**Aviation Safety Council**

**Taipei, Taiwan**

# SQ006 Accident Investigation
# Factual Data Collection
# Group Report

## Survival Factors Group

**February 22, 2001**

ASC-FRP-01-01-006

## I. Team Organization

| |
|---|
| Chairman: |
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| Members: |
| 1. Pei-Da Lin<br>Engineer, ASC |
| 2. Lin Yon-ching<br>Instructor Chief ,Emergency Training, China Airlines |
| 3. Azone Lee<br>Assistant Engineer, ASC |
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| 6. Cynthia L. Keegan<br>Survival Factors Engineer, NTSB |
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| 8. Jan L. Risheim<br>Aerospace Engineer, FAA |
| 9. Rick Baggette<br>Lead Engineer, Boeing Commercial Airplane Group |

## II. History of Activities

| Date | Activities |
|---|---|
| 11/01/00 | 1. Reached the accident site for general view<br>2. Set up temporary command post at Tower area<br>3. Taking pictures<br>4. Communication with Operations of Airport<br>5. Reception and General Briefing of accident procedures in Taiwan to Accredited Representatives of Singapore<br>6. Prepared to interview pax and cabin crew<br>7. Took CVR and DFDR under the permission of District Attorney.<br>8. Set up telephone and fax system for CP with the help of CKS Airport Weather Station |
| 11/02/00 | 1. Made general briefing of factual information to Dr.Yong after his disembarkation from CI-007.<br>2. Looking for a better command post at terminal 2 with Dr.Yong. Dr.Yong decided to choose room 2009.<br>3. Reviewed the accident tape, which was made by a passenger in Central Control Room.<br>4. Took pictures and made site survey.<br>5. Arranging PWA, Boeing and Singapore representatives to join each of the investigation group.<br>6. Dr.Yong and all representatives have the first official meeting including AR of NTSB and MCIT of Singapore at 10 PM at CP 2009. |
| 11/03/00 | 1. Receiving documentation from SIA<br>2. Obtaining information from Manager Tsai of SIA<br>3. Interviewing the fire fighter chief<br>4. Interviewing injured passengers and cabin crew<br>5. Rear cabin damage inspection<br>6. Emergency exit slides inspection |
| 11/04/00 | 1. Continued interviewing injured passengers and cabin crew |

| | |
|---|---|
| | 2. After section structure integrity inspection<br>3. Emergency equipment inspection<br>4. Passenger and crew injury table making<br>5. Over head bin structure inspection<br>6. Removing tie rods and batteries of emergency lights |
| 11/05/00 | Free |
| 11/06/00 | 1. Started writing Survival Factors Report<br>2. Started compiling a passenger questionnaire<br>3. Visited the morgue and found out that all bodies had been released to the families and no death causes were determined for fatalities<br>4. Interviewed more passengers and cabin crew |
| 11/07/00 | 1. Working on factual report of S.F.<br>2. 1L, 2L slides inspection as they were not fully inflated<br>3. Removed 4 overhead bin tie rods for further metallurgical examination<br>4. Removed floor lighting batteries for inspection<br>5. Asked system group to help to check batteries condition<br>6. Completed pax questionnaire<br>7. Interviewed passenger who was from seat number 64H |
| 11/08/00 | 1. Interviewed a CKS airport senior flight operation officer who was one of those to reach the accident site first.<br>2. Factual report writing<br>3. Injured passenger and crew chart compiling<br>4. Requesting ATC group to get the tower transcript after the accident |
| 11/09/00 | 1. One more passenger interviewed<br>2. Requesting passenger address for sending the questionnaire<br>3. Slide condition further inspection by contacting BFGoodrich<br>4. A new battery was used to power up the door side emergency light. Found lights could be illuminated. |

| | |
|---|---|
| 11/10/00 | 1. Compiling S.F. preliminary report<br>2. Prepare to request for the report of cause of death from Ministry of Justice<br>3. Compiling interview report |
| 11/13/00 | 1. Connecting with BFGoodrich representative in Singapore and requesting BFG to send specialist to inspect the slides<br>2. Interviewing data compiling<br>3. Passing NTSB accident report number AAR-84/10, a KAL -084 ,DC-10 runway incursion and collision with PA-31-350<br>4. SF report compiling –Appendix and photos |
| 11/27/00~ 11/28/00 | Trip to SIA for cabin safety information |
| 12/01/00~ 12/30/00 | Factual report compiling |
| 01/03/01~ 01/20/01 | Factual report review |
| 01/15/01 | Slides 1L,2L and 4R were shipped to BFGoodrich, Phoenix |
| 02/02/01 | Pilot Interview |
| 02/05/01~ 02/06/01 | Final review of factual report of survival factors |
| 02/15 | Slides 1L,2L,4R examination in Phoenix |
| 02/19 | Fire Engine Running Test from Southern Station to far end of Runway 05L |
| 02/20-21 | Factual report verification |

## III. Factual Description

### 1.2 Injuries to persons

### 1.2.1 Injury Table:

Table 1.2-1 Injury table

| Injuries | Flight Crew | Flight Attendants | Passengers | Other | Total |
|---|---|---|---|---|---|
| Fatal | 0 | 4 | 79 | 0 | 83 |
| Serious | 0 | 4 | 35 | 0 | 39 |
| Minor | 1 | 9 | 22 | 0 | 32 |
| None | 2 | 0 | 23 | 0 | 25 |
| Total | 3 | 17 | 159 | 0 | 179 |

Note 1: 49 CFR 830.2 defines "Fatal Injury" as: any injury which results in death within 30 days of the accident" and "Serious Injury" as: "an injury which (1) Requires hospitalization for more than 48 hours, commencing within 7 days from the date the injury was received; (2) Results in a fracture of any bone (except simple fractures of fingers, toes, or nose); (3) causes severe hemorages, nerve, muscle, or tendon damage; (4) involves many internal organ; or (5) involves second or third degree burns, or any burn effecting more than 5 percent of the body surface."

### 1.2.2 Distribution of Injuries

The Boeing 747-400 was configured with 12 first class seats, 28 business class seats, and 316 economy class seats on the main deck and 30 business class seats on the airplane's upper deck. There were 2 pilots seats and 2 observer seats in cockpit; sixteen cabin crew seats positioned in forward, mid and aft section of the main deck cabin and 3 seats situated in the upper deck.

The following diagram (Figure 1.2-1) shows the passenger seat positions and the severity of injuries that they sustained. The information on the passenger seat position is from the airline-seating plan and from interviews with passengers.

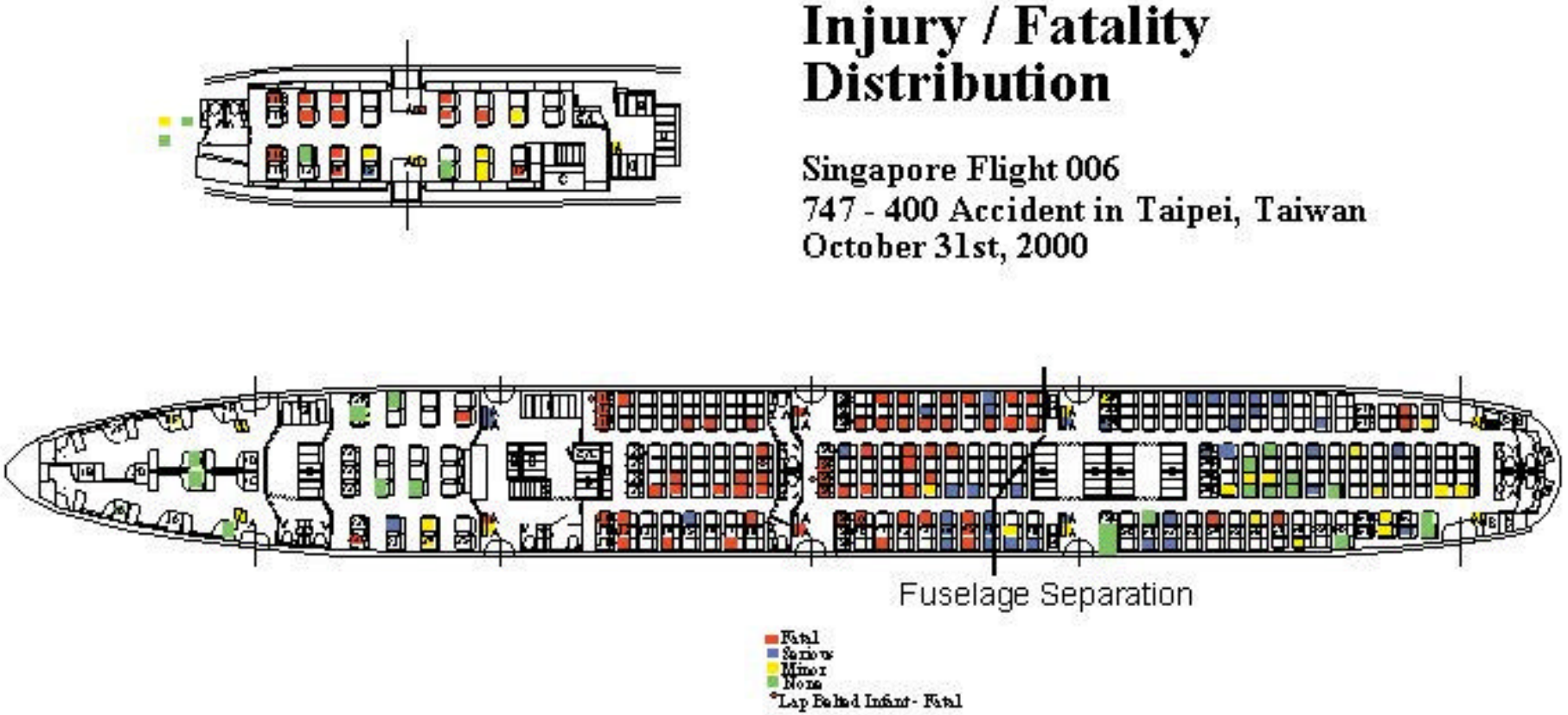



**Figure 1.2-1 Injury/Fatal Distribution**

### 1.3 Damage to Aircraft

The airplane broke into two main sections at about fuselage station 1560 and came to rest approximately 6,840 feet beyond the runway 05R threshold. The left and right wing remained attached to the forward fuselage section, which came to rest on a heading of about 085 degrees. It was reported from the fire fighters that the aft section was originally oriented on a heading of approximately 150 degrees resting on its left side. The final position of the aft section was found in the upright position and on a heading of 050 degrees.

The passenger seats that remained in the cabin of the tail section consisted of rows numbering from 49 to 64. The fuselage and the windowpanes along the left side of the fuselage were scraped and crazed.

The forward cabin and upper deck including the cockpit, first class, and business class were consumed by fire through to row 48 in economy class. The exterior left side of the fuselage from the upper deck door to the 3L door was not [1]consumed by fire.

#### 1.3.1 Cockpit Damage

The cockpit was consumed by fire.

#### 1.3.2 Cabin Damage

The forward cabin from business class on the upper deck, and first class at the nose of the airplane all the way through the cabin to row 48 was consumed by fire. The aft cabin which contained the seats and cabin furnishings from rows 49 through 64 separated from the airplane.

The airplane was equipped with 9 galleys. The forward galleys (G1, G2, G3, G3A, and G4) were consumed by fire. Galleys G5 and G6 had separated from the cabin floor and were found near the aft fuselage wreckage. The G7 and G8 galleys remained in the aft fuselage and were found leaning toward the left side of the cabin.

Examination of the emergency lights and floor proximity emergency lighting system positioned between doors 4 and 5 (figure 1.3-1,1.3-2) area revealed that each of the battery packs showed that they were completely discharged. See 1.16.2 for the emergency exit lights examination.

Figure 1.3-1 Illuminated Floor Proximity Lights during Testing

Figure 1.3-2 Illuminated Door 5 Left Emergency Light during testing
(The over door fairing panel was removed to access the emergency light battery check)

### 1.3.2.1 Cabin Crew Seats

The airplane was configured with 19 cabin crew seats. The seats are described as below table 1.3-1.

Table 1.3-1 Cabin crew seats condition

| Crew Seat Position | Condition of Cabin Crew Seats |
|---|---|
| Upper Deck Left | Consumed by fire |
| Upper Deck Right | Consumed by fire |
| Upper Deck Galley | Consumed by fire |
| Door 1L | Consumed by fire |
| Door 1R | Consumed by fire |
| Door 2L Outboard | Consumed by fire |
| Door 2L Inboard | Consumed by fire |
| Door 2R Inboard | Consumed by fire |
| Door 2R Outboard | Consumed by fire |
| Door 3L Outboard | Consumed by fire |
| Door 3L Inboard | Consumed by fire |
| Door 3R Inboard | Consumed by fire |
| Door 3R Outboard | Consumed by fire |
| Door 4L Inboard and Outboard | Forward inboard footing separated, significant structural damage surrounding the seat, inboard side of the seat frame separated from the seat back, seat pan is down and covered with debris. No fire or smoke damage. |
| Door 4R Inboard and Outboard  | Smoke and burn damage , handset interphone disconnected ,Seal broken on flashlight |
| Door 5L  | Not damaged |
| Door 5R | Not damaged |

### 1.3.2.2 Doors and Evacuation Slide/Rafts

The Door and Slide status are listed in the following table1.3-2:

Table 1.3-2 Doors and slides conditions

| Doors | Status | Open By | Slide Condition |
|---|---|---|---|
| Upper Deck Left | Open | Unknown | Deployed and burnt |
| Upper Deck Right | Open | Unknown | Not found |
| Door 1 Left | Open | 1L F/A | Not fully deployed |
| Door 1 Right | Closed | | Minor burn damage |
| Door 2 Left | Open | 2R(outboard) F/A | Not Fully Deployed |
| Door 2 Right | Destroyed by Fire | | Not found |
| 3L | Partially Open | Unknown | Moderate burn damage |
| 3R | U Destroyed by Fire | | Not found |
| 4L | Closed | | In Package |
| 4R | Open | Unknown | Auto Deployed in the Cabin |
| 5L | Closed | | In Package |
| 5R | Closed | | Auto Deployed in the Cabin |

Door 1L

Door 1L was found intact and in the "opened" position, its Mode selection lever: Found in the "Automatic" (i.e. Armed) position, Handle position: 11:00 relative to the door interior. The Power assist status: Power assist bottle was found burned – not able to determine status after accident

Slide Condition: The following information was obtained from this slide:

Door 1L Slide-BF Goodrich control drawing no. 7A1467-21 Rev M

S/N GH1651, date mfg. 1/96

Overhaul manual 25-66-19 Rev 6 or later

TSO 69B

The slide was found partially deployed outside the airplane. The fuse pins remained connected near the base of the girt skirts preventing the slide from fully deploying. The following fuse pin numbers were found connected:

?? 70 - connected

?? 480 - connected

?? 375 – connected

?? Burn damage was found at the door end of the slide

?? Found 1 inflator unit w/ the baffles sealed closed

Surrounding Structure: No significant damage noted to the door frame structure

Door 1R

Door 1R was found located in a pile east of door 1L. The post crash fire damaged the mechanism, however inspection of the Mode Selection lever mechanism revealed it to be in the "Manual" (i.e. Unarmed) position. Its handle was destroyed.

Power Assist status: Power assist bottle was found burned – not able to determine status after accident

Slide Condition: Un-deployed slide pack was found adjacent to the door frame structure. The slide pack appeared to have sustained minor burn damage

Surrounding Structure: None Found

Door 2L

Door 2L was found intact and in the "opened" position, its Mode selection lever: Found in the "Automatic" (i.e. Armed) position, its Handle was in the 9:00 o' clock position relative to the door interior. The Power assist status: Power assist bottle was found burned – not able to determine status after accident

Slide Condition: The following information was obtained from this slide:

Door 2L - BF Goodrich control drawing no. 7A1479-13 Rev 13
S/N G691, date mfg. 7/93
Refurbished per B.F.G. overhaul manual 25-66-18 Rev 6 or later Revision
TSO 69A

The slide was found partially deployed outside the airplane. The fuse pins remained connected near the base of the girt skirts preventing the slide from fully deploying.

?? 410 - connected

?? 70 - disconnected

?? 310 –main (larger) – connected 2 smaller – disconnected

?? Significant burn damage was found to the slide

?? The slide was burned away from the girt bar

?? Found 1 inflator with the baffle seal broken

Surrounding Structure: No significant damage noted to the door frame structure

Door 2R and Door 3R

Door 2R and Door 3R were found located in a pile east of the main wreckage of Zones B&C. The doors were badly damaged (burned), only a small portion of the door mechanism remained. It was not possible to identify which mechanism belonged to Door 2R or Door 3R.

Mode Selection lever: Not enough of the mechanism left to determine mode selector status, Handle Position: Not enough of the mechanism left to determine handle position, Power Assist status: Not enough of the door left to determine power assist status.

Slide Condition: Not Located

Surrounding Structure: None Found

Door 3L

Door 3L was found intact and in the "partially opened" position. Its Mode selection lever: Found in the "Automatic" (i.e. Armed) position. Handle position: 9:00 relative to the door interior. Power assist was destroyed by fire.

Slide Condition:

The slide was found on the ground below Door 3L.The slide did not appear to have inflate. Slide sustained moderate burn damage

Surrounding Structure: Door deformation noted in the girt bar area

Left Upper Deck Door

The L UD door was found intact and in the "opened" position. The bottom of the door structure was in contact with the ground. The door structure was supporting the remainder of the U/D frames

Its mode selection lever was found in the "Automatic" (i.e. Armed) position. Its handle was in the 'Up" position (90 degree relative to the door.) The power assist bottle was found burned – not able to determine status after accident.

Slide Condition:

The slide was found deployed but deflated outside of the airplane. Significant burn damage was found to the slide – only top 7 feet of the 46.5 foot

slide remain. Girt bar found attached to the sill
Surrounding Structure: Interior of the door shows no signs of exposure to fire

Right Upper Deck Door

The R UD door was found west of the main wreckage.
Mode selection lever: Not found
Handle position: Handle in the down (closed) position (10 degree relative to the door)
Power assist status: Not found
Surrounding Structure:

The door structure suffered significant burn damage. The area below the opening handle was missing. Burn damage to the exterior of the door was more significant than to the interior. Broomstrawing of hinge area indicates impact while hot

Slide condition was not found

Door 4R

Door 4R was not opened by cabin crew but found intact and in the "opened" position by the rescue people, its mode selection lever: Found in the "Automatic" (i.e. Armed) position, its handle was found in the 1:00 o' clock position relative to the door interior. Power assist status: Power assist bottle was found discharged

Slide Condition:

The slide was found deployed (deflated) inside the airplane – extended laterally to Door 4L. The cabin crew of 4R Inboard revealed that this slide inflated in cabin automatically. One inflator found with a scarf ingested into the unit (ser # 4079). One Inflator found with significant burn damage to the slide material adjacent to the inflator (Ser# 4089). Both Inflators P/N - 5A2870-1 Rev F.Slide pack board and door bustle found inside the cabin forward of the door. Inflator cable had NO "bullet"

Door 4L

Door 4L was found intact and in a "cocked open" position. According to interview data of the cabin crew the door handle was not touched during

evacuation. Its mode selection lever: Found in the "Automatic" (i.e. Armed) position, It' s handle was found in the 11:00 o' clock position relative to the door interior. Power assist status: Power assist bottle was found discharged.

Slide Condition:

The slide was found intact, not inflated and charged

Surrounding Structure:

Door frame/surround structure fractured on the forward side. Door frame separated from lining.

Door 5R

Cabin crew did not open door 5R that was found intact and in the "opened" position. This door was opened by the CVR/FDR retrieving people. Its mode selection lever found in the "Automatic" (i.e. Armed) position, its handle was found in the 12:00 o' clock position relative to the door interior, its Power assist status: Power assist bottle was found discharged.

Slide Condition:

Door 5R Slide–Slide/Raft Assembly Model 747

B.F. Goodrich drawing No. 7A1469-14 Rev 11

S/N G518

Date if Mfg 9/92

Overhaul Manual 25-66-20

Revision 4 or later

The slide was found deployed (deflated) on the tarmac near door 5R. Found slide w/ girt bar end attachment bracket engaged on the aft side.Forward girt attachment bracket found wrapped in the slide.Slide Pack board was found on the door. Door bustle found on the door with the aft upper attachment engaged..Inflator cable had "bullet" .

Surrounding Structure:

No damage noted

Door 5L

Door 5L was found intact and in the "closed" position, its mode selection lever: Found in the "Automatic" (i.e. Armed) position, its handle was found in the 2:00 o' clock position relative to the door interior, its power assist status: Power assist bottle was found charged

Slide Condition:

The slide was found intact, not inflated and charged

Surrounding Structure:

?? Upper door lining separated at all 3 upper bracket

?? Center tie rod clevis found fractured

The door 1 left, door 2 left and door 4 right slides recovered from the accident airplane were sent to the manufacturer, BF Goodrich for testing. The Survival Factors Group reconvened in Phoenix, Arizona, on February 15, 2001, at BF Goodrich Aerospace to examine the slide/rafts. See 1.16.3 for the test result.

### 1.3.2.3 Aft Fuselage Overhead Bins Damage

The center overhead bins separated from the upper fuselage frames at the tie rod ends (Figure 1.3-3) in the aft cabin between seats 54 D, F, G & H, and 60 D, F, G & H. Four of the fractured tie rods and one intact tie rod were removed for further metallurgical inspection and testing. The tie rods were removed from left to right and from the rear of the airplane to the front of the aft end of the cabin and were identified with masking tape as follows:

Tie rods - A, B, and C (from left to right)

Assembly: 1-6 (aft to forward)

Removed Tie Rods: 2A, 2B, 2C (intact), 3C, 5A, and 6B

The details of tie rod condition see the Table 1.3-3

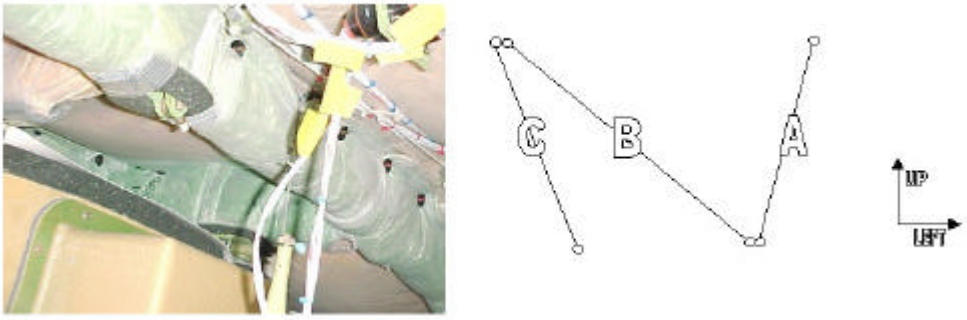



Figure 1.3-3 Tie rod photo

Table 1.3-3 Tie Rod Condition

| Assy # | A Upper | A Lower | B Upper | B Lower | C Upper | C Lower |
|---|---|---|---|---|---|---|
| 1 | Fractured | Attached | Fractured | Attached | Attached | Fractured |
| 2 | Attached | Fractured | Attached | Fractured | Attached | Attached |
| 3 | Fractured | Attached | Attached | Attached | Fractured | Attached |
| 4 | Attached | Fractured | Attached | Fractured | Fractured | Attached |
| 5 | Fractured | Fractured | Fractured | Fractured | Fractured | Attached |
| 6 | Attached | Fractured | Fractured | Attached | Fractured | Attached |

Frames at the following stations ruptured at stringer 1R near the B-Upper, C-Upper Tie rod connections: Station 1900,1960,1980,2000,2020,2040,2060 and 2080.

The fractured tie rods were inspected by the material lab of Chung Shan Institute of Science and Technology. Initial report stated that the main cause of fracture is overstress. (See Appendix 6-1)

### 1.5 Personal Information

There were 3 pilots and 17 cabin crewmembers onboard SQ006

#### 1.5.1 Cockpit Crew Interview

The Captain and the two First Officers were interviewed in survival factor aspects. See Appendix 6-2 for the interview notes.

#### 1.5.2 Cabin Crew Interview

The 13 surviving cabin crewmembers were interviewed. See Appendix 6-3 for the interview notes.

##### 1.5.2.1 Summary of Cabin Crew Interview Notes

**Takeoff**

There was nothing unusual about the take off, except for the rain and wind. There were 9 and 19 passengers seated at the main deck ands upper deck business class section respectively. Though the visibility was poor, the crew seated at door 5 left seat could see the runway edge light.

**Impact**

Cabin crew heard loud "bangs" and explosions on impact. Fire could be

seen outside the aircraft. Fire appeared at door 2 left and 2 right areas and fire, smoke and fumes entered the aft fuselage cabin section before the aircraft came to a stop. Fire was seen coming to the forward section from the mid-section.

**Door Operation**

The 1 left and 2 left main deck doors were open by the cabin crew seated at the respective positions. One of the two surviving cabin crew seated at the upper deck cabin, reported that the left upper deck door was opened by the cockpit crew and saw the other cabin crew who was seated at the right upper deck door seat attempting to open the right upper deck door but it did not open.

The 1 right and 2 right main deck doors were not opened because of the fire outside the door. The main deck doors 4 left and 5 left could not be opened as the left side of aft fuselage section was resting on the ground. Door 4 right was reported to have opened on impact without any operator action. Operation of door 5 right could not be attempted because the right side of the aft fuselage section was overhead and not reachable

**Slide Operation**

The door 1 left and 2 left slides did not inflate fully before it deflated. The cabin crew seated at the left upper deck door crew seat reported that the left upper deck slide did not inflate.

The slides at door 4 right inflated inside the cabin without any operator action. The inflated slide trapped the cabin crew seated at that position and separated the crew from the passengers seated opposite her. The slide at door 5 right inflated inside the cabin without any operator action. The inflated slide pinned the crew seated at that position and obstructed the escape path and vision of the crew.

**Exits Used**

The exits used for evacuation were the left upper deck door, the 1 left and 2 left main deck doors and the severed end of the aft fuselage section.

**Evacuation**

The 2 cabin crew seated at doors 1 left and 1 right evacuated with about 5 to 9 passengers through door 1 left. One cabin crew seated at door 2 left, the 2 seated at door 2 right and the 1 seated at the upper deck galley seat evacuated through door 2 left with about 3 to 4 passengers. All the 6 cabin crew seated at doors 4 left and right and 5 left and right evacuated through the severed end of

the aft fuselage section with about 30 passengers. The cabin crew fatality seated at door 2 left was momentarily seen at the upper deck. The first office (right hand seat) after evacuating through the upper deck left door signaled to those at the upper deck to follow him.

**Emergency Lighting**

The emergency lights and floor track path lights did not illuminate, except for the emergency exit light at door 4 left.

**Seat Belts and Shoulder Harness**

Cabin crew did not encounter any difficulties removing their seat belt and shoulder harness.

**Evacuation Commands**

The cabin crew did not hear any evacuation commands from the pilots. Passengers in the forward, mid and the aft cabin sections were given evacuation instructions.

**Evacuation Conditions**

The upper deck and forward cabin sections were filled with dense smoke and fumes and it was dark and difficult to see. The visibility within the forward cabin was about arms length and only silhouettes can be seen. Fire spread to the forward cabin during evacuation. The fire inside and outside the wreckage, poor visibility within the cabin because of smoke, the presence of fumes in the cabin and the heat from the fire hampered the evacuation process. The lack of useable exits, and the obstructions in and the orientation of the aft fuselage section also added to the difficulties

**Aft Overhead Storage Compartment**

The aft fuselage cabin section ceiling and center overhead storage compartments collapsed during the impact. The forward overhead storage bins collapsed.

**Post Evacuation**

After evacuating, cabin crew did not see any rescue personnel or noticed any fire fighting activities. The pilots assisted passengers at the crash site.

Some cabin crew had to guide and help their passengers to cross a drain and to get to the terminal building. Some of them were pickup by a bus approximately halfway between the drain and the terminal building.

There were a lot of comments by cabin crewmembers that there were barely any first aid facilities and medical assistance provided to them including

the injured at the terminal building. Most of the assistance they received were from their fellow crewmembers and passengers. When help arrived at the terminal building, there was poor co-ordination and identification of those who needed urgent medical attention.

### 1.5.3 Cabin Crew Training Record

The cabin crewmembers onboard SQ-006, received their initial and recurrent training at Singapore Airlines on the following date as listed in table1.5-1.

Table1.5-1 Cabin crew training record list

| Crew Seat Position | Initial Training Date | Recurrent Training Date | C-I-C(Crew-In-Charge) Recurrent Training Date |
|---|---|---|---|
| Upper Deck Left | 29 Oct 97 | 10 Oct 00 | Not Applicable |
| Upper Deck Right | 30 Jun 78 | 19 Sept 00 | 28 Apr 00 |
| Upper Deck Galley | 11 Nov 97 | 10 Oct 00 | Not Applicable |
| Door 1L | 25 Sept 90 | 30 Mar 00 | Not Applicable |
| Door 1R | 3 May 89 | 23 Aug 00 | Not Applicable |
| Door 2L, Inboard | 3 Aug 73 | 25 Nov 99 | 23 May 00 |
| Door 2L, Outboard | 21 Oct 98 | 11 Oct 00 | Not Applicable |
| Door 2R, Inboard | 23 Dec 87 | 13 Sept 00 | Not Applicable |
| Door 2R, Outboard | 7 Nov 79 | 20 Jul 00 | 13 Jan 00 |
| Door 3L, Inboard | Not occupied | Not Applicable | Not Applicable |
| Door 3L, Outboard | 13 Jul 92 | 31 Aug 00 | Not Applicable |
| Door 3R, Inboard | Not occupied | Not Applicable | Not Applicable |
| Door 3R, Outboard | 30 Apr 96 | 27 Apr 00 | Not Applicable |
| Door 4L, Inboard | 16 Oct 95 | 22 Aug 00 | Not Applicable |
| Door 4L, Outboard | 11 May 92 | 6 Apr 00 | Not Applicable |
| Door 4R, Inboard | 10 Aug 00 | Not due | Not Applicable |
| Door 4R, Outboard | 13 Jan 95 | 23 Dec 99 | Not Applicable |
| Door 5L | 24 Feb 00 | Not due | Not Applicable |
| Door 5R | 23Feb 00 | Not due | Not Applicable |

### 1.13 Medical and Pathological Information

The injured passengers were transported to the following hospitals: Chung-Li Ten-Chen Hospital, Tai-Yuan Ming-Sheng Hospital, Taipei Veteran Memorial Hospital, McKay Memorial Hospital, Lin-Kou Chang-Geng Hospital, Chung-Li Li-Shin Hospital, Taoyuan Min-Sheng Hospital, Tao-Yuan Hsin-Yang-Min Hospital. The pilots were sent to National Taiwan University Hospital.

The Department of Forensic Pathology Institute of Forensic Medicine, Ministry of Justice conducted some autopsy. The reports have not been submitted to ASC.

### 1.14 Fire

The forward and mid section of the B747-400 burst into flames immediately after the impact. There was a total of 123,000 kilograms of aviation jet fuel carried in the aircraft fuel tanks from load sheet. According to the CKS Fire Chief, the fire kept burning at the forward and mid section of the wreckage and consumed most of them. The fire was under control after 10 to 15 minutes, but flashback and re-ignition occurred and was fully extinguished after 40 minutes. There was only minor exterior fire damage to the aft section of the severed rear section.

As the fire fighters rushed to the site, they found the fuselage had broken into two parts. They found the engines had separated and debris were scattered on runway 05R. The airplane nose section, mid-section and wings were all on fire. The fire was intense because of the gusty wind conditions. .

Fire fighter chief ordered the fire fighters to position at up wind side and discharge the extinguishing chemical at the burning forward and mid-section of the aircraft. The fire fighters also sprayed chemical extinguishing agent into the cabin. Three passengers at the door 1 left area were rescued by fire fighters. The fire fighters saw two pilots waving their arms and shouting to the fire fighters. The fire fighters also rescued several burnt passengers who jumped out of cabin at the right hand side of the aircraft.

Fire fighters encountered intense fire around the nose and mid-section of fuselage. The fire at the tail section was less intense and was brought under control quickly. .

After other fire engines from Taipei County, Taipei city and Shin-Chu county

arrived, fire fighting was concentrating on the forward and mid section fuselage. By midnight most of the fire was extinguished except for the bottom of the wreckage. Water was used to cool the wreckage .

CKS airport fire fighting group (Figure 1.14-1) had used 40,000 gallons of water and 2,300 gallons of chemical in this action.

Figure 1.14-1 Fire Fighting Condition

### 1.14.1 Crash/Fire/Rescue (CFR) Response

Paragraph 1.14.1 is based on interview with the CFR of CKS Airport and Channel 1 Radio Communication Transcript. See appendix 6-4 for the interview notes.

#### 1.14.1.1 Activation phase

On 31 Oct 2000, the CKS South Fire Station audio crash alarm sounded followed by a RT transmission from ATC at 15:17:36 hours according to the translation of the Channel 1 Radio Communication Transcript. A telephone call from ATC was also made to CFR subsequently. The location of the crash site was given by ATC as on the runway in use, instead of a grid map position.

#### 1.14.1.2 Response phase

The initial responding fire-fighting vehicles by South Fire Station were 2 RIVs, 4 foam tenders, 1 nursing truck, 4 ambulances and 2 lighting units.

The driver of the first arriving vehicle, Fire Tender No. 3 was alerted by the sound of explosion and responded immediately in the general direction of Runway 05/23 by the appearance of fire prior to the alarm from the standby room. He encountered low visibility strong winds and heavy rain while responding to the crash site due to the typhoon conditions and monsoon flow. The fire vehicles responding from the South Fire Station were required to cut across an active runway (RW 06/24) and a taxiway before entering the north runway. They were guided along by the green centerline taxi lights along East Cross and the visual sighting of the fire at the crash site. According to Channel 1 Radio Communication Transcript, there was a transmission "Shoot chemical first. Shoot chemical first" at 15:20:45. The accident occurred at 15:17:17. There is no record on the arrival time of the second and subsequent fire tenders. The first responding vehicle, Fire Tender No. 3 did not communicate with ATC for clearance to cross the active runway while en-route to the crash site.

. The South Fire Station is operated at all times. Due to the closure of the North Fire Station, two tire tenders are stationed at the Domestic Terminal daily from 0100 hours to 1400 hours. The crash occurred 15:17:17.

The external supporting vehicles from other agencies started congregation at 15:40 from the North Gate, some requesting for directions to the crash site.

### 1.14.1.3 Fire-fighting and rescue operations

Upon arrival, all the fire tenders were positioned on the upwind side, surrounding the forward fuselage, in an arc formation from the North East to the Southeast. However, CFO was unable to recall the actual position of the individual fire tenders. On 21 February 2001, CFO provided ASC with a chart indicating the positions of the fire tenders at the crash site.

Accordingly to the driver of the first fire tender (Fire Tender No. 3), on arrival he immediately took up position on the upwind side of the crash site, between the nose and the left wing. He quickly carried out fire fighting intervention with the discharge of aqueous film fighting foam (AFFF) which was activated by a master switch from the driver cabin console panel.

Fire fighting efforts were concentrated initially on the critical area at the left fuselage and left wing root area. The fire subsequently spread to the rest of the aircraft. According to fire chief report, the fire was brought under control within 10 to 15 minutes. However, flash back and re-ignition occurred and the fire was extinguished approximately 40 minutes after the crash.

The fire at the APU area on the aft fuselage/tail section was extinguished within 40 to 60 seconds by Fire Tender No. 6. Entry was made into the tail section after the fire had been extinguished, however, CFR reported that they did not find any passengers or crewmembers inside the tail section. (It was reported by the pilots that a female passenger was carried out of the tail section by rescuers).

The initial fire fighting capabilities of CKS CFR deployed at the crash site were:

2 RIVs of 6000 litres,
4 foam tenders of 12,000 litres each,
1 foam tender of 14,000 litres,
for a total of 74,000 litres.

The extinguishing agents used were:

Water - 160,000 litres

AFFF- 7,000 litres

Fluoroprotein- 2,300 litres

Another 34 fire trucks, 54 ambulances and 7 lighting units from local fire stations, hospitals, police and military were arrived subsequently to support the fire fighting and rescue operations. A total of 4336 personnel were involved in the entire fire/rescue operations. The fire fighting and rescue people interview and communication reports see Appendix 6-4.

Table 1.14-1Emergency vehicle and manpower used in this occurrence

| **Organization** | **Fire Engine** | **Ambulance** | **Spot light Vehicle** | **Logistics Vehicle** | **Number of people** |
|---|---|---|---|---|---|
| CKS Airport | 9 | 4(One large Vehicle) | 3 | 15 | 100(64 in Fire Fighting) |
| Tao-Yuan County | 32 | 8 | | | 351 |
| Taipei City | | 7 | 3 | | 24 |
| Taipei County | | 16 | 2 | | 40 |
| Shin-Chu County | | | 1 | | 2 |
| Taoyuan Hygienic | | | | 2 | 3 |
| Tao-Yuan County Hospitals | | 17 | | | 34 |
| Tao-Yuan Police station | | | | 65 | 260 |
| Armed Forces Hospital | | 4 | | | 12 |
| Taoyuan airforce Base | 1 | 2 | | 20 | 350 |
| CPC Taoyuan Petroleum | 1 | | | | 3 |
| Air Police station | | | 1 | | 253 |
| Security Police Group #1 | | | | | 330 |
| Communication Police | | | | 1 | 9 |
| Taoyuan Military Police | | | | | 120 |
| Military Group#249 | | | | 30 | 720 |
| Taoyuan | | | | 7 | 20 |

| | | | | | |
|---|---|---|---|---|---|
| Airport Service Co. | | | | | |
| Eva Ground Service | | | | | 156 |
| Eva airlines | | | | | 37 |
| Eva Group Aviation Tech | | | | | 20 |
| China Airlines | | | | | 40 |
| Coast Guard | | | | | 30 |
| CAA,CKS Station | | | | | 20 |
| Dentist ASSO. | | | | | 21 |
| Medical Doctor Asso. | | | | | 21 |
| Tzeu-Gi Charity | | | | | 170 |
| Fa-Gu-San Foundation | | | | | 20 |
| Lin-Geo-San Foundation | | | | | 200 |
| Yuan Kwang Buda College | | | | | 300 |
| International Buda Asso. | | | | | 500 |
| Da-Yuan Catholic | | | | | 15 |
| China Christian Rescue Asso. | | | | | 150 |
| Yan-Ming Sea Transportation | | | | 5(40 feet refrigerator) | |
| Total | 43 Vehicles | 58 Vehicles | 10 Vehicles | 145 Vehicles | 4336 people |

Immediate rescue efforts were conducted by the firefighters upon arrival on site. Two passengers on the ground by the side of the aircraft and a passenger still strapped to his seat by the doorsill were rescued by the fire crew during the initial phase of rescue operations. All these three passengers had sustained severe burn injuries and were sent to the hospital by the CFR ambulances. No breathing apparatus was used during the rescue attempt (it was explained by CFO that the breathing apparatus were not used because the rescuers were in the upwind position).

Accordingly to the Chief of Flight Operations Section, he picked up 7 to 8 passengers with minor or no injuries and suffering from shock and sent them to the CCS.

None of the CFR personnel were injured during the entire rescue efforts.

Replenishment of the fire tenders with water was from the hydrant near to the north fire station as well as from the south fire station.

No complimentary extinguishing agents, i.e. dry chemical powder, BCF or CO2 were used in the entire operation.

#### 1.14.1.4 Casualty Clearance Station

No triage and mobile casualty clearance areas were set up at the crash site due to the typhoon conditions. The Chief of Flight Operations Section who was the on-scene commander instead established Flight Operation Information Services, which was below A9 boarding gate as the Casualty Clearance Station (CCS). There was no medical facility initially at the temporary designated CCS. Two of the staff from Flight Operations Section with first aid skills were tasked to take charge of the CCS and also to inform all agencies of the establishment of A9 as the CCS. The command of the CCS was subsequently handed over to the Medical Coordinator from the Bureau of Hygienic and Health, Touyan County.

The first 10 survivors were sent directly to the local hospital by the 4 CFR ambulances because of the typhoon conditions. CFR was unable to recall the time when the first casualty was picked up or when the first ambulance departed with the casualties. The subsequent casualties were sent to the temporarily designated CCS, below A9 boarding gate.

After the CFR ambulances were dispatched to the local hospitals, there was no medical aid at the crash site until the arrival of the first local hospital ambulances at about 15:40 hours. Some of the local hospital ambulances were dispatched to CCS.

Survivors from the crash site were transported to CCS by ground service vehicles, airport authority vans and ambulances. Some passengers walked to the CCS drawn by the flashing beacon lights of the emergency vehicles that had responded there.

### 1.14.1.5 On Scene Command & Control

A bus was set up at 50 meters east of the tail section as a mobile command post about one hour after the crash and was manned by flight operations of the airport authority. No common radio frequency was used. The rescue agencies were operating on their individual organization's radio frequencies to communicate with their own units at the site.

The security of the crash site was handled initially by the airport police, who were subsequently assisted by the local military police.

### 1.14.2 Exercises of airport emergency response

According to the airport emergency response planing, the aircraft crash exercises of CKS airport were conducted twice annually, of which one is on a large scale involving all external agencies. The last large-scale exercise was conducted on 5 July 2000.

The Breathing Apparatus(BA) and hot fire training for CFR personnel are conducted once every three months. The hot fire training is conducted at their hot fire training area while BA training is accomplished without any simulated conditions.

## 1.15 Survival Aspects

### 1.15.1 Evacuation

According to cabin crewmember, flight crewmember and passenger statements, the passengers and crewmembers evacuated the airplane through the left upper deck door, the 1 left and 2 left main deck doors and the severed end of the aft fuselage section around row 49.

The cabin crewmembers did not receive the evacuation command from the cockpit. Attempts by the commander of the aircraft to order the evacuation over the PA were unsuccessful because there was no electrical power on the aircraft.

### 1.15.2 Environmental Conditions

The evacuation was conducted in darkness and typhoon conditions. The weather at the time of the accident was reported by ATC as heavy rain with wind of 020 degrees at 36 knots, with gusts up to 56 knots.

### 1.15.3 Evacuation Conditions

Interview statements from the survivors indicates that there was fire, smoke and fumes in the cabin before the aircraft came to a stop. Crewmembers reported that, the fire inside and outside the wreckage, poor visibility within the cabin because of smoke, the presence of fumes in the cabin and the heat from the fire made evacuation very difficult. The lack of useable exits and the orientation of the tail section also added to the difficulties. Despite the difficulties they were able to evacuate the passengers.

### 1.15.4 Exit Door Operation

Interviews with both the flight and cabin crewmembers found that both the left and right upper deck doors and the 1 left and 2 left doors were opened by cabin crew. The cabin crew did not attempt to open doors 1 R and 2 R because of fire at the vicinity of the doors. Doors 4 L and 5 L could not be opened because it was lying against the ground. Door 4 R was reported to have opened on impact without any operator action. Operation of door 5 right could not be attempted because the right side of the aft fuselage section was overhead and the door was not reachable. The door 3L was found partially opened. The operation of door 3 R cannot be established because the cabin crew assigned to this door was amongst the fatalities

### 1.15.5 Slide Operation

Both the flight and cabin crewmembers indicated that the slides of the left upper deck door and doors 1 L and 2 L used for evacuation were automatically inflated, but subsequently deflated because of fire damage.

The door 1 left and 2 left slides did not inflate fully before it deflated.

The slides at doors 4 R and 5 R inflated inside the cabin without any operator action. The slides at doors 1 L, 2 L and the 4 R were examined by BF Goodrich for physical examination and lab type test.

### 1.15.6 Slide Operating Limits

At the accident site, the wind was reported up to 56 knots. Slides are tested for use in up to a 25 knots wind in the most critical wind direction in accordance with FAA requirement. See Appendix 6-5.

### 1.15.7 Post Evacuation

Based on cabin crew and passengers reports, after evacuating from the aft fuselage section, they did not see any rescue personnel or noticed any fire fighting activities taking place. Cabin crew had to guide and help their passengers to cross a drain and to get to the terminal building. Some of them were pick-up by a bus approximately halfway between the drain and the terminal building. A review of the videotape (see appendix 6 -8) taken during the time of the accident by a passenger onboard China Airline CI 004 departing for San Francisco showed that some passengers walked all the way to the terminal building. There were a lot of comments by crewmembers and passengers that there were barely any assistance provided to them including the injured at the terminal building. Most of the assistance they received was from their fellow crewmembers and passengers. When help arrived, there was poor co-ordination and identification of those who needed urgent medical attention.

### 1.15.8 Passenger Information

There were 153 adults, 3 children and 3 infants onboard SQ006. Nineteen adult passengers from the flight were interviewed. See Appendix 6-7 for the passengers' interview notes. Additionally, a set of questionnaires was developed and sent to all the surviving passengers. A sample of the passenger questionnaire is included in Appendix 6-8 of this report.

## 1.16 Tests and research

### 1.16.1 The post emergency response time tests

**From South Station to Crash Site**

A test was conducted on 12 December 2000 at 1355 hours to determine the response time for the CKS Airport ARFF to respond to a crash alert. It was conducted at a close to optimum conditions, i.e. good visibility, no rain but damp surface. Prior clearance was obtained from ATC to conduct the test, as the CKS airport runways were active. The route taken for the test was across runway 06/24, along East Cross to its intersection of RW 05R/23L, along RW 05R/23L to the intersection of N7 and RW 05R/23L (crash site).

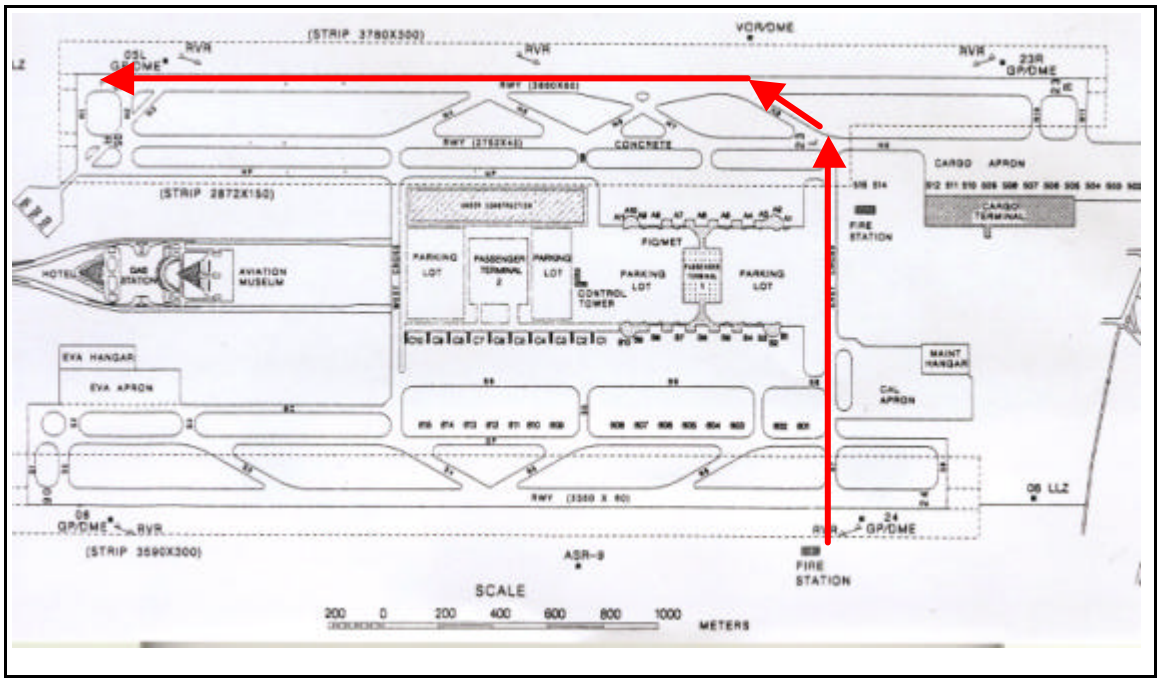
The No. 3 foam tender was chosen to participate in the test by ARFF, as it was the first responding fire vehicle to arrive at the scene on 31 Oct 2000. The results of the test were recorded as follow:

| | | |
|---|---|---|
| 0 seconds | - | Crash Alarm |
| 22 seconds | - | Vehicle leaves station |
| 39 seconds | - | Cross RW 06/24 |
| 1 min35 seconds | - | Intersection of East Cross and RW 05R/23L |
| 2 mins11 seconds | - | Discharging Water at the intersection of N7 and RW 05R/23L. |

**From South Station to the start of runway 05L**

Another test was conducted on 19 February 2001 at 1700 hours to determine the response time for the CKS Airport ARFF to respond to a crash alert. It was conducted at an optimum condition, i.e.good visibility and no rain.

Two fire tenders were involved in the test. Fire tender No.1 loaded with 6000 liters and No.3 with 12000-liter of water. The fire fighters were on standby in their rest area. ATC clearance to cross runway 06/24 was requested from the dispatching office after the alarm sounded. The fire tenders were cleared to cross the active runway by the tower. The route taken by the fire engines is highlighted in the chart below. No. 3 fire tender reached the runway end in 2 minutes 48 seconds followed closely by No. 1 fire tender.




**Test Result**

Fire Alarm Time 17:47:44

Vehicle leaved station 17:47:54

Cross Runway 06 on East cross 17:48:14

NP 17:49:04

05L 17:49:19

First shooting before 05L threshold 17:50:32

Elapsed Time 2 minutes and 48 seconds

ATC clearance was obtained before the fire tender reached the holding point of runway 06/24. As a result the fire tenders were able to cross 06/24 without having to stop at the holding point. Marshals were pre-deployed to control vehicular movements along the route taken by the test vehicles.

In January 2001, the CKS Fire Service has placed a 24 hours standby fire-fighting group at the Domestic Terminal.

### 1.16.2 Emergency Exit Lights Test

Four emergency lights battery packs were removed from E zone. These packs were located in the overdoor fairings at doors 4L, 4R, 5L, and 5R. The fifth pack was not recovered.

Battery locations, part number and serial numbers as listed Table 1.16-1.

Table 1.16-1 Battery part and serial number list

| Location | Part Number | Serial Number |
|---|---|---|
| 4L | 2013-1A | 20350 |
| 4R | 2013-1A | 20130 |
| 5L | 2013-1A | 31828 |
| 5R | 2013-1A | 9599 |

The battery packs were tested to determine their state of charge following the accident at China Airlines workshops at CKS airport. Each of the four packs was subjected to a 7 amp light load, as is used during functional testing of serviceable batteries. When each battery pack was connected to the load, the voltage across the terminals briefly rose to approximately 5.2 volts DC, and then dropped to less than 0.1 volts DC within 10 seconds. These readings are consistent with battery packs that are fully discharged. All four battery packs behaved the same way.

In the airplane, the control circuit wiring was checked to each of the four packs. Using a digital ohm meter, the resistance from pin 3 and pin 4 to pin 1

(airplane ground) was measured on the ship side wiring at each battery charger location. Pin 1 to pin 3 was an open circuit. Using the digital ohm meter, the measured resistance between pin 1 and pin 4 alternated between ~650 ohms and open circuit. The meter did not stabilize on a single reading. When this test was conducted, the remaining battery chargers were connected to the ships wiring. All four locations yielded the same results.

A serviceable and fully charged battery was obtained and used to sequentially test the emergency lights in E zone. The results are listed to be Table 16.2-1. Lights not mentioned were not visible in the wreckage or were not noticed.

Table 16.2-1 Emergency light test result

| Location | Light | State |
|---|---|---|
| 4L | Exit sign above and beside door | Off |
| | Floor light adjacent to attendant seat forward of door | Off |
| 4R | Ceiling mounted emergency light in overdoor fairing | On |
| 5L | Exit sign above and beside door | On |
| | Exit sign above aisle just forward of door 5L | On |
| | Floor prox lights on outboard side of left aisle | On from door 4L to 5L |
| 5R | Exit sign above and beside door 5R | On |
| | Floor prox lights on outboard side of right aisle | On aft of seat row 57 |
| | Exit sign above aisle just forward of door 5R | On |

### 1.16.3 Evacuation slide/raft examination

The L1, L2 The L1,L2 and R4 slides were sent to manufacturer for inspection

and R4 slides were sent to manufacturer for further inspection on February 15,2001 .

### 1.16.3.1 Examination of the 1L Slide/Raft

The data on the upper ply of the girt was as follows:

Slide/Raft Assembly, Model 747

B.F. Goodrich

P/N 7A1467-21
S/N GH1651
Date of Manufacture 1/96
Boeing SCD P/N S416U001-113
TSO C69b

Examination of the 1L slide/raft was found burned through the slide/raft material on the aft pusher tube section that measured 20 inches long, 12" from the aft side of the girt bar and a 13 X 7 inch section of the aft lower pusher tube was melted. The aft left corner of the head end tube had melted material at 3 locations that were 4 inches apart and approximately 7 inches long. All of these burned sections of material would normally contact the fuselage when the slide/raft inflates.

There was no burn or fire damage to the red boarding strap adjacent to the melted aft pusher tube. The strap does not normally make contact with the side of the airplane. The forward ballast bag is melted and 2 small melted holes were found in the forward side of the bag ballast material.

The first main restraint (375 lot #2984, P/N 150125) from the top of the slide/raft did not release. The group removed the restraint and tested it on an Instron Load Tester. It released at 401 lbs. The release is rated for 375 lbs with a +- 6% tolerance (or 23 lbs)2. The 2 (70 lb.) aspirator restraints had released.

The regulator's (located on the inflation cylinder, S/N 1025) firing cable was fully extracted and the trigger levers were in the fired position, and the firing piston was in the up (fired) position. The manual inflation handle is in its stored position attached by velcro to the girt flap. The fusible plug was intact. The gage elbow was rotated about 10 degrees. The data stamp on the inflation bottle (S/N 411-9322) revealed that the last hydrostatic test was February 1999. The bottle had a long cut through its upper layer fibers, and the bottle had two areas where it was deformed inward (valleys), and its inflation hose had some abrasion damage. The inflation bottle had a rivet head imbedded in the lower side of the bottle just above the bottom hemisphere.

The forward aspirator flappers were found opened and its closure sleeve was found closed.

Small cuts were found in between the first and second canopy tubes on the

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[2] It is not known how elevated temperatures will affect the performance of the restraint.

upper and lower main body inflation tubes along forward side of the slide/raft. There were also some jagged small holes on the upper main body inflation tube by the second canopy support tube. The slide/raft' s center tube had a 3-inch section of melted material and a 20-inch torn section of center tube, adjacent to the third canopy support tube.

The forward sliding lane was torn and scraped adjacent to the 3rd and 4th canopy support. The slide/raft' s toe end lifeline separated at the aft side of the slide. The intermediate tension strap attachment had separated from the slide/raft.

The aft lower main body tube had a 30-inch tear, a 12-inch tear, and a 8 X 6-inch "L" shaped tear between the 2nd and 3rd canopy support from the toe end of the slide. The tension strap was cut at the wrap around tube, and there were tears (10 x 9-inch "L" shape, and 12-inch) in the aft main body tube. There were tears (12 x 16 inch "L" shaped tear, and 2- 5-inch tears) between the 1st and 2nd canopy support. The upper main body tube had a 4-inch tear adjacent to the 2nd canopy support tube from the top of the slide/raft. The aft aspirator flappers were in the closed and locked position.

**1.16.3.2 Examination of the 2L Slide/Raft**

The data on the upper ply of the girt was as follows:

Slide/Raft Assembly, Model 747
B.F. Goodrich
P/N 7A1479-13, rev "R"
S/N G691
Date of Manufacture 7/93
Boeing SCD P/N S416U001-213
TSO C69a

The examination of the 2L slide/raft found that the girt material was consumed by fire had separated from the girt bar, but remained attached at the forward strap. The slide' s main restraint had been manually detached at the lower clevis. Both of the upper 70 lb. restraints had released. The forward and aft aspirator flappers were open and the sleeves were closed.

The regulator' s, (P/N 5A2851) firing cable was fully extracted and the trigger lever was in the fired position, and the firing piston was in the up (fired) position. The manual inflation handle is in its stored position attached by velcro

to the girt flap. The fusible plug was intact.

There was a 30 x 60 –inch area of slide/raft lane and surrounding main body tubing that was consumed by fire (the edges were melted and charred) about 70 inches below the girt bar. There was a 4-5 –inch section of molten slide/raft material in the toe end of the main body tube. Both the lower 70 lb. restraints had released. There was a 12 x 18 –inch section of slide/raft material that was consumed by fire (the edges of the hole were melted and charred), the Kevlar tension webbing was charred and melted, and there was an 8-inch tear above the forward aspirator.

**1.16.3.3 Examination of the 4R Slide/Raft**

The data on the upper ply of the girt was as follows:

Slide/Raft Assembly, Model 747
BFGoodrich P/N 7A1467-24 Rev "I"
S/N GH1426
Boeing SCD P/N S416U001-414
Date of Manufacture 1/94
TSO-C69b

The 4R slide/raft was rolled out for review. The inflation cylinder bottle was missing and the inflation hoses were cut adjacent to where the bottle had been. The manual inflation handle is in its stored position attached by velcro to the girt flap.

The aft aspirator had fabric ingested through one of its flappers. The other three flappers were closed. The fabric was removed from the aspirator and appears to be similar to the Singapore cabin crewmembers uniform fabric. The forward aspirator flappers were open, and the closure sleeve was closed. Soot was visible inside the aspirator. There was a 6 x 3-inch hole with molten edges on the aspirator tube, and several smaller holes near the aspirator area. The mooring line release pouch was slightly melted.

There was a long series of holes with molten edges, surrounded by blistered fabric along the upper main inflation tube on the forward side of the slide/raft. The first hole was 18 inches long, located near the second canopy support tube from the head end. The second hole was 32-inches long and located on the toe end side of the cross tube. The adjacent ballast bag walls were stuck together. The third hole was 7 inches long and located near the

second canopy tube from the toe end of the slide/raft. There was one small tear in the forward cross tube next to the center tube.

The aft aspirator restraint remained connected (did not release.) The forward aspirator restraint had released. The main 375-pound restraint was found connected but the lower clevis was disconnected and the clevis pin was missing. The 70-pound restraint on the aft side of the lower slide/raft was found connected, and the forward restraint had released. The lower center frangible restraint was connected, the geometric release cord was fully extended, and the attached pin pulled free from the restraint. The inside of this restraint' s pouch was discolored (rusty).

## IV. Appendices

Appendix 6-1 Tie Rods Test Result

Appendix 6-2: Survival Factor Aspect Interview Notes of Cockpit Crew

Appendix 6-3: Cabin Crew Interview Notes

Appendix 6-4: Cks Airport Flight Operation Reports and Interview Notes

Appendix 6-5: Slide Operating Limits

Appendix 6-6: Videotape Taken by Passenger Of CI 004

Appendix 6-7: Passenger Interview Notes

Appendix 6-8:The Questionnaire for Survival Passenger