Beryl Claire Clarke (as personal representative of the Estate of the Late Eugene Francis Clarke) v Silkair (Singapore) Private Limited
[2001] SGHC 326

Case Number : Suit 1746/1999, 1748/1999, 1749/1999, 1750/1999, 1751/1999, 1752/1999

Decision Date : 24 October 2001

Tribunal/Court : High Court

Coram : Tan Lee Meng J

Counsel Name(s) : Michael Khoo SC, Josephine Low and Andy Chiok (Michael Khoo & Partners) for the plaintiffs; Lok Vi Ming, Ng Hwee Chong and Joanna Foong (Rodyk & Davidson) for the defendants

Parties : Beryl Claire Clarke (as personal representative of the Estate of the Late Eugene Francis Clarke) — Silkair (Singapore) Private Limited

Damages – Limitation – Limitation of carrier's liability – Crash of aircraft resulting in loss of lives – Recklessness of pilots – Wilful misconduct of pilots – Whether crash deliberate – Whether carrier can limit its liability for passengers' deaths – s 3 Carriage by Air Act (Cap 32A, 1989 Ed) – Warsaw Convention and Warsaw Convention as amended by the Hague Protocol arts 25

Words and Phrases – 'Wilful misconduct' – art 25 Warsaw Convention

Judgment

1. The present suits (Suit No 1746 of 1999, Suit No 1748 of 1999, Suit No 1749 of 1999, Suit No 1750 of 1999, Suit No 1751 of 1999 and Suit No 1752 of 1999), which were consolidated on 8 June 2001, involve claims by personal representatives and/or dependants of persons who perished in an air crash near Palembang, Sumatra, on 19 December 1997. The defendants, SilkAir (Singapore) Private Limited (hereinafter referred to as "SilkAir"), a regional carrier, operated the aircraft which crashed. SilkAir contended that it is entitled to limit its liability for the death of the passengers in accordance with the provisions of the Warsaw Convention and the Warsaw Convention, as amended at The Hague in 1955 (hereinafter referred to as the "amended Convention"). However, the plaintiffs claimed damages from SilkAir on the basis that the question of limitation of liability under the Warsaw Convention and the amended Convention does not arise in the circumstances of the case.

A. BACKGROUND

2. On the afternoon of Friday, 19 December 1997, SilkAirs Flight MI 185 took off from Jakartas Soekarno-Hatta International Airport at around 08:37:13 Co-ordinated Universal Time (hereinafter referred to as "UTC"), or 15:37:13 hours local time, on a scheduled flight to Singapore. The aircraft, a brand new Boeing 737-300, bearing registration number 9V TRF, had flown a little over 2,000 hours, all of which were in the service of SilkAir. It was commanded by Captain Tsu Way Ming and his co-pilot was First Officer Duncan Ward (hereinafter referred to as F/O Ward). There were 5 other crew members and 97 passengers on board the aircraft.

3. The weather over the intended route was generally fine, but partly overcast. After leaving Jakarta, the aircraft received clearance from Jakarta Air Traffic Control to climb to an altitude of 35,000 feet and to head directly to Palembang. At 09:10:26 UTC, F/O Ward acknowledged a call from the air traffic controller, who had given instructions for the cruising altitude to be maintained and for Singapore Air Traffic Control to be contacted at PARDI, a reporting point north of Palembang, where responsibility for air traffic control is transferred to Singapore. At 09:12:09 UTC, the radar readings indicated that the aircraft was still at its cruising altitude of around 35,000 feet. The next radar

return, some eight seconds later, revealed that the aircraft was 400 feet below its cruising altitude and a rapid descent followed. The last recorded radar data at 09:12:41 UTC showed that the aircraft was at an altitude of 19,500 feet. After that, for unknown reasons, the aircraft disappeared from the radar screen. Its empennage broke up in flight and it crashed into the Musi River delta, some 50 km away from Palembang. The crash occurred in daylight and good weather conditions. No distress call had been received from Captain Tsu or F/O Ward and no distress signal had been received from the aircrafts transponder. Furthermore, no emergency locator beacon transmissions were detected near the crash site. The pilots, the crew and all 97 passengers died in this tragic crash, the first in the history of SilkAir.

4. In line with international practice, an investigation was conducted in accordance with the standards and recommended practices of Annex 13 of the Chicago Convention by the Indonesian National Transport Safety Committee (hereinafter referred to as "NTSC"), formerly known as the Aircraft Accident Investigation Commission. Professor Oetarjo Diran, the NTSCs chairman, led the investigation team. Among its members were accredited representatives from the United States National Transport Safety Board (hereinafter referred to as "NTSB") and Singapores Ministry of Communications. The sole objective of this investigation was to prevent accidents and incidents and not to apportion blame or liability.

5. Intensive salvage operations were carried out but work was severely hampered as the wreckage of the aircraft, which was completely destroyed and fragmented on impact with the Musi River, had penetrated deep into the river bottom. Furthermore, visibility in the water was poor and there was a strong tidal current flow. Notwithstanding the adverse conditions, the cockpit voice recorder and the flight data recorder, often referred to as the "black boxes", and small parts of the aircraft were retrieved from the crash site. The parts which were recovered included a large portion of the wing structure, all actuators except for one of the Krueger flap actuators, the two aileron power control units, aileron tab rods, several pieces of aileron hinge fittings, the trailing edge flap transmissions and large fragments of the left hand and right hand landing gear beams. In addition, parts of the rudder skin and the outboard sections of the horizontal stabilizer were recovered on land, the furthest being about four kilometres from the site of the main impact.

6. The cockpit voice recorder (hereinafter referred to as the "CVR") and the flight data recorder (hereinafter referred to as the "FDR"), which record information about the flight, were sent to laboratories in Washington DC for analysis. In its first interim report dated 25 March 1999, the NTSC disclosed that the aircrafts CVR and FDR stopped recording several minutes before the crash.

7. In its second interim report, which was released on 25 August 1999, the NTSC revealed that the horizontal stabilizer of the aircraft, which was recovered from the crash site, had a nose-down trim which was different from the last known trim setting before the FDR stopped recording. This meant that there could have been a manual input from the cockpit which caused the aircraft to dive down very steeply. Although the NTSC stated that it had not established who was responsible for the input, there was speculation that the aircraft may have been deliberately crashed.

8. As a result of the NTSCs comments, Singapores accredited representative lodged a police report on 25 August 1999. In view of this, the Criminal Investigation Department (hereinafter referred to as "CID") formed a team to investigate whether or not there was any indication of possible suicidal intent on the part of the pilot, co-pilot or the crew. After an exhaustive investigation, the CID concluded that it found no evidence that the pilot, co-pilot or any crew member had suicidal tendencies or a motive to deliberately cause the crash of Flight MI 185.

9. On 14 December 2000, almost three years after the crash of Flight MI 185, the NTSC issued its

Final Report. In it, the NTSC pointed out that it had conducted a very extensive, exhaustive and complex investigation and added that it was an extremely difficult investigation due to the degree of destruction of the aircraft, the highly fragmented wreckage, the difficulties presented by the accident site and the lack of information from the flight recorders during the final moments of the flight. The NTSC concluded as follows:

> The NTSC accident investigation team members and participating organisations have done the investigation in a thorough manner and to the best of their conscience, knowledge and professional expertise, taking into consideration all available data and information recovered and gathered during the investigation.
>
> Given the limited data and information from the wreckage and flight recorders, the NTSC is unable to find the reasons for the departure of the aircraft from its cruising level of FL350 and the reasons for the stoppage of the flight recorders.
>
> *The NTSC has to conclude that the technical investigation has yielded no evidence to explain the cause of the accident.*
>
> (emphasis added)

10. The United States NTSB, which participated in the investigation as the accredited representative of the State of Design and Manufacture of the aircraft in question, disagreed with the conclusion of the NTSC. In a letter dated 11 December 2000 to Professor Diran, Mr Jim Hall, the acting chairman of the NTSB, stated as follows:

The examination of all of the factual evidence is consistent with the conclusions that 1) no airplane-related mechanical malfunctions or failures caused or contributed to the accident, and 2) the accident can be explained by intentional pilot action; specifically, a) the accident airplanes flight profile is consistent with sustained manual nose-down flight control inputs, b) the evidence suggests that the cockpit voice recorder was intentionally disconnected, c) recovery of the airplane was possible but not attempted, and d) it is more likely that the nose-down flight control inputs were made by the captain than by the first officer.

11. The NTSC, which noted that it is aware that others may draw different conclusions from the same set of facts, vigorously defended its position. The NTSBs comments and the NTSCs response to these comments were included in Appendix N of the NTSCs Final Report.

12. Apart from suing SilkAir, some of the personal representatives of those who died in the air crash commenced proceedings in the United States against Boeing, the manufacturers of the aircraft, and the companies which manufactured the engines, rudder and toilets for the aircraft. SilkAirs insurers, Singapore Aviation and General Insurance Company (hereinafter referred to as "SAGI") have also sued Boeing as well as a number of companies who manufactured components for the aircraft. SAGI contended that the crash of Flight MI 185 was caused by either a defective rudder control mechanism on the aircraft or a design defect in the head or galley area. In the American action, SAGI claimed damages with respect to the loss of the aircraft, the compensation paid to the families of those who perished in the crash and the expenses for recovering the wreckage.

B. THE WARSAW CONVENTION AND THE HAGUE PROTOCOL

13. Singapore and Indonesia are both High Contracting Parties to the Warsaw Convention while

Singapore is a High Contracting Party to the amended Convention as well. Both the Warsaw Convention and the amended Convention have the force of law in Singapore by virtue of section 3 of the Carriage by Air Act (Chapter 32A) in so far as they relate to, inter alia, the rights and liabilities of carriers and passengers. It is common ground that the amended Convention is applicable to passengers who purchased a round trip ticket from Singapore while the Warsaw Convention is applicable to passengers who purchased a single trip ticket from Jakarta to Singapore.

14. The main issue to be determined in this case is whether or not SilkAir is entitled to limit its liability for the crash in accordance with the provisions of the Warsaw Convention and the amended Convention. For this purpose, reference should be made to Article 17 of SilkAirs General Conditions of Carriage for Passengers and Baggage, which provides as follows:

> Carriage hereunder is subject to the rules and limitations relating to liability established by the Convention unless such carriage is not international carriage to which the Convention applies. In international carriage as defined by the Warsaw Convention the liability of the Carrier for each passenger is limited to the sum of 125,000 French gold francs or its equivalent (US equivalent approximately $10,000); and in international carriage as defined by the Warsaw Convention as amended at The Hague, 1955, the liability of the Carrier is limited to 250,000 French gold francs or its equivalent (US equivalent approximately $20,000).
>
> SilkAir (Singapore) Private Limited agree that for a carriage which is subject to the Warsaw Convention or the Warsaw Convention as amended at The Hague and performed on a SilkAir Services, not being a journey to from or having an agreed stopping place in the United States of America, the limit of liability for death or bodily injury to a passenger shall be increased to US$58,000 (or the appropriate currency equivalent) plus legal expenses or US$75,000 (or the appropriate currency equivalent) inclusive of legal expenses in those countries where legal expenses are recoverable additionally.

15. Under the Warsaw Convention and the amended Convention, a carrier is barred from limiting its liability under certain circumstances. As far as the amended Convention is concerned, Article 25 provides as follows:

> The limits of liability specified in Article 22 shall not apply if it is proved that the damage resulted from an act or omission of the carrier, his servants or agents, done with intent to cause damage or recklessly and with knowledge that damage would probably result; provided that, in the case of such act or omission of a servant or agent, it is also proved that he was acting within the scope of his employment.

16. As for the Warsaw Convention, it provides that the right of a carrier to limit its liability will be lost if the circumstances of the accident fall within the ambit of Article 25, which provides as follows:

> (1) The carrier shall not be entitled to avail himself of the provisions of this Convention which exclude or limit his liability, if the damage is caused by his wilful misconduct or by such default on his part as, in accordance with the law of the court seised of the case, is considered to be equivalent to wilful misconduct.
>
> (2) Similarly the carrier shall not be entitled to avail himself of the said provisions

if the damage is caused as aforesaid by any servant or agent of the carrier acting within the scope of his employment.

C. THE PLEADINGS

17. The main ground for the plaintiffs assertion that SilkAir is not entitled to limit its liability for the crash of Flight MI 185 in accordance with the provisions of the Warsaw Convention and the amended Convention is stated in para 12 of their amended Statement of Claim in the following terms:

> As the [NTSC] investigations have not found any indication that anyone else was in the cockpit other than the two pilots in the final minutes before the stoppage of the CVR, the plaintiffs aver that the irresistible inference is that the manual input from the cockpit setting the horizontal stabilizer of the said aircraft to a nose-down trim which caused the crash of SilkAir Flight MI 185, was the result of the wilful misconduct or default of either or both of the Defendants servants or agents having control of the aircraft, or was done by either or both with intent to cause damage or recklessly and with knowledge that damage would probably result.

18. In the alternative, the plaintiffs asserted that Captain Tsu caused the crash of Flight MI 185. In para 13 of their amended Statement of Claim, the plaintiffs asserted:

> Further or in the alternative the Plaintiffs aver that the irresistible inference to be drawn from the facts disclosed by *inter alia* the NTSC investigations and the Defendants to date, is that the sustained flight control inputs were made by Captain Tsu who had committed prior breaches of the proper safety procedures and/or of international safety standards that were in force at the material time and who had a history and record of failure to observe and/or to comply with proper safety procedures.

19. The plaintiffs also asserted that the crash was caused by the default of SilkAir in permitting Captain Tsu to take control of Flight MI 185.

20. Initially, the plaintiffs contended that the aircraft was unsafe and defective and that by operating the aircraft, SilkAir acted recklessly and with knowledge that damage would probably result. Furthermore, they took the position that SilkAir failed to maintain the aircraft to ensure its airworthiness. During the trial, the plaintiffs amended their statement of claim and deleted paragraph 17, which alleged that the aircraft was unsafe and defective, and paragraph 18, which alleged that SilkAir had failed to properly maintain the aircraft to ensure its airworthiness.

21. SilkAir denied that intentional or reckless pilot action caused the crash of Flight MI 185 and asserted that the NTSC rightly concluded in its Final Report that the cause of the crash could not be ascertained. SilkAir also took the position that the descent and crash of the aircraft may have been due to the following:

> (a) depressurisation or rapid depressurisation of the aircraft or a faulty indication of depressurisation; and/or
>
> (b) mechanical failure; and/or

(c) rudder failure; and/or

(d) some other undetermined cause.

22. Although the plaintiffs amended their statement of claim and withdrew the allegation that the aircraft was unsafe or defective, SilkAirs counsel, Mr Lok Vi Ming, noted that in a number of actions in the United States against Boeing and the manufacturers of parts of the aircraft, some of the plaintiffs in the present case asserted that Boeings breaches and negligence were the cause of the crash of Flight MI 185. Mr Lok said that this contradicts their contentions in the present proceedings that the irresistible inference is that the pilot intentionally crashed the plane. He added that the plaintiffs assertions in the Singapore and United States courts are diametrically opposed to each other and are irreconcilable.

D. EVIDENCE FROM THE CRASH SITE AND SIMULATION TESTS

23. To determine whether or not Flight MI 185 was intentionally crashed, the evidence from the crash site and the results of simulation tests will first be considered.

The NTSCs findings on the evidence from the crash site

The NTSCs findings on the evidence from the crash site were summarised in its Final Report as follows:

- There was no evidence found of in-flight fire or explosions.
- From flutter analysis and wreckage distribution study, the empennage break-up could have occurred in the range between 5,000 and 12,000 feet altitude.
- Examination of engine wreckage indicated that the conditions of the engines at impact were not inconsistent with high engine rotation speed. No indications were found of in-flight high energy uncontained engine failures. Therefore, the engines were considered to be not a factor contributing to the accident.
- Examination of the actuators of flight and ground spoilers, trailing and leading edge flaps, as well as engine thrust reversers indicate retracted or stowed positions of the respective systems.
- Examination of the main rudder power control unit (including the servo-valve), the yaw damper modulating piston, the rudder trim actuator, the rudder trim and feel centering unit, the standby rudder PCU, the aileron PCUs, the elevator PCUs, and the horizontal stabilizer jack-screw components, revealed no indications or evidence of pre-impact malfunctions.
- Examination of the 370 kg of recovered electrical wires, connectors and circuit boards showed no indication or evidence of corrosion, shorting, burning or arcing in these wires or parts.
- The CVR stopped recording at 09:05:15.6 and the FDR stopped recording at 09:11:33.7. The examination of the CVR and FDR showed no malfunction of the units. The stoppages could be attributed to a loss of power supply to the units. However, there were no indications or evidence found to conclude on the reason for the stoppages due to the loss of power. The cause of the CVR and FDR stoppages and the reason for the time difference between the stoppages could not be concluded.
- The inspection of the aircraft maintenance records did not reveal any defects or anomalies that could have affected the airworthiness of the aircraft or that may have been a factor contributing to the accident.
- The horizontal stabilizer trim was found to be in the 2.5 units position which matched the forward limit of the manual electrical trim.

The simulation tests

25. A number of simulation tests were conducted on the basis of the limited radar data that was available. The first and second tests were conducted on 23 January 1998 and 12 May 1998 at the Boeing M-Cab simulator facility in Seattle. The objective of these tests was "to explore and understand the various possible combination of one or more malfunctions of flight controls, aircraft systems and power plants that would result in the extreme descent flight trajectory as suggested by the radar plots".

26. A third simulation test was conducted by the NTSC at Garudas B737-300 simulator facility in Jakarta on 17 February 1999 and 6 March 1999. The NTSC also performed computer fly-out studies of Flight MI 185s descent trajectory with scenarios similar to those used at the simulation tests at the Boeing simulator facility in Seattle on 12 May 1998. Finally, a fourth simulation test was conducted on 13 July 1999 at the Boeing simulator facility in Seattle to review and reaffirm the results of the simulation tests already conducted.

27. The following extract from para 2.10 of the NTSCs Final Report explains the tests conducted and the results obtained:

> The last five [Air Traffic Control] radar points recorded represent the flight trajectory of the aircraft from the cruise altitude 35,000 feet to approximately 19,500 feet. Each point consisted of data relating to time, altitude and geographical coordinates.
>
> Simulator tests and computer simulation fly-out studies were done to determine failures or combination of failures of the flight control and autopilot systems that could result in the extreme descent trajectory. Aircraft flight data were not available for the time period after the stoppage of the FDR. The initial condition for these tests and studies was cruise configuration at 35,000 feet based on the last known FDR data. The altitude range for the simulations was from 35,000 feet to approximately 19,500 feet.
>
> The results of these simulation studies are summarized as follows:

- Any single failure of the primary flight controls such as hard-over or jamming of aileron, rudder or elevator did not result in a descent time history similar to that of the last ATC radar points. In simulations of these flight control failure conditions the aircraft could be recovered to normal flight manually.
- Any single failure of the secondary flight controls such as hard over or jamming of yaw damper, or runaway of the stabilizer trim would not result in a descent time history similar to that of the last ATC radar points. In simulations of these flight control failure conditions the aircraft could be recovered to normal flight manually.
- Manipulation of the primary flight controls without horizontal stabilizer trim would result in a descent time history similar to that of the last ATC radar points. But this required large control column input forces and the aircraft was subjected to a loading exceeding 2 G. However, if the control column input forces and the aircraft were relaxed, in the simulations the aircraft would recover from the steep descent due to its inherent stability.
- Among other possibilities, a combination of changing the stabilizer trim from about 4.5 to 2.5 units and an aileron input could result in a descent time history similar to that of the last ATC radar points. This simulated descent trajectory would result in the aircraft entering an accelerating spiral and being subjected to a loading of less than 2 G. Furthermore, the aircraft would continue in the spiral even when the control forces were relaxed.

Plaintiffs interpretation of the evidence

28. The plaintiffs asserted that there was ample evidence that Flight MI 185 was brought down as a result of intentional pilot inputs in the cockpit. In support of their assertion, the plaintiffs relied on, inter alia, the following:

> *(a) The projected flight trajectory of the final descent of the aircraft from its cruising altitude of 35,000 feet to 19,500 feet.*
>
> The plaintiffs pointed out that the speed of the aircrafts descent from its cruising altitude of 35,000 feet to 19,500 feet and the steep angle of the descent were alarming.
>
> *(b) The position of the jackscrew of the horizontal stabilizer and the fact that the engines were at full throttle.*
>
> The plaintiffs said that the fact that the horizontal stabilizer trim was found to be at 2.5 units meant that the aircraft had been programmed by the pilot or pilots to dive down in the steepest possible position. They also asserted that the fact that the engines were at full throttle indicated that no attempt had been made to recover the aircraft from its dive into the Musi River.
>
> *(c) The simulation studies based on the flight trajectory to determine what might have happened in the cockpit during the final moments of Flight MI 185.*
>
> The plaintiffs, who accepted that a change in the horizontal stabilizer trim from 4.5 units to 2.5 units alone would not cause the plane to plunge down as fast as it did from its cruising altitude of 35,000 feet to 19,500 feet, contended that the descent history of Flight MI 185 resulted from a change in the horizontal stabilizer trim to 2.5 units, an aileron input and/or a large control column input. They pointed out that the NTSB noted that on the basis of the engineering simulations, it is very likely that from the time the aircraft departed from cruise flight until the end of the recorded data, it was responding to sustained flight control inputs from the cockpit.
>
> *(d)*
>
> *The CVR and FDR were shut down before the crash*.
>
> The plaintiffs submitted that the CVR and FDR were deliberately shut down in order to conceal evidence of the alleged deliberate pilot inputs which caused the crash.

Plaintiffs expert witnesses agreed with the NTSB

29. The plaintiffs three expert witnesses agreed with the NTSBs conclusions on the cause of the crash of Flight MI 185. The first expert witness, Captain John Laming, an air crash consultant, an experienced pilot and a flight simulator instructor, conducted his own simulation tests to ascertain what might have caused the crash of the aircraft. He said as follows in his report:

> Study of the NTSC Accident Report, coupled with extensive personal experience in command of the 737 aircraft, leads me to the following conclusion:

> Only continually applied manual control forces by someone on the flight deck, accompanied by deliberate action to activate full forward electrical stabiliser trim control and full engine power, would force the aircraft into such a steep dive as that experienced by MI 185. With these actions held for a number of seconds and no attempt taken to recover, the aircraft would eventually reach the point of no return and break up.

30. When cross-examined, Captain Laming reiterated his position in the following terms:

> For what purpose I dont know. All Im saying there is quite straightforward. Someone pressed the stabilizer trim switch and held it for 7 seconds --- 8 seconds. You can cause your own conclusions on this. I cannot say for deliberate crashing of the plane or someone who was playing silly people. I dont know. Someone held the switch forward because it takes such a long time to get that switch forward.
> (V/N p 270)

31. The plaintiffs second expert witness, Captain Maurie Baston, a former chief flying instructor at the Royal Australian Air Force Central Flying School and a former aerobatic display pilot, agreed that the aircraft had been deliberately crashed. He stated as follows in his report:

> I agree that having regard to all the evidence and the facts as found during the investigation, that the probable cause of the crash was intentional pilot action. In my opinion, there is more than sufficient available technical evidence to support the view that the aircraft was literally driven to the ground.

32. When cross-examined, Captain Baston explained what he meant by "technical evidence" in the following terms:

> [T]here was no technical evidence to suggest that the aircraft had any major component damage prior to impact. There was considerable technical evidence, both factual and theoretical, to say that the aircraft followed a certain trajectory in a certain time; there was an average rate of descent over the first rough 15,000 feet or 30,000 feet a minute, which is 15 times the normal cruise descent rate; is 3 times the normal emergency descent rate, and to achieve those sort of descent rates which would have been increased a little later, you can only conclude with competency, not in doubt, that there had to be a deliberate action of some sort. It wasnt in my view, accidental.
> (V/N p 448)

33. The plaintiffs third expert witness, Mr Macarthur Job, an air safety consultant, concluded as follows in his report:

> In summary, the investigative findings strongly support the conclusions that no airplane-related mechanical malfunctions or failures caused or contributed to the accident, and the accident can be explained by intentional pilot action.

SilkAirs expert witnesses disagreed with the plaintiffs assertions

34. SilkAirs expert witnesses did not agree that Flight MI 185 crashed as a result of intentional pilot inputs in the cockpit. They thus agreed with the NTSC, which, when responding to the NTSBs assertion that the aircrafts flight profile is consistent with sustained nose-down manual flight control inputs, stated its position as follows:

> There is no evidence to conclude that there was manual intervention. After the stoppage of the FDR, which occurred before the airplane started its descent, there was no data available on the inputs made to flight control surfaces or engine thrust levers up to the point of impact.

35. Emeritus Professor Denis Howe of the College of Aeronautics of Cranfield University, an aviation consultant and a former Professor of Aircraft Design, said that the NTSC had rightly decided not to identify the cause of the crash of Flight MI 185 in spite of a thorough and detailed investigation. When questioned by Mr Lok, he explained:

> Well, Professor Diran and his team had examined all the evidence that they had available and they had come to the conclusion that they could not find convincing evidence to allocate any cause to the accident, and in this respect of course they were following the NTSB action in that infamous Colorado Springs event . There, the NTSB, although they felt they knew the answer being a wind sheer or a rotor problem on the aircraft and also had ruled out as a very remote possibility any difficulty with the controls of the aircraft, nevertheless just had this feeling that they did not have enough evidence to come to any conclusion. And we know they were right in that because subsequent events at Pittsburgh and afterwards actually showed that had they come to the conclusion that it was a rotor or wind sheer which they were inclined to do, they would have been wrong.
> (V/N p 1180)

36. SilkAirs other expert witness, Captain Robert Galan, a French aeronautical expert, a test pilot and an experienced aircraft accident investigator, also asserted that the evidence did not support a conclusion that the aircraft had been deliberately crashed. In his view, the final descent of Flight MI 185 was an emergency descent and not a deliberate descent for the purpose of crashing the aircraft. When cross-examined, he said as follows:

> I consider that the descent of the accident looks like an emergency descent . This behaviour is really coherent with an emergency descent but not coherent at all with something which is [a] voluntary descent.. [I]t is more likely that it is a bad emergency descent than a voluntary descent.
> (V/N p 1078)

37. When Mr Khoo SC pointed out that the question of an emergency descent did not arise because the aircraft was going down far too fast for such a descent, Captain Galan disagreed vehemently. He said as follows:

> . I am discussing about the beginning, because after that, something occurred, I dont know what, but the descent which was at the beginning, an emergency descent, became something completely wrong . But at the beginning, it looked exactly like an emergency descent.
> (V/N p 1124)

38. Captain Galan, who stressed that the pilot did not deliberately fly out of the flight envelope, summed up his position during cross-examination as follows:

Q. [W]hen you say that the aircraft was flown inadvertently out of the normal flight envelope, you are concluding that this was a proper descent?

A. No, no, no. I am saying that he went out of the normal envelope inadvertently because it started as an emergency descent. And after that, it went out of the envelope. *So he did not decide to crash*.

(V/N p 1107; emphasis added)

39. Professor Howe took the view that the NTSB concluded that the accident can be explained by intentional pilot action because it was influenced by what it believed to have been the flight trajectory of the aircrafts final descent from its cruising altitude of 35,000 feet, simulation studies based on the projected flight trajectory and the fact that the horizontal stabilizer trim was found at the crash site to have been at 2.5 units. His criticisms of all these assumptions will be considered below.

Whether the radar data relied on for charting the flight trajectory of the aircrafts final descent is accurate

40. To begin with, Professor Howe questioned the accuracy of the radar data, which was relied on for reconstructing the flight trajectory of the aircrafts final descent.

41. For the reconstructed flight trajectory of Flight MI 185s final descent to be relevant to an investigation on the cause of the crash, the radar data on which it was based must be correct. When cross-examined, Mr Job accepted that as there is no other data regarding the aircrafts final descent from its cruising altitude, the accuracy of the radar data is very important. (V/N pp 790-791) A similar view was expressed by Captain Baston. (V/N p 473)

42. Professor Howe said that it must be borne in mind that the flight trajectory of the final descent of Flight MI 185 was projected on the basis of radar data furnished by the Indonesian authorities, adjusted by Hughes-Raytheon, the manufacturers of the radar, and re-adjusted by Boeing and the NTSB. This was pointed out in paras 1.18.2.2 and 1.18.2.3 of the NTSCs Final Report, which stated as follows:

> The radar data and information recorded and displayed by the GUARDIAN system were sent to the United States in January 1998 for examination at Hughes Raytheon [Air Traffic Control] laboratory at Fullerton, California. Data from Soekarno-Hatta (Jakarta) and Palembang [Secondary Surveillance Radar] were selected for the examination as these two radars covered the flight path of MI 185 and provided information on date, time, altitude, x/y position, x/y velocity, ground speeds, range, azimuth and minimum visible altitude.
>
> The radar data and information retrieved from the GUARDIAN system was further examined and corrected, by Boeing as well as NTSB, focusing particularly on the last twelve radar returns. Based on this final radar data, the aircraft flight path and its ground track projection was reconstructed.

43. Professor Howe asserted that the corrected radar data and the reconstructed flight trajectory

of the aircraft during its final descent from its cruising altitude of 35,000 feet to an altitude of 19,500 feet were fundamentally flawed because if they were correct, the aircraft would have flown much faster than the speed of sound, a speed which was beyond the capabilities of a Boeing-737. In para 19 of his affidavit of evidence-in-chief, he explained as follows:

> The radar data given in the Final Report indicates a 32 second time elapse between departure from 35,000 feet cruise altitude and the last data at 19,500 feet altitude. This represents an average rate of descent of 36,600 feet/minute. The rate of descent during the first 8 seconds of this period is modest, achieving about 8,000 feet/minute at 34,600 feet. It is estimated that the final vertical speed would need to be about 1,200 feet/second to be consistent with the data. That is in excess of the speed of sound. This is a speed the aircraft would be unlikely to be able to reach.

44. When Professor Howe was cross-examined, he reiterated his misgivings about the accuracy of the corrected radar data when he said as follows:

> Q. [H]ave you any reason or any information which would suggest that the corrected data as presented in the NTSC Report is wrong?
>
> A. . The information that I have deduced that the corrected radar data is wrong, is because I believe it implies a flight path for the aircraft towards the end of its descent to 19,500 feet, which was unrealistic. It implies Mach numbers considerably in excess of a Mach number of 1, and every expert witness so far and Boeing, by their testimony on Figure 14 of the report, also suggest that the aircraft cannot go above Mach 1. So my deduction is that the radar data is incorrect.
>
> (V/N p 1274)

45. Captain Galan agreed with Professor Howe that a speed in excess of Mach 1 far exceeded the design capability of most commercial aircraft, including the B-737 in question.

46. Captain Baston testified that while the aircrafts speed may not have reached Mach 1, the speed of the wing airflow could have reached Mach 1. Professor Howe countered that this did not affect his assertion regarding the unachievable speed of the aircraft if the flight path of the aircrafts final descent is to be believed. He explained:

> The situation is that as the aircraft increases its Mach number from something in the case of Boeing 737, a Mach number of 0.8, the local airspeeds over parts of the aerofoil section, especially the upper surface of the wing, will increase above the overall Mach number of the aircraft as a whole, due to the curvature of the surface and the cross-sectional area of the wing. And therefore, there will be parts of the aircraft which will reach Mach numbers in excess of Mach 1, probably at speeds overall aircraft speeds of from about 0.89 onwards but certainly by 0.9 Mach number of 0.95. But here the question really is, what is the speed of the aircraft as a whole? In other words, the flight speed of the aircraft along its flight path, not the local airspeeds. So Captain Baston is quite right, there will be local areas on the aircraft which could be Mach 1 or higher, but overall I think he actually is saying that the aircraft itself would not exceed Mach 1.

(V/N pp 1331-1332)

47. When Mr Khoo SC pointed out that the corrected radar data had been accepted by the NTSC, Professor Howe stood his ground. He said as follows:

> Q. But we know that the investigation team accepted the final radar data as correct .
>
> A. They are relying upon it for their non-conclusion, yes. I would add that the radar information was supplied to them by NTSB, and one of the difficulties that Professor Diran had, was his own lack of resources in his own country and he has necessity to rely upon evidence from elsewhere. And his final recommendation is almost a cry from the heart, that he felt very exposed that having to rely upon this data, and he recommended that there should be an Asian air investigation organised and established so that in Asia, you could become independent .
>
> Q. You see, Professor Howe, on the assumption that the corrected data is correct
>
> A. Which I will not accept.
>
> (V/N p 1275)

Reliability of the corrected radar data is an issue in the United States proceedings

48. It is worth noting that the reliability of the corrected radar data is an issue in proceedings in the United States against, inter alia, Boeing, with respect to the crash of Flight MI 185. In those proceedings, the American counsel for some of the plaintiffs in the present case went so far as to insinuate that everyone who corrected the radar data "eyeballed it so that it could work out right", an accusation which was of course denied. The following extract from Boeings Mr Martin Inghams deposition provides a rather clear picture of the position:

> Q. Well, basically what you did was you took the raw data , decided that that has to be in error because of some other things that you looked at, --
>
> A. Right.
>
> Q. [A]nd you just moved it *so that it would work out right from your point of view in terms of the track of the airplane.*
>
> A. The process that moved this was deemed satisfactory to all the members who reviewed this, not just Boeing, but the NTSB as well as Raytheon, so it was an accepted correction by all the parties.
>
> Q. Without the pejorative connotation of the term eyeballing, what you did was you found a data point that you didnt like and you moved it to where you thought it should be?
>
> A. We found data points that were not correct and we corrected them.

49. Boeings representative, Mr Ingham, agreed that the correction of one of the radar points

resulted in it being moved some two and a half miles from its uncorrected point because, in his own words, "the azimuth data that was used to produce the original data for that particular point was in error." This change resulted in a different flight trajectory. When cross-examined, Captain Baston said:

> Q. [B]ecause its already displaced, the starting point is displaced by two and a half nautical miles, there will be a different set of trajectory.
>
> A. Yes.
>
> (V/N p 471)

50. It is not surprising that SilkAirs counsel, Mr Lok, pointed out that it is ironical that while the plaintiffs relied on the corrected radar data in the present proceedings, they were challenging the reliability of the said data in their actions in the United States.

Projected descent below 19,500 feet was also criticised

51. Apart from criticising the corrected radar data, Professor Howe was also wary of the projected descent of the aircraft from an altitude of 19,500 feet to ground level. When cross-examined about the projected descent of the aircraft to the point of impact, he explained why he had reservations about it when he said as follows:

> Q. And what about right to the descent of the aircraft at impact?
>
> A. The data doesnt go beyond that because the last radar point was at 19,500 [feet] and anything that goes beyond that point down is pure assumption because we had no eye witnesses as far as I know with a watch in their hand measuring the time of impact.
>
> (V/N p 1305)

52. Captain Galan also had reservations about the projected descent of the aircraft from an altitude of 19,500 feet to ground level. When cross-examined, he said as follows:

> Q. [L]ets assume there was no radar data at all. Dont you think you can tell what the rate of descent was?
>
> A. If we dont know the exact time of the crash. We cant. No.
>
> (V/N p 1133)

The irrelevant evidence regarding the uncorrected radar data

53. At this juncture, it ought to be noted that Professor Howes evidence that the corrected radar data relied upon in the NTSCs Final Report differed from the uncorrected radar data in a document furnished to him by someone from Singapore Airlines cannot be taken into account because the authenticity of the said document was not established. The exclusion of this portion of his evidence does not affect the veracity of his assertion that the corrected radar data is flawed. When Mr Khoo

SC suggested that his assertion that the corrected radar data is inaccurate rested on an unknown source of radar data, Professor Howe replied as follows:

> No, no, no, based on the implications of that data in terms of what it means in Mach number of the aircraft at the end but nothing to do with unknown source. Completely ignore that. On the data as presented, it gives to me an unrealistic flight path requiring the aircraft to achieve Mach numbers which are outside anything that any of the witnesses said can be achieved.
> (V/N p 1302)

54. When subsequently questioned by Mr Lok, Professor Howe reiterated that his conclusions on the inaccuracy of the corrected radar data remain valid even if the document containing the uncorrected radar data is totally disregarded. He said as follows:

> Q. And .. the problem you have [with respect to the data] irrespective of, that means independent of, the set of initial radar data that you were given by somebody from [Singapore Airlines]?
>
> A. Yes, its nothing to do with that.
>
> (V/N p 1321)

Extent of the applicability of the simulation tests

55. Apart from doubting the accuracy of the corrected radar data, Professor Howe also questioned the extent to which simulation test results may be applied to a case such as this, where the aircraft had already flown beyond its flight envelope or limits. The NTSC was fully aware of this. In its response to the NTSBs comments on its draft Final Report, the NTSC stated that it "recognised that simulation tests cannot fully replicate actual flight conditions especially flight conditions beyond the normal flight envelope".

56. Professor Howe said that simulation studies are only useful when investigating situations occurring within the normal flight envelope. In para 14 of his affidavit of evidence-in-chief, he said as follows:

> The Final Report [of the NTSC] does suggest (paragraph 2.10) that the combination of maximum nose-down trim setting of the actuator and aileron can result in the aircraft entering an uncontrolled spiral. There is however no evidence that this occurred. This postulation is based on simulation studies conducted by the NTSC, NTSB and Boeing. In my opinion, simulation studies are only useful tools when investigating situations occurring within the normal flight envelope. If an aircraft goes beyond the test clearance flight envelope, as the radar readings in this case clearly indicate, any simulation study is based on pure extrapolation beyond a certain point. It is inappropriate to place any reliance on such studies as proof in these cases.

57. When questioned by Mr Lok, Professor Howe elucidated his view in the following terms:

> . Clearly, what I am saying is that very early on, possibly soon after 31,900 feet, down here somewhere, the aircraft went right outside the extrapolated data

> even which, in fact, is the validated area for the simulator. [T]herefore any attempt to match these radar points to simulator studies is not tenable because the radar points actually show the aircraft going a long way outside anything that any simulator has been validated for. And so conclusions made that the flight which is being proposed by NTSB, for example, and I believe also followed by the plaintiffs that the simulator studies can actually confirm what happened to the aeroplane, I believe, is erroneous.
>
> (V/N p 1206)

58. Captain Baston accepted that the aircraft went outside its flight envelope shortly after it commenced its descent from its cruising altitude of 35,000 feet. When questioned by Mr Khoo SC, he said as follows:

> Q. In this case, where would the aircraft have exceeded the test flight clearance envelope? .
>
> A. Just above 30,000 feet.
>
> Q. . And thereafter, the aircraft would have entered into an unknown area?
>
> A. Yes.
>
> Q. Not tested at all by either the manufacturer or anybody else?
>
> A. Correct.
>
> (V/N p 885)

The horizontal stabilizer

59. Apart from questioning the veracity of the projected flight path of the aircrafts final descent and the applicability of the simulation tests, Professor Howe also thought that the plaintiffs case did not rest on solid ground because it depended to a great extent on the fact that the horizontal stabilizer trim was found to be at 2.5 units when it was recovered from the wreckage. As has been mentioned, this matched the forward limit of a pilots ability to operate the main electrical trim to put the aircraft in the steepest possible nose-down position.

60. Although the NTSC asserted that there was no evidence that pilot input was responsible for the final position of the horizontal stabilizer trim, the plaintiffs insisted that the fact that it was found to be at 2.5 units must be taken into account when determining whether or not that the aircraft was intentionally crashed. Professor Howe, who declared that the "pivotal aspect" upon which the dissenting NTSB report relied on is that the setting of the horizontal stabilizer trim actuator was found to be in the maximum cruise nose-down trim position, was not convinced that this was the final setting by the pilots. In paras 11-12 of his affidavit of evidence-in-chief, he stated:

> 11. It should firstly be pointed out that examination of photographs of the recovered wreckage indicates that the setting of the nut on the ball screw may actually be at some position between the normal cruise and maximum cruise nose-down trim position ..

(c) On the basis of the location of fracture, a calculation of approximately 3.05 units trim setting is obtained.

This, if correct, does indicate that the stabilizer was not at the maximum nose-down trim.

12. Further, even if the NTSC is correct to say that the ball screw actuator was at the maximum cruise nose-down setting at the time of the recovery of the wreckage, there is no evidence that it was at this setting position at the time of the initial descent of the aircraft from its controlled cruising flight. In fact, the simulation study of the Cranfield Impact Centre has shown that should the ball screw/nut unit be severed from the drive unit at its lower end and the stabilizer arm at its upper end, the nut can rotate on the screw even under substantial friction conditions. Such a severance of the ball screw/nut assembly could well have occurred at the time when the horizontal stabilizer disintegrated and parts separated from the rest of the airframe.

61. When cross-examined, Professor Howe explained his position in the following terms:

> [O]ne of the few things we do know in this accident is that certain parts of the horizontal stabilizer failed due to flutter. A flutter failure is a very, very violent failure indeed. The Boeing estimation was that there were 22 oscillations per second .The only issue is when it occurred. And my proposal is it actually occurred at some time during the descent of the aircraft, at the time in fact the horizontal stabilizer fluttered and failed. Looking at the nature of the wreckage from wreckage photographs, also indicates that there may have been some damage to the ball screw actuator subsequent to that failure indicating that at impact, there may have been further damage which may not have occurred had it been attached to the impact point. So my contention is that there could well have been a failure of the attachment of the ball screw actuator to the front of the horizontal stabilizer in the fuselage, and that this failure having occurred, the ball screw itself could then rotate because it was no longer constrained, and turn through a number of turns in a relatively short period.
> (V/N pp 1189-1191)

62. Mr Lok pointed out that while Professor Howes view is based on the results of the tests undertaken by the Cranfield Impact Centre, the plaintiffs expert witnesses had not carried out any independent experiment to verify the final setting of the horizontal stabilizer trim before the separation of the actuator from the rest of the airframe. As such, they were in no position to challenge Professor Howes view. In fact, Captain Laming conceded that it was possible that the horizontal stabilizer trim may not have been finally set at 2.5 units. (V/N p 329) However, he added that whether or not the horizontal stabilizer trim was at 2.5 units or 3.05 units was not fundamental to his conclusions. When questioned by Mr Khoo SC, he explained as follows:

> Q. Would it have mattered to your conclusion whether the forward trim was at 3.05 or 2.5 units in respect of the descent rate of descent, angle of dive?
>
> A. No, very little difference.
>
> Q. And could you explain to his Honour why? .

> A. Because once the stabiliser trim is moved out of its normal cruise position for several seconds, each second becomes more critical. So we are talking, I think, 10 seconds from 4.5 to 2.5 and 7 seconds from 4.5 to 3.05. That is still a most unusually long completed application of the trim. It will still cause a very steep dive; a most unusual application.
>
> (V/N p 387)

63. Professor Howe, who was not prepared to concede that the horizontal stabilizer trim was finally set at 3.05 units when the aircraft started to descend, said that it could have been set at a higher number. When questioned by Mr Lok, he said as follows:

> Q. [B]ased on this study, you feel that at the point of impact, it would have been 3.05 [units]?
>
> A. That is correct.
>
> Q. But that reading of 3.05 may not necessarily be the final setting of the horizontal stabilizer at the point of the descent of the plane?
>
> A. At the point the aircraft started to descend, no. I would agree that it was not necessarily set at 3.05.
>
> Q. And that is your evidence before this court?
>
> A. Yes.
>
> (V/N p 1208)

64. Taking all circumstances into account, Professor Howes evidence on the final setting of the horizontal stabilizer trim gives much food for thought.

Whether the pilots attempted to recover the aircraft

65. The plaintiffs assertion that the pilots did not attempt to recover the aircraft from its dive into the Musi River will next be considered. The plaintiffs relied on the following comments of the NTSB on the NTSCs draft Final Report to support their assertion:

> Regardless of the reason for the airplanes departure from cruise flight, it could have been easily recovered using conventional techniques that both pilots had received training for and that were within the capabilities of both pilots. Further, there was ample time for the pilots to take such corrective action to return the airplane to a straight and level attitude and flight. It is apparent that, had the pilot attempted to recover by initiating immediate corrective action using standard flight control inputs and techniques, the airplane would have recovered to a straight and level altitude with a minimum loss of altitude.

66. SilkAirs counsel, Mr Lok, contended that it could not be assumed that the pilots did not try to recover the aircraft. After all, the NTSC had noted as follows in its comments on the NTSBs views:

> There was no evidence that the recovery of the airplane was not attempted. The fact that during impact the engine was in high power and that the undercarriage was retracted do not preclude the possibility of pilot attempts to recover from the steep dive by using flight controls and varying engine thrust.

67. Mr Lok accepted that the textbook procedure for effecting an emergency descent in the face of rapid cabin depressurisation is to simultaneously retard the thrust levers, deploy the speed brakes and initiate the descent of the aircraft. However, he added that a pilot who is executing an emergency descent may, depending on the circumstances of the case, find it necessary to increase the engine thrust. His argument was supported by Captain Galan, who said that a failure to accelerate may, in some cases, result in a bad descent. He explained the position as follows:

> You could have two different sorts of descent which [are] no good. The very bad descent is a descent in which you dont accelerate. You descend but in keeping your actual speed. In this case, this descent will be a bad one because you need a long time to descend to 10,000 feet which is around the good altitude to end in emergency descent. You take a long time, you need maybe something like two, three minutes, which is too long because in the certification pattern, we have a minimum time to follow. So pilots are trained not to use this way, this pattern. There is another bad descent which is to try to descend too much, too quick and to accelerate before reducing the engine.
> (V/N pp 1029-1030)

68. Professor Howe agreed that it could not be assumed that the pilots did not try to recover the aircraft from its dive. When cross-examined, he said as follows:

> Q. Leaving aside the radar results, we find at the bottom of the river, a throttle box - . Full thrust forward . Nose speed brakes, engines in high rotation. Is that consistent with an attempt to recover?
>
> A. I cannot answer that question. I would say you were right in suggesting it may not be. But then, I do not know what the final flight path of the aircraft was at the time when final control of the aircraft was lost. The pilot may have been attempting to recover from a dive, in which case he may have wanted to lift the nose of the aircraft up. He certainly might, what not, speed brakes. I cannot answer that question but I dont believe we have enough scenario information at all.
>
> (V/N p 1283)

69. Professor Howe added that having an increased engine thrust could retard the dive of a plane. When questioned by Mr Lok, he said as follows:

> Q. And in your understanding, a throttle in high thrust, could that be used --- could that be evidence of a possible application by the pilot to recover the plane?
>
> A. Yes, because it will give a nose-up pitch and it will tend to give him a more horizontal flight path.
>
> (V/N p 1322)

70. Captain Laming accepted that having the engines on high thrust could retard the dive of an aircraft. When cross-examined, he said as follows:

> Q. Would it be correct that if the thrust is increased to the engines, that the increased thrust would provide an additional lift to the plane?
>
> A. That is true.
>
> Q. . [T]herefore the fact that the engines are put at high thrust, could it have the effect of retarding the dive of the plane?
>
> A. That could be.
>
> Q. . [It] is therefore not necessary in fact for the engines to be at high thrust for your theory?
>
> A. If you had the engines off I think the dive will probably be steeper.
>
> (V/N p 363)

71. Mr Lok submitted that as an increased thrust provides additional lift to an aircraft and could be an indication of recovery action by the pilots, the only inference that can be drawn from the evidence with respect to the throttle box is that if the pilots had applied forward thrust, they must have intended to recover the aircraft from its dive and not to destroy it. What may be said with confidence is that the fact that the engines were at high power before the crash does not, without more, assist the plaintiffs in establishing that the aircraft was deliberately crashed.

72. It should also be borne in mind that recovery of an aircraft becomes more difficult once it has left its normal flight envelope. Captain Galan made it clear that the ability to control the aircraft in question during its final descent must be viewed in the context of an aircraft that had inadvertently left its flight envelope.

73. Mr Job accepted that it is more difficult to recover an aircraft once it has left its flight envelope. When questioned by Mr Khoo SC, he said as follows:

> Q. Assuming a pilot who did that input, nose down trim, elevator is down, had wanted to make a recovery at say, 18,000 or 15,000 feet, at 15,000 feet, could he have made a recovery?
>
> A. This is entering into the area of very high Mach numbers and the behaviour of an aircraft is unpredictable in that area. Im not qualified to say what degree of recovery could have been achieved in that area. But it would have been difficult.
>
> (V/N p 813)

74. When questioned further by Mr Khoo SC, Mr Job accepted that it is possible that there was an attempted recovery of the aircraft from its dive but this failed because the aircraft went beyond the point of recoverability. (V/N p 863)

75. The question of recovering an aircraft which has left its flight envelope was also noted by the NTSC, which recommended that flight crew be trained in "recovery from high speed flight upsets

beyond the normal flight envelope to enhance pilot awareness on the possibility of unexpected hazardous flight situations". The NTSB objected to this recommendation as it implied that the NTSC had concluded that the accident may have been caused by an unexpected unusual flight upset and that the flight crew had not been properly trained to handle the aircraft in such a situation. The NTSC responded to the NTSBs objection in the following terms:

> The evidence showed that the airplane had exceeded its flight envelope during its high-speed transonic descent. This recommendation is to generate crew awareness of the narrow margin between the normal high-speed flight regime and the limits of the flight envelope, and the hazards of exceeding the normal flight envelope.

Whether the CVR and FDR were intentionally disconnected

76. No discussion of whether or not the aircraft was intentionally crashed will be complete without a consideration of the plaintiffs allegation that the CVR and FDR were deliberately disabled to hide the sinister intention of the errant pilot or pilots to down the aircraft. In their view, someone in the cockpit intentionally tampered with the circuit breakers of the equipment.

77. The NTSC stated that an examination of the CVR and the FDR revealed no malfunction of the units. As far as the CVR is concerned, its manufacturers, Allied Signals, reported that the loss of power was most likely not due to the pulling of the circuit breaker as there was no audio indication of such an act. A subsequent test revealed that the ambient noise of an aircraft in the air could obscure any sound resulting from the pulling of the circuit breaker. The result of this test does not establish whether or not the circuit breaker had been pulled out. As such, there is no evidence that the circuit breaker had been pulled out by someone in the cockpit.

78. The NTSC pointed out that the stoppage of the CVR and FDR could be attributed to a loss of power supply to the units but noted that there was no evidence to explain this. It added that a break in the wire supplying power to the CVR could also have led to its stoppage but as only a limited amount of electrical wires was found, it could not be determined if this had caused the equipment to stop running. In view of the uncertainties, the NTSC concluded that the cause of the stoppage of the CVR and the FDR could not be conclusively determined and that there was no evidence to explain the time difference of six minutes between the stoppage of the CVR and FDR.

79. Professor Howe agreed that there was no evidence to support the plaintiffs assertion that the CVR and FDR had been intentionally disconnected. In para 8 of his affidavit of evidence-in-chief, he stated as follows:

> The Final Report [of the NTSC] indicates that the stoppage of the CVR was not due to a short circuit or overload. The Report accepts that both the CVR and the FDR may have stopped as a result of a loss of power supply. (In the case of the FDR, the possibility that the unit malfunctioned was also not ruled out.) While the NTSB has strongly suggested that the loss of power was due to manual interference, there is no real evidence to support this suggestion. The fact that the stoppages were not simultaneous has not been explained but it is not unreasonable to imply the possibility that a progressive power supply failure occurred.

80. SilkAirs counsel, Mr Lok, submitted that the fact that the aircrafts transponders failed to work

after the aircraft went below 19,500 feet indicated that a likely cause of the stoppage of the CVR and FDR was progressive electrical failure. For the aircraft to be tracked, its transponders had to send a signal to the radar station. As has been mentioned, the aircraft was last tracked on the radar screen when it was at an altitude of 19,500 feet. As it was projected that the aircraft broke up while it was between an altitude of 5,000 to 12,000 feet, it should have been tracked on the radar screen a number of times before it broke up. The radar equipment on the ground was not faulty and other aircraft in the vicinity were tracked at the material time.

81. Mr Lok pointed out that the possibility that the aircrafts transponders had no electrical power after the last recorded radar sweep at 19,500 feet was conceded by Boeings Mr Ingham in proceedings in the United States. The following excerpts from his answers to questions posed by some of the plaintiffs American counsel during those proceedings may be borne in mind for the sole purpose of noting that the possibility of a loss of electrical power was considered:

> Q. So one of the scenarios that could explain the absence of a radar reply in the period subsequent to the time the aircraft was at 19,500 feet would be the loss of electrical power to the transponder, correct?
>
> A. Thats a possibility.
>
> Q. You talked about speculating why the radar didnt pick up the aircraft between 19,500 feet, and one of the scenarios could have been a loss of electrical power. Did you have any other scenarios that you speculated could have caused this anomaly?
>
> A. Nothing that came to mind other than loss of electrical power.

82. Captain Laming disagreed that the failure of the transponders was due to progressive electrical failure but conceded that this was a possibility. When cross-examined, he said as follows:

> Q. Would [your opinion that there was no electrical failure] be changed by knowing now that the transponder stopped sending messages eight seconds after the last radar sweep at 19,500 feet?
>
> A. I wouldnt be surprised if [the transponder] did stop transponding. As I said, I think you are in an area which no person has ever flown before, so who knows what occurring inside the cockpit, inside the boxes where the electrical equipment is. It is an area we never tested. I think we are in an area of complete unknown but I think to speculate that it is a progressive electrical failure, I dont agree. Thats only an opinion.
>
> Q. Would you agree that there would be a possibility of that?
>
> A. As I said before, Sir, there was a possibility; anything is possible.
>
> (V/N pp 359-360)

83. Captain Galan, who doubted that the black boxes had been disabled for the purpose of concealing evidence, opined that if a pilot wanted to conceal any evidence of his alleged misdeed, he would have crashed the aircraft into the open sea as that would have concealed more evidence of his intention than a crash in Sumatra. Whether or not he is correct need not be considered. All that

needs to be said is that it was not established that the CVR and FDR had been deliberately disabled. In fact, as far as the FDR is concerned, even Mr Job, the plaintiffs expert witness, conceded that there was no evidence as to why it stopped recording. (V/N p 838)

Other possible causes of the crash

84. While arguing that there is no basis for a finding that Flight MI 185 was intentionally crashed by pilot inputs in the cockpit, Professor Howe pointed out that there could be other possible causes of the disaster, namely mechanical or electrical failure and rapid depressurisation.

85. When considering whether or not mechanical failure could be a cause of the crash, the NTSB suggested that the NTSCs Final Report state that "there was no evidence of a mechanical malfunction or failure of any flight control PCU or actuator that either caused or contributed to Flight MI 185s departure from cruise flight or the resulting accident". However, the NTSC, which declined to rule out mechanical failure as a possible cause of the crash, explained its position as follows:

> The evidence available does not rule out that there were no airplane-related mechanical malfunctions or failures as only 73% of the wreckage was recovered, most of which was highly fragmented. It is for this reason that NTSC has not made any conclusions on this. NTSC has taken the consistent position throughout the final report that conclusions must be backed by evidence.

86. The NTSCs refusal to rule out mechanical malfunction as a possible cause of the crash was endorsed by Professor Howe, who thought that mechanical failure included the possibility of electrical failure.

87. SilkAir maintained that the possibility of rudder failure should not be excluded. Mr Lok pointed out that in proceedings in the United States against Boeing and manufacturers of parts of the aircraft, the plaintiffs had alleged that the crash had been caused by, inter alia, the main power control unit of the aircraft rudder.

88. As far as the question of rudder problems is concerned, the NTSC stated its position in the following terms:

In view of the FAA 737 Flight Controls Engineering Test and Evaluation Board Report and the FAA AD --- which recommends that ---, the NTSC is of the view that this section should not contain a conclusion statement on whether the rudder PCU was or was not a cause or contributing factor in the accident.

89. Professor Howe did not discount the possibility of rudder problems being a cause of the crash of Flight MI 185. He stated in para 9 of his affidavit of evidence-in-chief as follows:

> [Mechanical failure] is certainly a possibility that has not been disproved.
>
> The Final Report [of the NTSC] itself makes reference to issues raised with respect to rudder problems of B-737s in the aircraft accidents in Colorado Springs, Pittsburgh and Bournemouth. The Final Report indicates that thermal shock leading to rudder reversal arising from warm hydraulic fluid was unlikely in temperatures created during real flight; and that corrosion to the electrical and electronic compartment leading to uncommanded rudder movement was unlikely

> based on inspection of a sister SilkAir B-737. It has to be accepted that no positive evidence is present to prove rudder failure. Equally however, there is no evidence that conclusively excludes this possibility.

90. Mr Khoo SC pointed out that if any rudder failure similar to that which occurred in the Boeing 737 air crashes at Pittsburgh and Colorado Springs had been faced by the pilots of Flight MI 185, the aircraft was at a sufficiently high altitude for it to be steadied and recovered. However, Professor Howe said that the crash of Flight MI 185 might have been due to another type of rudder problem altogether. When cross-examined, he said as follows:

> Im just reserving the position that there might have been some other rudder failure which is not yet been revealed and may, hopefully never be revealed because maybe it wasnt there, but we might have the sad situation where in the future another 737-300 disappears from cruise conditions under mysterious circumstances and maybe investigations would reveal, as it did at Pittsburg, that there was a problem.
> (V/N p 1254)

91. As for the other suggested possible cause of the crash, namely rapid depressurisation, Professor Howe conceded that it was very unlikely that there was a complete cabin depressurisation. However, he added that a false warning of cabin depressurisation could not be ruled out. This was endorsed by Captain Galan, who testified that of the range of possible causes of the crash, this cause would be most likely while the pilots suicide would lie at the opposite end of the range.

92. The possibility of an emergency descent as a result of rapid cabin depressurisation was considered by the NTSC. It noted that the last pilot radio transmission about two and a half minutes before the final descent of the aircraft was normal and there was no mention of any in-flight fire or smoke. Furthermore, the wreckage revealed no evidence of in-flight fire or explosion and it was ascertained that the recovered oxygen generators had not been activated. Based on these findings, the NTSC concluded that there was no indication of an emergency descent due to fire, smoke or rapid depressurisation. Both Professor Howe and Captain Galan pointed out that not all the oxygen generators were recovered. Professor Howe said that it was possible that there was no time or reason for those generators which were found to be activated. As such, he stressed that it was wrong to rule out depressurisation or a false alarm of depressurisation as a reason for the emergency descent which finally caused the aircraft to crash.

93. The evidence adduced does not justify a conclusion that mechanical failure or rapid depressurisation caused the crash of Flight MI 185. All the same, the discussion of other possible causes of the crash of the aircraft was useful, if only because it showed how difficult it is to discharge the onus of proving the cause of the crash.

E. HUMAN FACTORS AND SUICIDE

94. The human factors relevant to the crash of Flight MI 185 will next be considered. That an investigation into the cause of the crash of Flight MI 185 must take into account human factors with respect to the persons piloting the aircraft is evident. When cross-examined, the plaintiffs expert witness, Mr Job, said as follows:

> Q. Mr Job, would you agree that in any investigation of air crashes that the human factor element would be an important part of that investigation?

A. Certainly.

(V/N p 737)

95. Captain Galan, who agreed that human factors must be looked at when investigating the cause of the crash, explained:

> I [have been] working [on] human factors [for] a long time, and we learn from the human factors that an accident does not start at the exact time where the first technical or visible operation is done. An accident starts a long time before [that] very often. And we have to consider the behaviour of the crew before as facts [to be considered as] evidence. So the accident for me does not start when somebody pull[s], push[es] on the stick or something like that but a [long] time before. [S]o human factors explain that the accident is not confined in this case [to] something like two minutes.
> (V/N pp 1072-1073)

96. In the present case, the human factors relevant to whether or not the pilots had any intention to kill themselves and all other persons on board the aircraft merit particular attention even though Mr Khoo SC reiterated on numerous occasions that the plaintiffs did not allege that either pilot wanted to commit suicide. He said that the motive for the intentional inputs to crash the aircraft was irrelevant. However, an assertion that there was intentional tampering with the controls of an aircraft to cause it to crash, if proven, leads to the conclusion that Captain Tsu and/or F/O Ward intended not only to crash the aircraft but also to commit suicide and kill 97 passengers and all the other crew members. When questioned by Mr Khoo SC, Captain Galan rightly said as follows:

> Q. Captain Galan, the fact remains, does it not, that the question of suicide must be separated from the manoeuvre itself?
>
> A. . Im sorry. For me, somebody who pushed the plane down to the ground is [committing] suicide.
>
> (V/N p 1129)

97. The plaintiffs expert witnesses conceded that a person responsible for inputs such as those allegedly made in the cockpit of Flight MI 185 would know that he was going to kill himself. In reply to my questions, Captain Laming said as follows:

> Ct. What is the inevitable consequence of someone in the cockpit continually pressing the button for eight seconds?
>
> A. If he presses the button by himself and does nothing in terms of the main control column, the aircraft will go into a dive. It probably would not recover.
>
> Ct. Would a Boeing 737 pilot know that what he was doing would lead to a point where extreme aerodynamic forces would prevent recovery?
>
> A. Most certainly.
>
> *Ct. In other words, he would know that if he pressed [the button] and did nothing else, he was going to kill himself.*

A. Yes.

(V/N pp 296-298; emphasis added)

98. Despite strenuous efforts to distance himself from the allegation of suicide, Mr Job finally conceded that the plaintiffs were in fact saying that the person who controlled the aircraft at the material time intended to kill himself. When questioned by me, he said as follows:

> Ct. [I]n your view, MI 185 came down because the person who manipulated the controls wanted to commit suicide and sadly, in the process, he became a mass murderer.
>
> A. Yes, I agree with that.
>
> (V/N p 784)

99. The thrust of the plaintiffs case is that it is more likely than not that it was Captain Tsu who deliberately crashed the aircraft. All the same, as the plaintiffs also asserted that F/O Ward could have been responsible for the inputs in the cockpit which caused the crash, the human factors relevant to both F/O Ward and Captain Tsu will be considered.

100. Mr Lok referred to the exhaustive investigation by Singapores CID in its attempt "to trace any indication of possible suicidal intent on the part of the pilot, co-pilot or the crew". More than 160 people in five countries were interviewed by the CID, which concluded that after a careful examination and analysis of all the materials obtained, it found no evidence that the pilot, co-pilot or any crew member had suicidal tendencies or a motive to deliberately cause the crash of Flight MI 185.

101. Mr Khoo SC pointed out that as he had no opportunity to cross-examine the CIDs witness, the findings of the CID should not be relied on by SilkAir. There are sufficient findings by the NTSC on human factors and only these findings will be relied on in this judgment.

F/O Ward

102. The human factors relating to First Officer Ward will first be considered. F/O Ward, who studied aviation at Massey University, New Zealand, joined SilkAir in September 1996, after having worked as a First Officer with Indonesias Garuda Airways. During his re-training to fly the Boeing-737, he was rated as "above average". No problems were noted during his training or during subsequent base checks in March and September 1997. According to para 1.18.4.1 of the NTSCs Final Report, other SilkAir pilots described him as an above average pilot with very good handling skills. Para 2.14.2 of the NTSCs Final Report added as follows:

> The investigation into [F/O Wards] personal and professional history revealed no unusual issues. No records of incidents or unusual events were found, and no career setbacks or difficulties were experienced. Financial records showed no evidence of financial problems. Interviews with family, close friends and relations seem to indicate that the [First Officer] was a well-balanced and well-adjusted person, and keen on his job, and planning to advance his flying career. There were no reports on recent changes in his behaviour.

103. First Officer Lawrence Dittmer (hereinafter referred to as F/O Dittmer), a colleague of F/O

Ward and Captain Tsu, testified that F/O Ward was a gentleman. When questioned by Mr Khoo SC about F/O Wards character, he said as follows:

> Probably, the most honest person Ive ever met. Initially, you would perhaps perceive him as being quite shy. but once you did get to know him youll soon realise that he had some fine attributes, namely his honesty, his belief and loving life, . I think, you just got the feeling that he was a great guy to know. Hes very friendly with everybody; you knew that he had no grudges against anybody. I think you could just safely say that he was an all-round gentleman.
> (V/N p 130)

104. As for F/O Wards financial position, the NTSC noted that while he owed his parents an amount of money for initial flight training expenses, this debt was less than his savings and there were no reports of other debts. There was nothing suspicious about his two insurance policies. One was purchased in 1992 while the other was a standard SilkAir policy.

105. In short, there is no evidence whatsoever that F/O Ward intended to commit suicide and kill every person on board the aircraft.

Captain Tsu

106. Captain Tsu, a former captain in the Republic of Singapore Air Force (hereinafter referred to as "RSAF"), joined the RSAF in 1975. He flew many types of fighter and trainer aircraft and was a member of the RSAFs Black Knights aerobatic team. He left the RSAF to join SilkAir in 1992. He was appointed Captain in 1996.

107. Captain Tsu was a family man. The NTSC noted that he left the RSAF and joined SilkAir in 1992 in order to spend more time with his family. His co-pilot on a number of occasions, F/O Dittmer, who gave evidence of his alleged breach of safety regulations, agreed that he was a family man. When questioned by Mr Khoo SC, he said as follows:

> Q. Can you tell us something of your appreciation of Captain Tsus basic character ?
>
> A. .We discussed a lot of things together involving his family background, his life, his children. Basically, the opinion I got was that he was a family man, and I like that. I was planning to have children in the future . So he was a nice guy to talk to.
>
> (V/N pp 131-132)

108. The plaintiffs asserted that Captain Tsus previous breaches of safety regulations must be taken into account when determining whether or not the aircraft was intentionally crashed. They also asserted that in the light of Captain Tsus breaches of safety regulations, SilkAir should not have put him in charge of any flight. Although the allegations of impropriety, when closely scrutinised, are not really relevant to the issue at hand, they will be discussed for the sake of completeness.

109. At this juncture, the following elucidation of SilkAirs levels of disciplinary action by SilkAirs Chief Pilot, Captain Leslie John Ganapathy, in para 30 of his affidavit of evidence-in-chief ought to be noted:

There are various levels of disciplinary action which can be taken against the pilots. The most serious is termination of their employment. This is followed by a demotion in rank. The pilot can also be removed from his position of Instructor Pilot or Line Instructor Pilot. This is known as a de-appointment. The next less severe penalty is a severe reprimand, followed by a reprimand. If the Company feels that the act does not warrant a reprimand, they will give a letter cautioning the pilot. In very minor cases, we would just issue the pilots a please be more mindful letter. This is basically a reminder letter just to make them aware that they should be more careful in the future. Letters of caution and reminders usually do not have a long term impact on promotions or increments. It is also our practice in cases where it is felt that pilots do require some guidance in procedural or operational matters for them to receive counselling from the Management.

110. Captain Tsu was involved in the following incidents, which merited the attention of SilkAir:

(a) An incident regarding the landing of an aircraft at Manado on 3 March 1997 (hereinafter referred to as the "Manado incident").

(b) An incident involving the disconnection of a CVR at Changi Airport on 24 June 1997 (hereinafter referred to as the "CVR incident").

(c) An incident involving a return to Changi Airport after having taken off for Kunming on 20 November 1997 (hereinafter referred to as the "Kunming flight incident").

The Manado incident

111. On 3 March 1997, Captain Tsu was the commander of Flight MI 274, which left Singapore for Manado. As the aircraft approached Manado, it was positioned too high and was moving too fast to be able to land at the airport. In such circumstances, Captain Tsu should have proceeded on a "go-around" before attempting to land. His co-pilot on this flight, F/O Dittmer, testified that instead of taking this course of action, Captain Tsu took the aircraft on "S turns" in an attempt to bring it down to a much lower altitude in order to land. He added that there were quick rolls to the left and right and he was scared. Unable to achieve his purpose, Captain Tsu then took the aircraft on a "go-around" before it landed at Manado airport. F/O Dittmer said that Captain Tsu had promised to report the "go-around" to SilkAir but did not do so. It is worth noting that no passenger filed a complaint about the flight in question and that in his own reports to SilkAir regarding the incident, F/O Dittmer did not mention that he was frightened by the "S turns".

112. Captain Galan said that an "S turn" may, depending on the circumstances, be acceptable. When questioned by Mr Lok, he said as follows:

Q. . Can you give us your comments on "S bends" and "S turns"?

A. . If these turns are done in good conditions, like turns done in a normal flight, there is no matter that it could be a problem except that in certain airlines, in certain airports, it could be not useful for the other aircraft and for navigation. But if there is no problem for the other aircraft, why not, you increase your distance without any problem if you make safe turns.

(V/N pp 1033-1034)

113. Captain Galan also thought that F/O Dittmers evidence on the "S turns" done by Captain Tsu lacked important details. When cross-examined, he said as follows:

> Mr Dittmer did not describe anything. He made a sign like that. You see, I am scientific. If you say to me a turn was at a bend of 25 or 35 or 60 degrees at a speed which was so and so and the altitude which was so and so, I would say to you if I would do that. But you say to me a manoeuvre that was described by Mr Dittmer and you say that if I did not describe something saying it as a strange manoeuvre. I am sorry that I cannot give you an answer to something which is so inadequate.
> (V/N pp 1157-1158)

114. In para 17 of his affidavit of evidence-in-chief, SilkAirs Deputy Chief Pilot, Captain Anthony Leong, said that he and Captain Ganapathy interviewed Captain Tsu and F/O Dittmer and made the following findings:

- Captain Tsu did not take measures early enough to prevent the aircraft from ending up in a position on finals from which a normal landing could not be made. This resulted in a go-around.
- Captain Tsu by not reporting the go-around in the voyage report or to Flight Operations department acted inappropriately. This resulted in the subsequent erasure of data that could have been used for an investigation.
- First Officer Dittmer by not reporting the go-around in the voyage report or otherwise to Flight Operations department also acted inappropriately.

115. As a result of the Manado incident, the Flight Operations Management recommended that Captain Tsu be given a letter of caution for failing to maintain a proper profile on the final approach to the airport and for not reporting the "go-around", which was an unusual occurrence. As for F/O Dittmer, it was recommended that he be counselled on the implications of not reporting to SilkAir matters that should have been reported. Before the letter of caution was issued to Captain Tsu, the cockpit voice recorder incident, which is discussed below, occurred.

The CVR incident

116. On 24 June 1997, Captain Tsu and F/O Dittmer discussed the Manado incident while they were in the cockpit of a SilkAir aircraft that was about to take off on a flight from Singapore for Jakarta. Captain Tsu told F/O Dittmer that he was upset by what he had heard from other crew members about the Manado incident. As a result of something which F/O Dittmer said, Captain Tsu pulled out the CVRs circuit breaker in order to preserve the recording of the conversation. As F/O Dittmer made it clear that he was not prepared to fly without the CVR in operation, Captain Tsu, who wanted to have the CVR tape downloaded, requested for and was given clearance to move the aircraft back to the gate. Subsequently, he changed his mind and reset the CVR. After that, the aircraft took off and proceeded to Jakarta without any further incident. In para 27 of his affidavit of evidence-in-chief, Captain Leong said that he compiled a report of the incident after consulting Captain Ganapathy. It contained the following findings:

- Captain Tsu acted inappropriately by de-activating the CVR before flight.
- Captain Tsus actions compromised the proper operations of the airline and served to intimidate F/O Dittmer who would have subsequently been unable to operate the flight in a settled state of mind.
- Captain Tsus [intention] to return to the gate to download the voice recorder tape at the

expense of and inconvenience to the passengers [and] delays to schedules [was] definitely not in the interest of the Company .
- Captain Tsus assertion that he had F/Os agreement to proceed without the CVR operating was denied by F/O Dittmer.

117. Captain Leong said that although the flight could have been performed without a serviceable CVR, the Flight Operations Department took a serious view of the incident and recommended that Captain Tsu be removed from his Line Instructor Pilot status with immediate effect.

118. On 3 July 1997, Captain Leong wrote to Captain Tsu to caution him with respect to his failure to act appropriately in the Manado incident. Captain Tsu was also informed that as a result of the CVR incident, he was reprimanded and removed from his position as Line Instructor Pilot with immediate effect. Captain Tsu was dissatisfied with the decisions. As a result, an inquiry was held, at which three charges in relation to the Manado incident and the CVR incident were made against him. In para 31 of his affidavit of evidence-in-chief, Captain Leong said as follows:

> The Defendants wrote to Captain Tsu on 15 July 1997, informing him that disciplinary proceedings at Company level would be instituted against him for three charges, namely:

- On 3 March 1997, while operating flight MI274, he did fail to take appropriate measures early enough to prevent the aircraft from ending up in a position on finals too high for a normal landing thereby resulting in a go-around;
- Subsequent to the go-around incident involving flight MI274 on 3 March 1997, he did fail to report or otherwise disclose to the company the said incident, an unusual occurrence which, in the companys interests, should have been reported and documented; and
- On 24 June 1997, while operating a public transport flight MI186, he did behave in a manner unbecoming of a Commander and contrary to the companys interests by deliberately rendering unserviceable equipment essential for the proper conduct of the said flight.

119. On 28 July 1997, the Inquiry Panel found that while the first charge was not proven, the remaining two charges were proven. As such, Captain Tsu was reprimanded for his actions and removed from the position of Line Instructor Pilot with effect from 28 July 1997.

The Kunming flight incident

120. On 20 November 1997, Captain Tsu was the commander of Flight MI 916, which was scheduled to fly from Singapore to Kunming. On take-off, one of the aircrafts engines did not achieve the target thrust. Shortly after taking off, Captain Tsu had second thoughts about proceeding to Kunming. After discussions with an engineering officer, a joint decision was made for the aircraft to return to Singapore. The aircraft, a Boeing 737, which had just taken off, did not have a fuel dumping capability. As such, it exceeded the maximum landing weight when it returned to Changi Airport. Such an overweight landing should have been recorded in the Technical Log and Incident Report Form. However, Captain Tsu did not do so. For this infringement, both he and his co-pilot received a "be more mindful" letter from SilkAir.

121. In relation to the overweight landing incident, the plaintiffs made two points. First, they asserted that Captain Tsu acted recklessly when he took off from Changi Airport without sufficient thrust. Secondly, they said that Captain Tsus failure to report the overweight landing was a serious breach of safety regulations.

122. While Captain Baston thought that Captain Tsu had taken off from Changi Airport with insufficient thrust in one of the aircrafts engines, Captain Galan took a totally different view. When

cross-examined, he said as follows:

> Q. In this case, we knew that even after fire-walling the engine, pushing the thrust completely forward, it was still below its take-off thrust?
>
> A. It was still below the maximum take-off thrust but above the possible take-off thrust.
>
> (V/N p 1159)
>
> Q. Dont you think something should have been done to remedy this problem towards the insufficient thrust?
>
> A. . You know that I call insufficient thrust a thrust which is insufficient. In this case, the thrust was sufficient because it was over the minimum thrust acceptable for its take-off. So the thrust was sufficient.
>
> (V/N p 1162)

123. SilkAirs Chief Pilot, Captain Ganapathy, agreed with Captain Galan. When cross-examined by Mr Khoo SC, he said as follows:.

> Q. [C]aptain Baston felt that the take-off which preceded the overweight landing incident was operationally flawed. Do you have any comments on that?
>
> A. No, I dont agree with that at all. The power that was available on the engine that had the power shortfall that day was well above what was required as the minimum take-off thrust for the flight. And the aircraft was in no way, I would say, at risk. It was well within its capabilities of taking off and climbing out satisfactorily.
>
> (V/N p 1499)

124. SilkAirs Deputy Chief Pilot, Captain Leong, also agreed that Captain Tsu did not take off from Changi Airport for Kunming with insufficient thrust in one of the aircrafts engines.

125. As for failing to report the overweight landing, Captain Tsu said that he did not file a report as he thought that the landing had been smooth. Captain Leong testified that in his view, this incident did not involve a breach of safety procedures. However, Captain Baston thought that Captain Tsus failure to report the overweight landing should not be viewed as an administrative oversight and that a smooth landing is not the criteria for determining whether or not such a report should be lodged. He said that such a report is required so that an airworthiness inspection can be conducted.

Effect of disciplinary action on Captain Tsu

126. The effect of the disciplinary action taken by SilkAir in 1997 on Captain Tsus morale ought to be considered. The NTSC took note of Captain Tsus employment record and said in para 2.14.3 of its Final Report as follows:

> During his professional career at SilkAir, he was involved in a few work-related events, which were in general considered minor operational incidents by the

> management. However, in one particular event, for non-technical reasons, [Captain Tsu] infringed a standard operating procedure i.e. with the intention to preserve a conversation between [him] and his co-pilot, [he] pulled out the CVR circuit breaker, but [he] reset the circuit breaker in its original position before the flight. This was considered a serious incident by the management, and [he] was relieved of his LIP appointment. [He] was known to have tried through existing company procedures to reverse the management decision. Although there were some indications of [Captain Tsu] being upset by the outcome of the events, the magnitude of the psychological impact on [his] performance could not be determined.

127. Captain Galan thought that Captain Tsus record should not have caused him much concern. He said as follows in para 11(b)(iii) of his affidavit of evidence-in-chief:

> The only recorded work problems that concerned [Captain Tsu] were, based on my experience as a commercial pilot, minor disciplinary mistakes that should not have affected him much. Certainly, they do not appear serious enough for a man to contemplate suicide.

128. Captain Galan said that those who worked with Captain Tsu would have known if he was depressed. In para 11(b)(iv) of his affidavit of evidence-in-chief, he explained:

> My personal experience with airline pilots is that a pilots nature of work brings him in such close contact with his fellow crew members that, if a pilot had been under any particular stress or was depressed, it would be impossible that this would go unnoticed.

129. Captain Tsus recent behaviour was considered by the NTSC, which stated as follows in para 2.14.3.1 of its Final Report:

> [Captain Tsus] recent behaviour was analysed from statements made by family members, friends and peers during interviews. [His] family reported no recent changes in his behaviour. Work associates who observed [him] on the day of the accident and on his most recent flights, reported nothing odd or unusual in his behaviour.

130. Captain Ganapathy testified that his working relationship with Captain Tsu remained cordial even after the latter was no longer a Line Instructor Pilot. He added that after the loss of that position, Captain Tsu had friendly chats with him during departmental meetings and social events. Referring to a meeting which he had with Captain Tsu a week before the crash, he said at paras 44 and 45 of his affidavit of evidence-in-chief as follows:

> 44. . On or about 11 December 1997, Captain Tsu paid me a visit at my office as he wanted to discuss the letter sent to him on the overweight landing.
>
> 45. He firstly admitted that it had been an oversight on his part in failing to report the overweight landing. The meeting ended on a positive note and I believe that Captain Tsu was grateful to be given the opportunity to explain the incident and to receive from me the reassurance as stated above.

131. In its thorough study of the human factors relating to Captain Tsu, the NTSC considered his

financial position at length. It found that Captain Tsus had a "positive net worth" at the time of the accident. In para 2.14.3 of its Final Report, the NTSC stated as follows:

> In the independent review of the NTSCs findings concerning financial background of [Captain Tsu] by Pricewaterhouse Coopers, the available information in regard to the assets, liabilities, income, expenditure and share trading were incorporated into a net worth analysis. This analysis reveals the following:

- [His] net worth (known assets less known liabilities) deteriorated over the period of 1994 to 1996, however it grew marginally during 1997.
- Between 31 December 1994 and 31 December 1996 his known assets declined, while his known liabilities increased resulting in a net decline in the value of [his] known net worth.
- Between 31 December 1996 and 19 December 1997, [his] known net worth increased again.

> Analysis of the net monthly income available for discretionary and general out-of-pocket expenses, based on a monthly combined gross income (including [his] and his wifes salaries), indicated that [he] had a relatively minor monthly cash shortfall at around the time of the accident. This should be considered in [the] light of [his] positive net worth at the time of the accident.

132. Captain Tsus liabilities, and especially his losses on shares, must thus be viewed in the context of his positive net worth at the time of his death. As for his insurance policies, one included a mortgage insurance policy which was applied for in December 1997. This is not an unusual policy and Captain Tsu did not know at the time of his death that his application for the mortgage insurance policy had been approved. As for his other insurance policies, they were effected many years ago and not under suspicious circumstances.

NTSCs findings on human factors are helpful

133. The findings of the NTSC on human factors are certainly helpful. As such, they will be considered together with the evidence from the crash site and simulation tests in the next part of this judgment in relation to whether or not the plaintiffs contention that Flight MI 185 was intentionally crashed is justified.

F. MY FINDINGS ON WHETHER THE AIRCRAFT WAS INTENTIONALLY CRASHED

134. The plaintiffs task of proving that Flight MI 185 was intentionally crashed is not an easy one in view of the paucity of evidence and the fact that their case rested on circumstantial evidence. As for the plaintiffs assertion that the irresistible inference is that the aircraft was intentionally crashed, it should be borne in mind that in *Caswell v Powell Duffryn Associated Collieries Ltd* [1940] AC 152, 169-170, where the precise nature in which an accident occurred could not be ascertained, Lord Wright said as follows:

> Inference must be carefully distinguished from conjecture or speculation. There can be no inference unless there are objective facts from which to infer the other facts which it is sought to establish. In some cases the other facts can be inferred with as much practical certainty as if they had been actually observed. In other cases the inference does not go beyond reasonable probability. But if there are no positive proved facts from which the inference can be made, the method of inference fails and what is left is mere speculation or conjecture.

135. Lord Wrights approach was endorsed by the Court of Appeal in *Singapore Airlines Ltd v Fujitsu Microelectronics (Malaysia) Sdn Bhd* [2001] 1 SLR 241.

136. The expert witnesses were sharply divided over the cause of the accident and the veracity of some of the conclusions of the NTSC and the NTSB. In the face of the dissenting views of the experts, many of the arguments advanced by Professor Howe and Captain Galan are not unpersuasive.

137. To begin with, for reasons already stated, there is enough room to question the accuracy of the projected flight trajectory of the aircrafts final descent and the corrected radar data on which the flight trajectory was based. Both Mr Job and Captain Baston accepted that with no other available data on the aircrafts descent into the Musi River, the accuracy of the radar data relied on to reconstruct the flight path of the aircrafts final descent had to be accurate. During the trial, no one seriously challenged Professor Howes assertion that the projected flight trajectory of the aircrafts final descent and the corrected radar points, if accurate, required the aircraft to achieve Mach numbers which are outside anything that any of the witnesses said could be achieved by it. Only Captain Baston dealt with this issue when he offered the view that wind flowing on parts of the aircraft could reach a speed of Mach 1 or more but this did not affect Professor Howes assertion, which is that while the local airspeed over parts of the aerofoil section could reach Mach 1, the speed of the aircraft would not exceed Mach 1. (V/N p 1332)

138. As has been mentioned, the reliability of the corrected radar data is being questioned by counsel for some of the plaintiffs in the present case in the actions initiated by them in the United States against Boeing. Captain Baston was honest enough to accept that his conclusions on the cause of the crash of Flight MI 185, which were based on the flight trajectory of the aircraft and the simulation tests, could, depending on the margin of error of the corrected radar data, change. When cross-examined, he said as follows:

> Q. In other words, if the radar data is shown to have been changed or amended in any way which subsequently is found to be incorrect, then there would have to be changes to the basis or the outcome of your opinion?
>
> A. Yes.
>
> (V/N p 479)

139. When questioned by me, Captain Baston confirmed that his conclusions are only valid if the corrected radar data relied on by him are correct. (V/N p 543)

140. As for the simulation tests conducted by Boeing, the fact that they were based on the controversial corrected radar data ought to be noted. This was made clear in the NTSCs Final Report, which stated that the objective of the simulation tests conducted by Boeing was "to explore and understand the various possible combination of one or more malfunctions of flight controls, aircraft systems and power plants that would result in the extreme descent flight trajectory as suggested by the radar plots". Apart from this, the relevance of the simulation tests is debatable because such tests are of limited use when, as in this case, the aircraft had exceeded its flight envelope.

141. There is also sufficient doubt as to what was the final position of the jackscrew of the horizontal stabilizer before the aircraft started to disintegrate in mid-air. The NTSC concluded that there is no evidence that intentional pilot input caused the jackscrew of the horizontal stabilizer to be at its maximum forward trim limit. Furthermore, it was not established that the pilots did not attempt

to recover the aircraft from its unusual attitude. The fact that the throttle was in a forward thrust position does not, without more, prove that that the pilots did not attempt to recover the aircraft from its dive. It was also not established that the CVR and FDR were intentionally disconnected.

142. I thus have no doubt that if one looks only at the evidence from the crash site, the projected flight trajectory of Flight MI 185s final descent and the simulation studies, the onus of proving that Flight MI 185 was intentionally crashed has not been discharged.

Human factors

143. In the light of my findings with respect to the evidence from the crash site, the projected flight trajectory and the simulation tests, the human factors relevant to the crash of Flight MI 185 have an added significance and will next be considered.

144. When considering whether or not Captain Tsu or F/O Ward intended to commit suicide and kill the passengers and crew on board the aircraft, it must be borne in mind that a finding that they intended to do so affects their reputation and character. In this regard, the following words of Morris LJ in *Hornal v Neuberger Products Ltd* [1957] 1 QB 247, 266-267 ought to be noted:

> Issues may be raised in a civil action which affect character and reputation, and these will not be forgotten by judges and juries when considering the probabilities in regard to whatever misconduct is alleged. There will be reluctance to rob any man of his good name: there will also be reluctance to make any man pay what is not due or make any man liable who is not or not liable who is. A court will not be deterred from a conclusion because of regret at its consequences: a court must arrive at such conclusion as is directed by the weight and preponderance of the evidence.

145. Morris LJ was of course echoing the approach enunciated in *Bater v Bater* [1951] P 35, 36-37 by Denning LJ, as he then was, who said:

> It is of course true that by our law a higher standard of proof is required in criminal cases than in civil cases. But this is subject to the qualification that there is no absolute standard in either case. In criminal cases the charge must be proved beyond reasonable doubt, but there may be degrees of proof within that standard.
>
> As Best CJ and many other great judges have said, in proportion as the crime is enormous, so ought the proof to be clear. So also in civil cases, the case may be proved by a preponderance of probability, but there may be degrees of probability within that standard. The degree depends on the subject-matter. A civil court, when considering a charge of fraud, will naturally require for itself a higher degree of probability than that which it would require when asking if negligence is established. It does not adopt so high a degree as a criminal court, even when it is considering a charge of a criminal nature; but still it does require a degree of probability which is commensurate with the occasion.

146. The evidence on human factors uncovered by the NTSC provides no basis for concluding that Captain Tsu or F/O Ward intended to commit suicide and kill the passengers and crew on board the aircraft. As far as Captain Tsu is concerned, it is important to note that on the days before the crash

and on the day of the crash itself, he showed no signs of a change in behaviour. The recorded conversation in the CVR before it was disabled revealed that he and F/O Ward chatted without any hint of tension or any sign that something ominous was to unfold a few minutes later. The NTSC pointed out that the two hours of CVR information available for analysis revealed cordial discussions between the two pilots which were unrelated to their work.

147. As for Captain Tsus financial problems, it should not be overlooked that he had, in the NTSCs words, a positive net worth at the time of the accident. Admittedly, he had some problems with his work but these were not serious enough to push him to take his own life and the lives of so many other persons. As for the mysterious failure of the black boxes, the NTSC stated in no uncertain terms that Captain Tsus act of disconnecting the CVR in Changi Airport in June 1997 to preserve his conversation with F/O Dittmer with respect to the Manado incident "had no bearing on this accident".

148. The NTSC also noted that Captain Tsu had forward planning and that he was organising his fathers birthday party, which was scheduled for 21 December 1997, just two days after the crash. It is unlikely that Captain Tsu, a family man who gave up his career in the RSAF in order to spend more time with his family, and who was planning his fathers birthday celebrations at the material time, would, without more, deny his wife a husband, his children a much needed father and his aged father a son. Furthermore, even if it is assumed for one moment that he wanted to commit suicide, it is unlikely that he would choose to distress his aged father by killing himself and so many other people just two days before his fathers birthday celebrations.

149. The plaintiffs case was focussed primarily on the evidence from the crash site, the simulation tests and the disciplinary action taken by SilkAir against Captain Tsu. Insufficient attention was paid to human factors relevant to the crash. While Captain Laming and Captain Baston understandably concentrated on the technical aspects of the crash because of their expertise, it cannot be fathomed why the plaintiffs third witness, Mr Job, an experienced air crash investigator, did not cast his eyes further afield. After all, during the trial, he reiterated on several occasions that attention should be paid to the human factors relevant to the crash of Flight MI 185. Some of his answers during cross-examination are reproduced below:

> Q. Would [the CID report] be relevant to your consideration whether or not the CVR and FDR were intentionally disconnected? .
>
> A. Yes, it would be relevant.
>
> Q. Would [the CID report] be relevant to your consideration whether the cockpit crew set the plane on a nose-down trim?
>
> A. Yes, it would be relevant.
>
> (V/N p 778)
>
> Q. Looking at those [issues regarding other possible reasons for the crash] in the light of the CID report, if you were the investigator, would you want to be a little bit more careful and look a little bit more closely at those other issues?
>
> A. Yes, I would, yes.
>
> (V/N p 787)

150. In view of Mr Jobs position, it is surprising that he did not give the human factors which were considered at great length in the NTSCs Final Report much attention. After all, he confirmed that whatever had been uncovered by the Singapore police had also been considered by the NTSC. (V/N p 803) When cross-examined, he explained why he did not pay much attention to the NTSCs findings on the issues considered by the Singapore police in the following terms:

> Q. . Did you read these portions of the NTSC report?
>
> A. Ive read them. *I understood that my brief was to concentrate on the operational aspects of the report. I didnt give them a great deal of consideration.*
>
> (V/N p 803; emphasis added)

151. Mr Jobs admission that his brief was to concentrate on the "operational aspects" of the report merits attention. What would have been his conclusion if his brief had been to concentrate on the human factors relevant to the crash of Flight MI 185? If this had been the case, would he have given scant attention to the evidence from the crash site? As an expert crash investigator, Mr Jobs role was to look at all the relevant factors and his testimony was undermined from the very start by his failure to give sufficient attention to the human factors which he himself thought to be relevant to an investigation into the cause of the crash of Flight MI 185.

152. Earlier on, I stated that the human factors relevant to the crash of Flight MI 185 have an added significance because of my findings regarding the evidence from the crash site and the simulation tests. The fact that there is no evidence that Captain Tsu or F/O Ward intended to commit suicide or murder provides added reason for concluding that it was not established that Flight MI 185 was intentionally crashed.

153. In agreeing with the NTSC that there is no evidence that the crash was intentionally caused by inputs in the cockpit, I have not adopted the NTSBs conclusions. The NTSB is very experienced in aircraft accident investigation and its views merit attention. All the same, it is not infallible and it has altered its conclusions on the cause of some, albeit a limited number, of air crashes in the light of subsequent evidence which showed that its original conclusions were wrong.

154. Captain Galan, who said that he had worked very often with the NTSBs investigators, noted that he had sharp disagreements with the NTSB on two previous occasions. He clearly did not agree with the conclusions of the NTSB on the cause of the crash of Flight MI 185.

155. The plaintiffs expert witness, Mr Job, agreed that the NTSB had been wrong in the past. When cross-examined, he said as follows:

> Q. Do you agree that in UA Flight 811, [the NTSB] attributed the cause finally to something which they initially dismissed as having only remote possibility?
>
> A. That is correct.
>
> Q. And that similarly in the Colorado Springs incident, something which was initially dismissed as having only an extremely low likelihood was subsequently found to be the probable cause?
>
> A. Yes.

(V/N p 717)

156. Mr Job also conceded that the NTSB could be wrong in the present case although he thought this to be unlikely. When cross-examined, he said as follows:

> Q. . And youll agree that for all the good and best intentions of NTSB, they might possibly make mistakes in MI 185 as well?
>
> A. As I have said before, anything is possible.
>
> Q. Do you agree with me that there is a possibility that somewhere out there in the wreckage that has still not been recovered, the answer to what actually happened to this crash may be found?
>
> A. I can only answer that, again, anything is possible.
>
> Q. And if that piece of answer is found, or if there is an improvement in technology, or if there is some sort of lesson to be learned from other mishaps, and an answer emerges a few years from now, the true cause will then be known?
>
> A. It is possible.
>
> (V/N p 717)

157. To be fair to the NTSB, its representatives did not testify in this case. As such, many of the exacting questions posed by SilkAirs expert witnesses in relation to its findings remained unanswered. On the basis of the evidence before me, the plaintiffs have clearly not discharged the burden of proving that the aircraft was intentionally crashed as a result of inputs in the cockpit by Captain Tsu and/or F/O Ward.

G. WHETHER THE PILOTS WERE RECKLESS

158. Whether or not SilkAir is barred from limiting its liability in accordance with the provisions of the Warsaw Convention and the amended Convention on the ground of recklessness on the part of the pilots will next be considered.

Position under the amended Convention

159. The position under the amended Convention will first be dealt with. The task which lies ahead of a plaintiff seeking to deny a carrier the right to rely on the limitation of liability provisions in the amended Convention was outlined by Eveleigh LJ in *Goldman v Thai Airways International Ltd* [1983] 3 All ER 693, 698 in the following terms:

> I say at once that, reading art 25 as a whole for the moment and not pausing to give an isolated meaning to the word recklessly, the article requires the plaintiff to prove the following: (1) that the damage resulted from an act or omission; (2) that it was done with intent to cause damage, or (3) that it was done when the doer was aware that damage would probably result, but he did so regardless of

> that probability; (4) that the damage complained of is the kind of damage known to be the probable result.

160. In similar vein, in *SS Pharmaceutical Co Ltd v Qantas Airways Ltd* [1991] 1 Lloyds Rep 288, 302, Kirby P said as follows:

> Even proof of reckless conduct is itself, and alone, not enough. It must be shown that, at the time of the reckless conduct, the servants or agents of the carrier concerned knew that such conduct would cause damage but went ahead regardless.

161. In Singapore, the approach adopted in *Goldman v Thai Airways International Ltd* and *SS Pharmaceutical Co Ltd v Qantas Airways Ltd* was endorsed by the Court of Appeal in *Singapore Airlines Ltd v Fujitsu Microelectronics (Malaysia) Sdn Bhd* [2001] 1 SLR 241. Chao Hick Tin JA, who delivered the judgment of the court, said at p 251:

> In our opinion, it is clear that the knowledge which must be proved is the actual knowledge of the wrongdoer, be it an individual or a group of individuals in a company. The fact that the amended Convention requires proof of recklessness as well as knowledge that damage would probably result, unmistakably indicates that recklessness per se is not sufficient.

162. The question of recklessness on the part of the pilots would arise if they took the aircraft for a dangerous joy ride or if they did what Captain Flaming described as "playing silly" in the sky. There is no proof that Captain Tsu or F/O Ward did these acts. Whatever inappropriate act Captain Tsu may have done in the sky in the past, he was, in the main, responding to a situation which required an input from him. He has never been accused of taking passengers on board an aircraft for a joyride or on a frolic of his own.

163. The remaining question is whether or not Captain Tsu and/or First Officer Ward acted recklessly when dealing with an unexpected situation or what they perceived to have been a problem faced by the aircraft. Mr Khoo SC, who maintained that an emergency descent is easy to execute, asserted that unless the pilots were incompetent or reckless, they could never have got out of the flight envelope. He submitted that competent pilots such as Captain Tsu and F/O Ward should have executed an emergency descent without difficulty unless they took reckless steps, which caused the plane to exceed its flight envelope and crash. However, Captain Galan stressed that there was no question of recklessness in this case. When cross-examined, he said as follows:

> Q. [T]he other possibility of how the aircraft got into problems at exceeding the flight envelope is that he did it the wrong way.
>
> A. He did the wrong way because the conditions were [such] that he could not do something else maybe.
>
> Q. Reckless? .
>
> A. Not for me. No, no. No possibility of recklessness in this case.
>
> (V/N pp 1130, 1132)

164. Professor Howe also said that the question of recklessness on the part of the pilots did not

arise. When cross-examined, he said as follows:

> Q. You see, if either the pilots had acted on instinct rather than act only after assessment of a situation, then they would have been wrong in executing the high-dive manoeuvre?
>
> A. They would have been wrong, but not reckless.
>
> Q. And I have to suggest to you, Professor Howe, that if they did something which was contrary to what they had been trained to do, that would be recklessness.
>
> A. No, definitely not. Recklessness would only be if they were aware of the fact that they were doing something which was wrong and would put the aircraft and its occupants into danger.
>
> (V/N p 1266)

165. Subsequently, Mr Khoo SC returned to the same subject but Professor Howe, who steadfastly refused to concede that the pilots had been reckless, said as follows:

> Q. I would suggest to you there would not have been this disastrous result unless someone had done it all wrong.
>
> A. Not at all. I would not accept that because we do not know the circumstances in the cabin of the aircraft, in the cockpit of the aircraft on the occasion. And I think to say at this stage that the pilots or pilot initiated an emergency descent and got it all wrong is really a gross assumption which cannot be justified by the evidence.
>
> (V/N pp 1316-1317)

166. SilkAirs chief pilot, Captain Ganapathy, who knew Captain Tsu quite well, also did not think that the latter would have been as reckless as alleged. When questioned by Mr Lok, he said:

> Q. Well, it was one of the plaintiffs suggestions in this case that Captain Tsu was reckless in his operation of the plane and that somehow this might have led to the plane crash on the 19th of December, and what are your views on this?
>
> A. I could not believe that that would be true. I knew him well and I cannot believe that he would have done something reckless.
>
> (V/N p 1575)

167. When considering whether or not there was recklessness on the part of either Captain Tsu or F/O Ward, it should not be overlooked that the time within which a pilot responds to a real emergency may not be that taken during exercises in a simulator. Even Captain Laming, who said that an emergency descent is not difficult to execute, agreed that responding to an emergency in a simulator is quite different from dealing with a real emergency while the aircraft is in the air. When cross-examined, he said:

Q. Would you be able to replicate in a simulator the psychological pressure that a pilot may face in a real life depressurisation situation that the aircraft might crash or there might be a loss of lives if the situation is not rectified or would you consider that an irrelevant consideration?

A. I think its a difficult question to answer correctly. What I am saying is that in the simulator, there is a lot of --- theres a tense atmosphere. Theres a tense atmosphere because usually if you are training, thats fine. If you are under test, there is very tense atmosphere indeed or there can be. In terms of say how you are going to die, if you can have this dive, you know from prior knowledge, reading, the experience, that they may not recover from a certain angle but the simulator has limitations too. Its not a very good reply to you but Im trying.

Q. Yes. The only thing I wanted to know is that do you consider that to be another difference between a real life emergency situation and a ... situation in a simulator?

A. Yes, there is a difference.

Q. So in addition to the physical changes, the physical differences in a real life depressurisation, there is also the psychological stresses which are present in a real life situation.

A. There would be.

(V/N pp 313-314)

168. Captain Galan agreed that Captain Tsu and F/O Ward had been trained for an emergency descent but pointed out that while executing such a descent may appear easy from a text book, the position is quite different when a pilot is faced with a real threat to the aircraft and its passengers. When cross-examined, he said as follows:

Q. [An] emergency descent was a simple manoeuvre to execute. What are your comments on that?

A. I dont agree at all . Emergency descent is, in fact, something which is very, very difficult. We had at the very beginning of the seventies to make an evaluation of the different tasks of the pilot in the commercial aircraft . All the tasks from take off to landing, all the tasks in normal and abnormal conditions. So we did this job during months and months with a subjective means, that means, we used pilots and we asked them how difficult was this task but we also used the objective means in using devices coming from doctors. We used the measurement of the breathing, measurement of blood pressure, measurement of the electro-cardiogram and after some months, we took different pilots from different airlines in simulators. We have to recognise that the emergency descent was one of the highest workload that we could meet in cases of problem in flight.

(V/N pp 1024-1025)

169. Captain Galan added that the fact that there were two pilots in the cockpit does not mean

that an emergency descent would have been an easy manoeuvre. When cross-examined, he said as follows:

> Q. If there were two pilots, there shouldnt be difficulty in managing a high dive, as you say, as opposed to one pilot?
>
> A. [I]f there are two pilots, its a heavy difficulty. With one pilot around, its an extreme difficulty but with two pilots, it is very difficult anyway.
>
> (V/N p 1105)

170. Captain Baston also accepted that a pilots response to a real emergency may be different from his response during an exercise. When explaining the element of surprise and why a co-pilot may not have sufficient time to negate the effects of an errant pilots deliberate manoeuvres to crash a plane, he said as follows:

> But I am talking about reaction times. We have quick donning oxygen masks. We can just grab the mask, put it on. Now, in a simulated exercise, most people can get those masks on fairly quickly, or when you are sitting there checking them prior to flight. The FAA and the NTSB did a joint exercise back in the .. early 1980s, where they got normal line crew in a simulator, did not brief them, and where everybody was thinking that they have had them on in two to five seconds, the average time for an average pilot [in] a surprise event was 17 seconds just to get the oxygen mask off and put it on and start breathing oxygen, so that its very difficult to make objective assessments of reaction time in a courtroom without doing a full study in the aircraft.
> (V/N p 903)

171. After taking all circumstances into account, I hold that it has not been established that Captain Tsu or F/O Ward acted in such a manner as to deprive SilkAir of its right to limit its liability in accordance with the provisions of the amended Convention.

Position under the Warsaw Convention

172. I now turn to the position under the unamended Warsaw Convention, which requires the plaintiffs to establish that the damage in question was caused by the wilful misconduct of either Captain Tsu or F/O Ward if SilkAir is to be barred from limiting its liability.

173. In *Horabin v British Overseas Airways Corporation* [1952] QBD 1016, 1019-1020, Barry J explained the ambit of the term "wilful misconduct" in the Warsaw Convention in the following terms:

> Wilful misconduct is misconduct to which the will is a party, and it is wholly different in kind from mere negligence or carelessness, however gross that negligence or carelessness may be .
>
> In order to establish wilful misconduct, the plaintiff must satisfy you that the person who did the act knew at the time that he was doing something wrong and yet did it notwithstanding, or, alternatively, that he did it quite recklessly, not caring whether he was doing the right thing or the wrong thing, quite regardless of the effects of what he was doing on the safety of the aircraft and

> of the passengers for which and for whom he was responsible. That is something quite different from negligence or carelessness or error of judgment, or even incompetence, where the wrongful intention is absent. All these human failings errors of judgment, carelessness, negligence or incompetence - may give rise to acts which in the judgment of ordinary reasonable people may amount to misconduct, but the element of wilfulness is there missing.

174. In similar vein, in *Thomas Cook v Air Malta* [1997] 1 Lloyds Rep 399, 408, Cresswell J had occasion to observe as follows:

> What does amount to wilful misconduct? A person wilfully misconducts himself if he knows and appreciates that it is misconduct on his part in the circumstances to do or to fail or omit to do something and yet (a) intentionally does or fails or omits to do it or (b) persists in the act, failure or omission regardless of the consequences or (c) acts with reckless carelessness, not caring what the results of his carelessness may be.

175. For reasons already stated in the discussion of proof of recklessness in relation to the amended Convention, there is no evidence that the crash of Flight MI 185 resulted from wilful misconduct on the part of Captain Tsu or F/O Ward.

H. CONCLUSION

176. At the end of the trial, it was evident that the cause of the crash of Flight MI 185 was not proven. In this regard, the following words of Lord Brandon in *Rhesa Shipping Co SA v Edmunds and Another (The Popi M)* [1985] 2 All ER 712, 714 are instructive although that case concerned the loss of a ship:

> [I]t is always open to a court, even after the kind of prolonged inquiry with a mass of expert evidence which took place in this case, to conclude, at the end of the day, that the proximate cause of the ships loss, even on a balance of probabilities, remains in doubt, with the consequence that the shipowners have failed to discharge the burden of proof which lay on them.

177. As the plaintiffs did not discharge the burden of proving their assertions regarding the cause of the crash of Flight MI 185, SilkAir is not barred by the Warsaw Convention and the amended Convention from limiting its liability with respect to the crash. The plaintiffs claim against SilkAir is thus dismissed with costs.

Sgd:

TAN LEE MENG
JUDGE