Aviation Safety Council
Taipei, Taiwan

SQ006 Accident Investigation
Factual Data Collection
Group Report

Flight Operations Group

February 20, 2001

ASC-FRP-01-01-001

I. Team Organization

Chairman:
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Members:
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3. Kenneth L. Egge National Transportation Safety Board, U.S.A.
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6. Captain Kenneth Edward Toft CAAS, MCIT, Singapore
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10. Captain Joseph M. MacDonald Boeing Commercial Airplane Group
11. Captain Anthony C. K. Tan SIA, Singapore
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(i) R.O.C. – Republic of China

(ii) U.S.A. – United States of America

(iii) MCIT – Ministry of Communications and Information Technology

(iv) CAAS – Civil Aviation Authority of Singapore

(v) SIA – Singapore Airlines

II. History of Activities

Date	Activities
Nov 03, 2000	1. Study SQ-006's Flight Data Recorder / Cockpit Voice Recorder (FDR / CVR). 2. The first interview of the three pilots and flight dispatcher. 3. Second interview of the three pilots.
Nov 04, 2000	1. Captain (CM –1), First Officer (CM-2) and Relief Pilot (CM-3) personnel information collected. 2. Completed the interview report of CM-1.
Nov 06, 2000	1. Completed the interview reports of CM-2, CM-3 and flight dispatcher. 2. Reenactment of the taxi route taken by SQ-006 using B747-400 Freighter airplane.
Nov 07, 2000	1. Completed the second interview reports of the 3 pilots. 2. Completed report of the taxi route reenactment.
Nov 08, 2000	1. Interviewed CI-004 First Officer. Completed the interview report of CI-004 First Officer.
Nov 09, 2000	1. Interviewed CI-004 Captain. 2. Completed the interview report of CI-004 Captain. 3. Interviewed CI-065 Captain by telephone.
Nov 12, 2000	Completed a Preliminary Group Report.
Nov 27, 2000	1. Interviewed Captain. (Flew with CM-2) 2. Interviewed Captain. (Flight Operations Deputy Head, CAAS) 3. Interviewed First Officer. (Flew with CM-1)
Nov 28, 2000	1. Interviewed Captain. (Performed CM-2's line check) 2. Interviewed Captain. (Performed CM-1's base check) 3. Interviewed Captain. (Performed CM-1's line check)
Nov 29, 2000	1. Interviewed Captain. (Performed CM-3's base check) 2. Interviewed Captain. (Flew with CM-3) 3. Interviewed Captain. (Performed CM-3's line check)
Nov 30, 2000	1. Interviewed CI-065 First Officer by telephone. 2. Completed the reports of the 10 interviews done from Nov 27 to 30, 2000.
Dec 01, 2000 to	Reviewed documents pertaining to the management of SIA's Flight Operations Division. 1. Reviewed Civil Aviation Authority of Singapore approval

Dec 15, 2000	documents for SIA's operations. 2. Reviewed Civil Aviation Authority, R.O.C., approval letter for SIA CAT-II operations at CKS Airport. 3. Reviewed SIA's Flight Operations Manual and/or Policy Manual pertaining to low visibility procedures and policies. 4. Reviewed SIA's Internal Notice to Airmen (INTAM) and Bulletins to determine the company procedures for updating crews as well as record keeping of flight operations documents. 5. Reviewed Training Manual to ascertain the low visibility and Para-Visual Display (PVD) procedures for crew. 6. Reviewed Training Records of the three pilots. 7. Reviewed the company's Crew Resource Management (CRM) training program. [known as Aircrew Resource Management (ARM) in SIA] 8. Reviewed Crew Competency Records for the three pilots especially pertaining to area and route, airports flown to, takeoffs and landings. 9. Reviewed airplane records such as Certificate of Airworthiness, Radio License and CAT-III currency. 10. Reviewed the three pilots' flight schedules to ensure compliance with Flight Time Limitations prior to the SQ-006 flight on Oct.31, 2000. 11. Reviewed Simulator approval ratings. 12. Interviewed the CAAS Flight Operations Inspector. 13. Interviewed 8 pilots who had flown with CM-1, CM-2 and CM-3 recently. 14. Checked if the three pilots had been paired before on previous flights. 15. Interviewed Check Airmen (known as Authorized Flight Examiners in Singapore) and Instructor Pilots. 16. Verified the periodicity of Base Checks, Instrument rating and Line/Route checks for pilots. 17. Verified the number of times each crewmember has operated into Taipei and if possible ascertain which runway the crew may have used on these occasions. 18. Reviewed contents of airplane library documents. 19. Verified Weight and Balance and Fuel sheet for the SQ-006

	flight on Oct. 31, 2000.
Feb 01, 2001 to Feb 06, 2001	Technical review meeting at ASC in Taipei.

III. Factual Description

1. FACTUAL INFORMATION

1.1 History of Flight

On October 31, 2000, at 1517 Universal Coordinated Time (UTC) (2317 Taipei local time), Singapore Airlines Flight SQ-006, a Boeing-747-400 airplane, bearing registration no. 9V-SPK, crashed on a partial closed runway during takeoff. Heavy rain and strong winds from typhoon "Sangsane" prevailed at the time of the accident. SQ-006 was on a scheduled passenger flight from Chiang-Kai-Shek（CKS）International Airport , Tao-Yuan, Taiwan, Republic of China to Los Angeles International Airport, Los Angeles, California, U.S.A. The flight departed with 3 pilots, 17 flight attendants, and 159 passengers aboard.

The airplane was destroyed by its collision with construction equipment, runway construction pits on Runway 05R and by post impact fire. The tail section of the fuselage, the engines and landing gear separated from the rest of the airplane. The forward and mid sections of the fuselage and the wings were totally destroyed by the fire. The tail section was slightly damaged by fire.

On August 31, 2000, Civil Aeronautics Administration (CAA), R.O.C., issued a Notice to Airmen (NOTAM) number A0606, indicating that a portion of the Runway 05R between Taxiway N4 and N5 was closed due to work in progress from September 13, 2000, to November 22, 2000.

The pilots commenced duty on October 30, 2000, in Singapore, for the scheduled Singapore→Taipei→Los Angeles→Taipei→Singapore trip sequence. They completed the Singapore→Taipei sector on October 30, and arrived at the hotel in Taipei city around midnight local time and stayed at the hotel until departure for the airport on the evening of October 31, 2000.

At 1235 UTC, the 3 pilots departed the hotel to CKS Airport and reported for duty at 1355 UTC. The flight SQ-006 had 3 pilots on board: one Captain (Crew Member-1, CM-1) and one First Officer (CM-2) with another First Officer as Relief Pilot (CM-3). SQ-006 was parked at Bay B5 where the airplane was prepared for departure. CM-1 was the pilot flying and conducted taxi and takeoff.

At 1507 UTC, after pushback from Bay B5, SQ-006 commenced taxiing via Taxiway SS, turned north and entered Taxiway WEST CROSS, and then turned left to Taxiway NP proceeding in a southwest direction.

At 1515:22 UTC, just before reaching the end of Taxiway NP, SQ-006 received takeoff clearance for Runway 05L. The pilots acknowledged the takeoff clearance for Runway 05L. The airplane made a right turn from Taxiway NP into Taxiway N1 and continued the right turn onto Runway 05R.

At 1516:36 UTC, after a 6-second hold, SQ-006 commenced takeoff roll from Runway 05R. Approximately 41 seconds later, it collided with the concrete jersey barriers, 2 excavators, 2 steamrollers, a bulldozer, an air compressor cart, and a pile of metal reinforcement bars on Runway 05R, between Taxiways N4 and N5.

At 1517:36 UTC, CKS Airport Control Tower signaled the emergency bell to the fire station after seeing explosions. Fire was seen along the takeoff path of the airplane. There were 123,800 kilograms of Jet A1 Aviation fuel on board the airplane. The fire fighters initiated the emergency response and informed Tao-Yuan County's Fire Fighting Action Center and Emergency Medical Service Center. The first fire fighting truck began discharging its chemical extinguishing agent at the accident site within approximately 3 minutes after the alarm. The fire was very intense at the forward and mid sections of the wreckage. The tail section fire was less intense and was brought under control by the fire fighters. Heavy rain, low visibility and strong winds prevailed at the time of the accident. The fire fighting group used a total of 2,300 gallons of chemical and 40,000 gallons of water during the fire fighting process.

A temporary command center was established at the accident site in a large passenger transportation vehicle. The security system established by the Airport Police Service Center consisted of a combination of airport police, local county police and military police. Nine fire trucks and 4 ambulance vehicles from CKS airport, and another 34 fire trucks and 54 ambulance vehicles from the local area were used.

All injured passengers and crewmembers were gathered at A9 terminal and sent to the local hospitals. Passengers that sustained burn injuries were sent to fire and burn intensive care center of the local hospital.

Seventy-nine passengers and 4 flight attendants were fatally injured. Thirty-five passengers and 4 flight attendants sustained serious injuries in this accident.

1.1.1 Sequence of Events During Taxiing and Takeoff

1457:16 UTC	SQ-006 copied Air Traffic Control (ATC) clearance.
1459:06 UTC	Tower approved SQ-006's request to use Runway 05L for departure, start and pushback clearance was issued.
1500:53 UTC	CVR began recording at this time. The engine start sequence was 1, 2, 3, and 4.
1501:25 UTC	The Automatic Terminal Information Service (ATIS) broadcast: "Taipei International Airport: Information Tango, one four five four Zulu. Runway zero five Left is in use, Runway zero six for departure only. Expect ILS Runway zero five Left, category-two approach, wind zero two zero at three six, gust five two, visibility five hundred meters, Runway zero five Left RVR four hundred fifty meters, Runway zero six, five hundred meters with heavy rain, cloud broken two hundred feet, overcast five hundred feet, temperature two one, dew point two zero, QNH one-zero-zero-one

	hectopascal, departure frequency one-two-five point one, caution windshear on Runway zero-five Left final. Due to radio interference, Tower frequency changed to one-two-nine point three. Caution Taxiway November Sierra has been re-marked, aircraft using November Sierra advise taxi slowly with caution. Taxiway November Papa behind Alpha one and Alpha three closed, Runway zero-five Right between November four and November five closed, due to work in progress, Taxiway November four and November five still available. Inform Taipei Approach or Tower initial contact you have Tango".
1504:35 UTC	CM-1 asked for the removal of the ground equipment, this was followed by response from Maintenance.
1505:22 UTC	The Crew commenced “after start checklist”.
1505:57 UTC	With the completion of pushback, taxi clearance was requested by SQ-006 and Ground Control provided the following: "Singapore Six taxi to Runway Zero Six via Taxiway…, correction Runway Zero Five Left via Taxiway Sierra Sierra, WEST CROSS and November Papa".
1506:08 UTC to 1506:29 UTC	CM-2 read back the taxi instructions to Control Tower with the assistance of CM-1. Taxi instructions discussed by Crew.
1507:10 UTC	CM-1 commenced taxi.
1507:21 UTC to 1507:53 UTC	CM-1, CM-2 and CM-3 discussed the weather details and return Alternate Airports.
1508:04 UTC	The flight controls check was commenced and carried out by CM-1 and CM-2.
1508:56 UTC to 1509:58 UTC	The before takeoff check was initiated and completed to the line by CM-1 and CM-2, and they set V_1-142, V_R-156, V_2-169.

1510:14 UTC to 1512:01 UTC	The 3 pilots commented on the weather.
1512:02 UTC	The ATIS Broadcast: “Taipei Chiang Kai Shek International Airport Information UNIFORM one five zero zero zulu runway zero six for departure only runway zero five left for category two approach and departure wind zero two zero at three six gust five six visibility six hundred meters runway zero five RVR four hundred fifty meters downward runway zero six RVR five hundred fifty meters downward with heavy rain cloud broken two hundred feet overcast five hundred feet temperature two one dew point two zero QNH one zero zero one hectopascal.”
1512:25 UTC	The airplane turned left into Taxiway November Papa.
1513:28 UTC	CM-2 contacted Control Tower on frequency 129.3 MHz and was told to hold short of Runway 05L.
1513:38 UTC	Tower advised: "Surface wind zero two zero at two four, gust four three, say intention".
1514:41 UTC to 1514:53 UTC	CM-1 and CM-2 discussed the turn into Taxiway N1, which is the second right turn at the end of Taxiway November Papa.
1515:02 UTC	SQ-006 called: “Singapore six ready”.
1515:04 UTC	Tower cleared SQ-006 to taxi into position and hold on Runway 05L: "Singapore Six roger, Runway Zero Five Left, taxi into position and hold".
1515:22 UTC	Tower reported: "Singapore Six, Runway Zero Five Left, wind zero two zero at two eight, gust to five zero, cleared for takeoff". The position of the Airplane at this time was on Taxiway NP between N1 and N2.
1515:48 UTC	Before takeoff checks below the line was completed by CM-1 and CM-2.

1515:50 UTC	Approaching Runway 05 Right, CM-2 commented: "OK, green lights are here".
1515:52 UTC	CM-1 said: "It's going to be very slippery. I am going to slow down a bit, slow turn here".
1516:07 UTC	CM-2 said: "And the PVD hasn't lined up ah".
1516:10 UTC	CM-1 said: "Yeah we gotta line up first".
1516:12 UTC	CM-3 said: "We need 45 degrees".
1516:23 UTC	CM-1 said: "Not on yet er PVD huh never mind we can see the runway, not so bad. OK, I am going to put it to high first. OK, ready eh, so zero one zero is from the left lah OK".
1516:36 UTC	Takeoff roll was commenced.
1516:55 UTC	CM-2 called: "Eighty knots".
1517:13 UTC	CM-2 called: "VEE one".
1517:16 UTC	CM-1 said: "- - - - something there".
1517:16 UTC	The FDR recorded the highest airspeed of 158 knots and Ground Speed 130.8 knots at the end of the data recording.
1517:17 UTC	Sound of first impact was recorded, followed by sounds of a series of impacts.
1517:22 UTC	The CVR recording ended.

1.1.2 Highlights from Flight Crew Interviews（Appendix 1-1）

1.1.2.1 CM-1 and CM-2 arrived at CKS Airport late in the evening of October 30, 2000 on SQ-006 from Singapore. CM-3 was a passenger on the same flight.

1.1.2.2 All 3 pilots were picked up from the hotel at about 1235 UTC, and reported for duty at CKS Airport, about 1355 UTC.

1.1.2.3 Upon request, the Crew of SQ-006 was assigned departure Runway 05L.

1.1.2.4 CM-1 selected this runway on the basis of the extra operational length available and the lower minimum visibility published for takeoff from this runway. Takeoff speeds had been set as follows: V_1 –142, V_R –156 and V_2 –169 KIAS. The Crew reported that they reduced the V_1 by 10 knots because the runway was wet.

1.1.2.5 CM-1 reported that he had operated into CKS Airport on more than 10 occasions using various runways, and had done about 10 night takeoffs from CKS Airport. He confirmed that he had previously operated into CKS Airport in rain and conditions of poor visibility.

1.1.2.6 CM-1 determined that the visibility, wind strength and crosswind component were within Company limits. CM-3 determined that the crosswind component was 28.5 knots. The maximum was 30 knots. The visibility was better than the minimum required for takeoff. CM-3 monitored the crosswind component from ATIS information as well as wind and weather information that the Control Tower provided to other flights.

1.1.2.7 CM-1 stated that he was aware of the NOTAM, which applied to works in progress on the northern apron and on Runway 05R. CM-1 stated that pre-briefed their taxi route to departure runway 05L via Taxiway SS, EAST CROSS, backtracking down Runway 05R, vacating via Taxiway N7, thence onto NP and N1.

1.1.2.8 CM-1 knew about the NOTAM relating to the closure of Runway 05R during his self-brief in Singapore. He said that he also noted the closure during his self-brief during the pre-brief for SQ-006 departure out of CKS Airport on October 31, 2000.

1.1.2.9 Both the official NOTAM and the Scandinavian Air System NOTAM were provided to the Flight Crew. The NOTAM made a reference to Aeronautical Information Publication (AIP) Supplement A007C015/00 dated October 3, 2000 for details. The Crew of SQ-006 could not recall the details of the supplementary SIA INTAM relating to runway lighting on Runway 05R, which was provided to them by the Flight Dispatcher as part of the pre-flight briefing package at CKS Airport.

1.1.2.10 CM-1 stated that the taxi clearance issued by Air Traffic Control (ATC) was different from the route that he had anticipated and briefed earlier. The final ATC taxi clearance was via Taxiway SS, WEST CROSS, NP for Runway 05L. CM-1 said he re-briefed the other pilots accordingly.

1.1.2.11 All 3 Pilots remarked about the power failures that occurred in the CKS Airport Main Terminal Building during their pre-flight preparations.

1.1.2.12 CM-1 stated that he had initially intended to let CM-2 operate the Taipei→Los Angeles sector, but CM-1 decided to carry out the takeoff from CKS Airport because of the typhoon. CM-1 performed pilot flying duties.

1.1.2.13 CM-1 stated that he taxied the airplane following the green centerline taxiway lighting via Taxiway SS, WEST CROSS, NP, and N1 onto Runway 05R.

1.1.2.14 All 3 Pilots stated that they thought that they were on Runway 05L.

1.1.2.15 CM-2 stated that as they were turning onto the runway, the Para-Visual Display (PVD) was not working. CM-3 stated that the airplane was not within 45 degrees of the runway heading as the reason for the PVD not activating. CM-1 said that he could see the runway.

1.1.2.16 CM-1 and CM-2 stated that the view of the runway ahead of them was normal. CM-3 stated that he was comfortable with the runway picture. CM-2 could not remember seeing any lights on the sides, but he stated that the runway picture looked correct. CM-1 did not recall seeing any other lights on the left side of the airplane.

1.1.2.17 CM-1 and CM-3 stated that they did not see any markings or obstruction lights that would indicate that the runway was closed. All airplane lights were switched on prior to commencing the takeoff roll.

1.1.2.18 CM-1 and CM-2 indicated that the airplane had already accelerated past V_1, when they saw objects on the runway. CM-1 said that he applied the elevator in an attempt to lift the airplane off the ground to avoid the object. All 3 pilots stated that they heard a thump/bang and the nose of the airplane slammed down on the runway and came to a stop.

1.1.2.19 CM-1 said that he made an evacuation announcement. All 3 pilots stated that the cockpit lost all electrical power when the airplane came to a stop. They stated that the cabin Passenger Address system (PA) and Very High Frequency (VHF) radio did not work. CM-1 ordered the evacuation of the cockpit. All 3 pilots stated that they evacuated the airplane via the upper left door.

1.1.3 Highlights from Flight Dispatch Interviews（Appendix 1-1）

1.1.3.1 SIA contracted with EVA Airways to provide flight dispatchers at CKS Airport. These dispatchers handle all computer flight plans and dispatch documentation for flights departing out of CKS Airport. The SQ-006 pilots were provided with a standard pre-flight briefing package. This contained weather information, NOTAM (from CKS Flight Information Service), the company INTAM and Scandinavian Airways Systems NOTAM.

1.1.3.2 EVA Airways Flight Dispatchers retrieve computer flight plans and INTAM from SIA. The EVA Airways licensed Flight Dispatchers check the documents to ensure compliance with SIA company policy before sending

a dispatch release to its Operations Officer at CKS airport who then delivers the pre-flight briefing documentation to the flight crew.

1.1.3.3 On October 31, 2000, the SQ-006 pilots received this documentation at about 1353 UTC at the aerobridge leading to Bay B5.

1.1.3.4 The EVA Airways Operations Officer stated that he highlighted (using a highlighter pen) certain information on the paperwork for SQ-006 on October 31, 2000.

[Note: Paragraphs 1.2 to 1.15 are covered in other Group Reports.**]**

1.16 Tests and Research

1.16.1 Taxi Trail Simulation（Appendix 1-2）

1.16.1.1 On Nov 6, 2000 a reenactment of the taxi route as taken by SQ-006 on Oct 31, 2000 was carried out using a Boeing 747-400 Freighter airplane at CKS Airport in visibility more than 10 kilometers and with slight rain. The aim of the reenactment was to familiarize accident investigators with aspects of the taxi route as well as the Runway 05L and 05R markings, signs and lighting. The weather and visibility conditions were much better on the night of the reenactment as compared to the night of the accident. A video and sound recording was made from the cockpit during the reenactment.（Attachment #1）

1.16.1.2 Observation according to the flight deck occupants during the taxi trail simulation:

1.16.1.2.1 The following markings and signs were observed in the vicinity of the approach end of Runway 05R:

(a) A black/red sign marked “N1/5R-23L” on the southwest side of N1.
(b) A white marking on the Runway 05R indicating “05” and “R”.
(c) A red “CAT 2” sign on N1 between 05R and 05L.
(d) A red/black sign marked “5L-23R/N1” on the northeast side of N1.

1.16.1.2.2 Additional Observations:

(a) The Instrument Landing System (ILS) localizer needle on both Primary Flight Displays (PFD) indicated full left deflection.

(b) The glide slope indicator showed one dot high on the left PFD and one dot low on the right PFD.

(c) The Navigation Display (ND) at the 10 NM range showed a small map error.

(d) There was no change (no map shift) on the Flight Management Computer (FMC) latitude & longitude when Takeoff/Go-Around (TOGA) button was activated.

(e) Runway lights on Runway 05L were difficult to see at ATC intensity level steps 1 & 2. (Runway 05L runway edge lights, touchdown zone lights and centerline lights has five intensity level steps.).

(f) There was no indication that the runway was closed nor was it possible to see any obstructions or obstacle lightings on the runway.

(g) After the airplane was lined up, the runway markings “05” and “R” were no longer visible from the flight deck.

1.17 Organizational and Management

1.17.1 Organization and Management of Civil Aviation Authority of Singapore

1.17.1.1 Organization

1.17.1.1.1 CAAS is a statutory board under the Ministry of Communications & Information Technology (MCIT) of Singapore. CAAS is the body responsible for the safety regulation of civil aviation in Singapore, and also the safety regulation of Singapore aircraft outside Singapore.

1.17.1.1.2 CAAS's aviation safety regulatory role and responsibilities cover the following:

(a) Regulating the operations and airworthiness of Singapore registered airplanes.
(b) Regulating the aerospace industry in Singapore.
(c) Licensing of flight personnel and maintenance engineers.
(d) Advising the Government on civil aviation matters.

1.17.1.2 Regulating the operations and airworthiness of Singapore-registered aircraft

1.17.1.2.1 Air Operator Certificate

CAAS issues an Air Operator Certificate (AOC) to Singapore operators for an aircraft to be operated for the purpose of public transport in Singapore. CAAS has established AOC requirements which are in accordance with ICAO Annex 6 – Operation of Aircraft and are published in the Air Operator Certificate Requirements (AOCR).

1.17.1.2.2 Operations Supervision

1.17.1.2.2.1 All aspects of airplane operation, including the management structure, adequacy of ground and flight crew and arrangements for their training, premises, equipment and airplane are assessed in relation to the scale, scope and circumstances of the operations. The operator is required to comply with, among other requirements, the ICAO Annex 6.

1.17.1.2.2.2 CAAS has a regular plan for inspection visits of each operating base (airplane ramp inspections and hangar maintenance inspections) and the operator's line stations. These checks are conducted to assess the suitability of an operator's organization, base facilities, overall standard of operation and level of compliance with regulatory and operations manual requirements.

1.17.1.2.2.3 Flight inspections are also carried out. The purpose of these checks is to assess the adequacy of the procedures and facilities provided by the operator to enable the crew to perform their duties both in the air and on the ground; to examine the standard of flight deck management and operations by the crew; and to assess the level of compliance with regulatory and operations manual requirements. The conduct of tests by CAAS authorized examiners and of crew training are also observed by CAAS.

1.17.1.3 Engineering and Maintenance Support

1.17.1.3.1 CAAS also assesses the operator's arrangements for engineering and maintenance support for the number, type and complexity of the airplane and the area and type of operations before issue or re-issue of the Air Operator Certificate.

1.17.1.3.2 CAAS performs regular safety oversight of the operator and his maintenance organization to check that they discharge their responsibilities to ensure that the airplane is airworthy for flight and that the airplane operated by the operator on such flights are operated safely in accordance with ICAO and Singapore airworthiness requirements. Regular inspection visits and audits are conducted on the operator, maintenance organization and line stations.

1.17.2 SIA Organization

1.17.2.1 The SIA Flight Operations Division (Appendix 1-3) is headed by a Senior Vice President who is responsible for the Division and also its organization, and development. The Division consists of 4 departments:-

(a) Line Operations,
(b) Training,

(c) Safety, Security and Environment, and,
(d) Flight Control Center.

1.17.2.2 The Line Operations Department is responsible for all Technical and Line matters related to operation of the four fleets in SIA and to ensure compliance with Singapore and international regulations.

1.17.2.3 The Training Department is responsible for all the flight and ground school training of technical crew, including recurrent training, base checks and line checks. The Training Department also oversees the safety equipment and procedures training for both flight and cabin crew.

1.17.2.4 The Safety, Security and Environment Department is responsible for:

(a) The reporting and investigation of all mandatory reportable occurrences,
(b) Training of flight and ground crew on security matters,
(c) Review and update of flight security,
(d) Cabin safety,
(e) Handling of Dangerous Goods procedures,
(f) Administration of a Flight Data Analysis Program.
(g) Security of all company property.

1.17.2.5 The primary function of the Flight Control Center Department is to ensure that Singapore Airlines' services operate with the least possible disruption or delay and that where services are disrupted or delayed, these services are rescheduled with the least possible inconvenience to passengers and at a minimal cost level consistent with safety, efficiency and service.

1.17.3 SIA Management

1.17.3.1 SIA Line Operations

1.17.3.1.1 The line operations management oversees the day-to-day operation of all fleets in SIA. This includes conduct and discipline of line crew, assignment of crew on all fleets, validity and currency of manuals and formulation of policies on operational matters.

1.17.3.1.2 The line management also ensures that crew comply with the procedures in the Flight Administration Manual and Operations Manual.

1.17.3.1.3 Singapore Airlines uses the Operations Manual as provided by the airplane manufacturers. SIA Line Management develops only the Operational and Fuel Policy chapters. The Normal Procedures and Checklist are customized for SIA. The SIA generated chapters and pages are submitted to CAAS for approval before promulgation.

1.17.3.1.4 The line management personnel also monitor and ensure the compliance of Air Operators Certificate Requirement (AOCR) by:

(a) Checking the Crew Operating Pattern (COP) for compliance with the approved flight time limitation scheme e.g. maximum permitted duty and minimum rest periods.
(b) Using computerized check-in system (Flight Reporting and Messaging System [FRAMS]) for flight crew to ensure validity of flight crew licenses, Base Checks, Line Checks and Safety Equipment and Procedures Training Competency Certificate and recency experience requirements before operating any flight.
(c) Reviewing of returned flight records documentation to ensure compliance.
(d) Conducting of all proficiency tests required by the AOCR (Base Checks, Instrument Rating Checks, Line Checks, CAT III/Low Visibility validation etc.) on each crew to ensure their competency.

Note: Aircrew Resource Management (ARM) – SIA's version of CRM for pilots is the responsibility of the Divisional Vice President (Projects).

1.17.3.2 SIA Training Department

1.17.3.2.1 The training department oversees training matters relating to flight crew, and, safety training for both flight and cabin crew. The department provides the following training:

(a) Aircraft Type Training
(b) Reactivation Training
(c) Recurrent Training

(d) Recency Training
(e) Reinforcement Training

1.17.3.2.2 In addition, the training department also provides joint safety and emergency procedures training and CRM training for cabin crew.

1.17.3.2.3 The training department also carries out command training for first officers selected for promotion to commanders and transitional training from piston engine airplane to jet engine airplane for pilots who have graduated from ab-initio training with the minimum 200 flying hours experience.

1.17.3.2.4 Selected training department personnel are also delegated by CAAS to carry out Authorized Flight Examiner responsibilities (Check Airmen) and to conduct ground school examinations on behalf of CAAS.

1.17.3.2.5 Six monthly Base Checks/Instrument Rating Test:
The Training Department conducts the Base Checks twice a year and the annual Instrument Rating Tests for all pilots in accordance with CAAS requirement.

1.17.3.2.6 Airplane Type Rating Training (Conversion Training):
The normal airplane type training comprises of the following:

(a) Two to 3 weeks of Computer Based Training on airplane systems, airplane performance and safety and emergency procedures.
(b) Ten to 15 simulator sessions covering Normal and Non-Normal procedures, including windshear, CFIT, FANS, CAT 3, TCAS, Unusual Attitude Recovery and Takeoff Safety Training.
(c) Airplane Base Training which includes engine-out approach, go-around and landing.
(d) At the end of the Ground/Simulator training phase, candidates will be required to pass the Airplane Rating Flight Test, Instrument Rating and an initial line check before commencing route training for 4 to 5 weeks.
(e) At the end of route training, candidates will be required to pass a final line check prior to being cleared for line duties.

1.17.3.2.7 Reactivation Training: This training is conducted for pilots who are returning to an airplane type they had flown previously or for familiarising newly

employed crew to SIA operational procedures and policy. The course comprises an abbreviated version of the Airplane Type Rating Training. (Conversion Training).

1.17.3.2.8 Recurrent Training: The department also provides a recurrent training program for all pilots twice a year. The program consists of 6 lessons which include Line Oriented Flying Training (LOFT) scenarios to refresh pilots on significant supplementary Normal and Non-Normal procedures not covered during the airplane rating tests. The emphasis in the LOFT focuses on flight deck management, situational awareness, leadership and resource management.

1.17.3.2.9 Recency Training: Recency Training is provided to pilots who have not operated an airplane for more than 28 days. The Recency training can be carried out in an airplane or in an approved simulator.

1.17.3.2.10 Reinforcement Training: The training department provides training for pilots who failed their proficiency tests and those who need extra training to address weaknesses.

1.17.3.2.11 Low Visibility Training: Low Visibility Training is given to pilots to qualify for CAT-III and Para Visual Display operations. It covers topics like ILS Critical Areas, lighting systems, runway and taxiway markings and the equipment required. The pilots are also required to view a video-tape on low visibility operations followed by training in an approved Level 2 simulator.

1.17.3.3 SIA Safety, Security and Environment Department

1.17.3.3.1 The Safety, Security & Environment Department is responsible for coordinating matters relating to flight, ground, industrial and fire safety; ground and flight security, and the environment.

1.17.3.3.2 The department manages a system for the reporting and investigation of all reportable airplane incidents and publishes a two-monthly summary of airplane incidents (for review and action) and an in-house safety magazine, the Flight Safety Review. This system is augmented by the administration of a Flight Data Analysis Program and the maintenance of replay

facilities for all QARs (Quick Access Recorders), FDRs and CVRs installed on SIA's airplane by the department. All ground incidents/accidents are investigated, and recommendations are made to prevent a recurrence.

1.17.3.3.3 In addition, it also produces and amends the Safety Equipment and Procedures Manual for cockpit and cabin crew. It also updates procedures for cabin safety and for the carriage of Dangerous Goods.

1.17.3.3.4 The department develops and promulgates security standards and provides specialist expertise and professional advice to Line Management on aspects of the security functions, e.g. intelligence, protection of company property and investigation. The department also provides training on security procedures to crew members, Station and Front-line Staff.

1.17.3.4 SIA Flight Control Center Department

1.17.3.4.1 Flight Control Center is responsible for the following decisions:-

(a) Cancellation of flights.

(b) Rescheduling flights due to weather, airport limitations, civil disturbances, crew duty time or sector limitations.

(c) Over-flights due to weather, airport limitations, crew duty time or sector limitations.

(d) Other issues related to delay, aircraft diversions, re-routing, rescheduling and recalling of flights, re-allocation of aircraft, recalling flights and/or repositioning of crews.

1.17.3.4.2 The function of the Flight Control Center Department is to ensure that a high level of discipline and operational efficiency are maintained especially when flights are disrupted, such services are re-scheduled with the least possible delay. This is achieved by carrying out regular evaluation of route and operational information, such as the serviceability of navigation aids, curtailment of airport facilities, refueling facilities and situations, meteorological warnings, crew duty and flight time limitations and other matters of immediate operational significance.

1.17.3.4.3 The department provide flight planning and associated dispatch services for flights operating out of Singapore, and for flights at line stations and planning flight re-routings as a result of tropical depressions, volcanic eruptions and airspace closures. This includes ensuring crew duty time and changes to crew operating patterns (as a result of flight delays or schedule disruptions) do not infringe any statutory requirement.

1.17.3.4.4 The department also ensures that manuals, documents and charts carried on board each airplane are kept up-to-date.

1.18 Additional Information

1.18.1 Witness Interviews

1.18.1.1 On the night of the accident, China Airlines Flight CI-004 was taxiing via Taxiway NP for takeoff on Runway 05L. The Pilot-In-Command (PIC) reported that wind conditions were gusty and it was raining heavily. The PIC stated that the performance calculations for takeoff had been based on a contaminated runway. The PIC stated that the visibility was not too bad and he did not think it was as bad as the RVR (Runway Visual Range) reported on the ATIS. He recalled that from Gate A7 he could see all the way to the end of Taxiway NP. The PIC reported that when his airplane was in the vicinity of Gate A7 he saw an airplane's landing lights on Runway 05R, followed almost immediately by an explosion. When he first saw the airplane he thought that it was about halfway between the runway threshold for 05R & Gate A6 and mentioned it to his crew. He did not recall seeing any lights on Runway 05R or 05L. The Taxiway NP taxi lights were switched on. The PIC also said that one has to have local knowledge and an alert mind otherwise one could mistakenly line up on Runway 05R.
（Appendix 1-4）

1.18.1.2 China Airlines Flight CI-065 had departed 16 minutes before the accident. The PIC recalled that he pushed back from either gate A5 or A7 and that he had been issued a taxi clearance along taxiway NP to Runway 05L. The PIC reported that he had made his takeoff calculations on the basis of ½ inch standing water on the runway. It was raining heavily at the time of his departure. The ATC Controller had appeared to lose visual contact with his airplane as they taxied along Taxiway NP in the vicinity of the Taxiway WEST CROSS. The PIC recalled that the airport was below landing minima. He did not require high intensity runway lighting for his departure and he confirmed that Runway 05L had the standard CAT-II runway lighting illuminated at the time his airplane departed. He held on the Runway threshold for 4 to 5 minutes before the crosswind component dropped sufficiently for the flight to proceed with the takeoff. The PIC could not recall if the runway lights were on or off for Runway 05R. （Appendix 1-5）

1.18.2 Interviews with Pilots who had flown with or checked the SQ-006 Pilots

1.18.2.1 Interviews were conducted with SIA pilots who had flown with or checked the SQ-006 pilots. Their views were consistent for each of the pilots and are summarized below:

(a) CM-1—A disciplined and skillful pilot who is thorough with his work. He is one of the better pilots in SIA. He is also a friendly and approachable person on and off duty.

(b) CM-2—An above average and disciplined pilot. He is also mature and would not hesitate to speak out on safety issues on a flight.

(c) CM-3—A mature and disciplined pilot with good flying skills. He is also forthright and respectful. He has the potential of becoming a commander in due course.

1.18.3 The Para-Visual Display (PVD) System

(Refer to Appendix 1-6)

IV. Attachments

1-1 **Taxi Trail Simulation**

V. Appendices

1-1	Interviews with the Accident Flight Crew and Dispatcher
1-2	Taxi Trail Simulation
1-3	Flight Operations Division Organizational Structure of Singapore Airlines
1-4	Interviews with CI-004 Captain
1-5	Interviews with CI-065 Captain
1-6	Para-Visual Display (PVD) System
1-7	Interviews with CI-004 First Officer
1-8	Interviews with CI-065 First Officer

Note： Appendices 1-7 and 1-8 are currently not cited in the report.
These may be used as future references for the investigation.