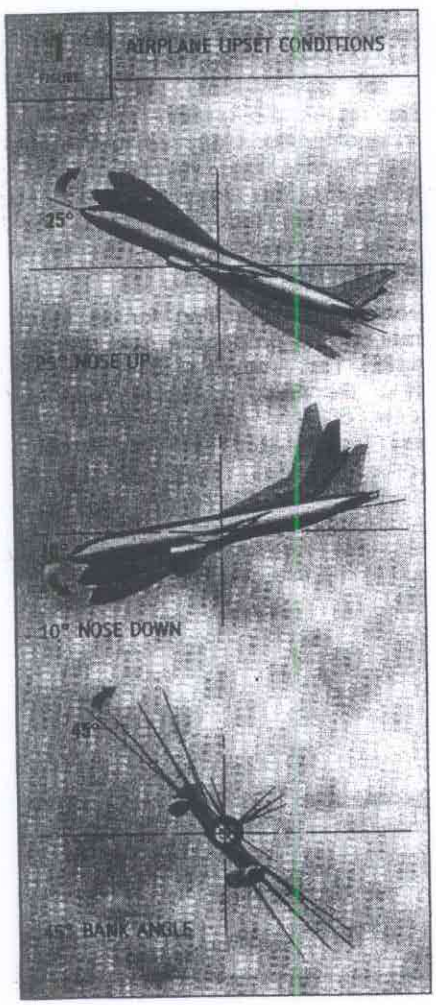
Any information contributed to aviation safety will be welcomed. Our hope is to broaden safety consciousness and awareness of every individual in any aspect of operations.

Flight Safety Information
November 1998 Vol. 82 No. 6

CONTENTS

Aerodynamic Principles of Large-Airplane Upsets

Aerodynamic principles applied to large, swept-wing commercial jet airplanes are similar among all manufacturers, and the recommended techniques for recovering from an upset in an airplane subject to these principles are also compatible. Pilots who understand the conditions of an upset, though such an event is unlikely, will be better prepared to recover from it. The four conditions that generally describe an airplane upset (figure1) are *unintentional:*



- Pitch attitude more than 25 degrees nose up.
- Pitch attitude more than 10 degrees nose down.
- Bank angle more than 45 degrees.
- Flight within these parameters at airspeeds inappropriate for the conditions.

In order to avoid an upset, or to recover from one, pilots must understand the following:

1. Aerodynamic fundamentals applied to large airplanes.
2. Application of aerodynamic fundamentals to airplane upsets.
3. Recovery techniques.

1. Aerodynamic Fundamentals Applied to Large Airplanes

Airline pilots are thoroughly familiar with airplane handling qualities under normal flight conditions. In general, if pitch is increased (the result of pulling back on the controls), altitude increases; in level flight, if thrust is increased, airspeed increases.

However, when an airplane is taken to the edges of the flight envelope, different situations result. It is possible, for example, to encounter flight conditions where an increase in thrust is needed to maintain a slower airspeed, and where an increase in pitch will decrease altitude. While airline pilots may have received training on how to use flight controls to recover from airplane upsets, they rarely, if ever, experience these conditions in line operations.

In the context of aerodynamics, the following three basic concepts should be understood:

- Energy management.
- Pitch control.
- Lateral and directional control.

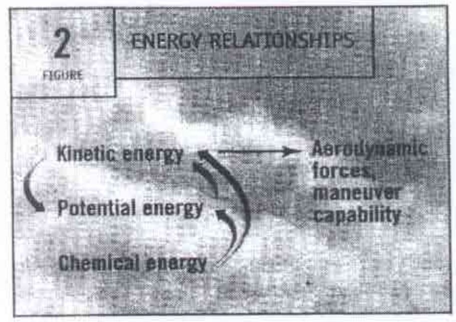
Energy Management

Three sources of energy are available to generate aerodynamic forces and thus maneuver the airplane: kinetic, which increases with increasing airspeed; potential, which is proportional to altitude; and chemical, which is from the fuel in the airplane's tanks. The term "energy state" describes how much of each kind of energy the airplane has available at any given time. The critical element to realize is that pilots who understand the airplane energy state will be in a position to know what options are available to maneuver the airplane.

The airplane is continuously expending energy in flight because of drag. Drag is usually offset by using some of the stored chemical energy - that is, by burning fuel in the engines. [At landing, the reverse is the case when wheel brakes (friction) and thrust reversers dissipate energy.]

During maneuvering, the three types of energy can be traded, or exchanged, usually at the cost of additional drag. This process of consciously manipulating the energy state of the airplane is referred to as energy management. Airspeed (kinetic energy) can be traded for altitude (potential energy). Altitude therefore can be traded for airspeed, as in a dive. This trading of energy, however, must be balanced with the final desired energy state in mind. For example, when a pilot trades altitude for airspeed by descending the airplane, the descent angle must be selected carefully in order to capture the final desired energy state with the introduction of the necessary chemical energy.

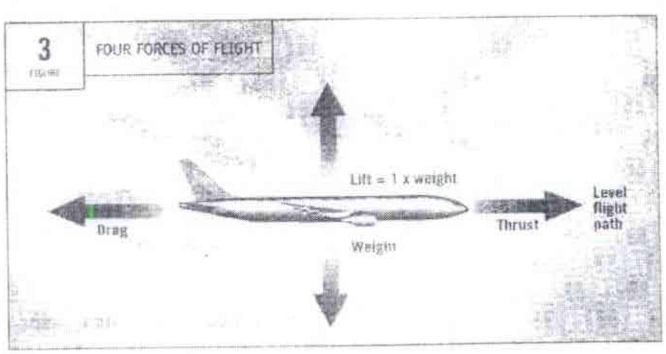
This becomes especially important when the pilot wants to generate aerodynamic forces and moments to maneuver the airplane. Kinetic energy can be traded for potential energy (climb). Potential energy can be converted to kinetic energy. Chemical energy can be converted by engines to either potential or kinetic energy, but only at specified rates. These relationships are shown in figure 2.



The objective of maneuvering the airplane is to manage energy so that kinetic energy stays between limits (stall and placards), potential energy stays within limits (terrain-to-buffet altitude), and chemical energy stays above certain thresholds (fuel in tanks). These concepts are especially important to understanding recovery from an airplane upset.

In managing these energy states and trading between the sources of energy, the pilot does not directly control the energy. The pilot controls the direction and magnitude of the forces acting on the airplane. These forces result in accelerations applied to the airplane. The result of these accelerations is a change in the orientation of the airplane and a change in the direction, magnitude, or both, of the flight path vector. Ultimately, velocity and altitude define the energy state.

This process of controlling forces to change accelerations and produce a new energy state takes time. The amount of time required is a function of the mass of the airplane and the magnitude of the applied forces, and is governed by Newton's laws. Airplanes of larger mass generally take longer to change orientation than do smaller ones. This longer time requires the pilot to plan ahead in a large-mass airplane to ensure that the actions taken will result in the final desired energy state.



1 dissipate : (cause to) disperse; go away

Thrust, weight, lift, and drag are the forces that act upon an airplane (figure 3). Maneuvering is accomplished by variations of these forces and is controlled by the throttles and flight controls.

The lift force in pounds or kilograms generated by a surface is a result of the angle of attack, the dynamic pressure of the air moving around it (which is a function of the airspeed and density), and the size and shape of the surface. Lift varies with angle of attack for constant speed and air density. As angle of attack is increased, the lift increases proportionally, and this increase in lift is normally linear. At a specific angle of attack, however, the resulting lift due to angle of attack behaves differently. Instead of increasing, it decreases. At this critical angle of attack, the air moving over the upper wing surface can no longer remain attached to the surface, the flow breaks down, and the surface is considered stalled. The breakdown of the flow and consequent loss of lift is dependent only upon the angle of attack of the surface. This is true regardless of airplane speed or attitude. An airplane stall is characterized by anyone (or a combination) of the following conditions:

- Buffeting.
- Lack of pitch authority.
- Lack of roll control.
- Inability to arrest descent rate.

These conditions are usually accompanied by a continuous stall warning. A stall must not be confused with the stall warning that alerts the pilot to an approaching stall. Recovery from an approach to stall is not the same as a recovery from an actual stall. An approach to stall is a controlled flight maneuver; a stall is an out-of-control, but recoverable, condition.

Flight controls give the pilot the ability to manage the forces acting on the airplane in order to maneuver; that is, to change the flight path of the airplane (figure 4).

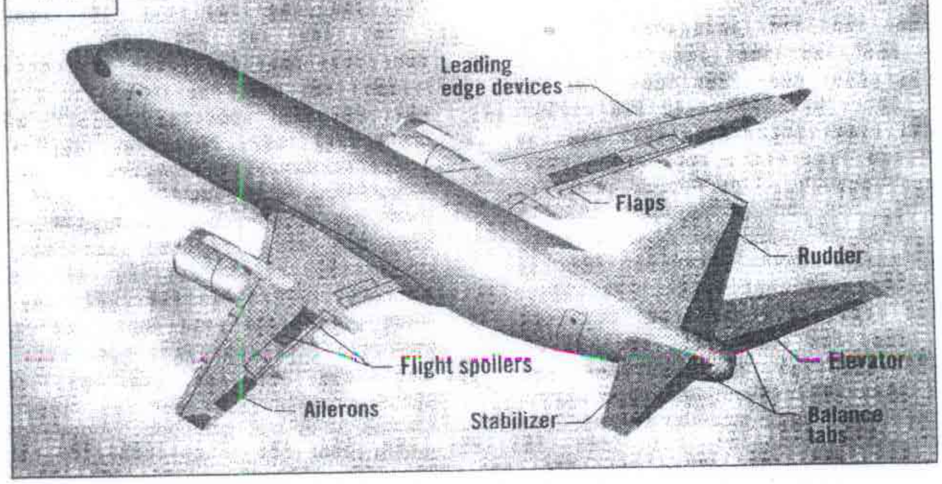
Pitch Control

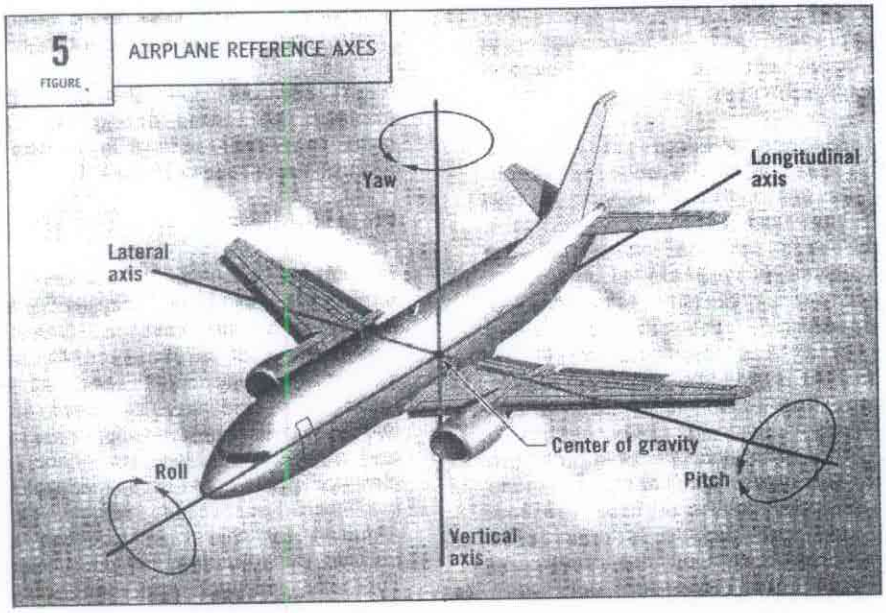
Movement around the lateral axis of an airplane is called pitch (figure 5), and is usually controlled by the elevator. Given any specific combination of airplane configuration, weight, center of gravity, and speed, all forces will be balanced at one elevator position. In flight, the two elements most easily changed are speed and elevator position; as speed changes, the elevator position must be adjusted to balance the aerodynamic forces. Control forces required for this new position can be neutralized by adjusting the pitch trim mechanism. Typically, the pitch trim mechanism adjusts the position of the horizontal stabilizer.

An important concept for pilots to understand is that if the airplane is at a balanced, "in-trim" angle of attack in flight, it will generally seek to return to the trimmed angle of attack if upset by external forces or momentary pilot input. This is due to the longitudinal stability designed into that airplane.

Changes in airplane configuration also affect pitch control. For example, flap extension usually creates a nose-down pitching moment; flap retraction usually creates a nose-up pitch. When extended, wing-mounted speed brakes usually produce a nose-up pitching moment.

4 FIGURE FLIGHT CONTROL SURFACES





Pitch attitude can also change with thrust (figure 5). With underwing engines, reducing thrust creates a nose-down pitching moment; increasing thrust creates a nose-up pitching moment.

The combination of elevator and stabilizer positions also affects pitch. In normal maneuvering, the pilot displaces the elevator by applying an elevator control force. The pilot then trims the stabilizer by driving it to a new position to remove the elevator control force. This new stabilizer position is faired with the elevator. If they are not faired (one is down and the other is up), one cancels out the other. This condition limits the airplane's ability to overcome other pitching moments from configuration changes or thrust.

Lateral and Directional Control

Similar to how feathers on the back of an arrow make it fly straight, airplanes have a vertical stabilizer to keep the nose into the wind. The rudder is attached to the vertical stabilizer, and movement of the rudder into the airflow creates a force and a resulting rotation about the vertical axis. This motion is called yaw (figure 5). The vertical stabilizer and the rudder are sized to meet two objectives: to control asymmetric thrust from an engine failure at the most demanding flight condition (greater than V_1), and to generate sufficient sideslip for crosswind landings. To achieve these objectives, the vertical stabilizer and rudder must be capable of generating powerful yawing moments and large sideslip angles.

Motion about the longitudinal axis is called roll (figure 5). Control inputs cause the ailerons and spoilers to control the airplane's roll rate. The aileron and spoiler movement changes the local angle of attack of the wing, changing the amount of lift and causing rotation about the longitudinal axis.

During an airplane upset, unusually large amounts of aileron or spoiler input may be required to recover the airplane. After input of full roll control, it may be necessary to use rudder in the direction of the desired roll. The amount of rudder required to coordinate the maneuver will depend on the airplane type and associated systems. An uncoordinated rudder movement results in a nose movement (yaw) in the direction of the rudder input. The yaw creates sideslip, which causes a roll in the same direction as the rudder input. The roll due to sideslip is referred to as dihedral effect.

When encountering an angle of attack associated with the onset of stick shaker, ailerons and spoilers are still effective at controlling roll. However, as the angle of attack continues to increase beyond the angle associated with stick shaker onset, the airflow over the wing separates and airplane buffet generally begins. Without decreasing the angle of attack, the combination of ailerons and spoilers in this separated airflow may not always generate a significant force; therefore, little rotation about the longitudinal axis occurs on some models. Since the vertical stabilizer/rudder is rarely aerodynamically stalled, it is still possible to generate a force and a nose rotation with associated roll rate.

However, at a high angle of attack, pilots must be extremely careful when using the rudder for assisting lateral control. Excessive rudder can cause excessive sideslip which could lead to departure from controlled flight.

Asymmetric thrust creates a yawing and a rolling moment. An engine failure creates an undesired yaw and roll. Conversely, an intentional engine throttle up or down could create a desired yawing moment followed by a desired rolling moment. Using asymmetric thrust to control roll is not precise because of the lag time associated with engine spool-up or spool-down and should be avoided unless no other means of roll control are available. Generally, the pilot should attempt to restore symmetric thrust conditions during an upset recovery.

2. Applying Aerodynamic Fundamentals to Airplane Upsets

Though airline pilots in line operation will rarely, if ever, encounter an upset, situation, understanding how to apply aerodynamic fundamentals in such a situation will help them control the airplane. Several techniques are available for recovering from an upset. In most situations, if a technique is effective, it is not recommended that pilots use additional techniques. Several of these techniques are discussed in the example scenarios below:

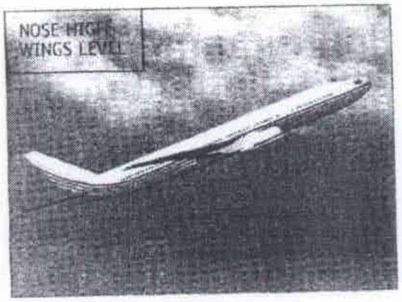
- Stall recovery.
- Nose high, wings level.
- Nose low, wings level.
- High bank angles.

Stall Recovery

In all upset situations, it is necessary to recover from a stall before applying any other recovery actions. To recover from the stall, angle of attack must be reduced below the stalling angle. Nose-down pitch control must be applied and maintained until the wings are unstalled. Under certain conditions, on airplanes with underwing-mounted engines, it may be necessary to reduce some thrust in order to prevent the angle of attack from continuing to increase. Once unstalled, upset recovery actions may be taken and thrust reapplied as needed.

Nose High, Wings Level.

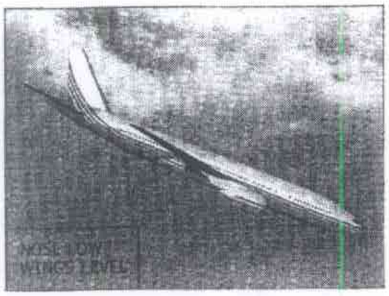
In a situation where the airplane pitch attitude is unintentionally more than 25 degrees nose high and increasing, the kinetic energy (airspeed) is decreasing rapidly. According to the energy management discussed earlier, the



energy is actually being stored as potential energy. As airspeed decreases, the pilot's ability to maneuver the airplane also decreases. If the stabilizer trim setting is nose up, as for slow-speed flight, it partially reduces the nose-down authority of the elevator. Further complicating this situation, as the airspeed decreases, the pilot could intuitively make a large thrust increase. This will cause an additional pitch up for underwing-mounted engines. At full thrust settings and very low airspeeds, the elevator - working in opposition to the stabilizer - will have limited control to reduce the pitch attitude.

In this situation the pilot should trade the potential energy of altitude for airspeed, and would have to maneuver the airplane's flight path back toward the horizon. This is accomplished by the input of up to full nose-down elevator and the use of some nose-down stabilizer trim. These actions should provide sufficient elevator control power to produce a nose-down pitch rate. It may be difficult to know how much stabilizer trim to use, and care must be taken to avoid using too much trim. Pilots should not fly the airplane using stabilizer trim, and should stop trimming nose down when they feel the g force on the airplane lessen or the required elevator force lessen. This use of stabilizer trim may correct an out-of-trim airplane and solve a less-critical problem before the pilot must apply further recovery measures. Because a large nose-down pitch rate will result in a condition of less than 1 g, at this point the pitch rate should be controlled by modifying control inputs to maintain between 0 to 1 g. If altitude permits, flight tests have determined that an effective way to achieve a nose-down pitch rate is to reduce some thrust on airplanes with underwing-mounted engines. The use of this technique is not intuitive and must be considered by each operator for their specific fleet types.

If normal pitch control inputs do not stop an increasing pitch rate, rolling the airplane to a bank angle that starts the nose down should work. Bank angles of about 45 degrees, up to



a maximum of 60 degrees, could be needed. Unloading the wing by maintaining continuous nose-down elevator pressure will keep the wing angle of attack as low as possible, making the normal roll controls as effective as possible. With airspeed as low as stick shaker onset, normal roll controls - up to full deflection of ailerons and spoilers - may be used. The rolling maneuver changes the pitch rate into a turning maneuver, allowing the pitch to decrease. Finally, if normal pitch control then roll control is ineffective, careful rudder input in the direction of the desired roll may be required to induce a rolling maneuver for recovery.

Only a small amount of rudder is needed. Too much rudder applied too quickly or held too long may result in loss of lateral and directional control. Because of the low energy condition, pilots should exercise caution when applying rudder.

The reduced pitch attitude will allow airspeed to increase, thereby improving elevator and aileron control effectiveness. After the pitch attitude and airspeed return to a desired range the pilot can reduce angle of bank with normal lateral flight controls and return the airplane to normal flight.

Nose Low, Wings Level

In a situation where the airplane pitch attitude is unintentionally more than 10 degrees nose low and going lower, the kinetic energy (airspeed) is increasing rapidly. A pilot would likely reduce thrust and extend the speed brakes. The thrust reduction will cause an additional nose-down pitching moment. The speed brake extension will cause a nose-up pitching moment, an increase in drag, and a decrease in lift for the same angle of attack. At airspeeds well above V_{MO}/M_{MO}, the ability to command a nose-up pitch rate with elevator may be reduced because of the extreme aerodynamic loads on the elevator.

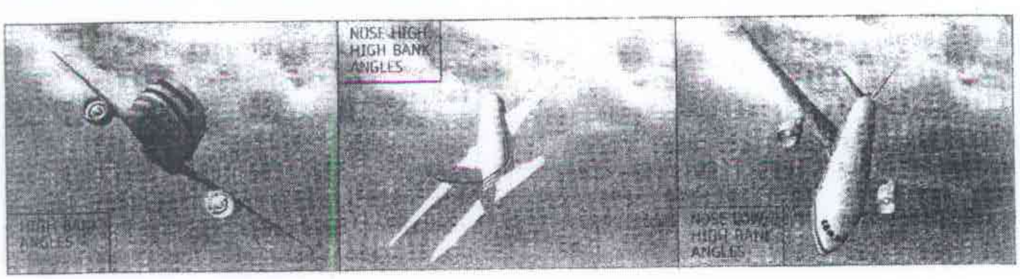
Again, it is necessary to maneuver the airplane's flight path back toward the horizon. At moderate pitch attitudes, applying nose-up elevator - and reducing thrust and extending speed brakes, if necessary - will change the pitch attitude to a desired range. at extremely low pitch attitudes and high airspeeds (well above V_{MO}/M_{MO}), nose-up elevator and nose-up trim may be required to establish a nose-up pitch rate.

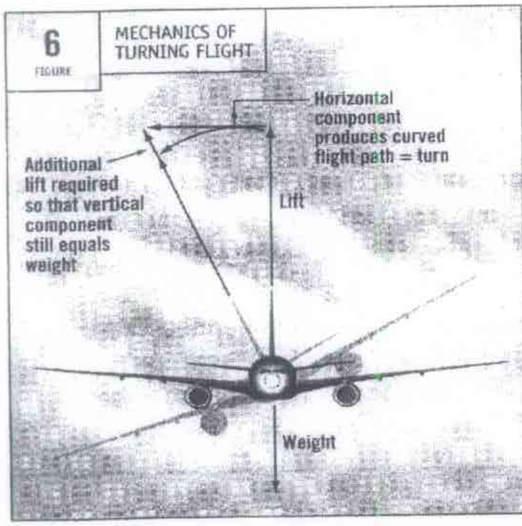
High Bank Angles

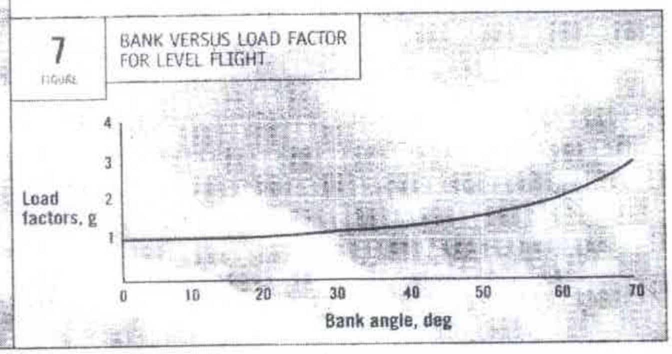
A high bank angle is one beyond that necessary for normal flight. Though the bank angle for an upset has been defined as unintentionally more than 45 degrees, it is possible to experience bank angles greater than 90 degrees.

Any time the airplane is not in "zero-angle-of-bank" flight, lift created by the wings is not being fully applied against gravity, and more than 1 g will be required for level flight (figure 6). At bank angles greater than 67 degrees, level flight cannot be maintained within flight manual limits for a 2.5 g load factor (figure 7). In high bank angle increasing airspeed situations, the primary objective is to maneuver the lift of the airplane to directly oppose the force of gravity by rolling to wings level. Applying nose-up elevator at bank angles above 60 degrees causes no appreciable change in pitch attitude and may exceed normal structure load limits as well as the wing angle of attack for stall. The closer the lift vector is to vertical (wings level), the more effective the applied g is in recovering the airplane.

A smooth application of up to full lateral control should provide enough roll control power to establish a very positive recovery roll rate. If full roll control application is not satisfactory, it may even be necessary to apply some rudder in the direction of the desired roll.







Only a small amount of rudder is needed. Too much rudder applied too quickly or held too long may result in loss of lateral and directional control or structural failure.

Nose High, High Bank Angles

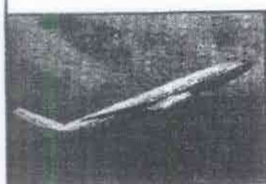
A nose-high, high-angle-of-bank upset requires deliberate flight control inputs. A large bank angle is helpful in reducing excessively high pitch attitudes. The pilot must apply nose-down elevator and adjust the bank angle to achieve the desired rate of pitch reduction while considering energy management. Once the pitch attitude has been reduced to the desired level, it is necessary only to reduce the bank angle, ensure that sufficient airspeed has been achieved, and return the airplane to level flight.

Nose Low, High Bank Angles

The nose-low, high-angle-of-bank upset requires prompt action by the pilot as potential energy (altitude) is rapidly being exchanged for kinetic energy (airspeed). Even if the airplane is at a high enough altitude that ground impact is not an immediate concern, airspeed can rapidly increase beyond airplane design limits. Simultaneous application of roll and adjustment of thrust may be necessary. It may be necessary to apply nose-down elevator to limit the amount of lift, which will be acting toward the ground if the bank angle exceeds 90 degrees. This will also reduce wing angle of attack to improve roll capability. Full aileron and spoiler input should be used if necessary to smoothly establish a recovery roll rate toward the nearest horizon. It is important to not increase g force or use nose-up elevator or stabilizer until approaching wings level. The pilot should also extend the speed brakes as necessary.

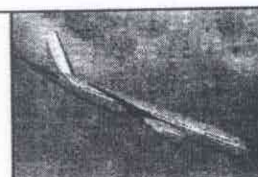
3 RECOVERY TECHNIQUES

It is possible to consolidate and incorporate recovery techniques into two basic scenarios — nose-high and nose-low — and to acknowledge the potential for high bank angles in each scenario described above. Other crew actions such as recognizing the upset, reducing automation, and completing the recovery are included in these techniques. Boeing and Airbus believe the recommended techniques provide a logical progression for recovering an airplane. The techniques assume that the airplane is not stalled. If it is, recovery from the stall must be accomplished first.



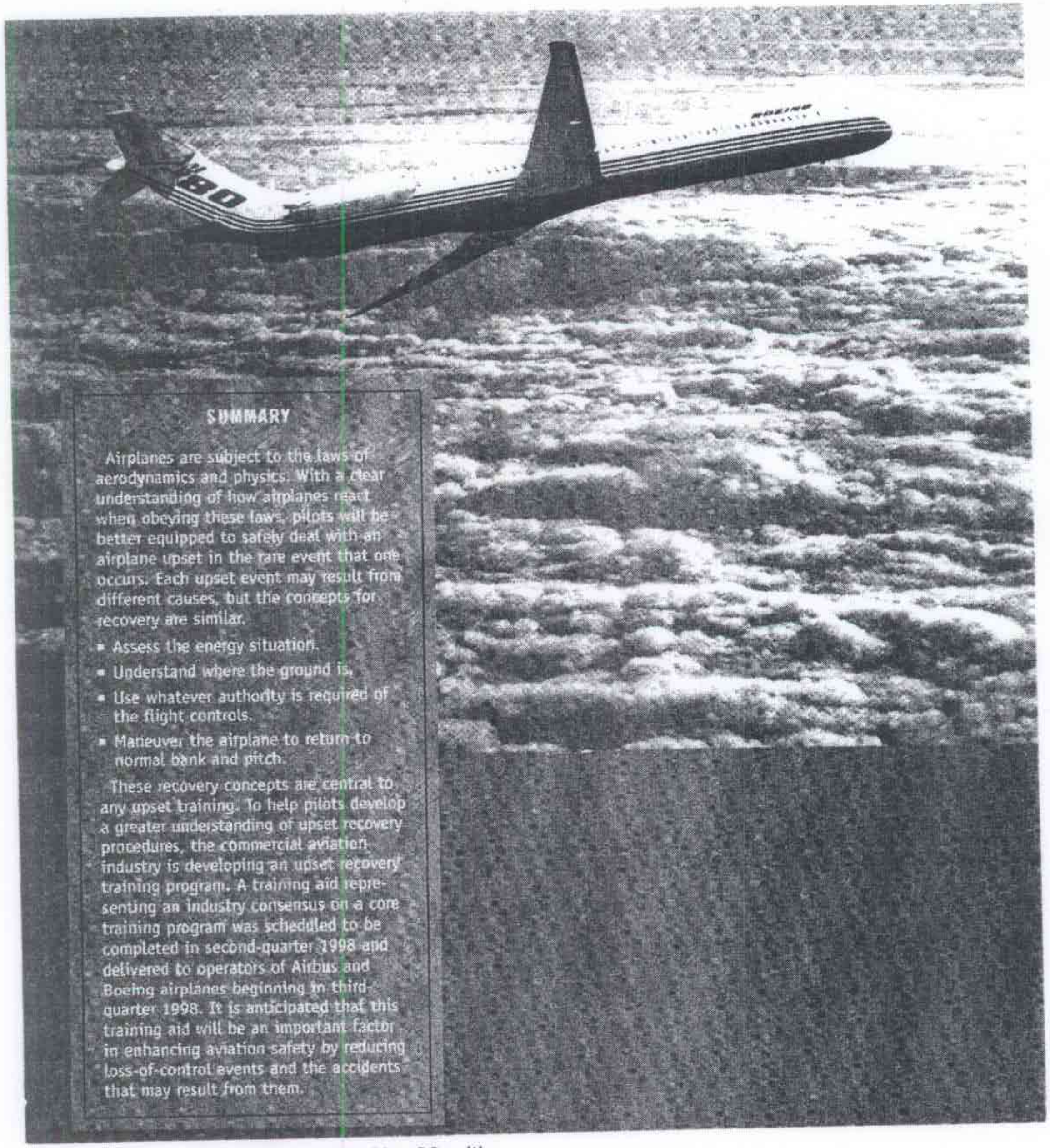
NOSE-HIGH RECOVERY

- Recognize and confirm the situation.
- Disengage autopilot and autothrottle.
- Apply as much as full nose-down elevator.
- Apply appropriate nose-down stabilizer trim.
- Reduce thrust (for underwing-mounted engines).
- Roll (adjust bank angle) to obtain a nose-down pitch rate.
- Complete the recovery:
  - When approaching the horizon, roll to wings level.
  - Check airspeed and adjust thrust.
  - Establish pitch attitude.



NOSE-LOW RECOVERY

- Recognize and confirm the situation.
- Disengage autopilot and autothrottle.
- Recover from stall, if necessary.
- Roll in the shortest direction to wings level (unload and roll if bank angle is more than 90 degrees).
- Recover to level flight:
  - Apply nose-up elevator.
  - Apply stabilizer trim, if necessary.
  - Adjust thrust and drag as necessary.



SUMMARY

Airplanes are subject to the laws of aerodynamics and physics. With a clear understanding of how airplanes react when obeying these laws, pilots will be better equipped to safely deal with an airplane upset in the rare event that one occurs. Each upset event may result from different causes, but the concepts for recovery are similar.

- Assess the energy situation.
- Understand where the ground is.
- Use whatever authority is required of the flight controls.
- Maneuver the airplane to return to normal bank and pitch.

These recovery concepts are central to any upset training. To help pilots develop a greater understanding of upset recovery procedures, the commercial aviation industry is developing an upset recovery training program. A training aid representing an industry consensus on a core training program was scheduled to be completed in second-quarter 1998 and delivered to operators of Airbus and Boeing airplanes beginning in third-quarter 1998. It is anticipated that this training aid will be an important factor in enhancing aviation safety by reducing loss-of-control events and the accidents that may result from them.

(Courtesy: AERO Magazine No. 03 with permission of the Boeing Company)

> *I always prefer to believe the best of everybody - it saves so much trouble.*
>
> *Rudyard Kipling*

Appendix 22

THAI Inter-Office Communication

To: OO

From: OS-B/AB6

Ref: 027/OS-SY/st

Date: 24 June 1999

Subject and text:

Following the accident at URT, DO requested that all AB6 pilots, in particular, must undergo semi-auto do around training. The emphasis was on all dangerous points detailed in BO-AB6 attached

(Capt. Somjed Yodsoonthorn)

CC: DP

To: OS-B/AB6

From: BO-AB6

Ref: BO-AB6/SP/kp

Date: 23 June 1999

Subject and text:

Ref. IOC from OS-B/AB6 regarding go-around training.

Normally, the go-around in unfavourable conditions training is in Fleet AB6 PFT syllabus I and II (see attachment – translated as in the original text).

Since the beginning of the year, the new syllabus called Extra Flight Simulator for semi-auto go-around was added as per DO request. The pilot instructors were trained and thoroughly informed. At present, all pilots in the fleet had under gone the training. The transition/ promotion pilots were also trained.

(Saksin Penkae)

Thai
Thai Airways International Public Co., Ltd.

Inter - Office Communication

TO		FROM			
AB6/310 PILOTS		BO-AB6			
Your Ref.	Your Letter	Our Ref.	BO-AB6/SP/ke	Date	05 MAR 99

Subject and text

GO-AROUND

Inspite of the fact that all of our pilots are trained regulary concerning situation awareness and standard operating procedure during a GO-AROUND as well as other phases of flight but in real life this phase of flight rarely happens. So there are some points which should be emphasized and reminded of.

BACKGROUND : The A310/A300-600 types develop rather high climb power when initiating a GO-AROUND at low A/C weight. Auto pilot/Flight director may exceed 18° target before reaching the stabilized pitch altitude. Stall speed should be in consideration due to increasing vertical acceleration (increasing airload supported by the wings)

1. GA with A/P engaged in command (AUTO GA)

- Do not try to force control column movement as this will induce a trim movement opposite to the input.
- If A/P behaves unusual or pitch attitude exceeds 18° Nu

- Disengage A/P immediately
- Manually push control column FWD. use electrical pitch trim (if inoperative use man trim wheel) to assist in reducing pitch attitude to 18° Nu or less with regard to terrain clearance

2. GA with A/P not engaged in command (SEMI-AUTO GA)

- Due to strong pitch up effect and auto trim not functioning

- Manually counter the control column immediately never let A/C pitch attitude exceed 18° Nu
- Electrical pitch trim should be used as soon as possible to assist in counteract strong nose up tendency (if inoperative, man trim wheel shall be used)

ON BOTH CASES ABOVE

The main objective is to fly attitude and never let A/C pitch attitude EXCEED **MAX 18° Nu**

During approach it is recommended to keep A/P engaged until positive landing is assured.

Best Regards

Saksin P.

Recommendation for extra Semi Auto Go-around training in Simulator

Aircraft Setting

- Normal automatic ILS approach
- Weigh: lightest possible in Normal Domestic flight
- CG: as nose heavy as possible in order that A/P trim noseup as much as possible (at LDW 105 tons, set CG 22% MAC resulting in 7.5 degrees N.U.)
- In order to have further trim and power change, it is possible to simulate speed high then reduce to approach speed or decrease Tailwind to Headwind.

Demonstration (Reset SIM to position before Outer Marker, then Auto APPR)

At Decision Altitude

1. Initiate Auto Go-around

   Notice: as Go-lever Depressed, Auto THR will accelerate to G/A pwr, Immediately A/P will trim down to maintain Altitude approx. 18 degrees N.U., Stab.trim will continuous until reaching Green Band in which Freeze SIM notice at the start of Trig Golever and when Trim is in Green Band.

2. Initiate manual Go-around (disconnect A/P) use Auto THR

   <u>Let go A/C control</u> No modification

   - Freeze SIM can be noticed when A/C reach stick shaker speed

   Point out: A/C Attitude > 30 degrees reached big "V", R/C reach max 6000 ft/min, speed rapidly dropped below V_{LS} (stop at 100 kts), ALT < 1000, Stab Trim remain at 7.5 degrees N.U. with G/A pwr (all these situations happen in only 7-8 sec. after started G/A)

3. <u>Let pilot take A/Ccontrol</u> with same condition as 2

   3.1 - Use only elevator to counteract with pitch up

   - Try to maintain not more than 18 degrees N.U. with only elevator

   Point out: If reaction time fast enough, with heavy push force on Elevator, 18 degrees N.U. can be maintained.

   3.2 - then use electric trim or manual trim wheel to ease nose up tendency down to Green Band range

   3.3 - back to 3.1, simulate stabilizer or pitch trim jam then ease nose up tendency by reducing thrust

   3.4 - same condition as 3.1

   - let attitude go beyond 18 degrees N.U. but not more than 30 degrees N.U.
   - then use elevator correction if unable to use electric trim or manual trim wheel

   Point out: At this attitude, elevator alone cannot counteract pitch up but immediate trim use (electric or trim wheel) pitch can still be bring down to normal attitude again

3.5 - same condition as 3.1
- let attitude go beyond 30 degrees N.U. then PFD become blank (no FD, no FMA info)

Point out: Recovery is impossible with any solution above then unusual attitude recovery needed

3.6 - try any of the above with Flaps and Landing gear retraction delay

Conclusion from 1-3

1. Reaction time of A/P is almost none, maintain Attitude well below 18 degrees N.U. and immediately trim fast moving toward the Green band
2. For manual control or lost of Autopilot, to keep the situation normal, as learned from Autopilot oper., you need fast reaction time and not allow the attitude to go beyond 18 degrees N.U. with any means of pitch control to help (elevator, elec trim, trim wheel), then bring stabilizer trim setting to the Green Band

   Note: all those situations happen in only normal conditions with our High thrust underwing engines but can cause some uncontrollable situations
3. Now that you know all normal situation controls. There are some normal operations that ease the effect
   - the effect from flaps and landing gear retraction
   - thrust reduction
4. The worst thing happens when the Malfunction with pitch control occur:
   - pitch trim dropped (reengage or not)
   - stabilizer trim runaway (toward A/C nose up)
   - unable to activate stabilizer trim (elect, manual)

   Note: even the load is heavy on the control wheel, pitch 18 degrees N.U. can be maintained for a while by elevator, then reduced the nose up caused by the engine with immediate thrust reduction
5. Situation in 4 but attitude gone beyond 18 degrees N.U. and 30 degrees N.U. then unusual attitude recovery needed

Recommendation for Preparation for Go-around

Review about *Weight, Thrust* used for Go-around and check for last *stab setting* for full LDG config

Caution during Go-around ... PITCH ATTITUDE 18 DEGREES NU, FAST REACTION TIME, STAB, TRIM

Alternative Go-around Procedures

- Using auto or manual go-around with auto thrust but select lower thrust on TRP
  - Check in advance for Flex t/o available for that A/D, then find out from chart for req. pwr setting and compare with CL or CR thrust. Then use the lowest selection close to the calculation
- Using manual go-around with manual thrust

Note: from latest revision Airbus FCOM, notice that after Flaps...retract, then Thrust....check/ adjust, after that

THAI AIRWAYS INTERNATIONAL

EXTRA A300-600 FLIGHT SIMULATOR
FOR SEMI-AUTO GO-AROUND

Captain/First Officer	Pers. No.	Date:	Instructor
....	....	........../............/............	....

	Remarks
1. Pre-flight preparation AD:..................... a. Weather and documents TOW:.................. b. Flight planning c. Checklist d. Engine start (normal/abnormal)	
2. Before takeoff procedure a. Takeoff data and MRL c. Taxi technique b. Briefing d. Line up	
3. Takeoff and climb (wind shear) a. Rotating technique or abort procedure b. Wind shear procedure	
4. Cruise a. Use of AFS and FMS b. Turbulence penetration c. Cruise control	
5. Descent a. Normal / Drift down procedure b. Checking of weather c. Planning	
6. Go-round discussion a. Characteristic / A/C performance during GA b. Understanding of AFCS c. Recovery if unusual A/C attitude both with A/P connected/disconnected	
7. Approach to DA, MDA/H then initiate auto go-around a. Freeze sim approx. 1000 ft. AGL b. Observe / point out A/C config. Attitude, speed, height, stab trim position (THS)	

	Remarks
from 7 make a new app. To DA, MDA/H disengage AP the GA with only auto throttle. a. Let go the control b. Freeze sim at stick shaker speed c. Observe / compare a/c characteristics with item 7. d. Point out manual control is mandatory	
7.2 Same criteria for GA as 7.1 , now let the pilot control the A/C a. Freeze sim approx 1000' AGL. b. Observe & compare A/C characteristics with auto GA (ITEM 7)	
7.3 Same criteria for GA as 7.2 but no sim freezing required a. Pilot shall complete GA procedure as laid down in AOM	
8. Discussions & Conclusion	

COMMENTS

Training completed ☐ Not completed ☐

Pilot sign	As PF	As PNF	Total	P/I sign
....	h m	h m	h m	....

AB6/SP/ke , 03 FEB 99

(REF. IOC from DO to all AB6 INSTRUCTORS 21 JAN 99)

R To initiate Go Around, simultaneously :

Announce . . . . "GO AROUND-FLAPS..."
Announce GO AROUND and the required FLAP setting

GO LEVERS . . . . Trigger

Note : Triggering one GO LEVER is sufficient to initiate GO AROUND.

R THROTTLE LEVERS . . . . GO AROUND thrust

R Follow through on THROTTLE LEVERS if ATS is armed or
R manually set GO AROUND thrust if ATS is not armed.

CAUTION

R PF should be ready to override or disconnect the
R autothrottle function in case of thrust asymmetry
R and to counteract aircraft yaw.

ROTATION . . . . Perform

Rotate aircraft to achieve a positive rate or climb and establish the required pitch attitude (not to exceed 18°) as directed by the SRS pitch command bar.

FMA indication . . . . Announce
Check THR, GO AROUND

Note : FMS CDU automatically switches to GO AROUND page.

FLAPS . . . . Retract one step

Announce new FLAP positon when indicated.

THRUST . . . . Check/Adjust

Announce . . . . "Positive climb"

Order . . . . "GEAR UP"

L/G . . . . UP

NAV or HDG mode . . . . Select

Announce . . . . "GEAR UP"

R L/G . . . . Neutral

At thrust reduction altitude

R THROTTLES . . . Check symmetrical retard movement

R Check CL on TRP.

R *Note : In case of asymmetrical throttle retard movement,*
R *A/THR should be disconnected and thrust manually*
R *set.*

At GA acceleration altitude

SPD/MACH . . . . Select 250 Kt

LVL/CH . . . . Select

– Retract slats/flaps on schedule

MISSED APPROACH PROCEDURE . . . . Follow

Appendix 23

- Pitch is controlled by the elevators and the Trimmable Horizontal Stabilizer (THS).
- The left and right elevators are connected by a coupling/uncoupling unit.

ELEVATORS

- Each elevator is controlled by the 3 hydraulic systems via 3 actuators, commanded by cable control runs from the Captain and First Officer control columns.
- If an elevator control run jams in flight (except for takeoff) the THS is used for pitch control.
- For takeoff, the elevator uncoupling/coupling sequence is as follows :
  - the elevator uncoupling unit (controlled by the Electrical FLight Control Unit, EFCU) uncouples the 2 elevators from 30 kt to 195 kt.
  - 2 bellcranks and detents connecting the front and rear ends of the 2 control runs (see diagram) allow the 2 control runs to be uncoupled so that, in case of elevator control jamming, the pilots can control the other elevator (overriding the detent requires a force of approximately 50 kg / 110 lbs).
  - above 195 kt, the unit recouples the elevators to prevent inflight asymmetric deflection of elevators.
- 2 independent artificial Pitch Feel systems, controlled by the Feel and Limitation Computers (FLC), provide increasing pitch control feel above 165 kt (high speed range). Below 165 kt (low speed range) the artificial pitch feel is a constant spring force.

  One system is active, the other is in stand-by.

  Each system uses its own hydraulic actuator (SYS 1 Green/SYS 2 Yellow).

  If both systems fail, the mechanism automatically returns to the low speed position, assisted by a spring (light elevator forces).

  If the system does not return to low speed mode, a warning of high speed mode operation is triggered when flaps reach 20° .
- The autopilot pitch actuator is connected to the linkage next to the left elevator. When one or both AP are engaged, the AP actuator drives the elevators.
- Stall warning is provided by electrical stick shakers fitted on the control columns (FWC activated).

PITCH TRIM

- Pitch trim is provided by the Trimmable Horizontal Stabilizer (THS). Mechanical stops are set at 3° nose down and 14° nose up.
- The THS is operated by two independent hydraulic motors (green and yellow hydraulic systems).
- The THS can be commanded:
  - by the electric trim using either trim switches (rocking levers) located on the control wheels,

  or
  - manually, by turning either pedestal trim wheel,

  or
  - automatically by the autopilot (autotrim function),

  or
  - automatically above a given speed, Mach number or angle-of-attack.

    At high speed and high Mach number, nose up pitch trim is applied automatically (Mach trim) to keep a neutral static stability.

    At high angle-of-attack and low speed, nose down pitch trim is applied automatically (Alpha trim) to counter excessive angle-of-attack.

    Alpha trim is available only with AP OFF.
- The Electric pitch trim inputs on rocking levers are inhibited when the AP is engaged in CMD (in case of an out-of-trim condition being experienced with the AP engaged in CMD, the AP must be first disconnected - using the AP instinctive disconnect pushbutton on the control wheel - before re-trimming the aircraft manually using the electric trim rocking levers.
- The autotrim orders are inhibited :
  - at take-off, if the landing gear is still extended 60 seconds after rotation,

- when landing gear is down locked during approach,
- during 5 seconds following the engagement of the GO AROUND mode.

• Electric pitch trim commands (rocking lever inputs) and autotrim commands (AP pitch trim orders) are processed by two ptich trim systems, provided the PITCH TRIM 1 and PITCH TRIM 2 levers are engaged.

The THS position is indicated on the pitch trim wheel scale.

• In normal operation PITCH TRIM 1 is operating, and PITCH TRIM 2 is in standby.

• The pitch trim (wheel and THS) runs approximately 5 time faster at low aircraft speed than at high speed.

Pitch trim speed also depends on the flap configuration (pitch trim runs faster when flaps are extended).

Pitch trim safety devices

• Electric and automatic pitch trim commands can be overridden manually using the pitch trim control wheel.

Overriding the electric trim and auto trim by using the pitch trim control wheel results in the automatic disengagement of both pitch trim systems (both PITCH TRIM levers trip to OFF).

• When the pitch trim is controlled by the electric trim (i.e either rocking lever), the THS automatically stops before reaching the mechanical stops (3° nose down and 14° nose up).

• When using the electric trim switches, if the THS runs for more than 1 second, an audio "Whooler" sounds to alert the pilots.

• If CM1 and CM2's electric trim switches (rocking levers) are held in opposite directions, trimming action stops.

• Each electric trim rocking lever actuates two switches. If switches provide contradictory orders both pitch trim systems disengage.

Pitch trim engagement conditions

• Pitch Trim lever can be engaged if:
  - power supply is available,
  - associated Flight Augmentation Computer (FAC) is operative,
  - associated Air Data Computer (ADC) is operative, if flaps are retracted,
  - at least 2 Angle-of-Attack sensors are operative, if slats are retracted,
  - associated THS motor is operative.

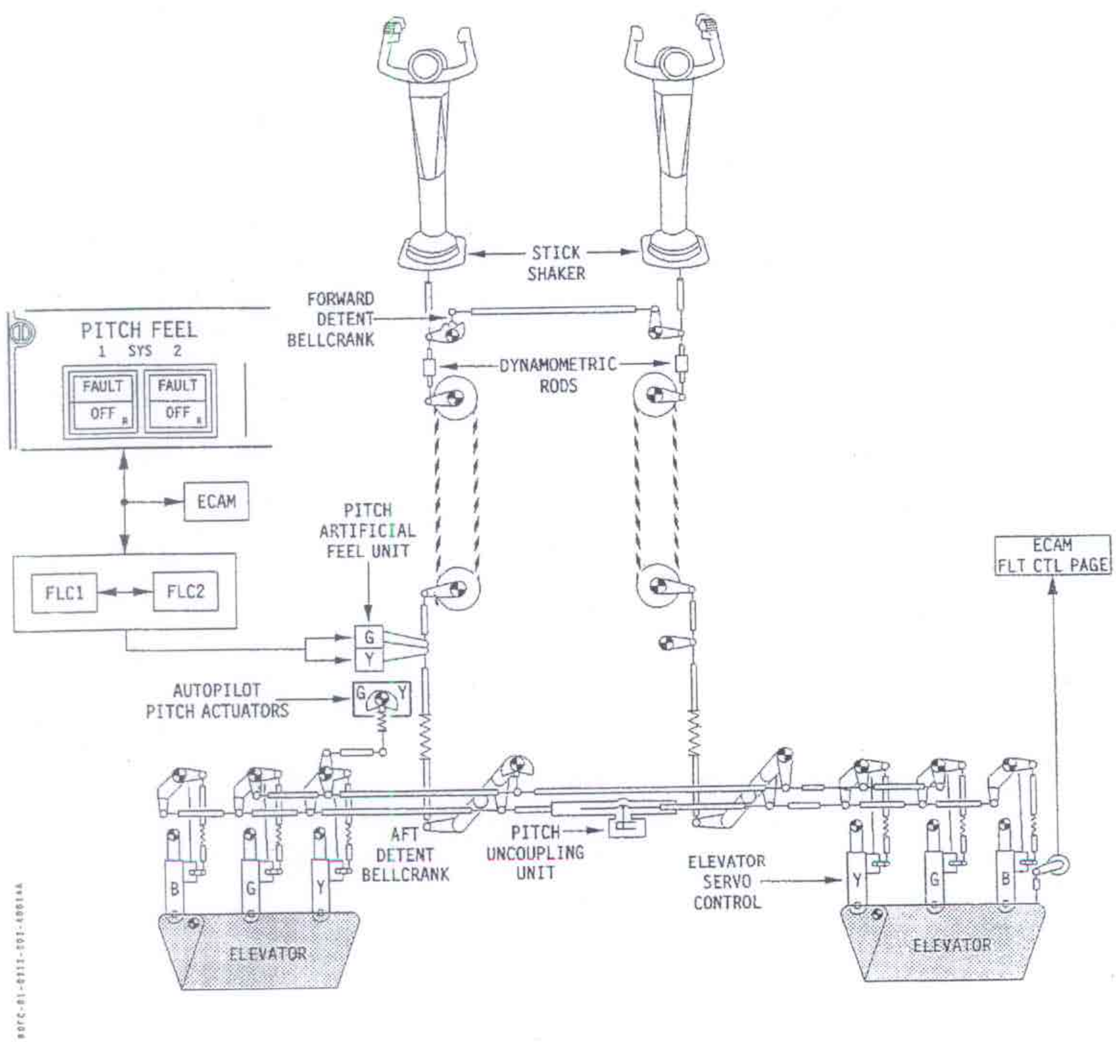
Pitch trim disengagement conditions

• If any pitch trim engagement condition is lost, the corresponding PITCH TRIM lever trips to OFF.

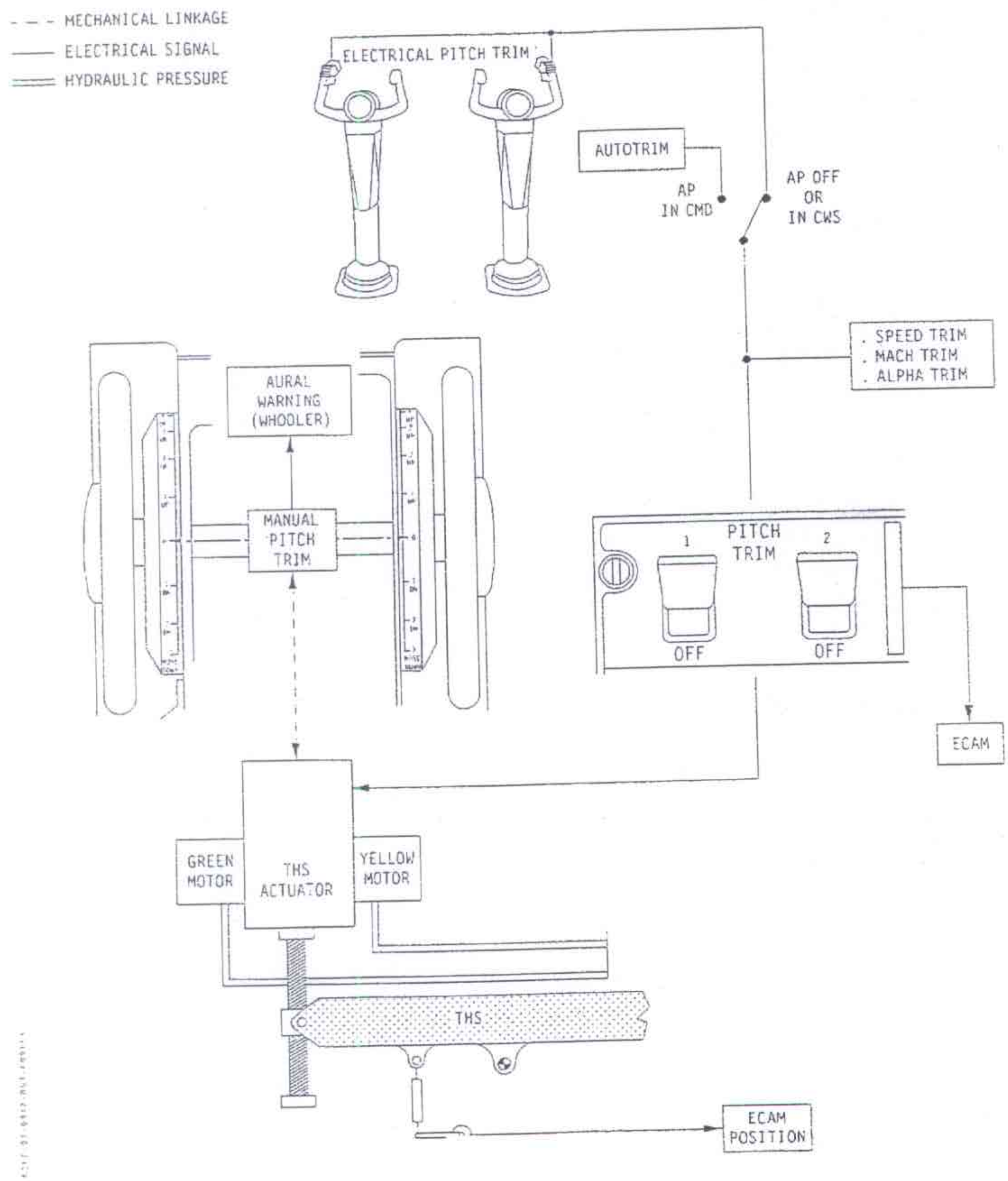
ECAM warning is activated.

The remaining pitch trim system continues to operate normally.

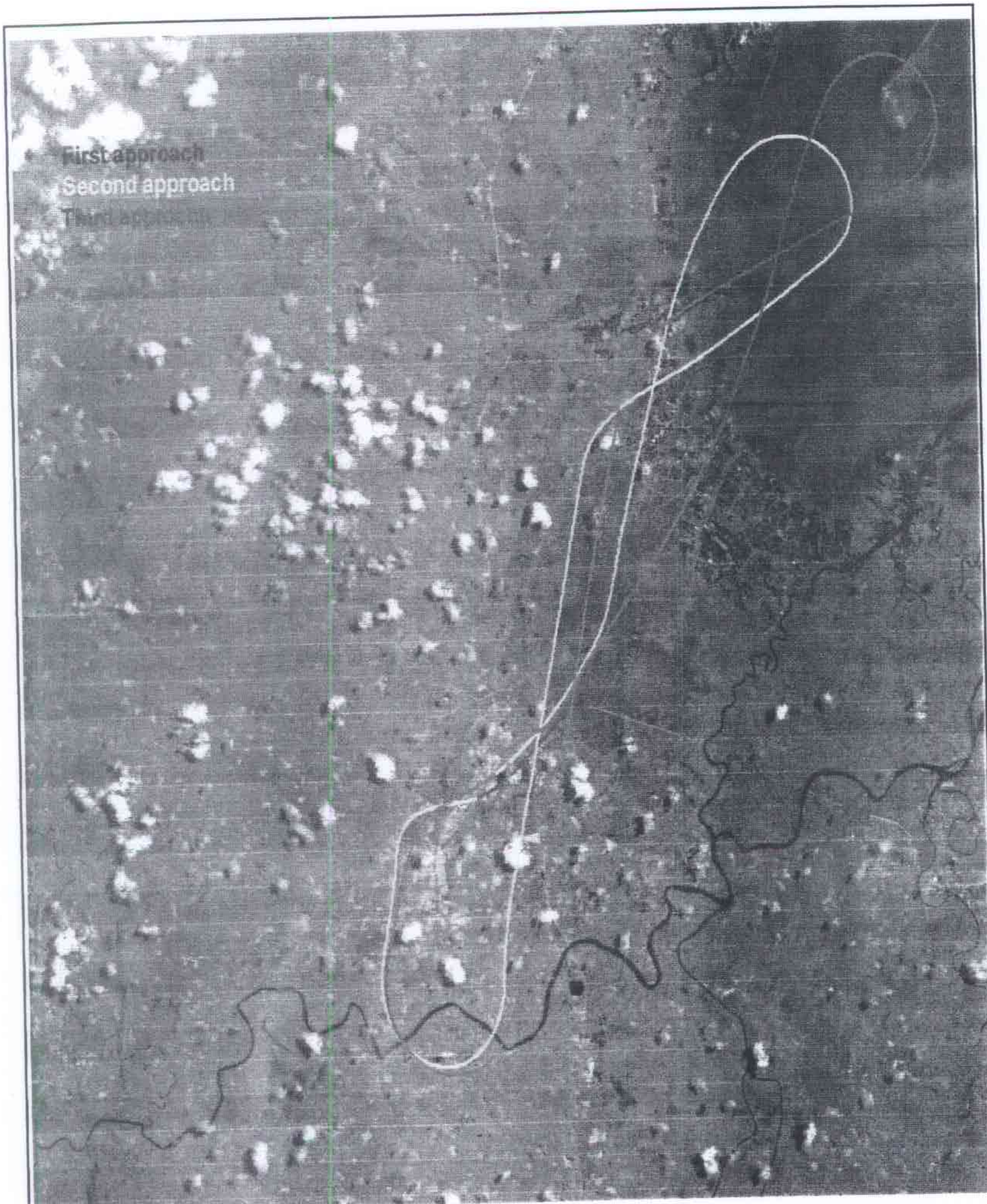
PITCH CONTROL



PITCH TRIM CONTROL



Appendix 25



Approach from 11.37.33 UTC to 12.07.35 UTC

Accident of HS-TIA A310 from THAI Airways
occured on December 11, 1998 at Surat Thani

Appendix 26

TAC letter head

Ref. No. TAC 103/ 2542 (C.E.1990)

Date: 9 December 1999

Re: Information on mobile phone signal transmission

Attention: Director of Air Safety Division
Department of Aviation

Kindly refer to your request for information on mobile phone signal transmission (World Phone 1800 and 1800) in the area of Surat Thani province during 19.04-19.08 hours on 11 December 1998.

Please be informed that we traced no record of mobile phone signal transmission from the passengers during the requested period.

Yours sincerely

Wirat Jaruchoktawichai
Senior Vice President
Customer Service Department

AIS letter head

Ref. No. BR.BR. 349/2542 (C.E. 1999)

Date: 22 March 1999

Re: Information on mobile phone signal transmission

Attention: Director of Air Safety Division
Department of Aviation

Your Ref. No. 0405/500 dated 9 February 1999

Enclosure: 1. Thai Airways International Public Company Limited dated 1 February 1999
2. AIS letter dated 8 February 1999

Kindly refer to your request for information on mobile phone signal transmission (Cellular 900 and digital GSM) in the area of Surat Thani airport on 11 December 1998.

We are writing to inform you that, following the requirement of Thai Airways International Public Company Limited on the mentioned information, we have notified them that there was no report on signal inaccuracy. However, in case of incoming calls, we do regret that we are not able to support the information on CDR as we had no CDR in the system.

We do hope that this information would be of some assistance to you. Please rest assured of our co-operation in the future.

Yours sincerely

Somchai Lertsuthiwong
Manager
Business Relation Department
Advanced Info Service Public Company Limited

Business Relation Department
Tel: 299-5377
Fax: 299-5376

Appendix 27

National Transportation Safety Board

Washington, D.C. 20594

February 4, 2002

Honorable Supote Kumpeera
Director General
Department of Aviation
71 Soi Ngarmduplee, Rama IV Road
Bangkok, 10120, Thailand

Dear Mr. Kumpeera,

Please accept my response to the Department of Aviation invitation for National Transportation Safety Board (NTSB) consultation in accord with ICAO Annex 13 for the draft Final Report of the investigation of the accident of Thai Airways International Company Ltd., Airbus A310, HS-TIA, at Surat Thani Airport, Thailand, on December 11, 1998.

I was the designated National Transportation Safety Board (NTSB) Accredited Representative and our staff participated in the investigation as the state of manufacture of the airplane engines and the flight recorders. Advisors from the Federal Aviation Administration (FAA) and GE Aircraft Engines also participated.

The complete report has been reviewed. However, it is appropriate to direct my comments to the airworthiness issues of direct concern to the United States. The draft report states the GE engines, type CF6-80C2A2, were examined and found to have performed normally. This fact was collaborated by the data on the flight recorders. The US participants are in agreement with this conclusion.

One additional mention, since the conclusions and safety recommendations address a flight path upset and related flight crew pitch control and trim inputs, it would be very beneficial to the reader to include in your report an additional Appendix with selected plots from the flight data recorder. To facilitate this point if you desire, suggested plots are attached. I have included both printed copies and the same information on a data disk.

Please allow me to thank the Department of Aviation of Thailand for this opportunity. Your efforts set a high standard for other agencies to follow.

With best regards,

Robert Benzon
Senior Air Safety Investigator
U.S. Accredited Representative, HS-TAI

Attachment, FDR Plots

Appendix 28

Ministère de l'Équipement
des Transports et du Logement

BEA

Bureau d'Enquêtes et d'Analyses
pour la Sécurité de l'Aviation Civile

Liberté • Égalité • Fraternité
RÉPUBLIQUE FRANÇAISE

Le Bourget, le 21 février 2002

N° 1840 /BEA/T/SEB

Objet : HS-TIA, 11 December 1998
V/réf :
P.J : 1

Supote Kumpeera
Director General
71 Soi Ngarmduplee, Rama IV Road
Bangkok 10120
THAILAND

Dear Mr. Kumpeera,

The Bureau d'Enquête et d'Analyses pour la Sécurité de l'Aviation Civile (BEA) highly appreciates the possibility that was given to its representatives and advisers to participate in the phases of the investigation of the accident to Thai Airways International Public Company Limited Airbus A310-204 registration HS-TIA on December, 11th 1998 near Surat Thani Airport, as well as the invitation to study and provide comments to the draft final report, in application of the provisions of Annex 13 to the Chicago Convention.

Please find here attached our comments on this Draft Final Report. We remain at your disposal for clarifications or if you so wish, for a meeting either in Bangkok or in Paris. I assume that the comments with which you do not concur will be appended to the Final Report.

I would like to take this opportunity to express my thanks to the Investigation Committee, and to all of your assistants, for the continuous spirit of cooperation throughout this investigation.

Sincerely yours,

L'Ingénieur Général de l'Aviation Civile
Chef du Bureau Enquêtes-Accidents

P.L. ARSLANIAN

Comments of the French Accredited Representative regarding the accident of the Airbus A310 registered HS-TIA, operated by Thai International Airways that occurred on 11th December 1998

The time reference of this document is the UTC time used in the draft final report.

1. *Comments on Chapter 1, "Factual Information"*

Comment n°1

Paragraph 1.6.2 Weight and Balance

The parameters used for the CG calculation are: computed airspeed (Vc), angle of attack (TAOA) and THS position. The calculation method is to find the equilibrium condition with those parameters, which results in weight and CG position. The accuracy of this CG calculation is ± 1% MAC.

As the weight of the aircraft at the time of accident was approximately 102 tons, we propose accordingly to rephrase the present sentence: "*The centre of gravity position was calculated to be 26.13 percent of mean aerodynamic chord (MAC) which was within permissible limit*" as:

> *"The calculated centre of gravity position based on DFDR data of the aircraft during the third approach, is between 28 and 30%."*

Comment n°2

Paragraph 1.11.1

First line contains a typing error in the DFDR part number.
It should be read: 980-4700-001

Comment n°3

From the parameters recorded by the FDR, an average wind speed of 20 to 25 knots and an average wind direction of 010° were computed at an altitude of 2000 feet (this calculation was agreed upon during the meeting hold in Bangkok from 1st August 2000 to 3rd August 2000). This wind (010°/20 to 25 kts at 2000ft) is consistent with the forecast for temporary weather on December 11, 1998 during the period 13.00-22.00 hours. It is also consistent with the following sentences of the Draft Report:

- Paragraph 1.18.8: *"The aircraft was on the left side of VOR course 215 degrees"*,
- Paragraph 1.18.9.2: *"The pilot said that they were of to the left of the course"* and *"The co-pilot agreed and added that it might be because the wind and rain were moving to the airfield"*,
- Paragraph 2.13: *"the pilot went too far left of the track all three times"*.

Therefore we propose to include the results of the computations of this average wind at 2000ft in paragraph 1.16: Test and Research:

> *"From the parameters recorded by the FDR, an average wind speed of 20 to 25 knots and an average wind direction of 010° was computed at an altitude of 2000 feet. This wind (010°/20 to 25 kts at 2000ft) is consistent with the forecast for temporary weather on December 11, 1998 during the period 13.00-22.00 hours."*

Comment n°4

Paragraph 1.18.5

a)- What could be understood reading this paragraph, is that a go-around procedure is dangerous, which would go against safety whereas flying a manual go-around is part of all pilot training programs. The pitch up phenomenon with power application is a standard aerodynamic behaviour of almost every large civil transport aircraft. Controlling pitch attitude, using control and trim inputs, is one of the most emphasized issues in pilot training programs. Therefore it is basic airmanship for pilots to control the aircraft's pitch attitude during a go-around.

We propose accordingly to add the following sentence between the first and the second sentences of the third paragraph:

> *"It is basic airmanship for pilots to control the aircraft's pitch attitude during a go-around."*

b)- The A310 is not a Fly-by-Wire aircraft so the reference in the paragraph to this technology should be deleted.

Comment n°5

Paragraph 1.18.6

The description of the "Pitch Trim systems" in paragraph 1.18.6 gives a general overview of the system. However we propose to be more specific on the Stall Trim function and the Angle of Attack monitoring (please refer to document BEA-2000-REC-LAB-2, "COMPLEMENT TO PRELIMINARY ANSWERS to the letter dated June, 2000 from Thailand Investigation Committee dealing with the accident of the Airbus A310 from THAI International Airways that occurred on December 11, 1998").

Accordingly, we propose to amend the paragraph as follows:

> *"1.18.6 Pitch Trim systems are processed by two pitch trim systems; pitch trim 1 and pitch trim 2. In normal operation, pitch trim 1 is operation while pitch trim 2 is in standby. (Detailed in Appendix 22)*
> *The main pitch trim devices are as followed:*
> - *pitch trim lever*
> - *flight augmentation computer (FAC)*

- trim rocking levers
- electric servo motor

·Engagement conditions for pitch trim 1 or pitch trim 2:

- Pitch trim lever 1 (2) engaged
- 115V, 26VAC, 28VDC available
- Servo motor 1 (2) OK
- Air Data Computer 1 (2) operative (if flaps retracted)
- At least 2 of 3 angle of attack probes operative (if slats retracted)
- Internal monitoring of the FAC

If the above condition is properly operative, pitch trim 1 or pitch trim 2 can be engaged by putting the pitch trim levers "on". Should any pitch trim engagement condition be lost, the system disengages and the corresponding pitch trim lever trips to "off". The 2 other conditions that can trip the system to off are :

2. Pitch trim control wheel directly locked or moved by the crew.
3. The 2 electric trim switches (trim rocking lever) on control column are held in opposite direction.

The pitch trim system operates the THS. Its command depends on the calculation and operation of the FAC and it has 4 functions :

1. Electric trim by using the rocking levers on control column ; This is the usual way to trim the A/C when flown manually.
2. Autotrim – when using autopilot only
3. Mach/VC trim – which trims the A/C nose up to keep a neutral static stability at high speed.
4. Alpha trim

a. At high speed. This is only available when the slats are retracted. This function is providing a protection against flight envelope deviation at high speed.

b. At high angle of attack and low speed. This is called Stall Trim. It applies a nose down pitch trim order automatically to counteract excessive angle of attack.

The Stall Trim function takes into consideration a calculated True Angle of Attack. (TAOA). To check the validity of this TAOA the Flight Augmentation Computer (FAC) carries out a monitoring (AOA monitoring). Both the Stall Trim Function and the AOA monitoring are explained in the following:

<u>Stall Trim function</u>

The Stall Trim function is activated when the average (see note below) TAOA ($TAOA_{avg}$) reaches Stall Trim activation threshold (between 16° and 21° depending on phase advance). This activation induces a 4° nose DOWN order on stabilizer with a maximum rate of 0.9°/second.

The Stall Trim function is reset when $TAOA_{avg}$ becomes lower than 14.4°. Then 4° nose UP command is sent to the THS with a maximum rate of 0.9°/s.

AOA monitoring

The three TAOA are monitored by the FAC 1 and 2 in order to validate the values of the different TAOA. From the three TAOA, the median one is selected and called «Voted TAOA». If the difference between this Voted TAOA and the two other TAOA is above 3.6 degrees for more than 450 ms, the affected TAOA is set to 0 for the whole flight. If not, the affected TAOA is validated by the FAC.

Note: the FAC 1 and 2 compute an average true AOA (noted $TAOA_{avg}$) with $TAOA_1$, $TAOA_2$ and $TAOA_3$ according to :

If three AOA sensors are available :
$TAOA_{avg} = [\ TAOA_1 + TAOA_2\ ] / 2,$
If two AOA sensors are available (one TAOA has been set to 0) :
$TAOA_{avg} = [\ TAOA_1 + TAOA_2 + TAOA_3\ ] / 2,$
If less than two AOA sensors are available (two TAOA have been set to 0) :
$TAOA_{avg} = 0$

There is a difference in system response depending on aircraft configuration:

With slat extended:
When the information of at least 2 angle of attack sensors is not valid in the AOA monitoring function in the FAC, the stall trim function cannot be activated or if already activated, is reset and the THS goes back to the position it had before the stall trim activation.

With slat retracted:
When the information of at least 2 angle of attack sensors is not valid for FAC AOA monitoring, the pitch trim system is disengaged. This is not the case on the accident aircraft because the slats were extended."

2. Comments on Chapter 2, "Analysis"

Comment n°6

Paragraph 2.5

The statement at the end of paragraph 2.5:

> *"... except stall warning and stall protection systems, the operation of which were different from AIRBUS A310 aircraft maintenance manual"*

is not correct. Actually it was demonstrated that the stall warning systems and stall protection systems functioned as per design, in a situation totally outside the normal operation of the aircraft (See documents BEA-2000-REC-LAB-1, "PRELIMINARY ANSWERS to the letter dated January 25, 2000 from Thailand Investigation Committee dealing with the accident of the Airbus A310 from THAI International Airways that occurred on December 11, 1998", and BEA-2000-REC-LAB-2, "COMPLEMENT TO PRELIMINARY ANSWERS to the letter dated June, 2000 from Thailand Investigation Committee dealing with the accident of the Airbus A310 form THAI International Airways that occurred on December 11, 1998").

Furthermore one should note that the Aircraft Maintenance Manual (AMM) role is to provide guidelines for the maintenance of the aircraft. It is not a reference document for design specifications.

Therefore paragraph 2.5 should be amended to read:

> *"The aircraft had undergone inspection schedule and had a valid airworthiness certificate. From the information obtained from the DFDR and the CVR, no aircraft malfunction was observed."*

Comment n°7

Paragraph 2.10

As already noted, the nose up pitch tendency of large aircraft with under-wing mounted engines when applying go-around power is a known phenomenon and it develops with the increase of thrust when the engines spin up to full thrust. It is part of the training and of basic airmanship to control pitch attitude especially during a go-around. However, this does not immediately lead to an upset condition.

The flight data recording has shown that there was no pilot input, neither on the pitch control nor on the pitch trim, to control the pitch attitude at the 18 degrees. (See document BEA-2000-REC-LAB-1, "Preliminary Answers to the letter dated January 25, 2000 from Thailand Investigation Committee dealing with the accident of the Airbus A310 form THAI International Airways that occurred on December 11, 1998"). Due to the crew failure to apply proper pitch attitude control (nose down pitch input), the pitch up moment eventually lead to triggering of the stall warning.

When following a stall warning, a nose down input is not given, a stall condition can develop. Although recovery from a stall condition is part of the recovery techniques from an upset condition, stall recovery itself is part of basic airmanship and is therefore included in pilot training around the world. However, from the DFDR it can be seen that in the accident case, the crew responded to the stall warning with a large nose up pitch input. It is this nose up input that lead to an upset condition. The upset condition occurred, not because of the pitch up moment due to the thrust increase, but because of the improper crew response.

Given the fact that the crew were properly trained and qualified for this aircraft, the fact that they had not received the upset recovery training played no role in their capability to control the aircraft to the proper pitch attitude during the go-around or to recover from the initial stall condition at the moment of stall warning.

When the aircraft entered into its upset condition, the altitude was approximately 1880 feet and the speed below 30 kts. This combination of speed and pitch attitude is not recoverable within the altitude margin of 1880 feet.

Consequently, in this case, application of 'Large Aircraft Upset Recovery Techniques' would not have prevented the accident. For that reason, reference to 'Large Airplane Upset Recovery Techniques' in the Draft Final Report is irrelevant.

We therefore propose to amend paragraph 2.10 to read as follows:

> *"The nose up pitch tendency of large aircraft with under-wing mounted engines when applying go-around power is a known phenomenon and it develops with the increase of thrust when the engines spin up to full thrust. Transport pilots are aware of this pitch up phenomenon and are trained extensively to control pitch attitude especially during a go-around (basic airmanship). If however proper pitch attitude control input is not applied, the pitch up moment eventually leads to the triggering of the stall warning. If, following this warning, a nose down input is still not given, a stall condition can develop.*
>
> *Furthermore, if instead of a nose down input the crew applies a nose up input, an upset condition may develop.*
> *From the DFDR it can be seen that in the accident case, the crew responded to the stall warning with a large nose up pitch input.*
> *Due to this nose up input, the aircraft entered into a more than 50° nose up condition, at an altitude of approximately 1880 feet and with a speed of below 30 kts. This combination of altitude, speed and pitch attitude was not recoverable."*

Comment n°8

Paragraph 2.15

The statement :

> *"There was not enough information to support that the pitch trim system functioned efficiently described as follow"*

is not correct. It is based on the incomplete description of the pitch trim system in paragraph 1.18.6 (see comment n° 5). We therefore suggest to delete this sentence. Also sub-paragraphs 2.15.1 & 2.15.2 do not properly reflect the functioning of the stall trim system. The proper functioning and the analysis of the stall trim system were given in the document BEA-2000-REC-LAB-1, "Preliminary Answers to the letter dated January 25, 2000 from Thailand Investigation Committee dealing with the accident of the Airbus A310 form THAI International Airways that occurred on December 11, 1998".

a)- We therefore propose to modify paragraph 2.15.1 as follows:

> *"2.15.1 The threshold for stall trim activation is not a fixed value, but a value between 21° and 16° depending on a phase advance term.*
> *The exact calculation in present situation, based on the DFDR data, is not feasible because the DFDR records only TAOA1 whereas FAC uses TAOA1, TAOA2 and TAOA3. However the result of an estimation of phase advance term based on TAOA1 only shows that stall trim threshold is close to 16°. Therefore the THS behaviour is consistent with aircraft design."*

b)- As for paragraph 2.15.2 we propose to modify it as follows:

> *"2.15.2 There is a difference in system response depending on aircraft configuration: slats extended or slats retracted."*

<u>Miscellaneous</u>: It seems that a word is missing in the sentence "No record of trim of both pitch trim systems throughout the flight". We believe it should read "No record of <u>fault</u> of both pitch trim systems throughout the flight"

In the following sentence "... The information received from DFDR at 19:07:59 ...". We believe it should read "... The information received from <u>CVR</u> at 19:07:59 ...".

<u>Comment n°9</u>

Paragraph 2.16

The statement

> *"the stall warning sounded when true angle of attack was 25.73 degrees which was not consistent with the threshold limit of 17.5 degrees"*

is not correct.

Actually, when recalculating the exact moment of warning activation from the DFDR and CVR recordings, the time delays for data collection and warning generation must be taken into account as mentioned in the document BEA-2000-REC-LAB-1, "Preliminary Answers to the letter dated January 25, 2000 from Thailand Investigation Committee dealing with the accident of the Airbus A310 from THAI International Airways that occurred on December 11, 1998".

Here is the detail of the calculation:

<u>Note</u>: Based on the standards of the other Airbus aircraft in the fleet of Thai International Airways, the most probable standard of the Flight Warning Computer (FWC) used on the HS-TIA was either Standard 07 or Standard 12.

The reference of the time delays of the Stall Warning recordings (CVR and FDR) are the following:

- theoretical minimum and maximum values are given in a design coordination memo of the system manufacturer,
- those values were checked in the laboratory during the design integration phase in a so called system integration test,
- those values were further verified during subsequent simulator test.

FDR Stall Warning recording:

The time delay between the time when condition for stall warning activation is fulfilled on TAOA (TAOA>17.5°) and the time when stall warning is recorded on the DFDR is due to the combination of :

- DFDAU sampling rate (1 point per second)

and

- Parameter processing time on FWC, which depends on the standard the A/C is fitted with.

The following table gives the computation of minimum and maximum time delay as well as the associated earliest and latest time for stall warning recording.

FWC standard 07

TAOA>17.5°		FWC processing time		Time delay due to DFDAU sampling rate		Time delay for stall warning recording		DFDR time for stall warning recording	
earlier	latter	Min	Max	Min	Max	Min	Max	earliest	latest
12:08:03.2	12:08:03.7	0.3	1.3	0	1	0.3	2.3	12:08:03.5	12:08:06.0

FWC standard 12

TAOA>17.5°		FWC processing time		Time delay due to DFDAU sampling rate		Time delay for stall warning recording		DFDR time for stall warning recording	
earlier	latter	Min	Max	Min	Max	Min	Max	earliest	latest
12:08:03.2	12:08:03.7	0.3	1.4	0	1	0.3	2.4	12:08:03.5	12:08:06.1

The result of this calculation is that, taking into account the time the stall warning condition has been fulfilled on the DFDR and the processing time within the FWC and the DFDAU, the stall warning could have been recorded

between 12:08:03.5 and 12:08:06.0 for FWC standard 07

or

between 12:08:03.5 and 12:08:06.1 for FWC standard 12.

The stall warning was recorded on the DFDR at 12:08:05.2 which is included in both time intervals.

CVR Stall Warning recording ("Cricket sound"):
The time delay between the time when condition for stall warning activation is fulfilled on TAOA (TAOA>17.5°) and the time when stall warning ("cricket sound") is recorded on the CVR is due to the processing time on FWC, which depends on the standard the A/C is fitted with. This 'CRICKET' signal is transmitted directly to the amplifier which feeds the speaker. Time delays for the amplifier are negligible.

The following table gives the computation of minimum and maximum time delay as well as the associated earliest and latest time for stall warning recording.

FWC standard 07

TAOA>17.5°		FWC processing time		DFDR time for stall warning recording	
earlier	latter	Min	Max	earliest	latest
12:08:03.2	12:08:03.7	1.8	3.2	12:08:05.0	12:08:06.9

FWC standard 12

TAOA>17.5°		FWC processing time		DFDR time for stall warning recording	
earlier	latter	Min	Max	earliest	latest
12:08:03.2	12:08:03.7	1.7	2.7	12:08:04.9	12:08:06.4

The result of this calculation is that, taking into account the time the stall warning condition has been fulfilled and the processing time within the FWC, the CVR stall warning could have been recorded

between 12:08:05.0 and 12:08:06.9 for FWC standard 07

or

between 12:08:04.9 and 12:08:06.4 for FWC standard 12.

The stall warning that was recorded on the CVR at 12:08:05 is included in both time intervals.

Consequently the stall warning recording (CVR and FDR) is consistent with the AOA threshold limit of 17.5 degrees.

Comment n°10

Paragraph 2.17.2

In this paragraph it is stated that

"..., the pilot still recognized the upset condition and recovered from it."

Actually, there was no upset condition during the first missed approach. The achieved maximum pitch attitude was 24.1 degrees whilst the definition of an upset (see appendix 20 of the draft report) is 25 degrees. However this emphasises the fact that even during the first approach the crew were not paying enough attention to the required pitch attitude (which must not exceed 18°).

We therefore suggest to delete the last two sentences of paragraph 2.17.2: *"Also, the pilot still recognized the upset conditions and recovered from it. (The large swept-back wings aircraft with engines under the wings are likely to enter upset condition when initiating a go-around at low weight)".*

Comment n°11

Paragraph 2.17.4.

The engine response to the triggering of the go-levers was entirely as per design. Therefore we suggest replacing the phrase *".. The engine spun up rapidly""* by *" ..The engine power increased from 59% to 102% N1 in 8 seconds as per design."*

Furthermore, the pitch inputs of +4.56° for 2-3 seconds and +7.74° for 5-6 seconds are largely inadequate to control the pitch attitude during a go-around, particularly if there is no nose down crew action on the THS (see comment n°7 to paragraph 2.10).

We therefore suggest modifying the sentence *"However, the pitch attitude still increased to 40 degrees before decreasing to 37 degrees"* to read:

> *"These nose down pitch inputs were far less than the maximum available nose down pitch input of +15 degrees. Because of this and the fact that the crew did not apply nose down action on the THS, the pitch attitude continued to increase, leading to the stall condition. Subsequent nose up input instead of nose down input, led to the upset condition from which no recovery was possible."*

Comment n°12

Paragraph 2.17.4.2

The power increase from 59% to 102% N1 in 8 seconds corresponds to the certification requirement for engine spool up when the go levers are triggered. (FAR 25.119 Landing climb all engines operating.)

Therefore it is misleading to state that *".. the power of engine increases rapidly".* Furthermore, as already stated in our previous comments, it is not the pitch up tendency of the aircraft which led to the upset condition but an improper pitch control during the go-around and the subsequent nose up input after stall warning.

We therefore suggest deleting the first and the last two sentences of this paragraph and modifying the remainder of the paragraph as follows:

> *"According to the DFDR, when the co-pilot said "trigger go lever" during the go-around, the power of the engines increased from 59% to 102% N1 in 8 second which corresponds to certification criteria."*

Comment n°13

Paragraph 2.17.5

It cannot be stated that the pilots were unaware of the risks. Firstly because the changed runway lighting was published in NOTAMS, the analysis of which is a basic part of a flight preparation. Secondly because all large transport aircraft experience a pitch up tendency at application of go-around power and all pilots are trained to control this phenomenon.

Based on the elements given in our comment n°7 to paragraph 2.10 it is clear that large upset recovery techniques would not have prevented this accident. However proper pitch control during the go-around and proper response to stall warning would have prevented the accident.

We therefore suggest deleting this paragraph altogether, only keeping the sentence stating that the visibility was below the standard set by Thai Airways.

3. Comments on Chapter 3 and 4, "Conclusion" and "recommendations"

Comment n°14

Paragraph 3.1.4

The statement

> *"..However, the anti-stall protection system (alpha trim) of the pitch trim system may not have function properly"*

is not correct according to the analysis of the systems (see comment n°8 to paragraph 2.15).

The statement

> *"..the THS moved from –4.6 degrees to –0.7 degrees in 8 seconds and immediately returned to –4 degrees in 8 seconds which might be the result of changed condition"*

is not complete. The DFDR shows that the THS moved from –4.6° to –0.7° in 4.5 seconds and back to –4.6° with the same rate (see comment n°8 to paragraph 2.15).

The statement

> *"..The pitch trim should have tripped but according to DFDR, none of the information indicated that the pitch trim had tripped"*

is not correct. The FAC monitoring disengages the pitch trims when AOA is not valid only if slats are retracted which is not the case in the situation of the accident aircraft (see comment n°8 to paragraph 2.15).

We therefore propose to replace the present text of paragraph 3.1.4 with the following:

> *"From the information obtained from the DFDR and the CVR, the engines, the pitch trim system and the stall trim functions operated as per design."*

Comment n°15

Paragraph 3.1.5

The statement of this paragraph is not correct. The stall warning system functioned properly (see comment n°9 to paragraph 2.16).

We therefore suggest replacing the text of paragraph 3.1.5 with the following:

> *"From the information obtained from the DFDR and the CVR, the stall warning system operated as per design and the engines functioned normally."*

Comment n°16

Paragraph 3.1.8

Based on the analysis as reflected in our comment n°7 to paragraph 2.10, we suggest replacing the text of paragraph 3.1.8 with the following:

> *"Improper pitch control during the go-around followed by nose up input after stall warning led to the stall condition and a subsequent evolution into an upset condition."*

Comment n°17

Paragraph 3.1.9

Based on the analysis as reflected in our comment n°7 to paragraph 2.10 we suggest deleting paragraph 3.1.9.

Comment n°18

Paragraph 3.2.4

Based on the analysis as reflected in our comment n°7 to paragraph 2.10 we suggest deleting paragraph 3.2.4.

Comment n°19

Paragraph 3.2.7

Based on the analysis as reflected in our comments to paragraph 2.15, 2.16, 3.1.4 and 3.1.5, we suggest deleting paragraph 3.2.7.

Comment n°20

Paragraph 4.8

Based on the analysis as reflected in our comment n°7 to paragraph 2.10 we propose deleting recommendation 4.8.

Comment n°21

Paragraph 4.9

Based on the analysis in paragraph 2.7 which showed that portable electronic devices played no role in this accident, we propose to delete recommendation 4.9.

Glossary

AGL	Above Ground Level
AIP	Aeronautical Information Publication
AMM	Aircraft Maintenance Manual
AOA	Angle of Attack
CAA	Civil Aviation Authority
CRM	Crew Resource Management
CVR	Cockpit Voice Recorder
DFDR	Digital Flight Data Recorder
DME	Distance Measuring Equipment
DOA	Department of Aviation
DVOR/DME	Doppler Very High Frequency Omnidirectional Radio Range/Distance Measuring Equipment
FAA	Federal Aviation Administration
FAC	Flight Augmentation Computer
FAF	Final Approach Fix
FCOM	Flight Crew Operating Manual
FL	Flight Level
FOM	Flight Operation Manual
ICAO	International Civil Aviation Organization
IF	Intermediate Fix
ILS	Instrument Landing System
MAC	Mean Aerodynamic Chord
MAP	Missed Approach Point
MDA/H	Minimum Descent Altitude/Height
NDB	Non-Directional Radio Beacon
NO.	Number
NOTAM	Notice to Airmen
NTSB	National Transportation Safety Board
OB	Flight Route Facility Department
OB-R	Route & Aircraft Document Division
OCA/H	Obstacle Clearance Altitude/Height
OM	Outer Marker
OO	Flight Standard Department

OP	Operation Control and Planning Department
OW	Dispatch Service Department
PAPI	Precision Approach Fix
PAR	Precision Approach Radar
PED	Portable Electronics Device
PFT	Periodic Flight Training
RTAF	Royal Thai Air Force
THS	Trimmable Horizontal Stabilizer
VASI	Visual Approach Slope Indicator
VOL.	Volume