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SURVIVAL FACTORS GROUP FACTUAL REPORT OF
INVESTIGATION

By: Cynthia Keegan
(16 page)

**NATIONAL TRANSPORTATION SAFETY BOARD
OFFICE OF AVIATION SAFETY
WASHINGTON, D.C.**

January 22, 1998

SURVIVAL FACTORS GROUP FACTUAL REPORT OF INVESTIGATION

A.	<u>ACCIDENT</u>	:	DCA97MA058
	LOCATION	:	Nimitz Hill, Guam, Mariana Islands
	DATE	:	August 6, 1997
	TIME	:	0142 Local Time
	AIRPLANE/OPERATOR	:	Boeing 747-3B5B (300), S/N 22487, Flight 801, Operated by Korean Air

B. Survival Factors Group

Group Chairman	:	Cynthia L. Keegan National Transportation Safety Board Washington, D.C.
Member	:	Bryan Stott Bureau of Air Safety Investigation(BASI) Canberra, Australia
Member	:	Jun, Kyung Jong Korea Air Seoul, Korea
Member	:	Hong, Sung Yul Korea Air Seoul, Korea

C. SUMMARY

On August 6, 1997, at approximately 0142 Guam Local Time, a Boeing 747-300 (3B5B), operated by Korean Air Co. Ltd. as Korean Air flight 801, en route from Seoul, Korea (RKSS) to Agana Guam, crashed on approach to runway 6 Left at the Guam International Airport (PGUM).

At the time of the accident the glide slope associated with the instrument landing system (ILS) to runway 6L was out of service and the crew was conducting a "localizer only" approach to the runway when the airplane contacted high terrain approximately 3 nautical miles southwest of the airport.

The 0132 reported weather at Guam International indicated that the wind was from 090° at 6 knots; visibility was 7 statute miles with showers and there was a scattered layer of clouds at 1,600 feet, a broken layer at 2,500 feet and an overcast cloud layer at 5,000 feet.

The flight was operated as a scheduled 14 Code of Federal Regulations (CFR) Part 129 passenger flight. There were two pilots, one flight engineer, one purser, 19 flight attendants (includes six deadheading flight attendants) and 231 passengers on board the airplane at the time of the accident. The airplane was destroyed by impact forces and a post-accident fire. Of the 254 occupants on board, 225 were killed; and 25 passengers and 4 flight attendants survived the accident with minor to serious injuries. However, during the 30 days following the accident, two passengers and one deadheading flight attendant succumbed to their injuries.

D. DETAILS OF THE INVESTIGATION

1. Airplane Configuration (See Figure 1)

The cockpit was configured in the standard captain, first officer, second officer arrangement, and two observer seats (which were not occupied for the accident flight.)

The cabin was divided from fore to aft in three sections: first class, prestige class (business), and economy class, with a total of 385 seats. There were 16 first class seats divided into two sections longitudinally separated by an aisle.

Prestige class had of 66 seats. Twenty-eight Prestige seats were located on the main deck and were divided into three rows of double seats longitudinally separated by two aisles. Thirty-eight Prestige seats were located on the upper deck and are divided into two rows of double seats longitudinally separated by one aisle. On the left there were 18 seats and on the right there were 20 seats.

There were 303 seats in economy class divided into three sections longitudinally separated by two aisles. On the left there were 104 seats, in the center there were 100 and on the right side there were 99.

There were 4 rear facing double occupancy flight attendant jump seats and 6 rear facing single occupancy flight attendant jump seats each equipped with 4-point restraint systems. Five emergency exit doors were located on each side of the cabin. (See Figure 1 for location of the cabin configurations and emergency exits.)

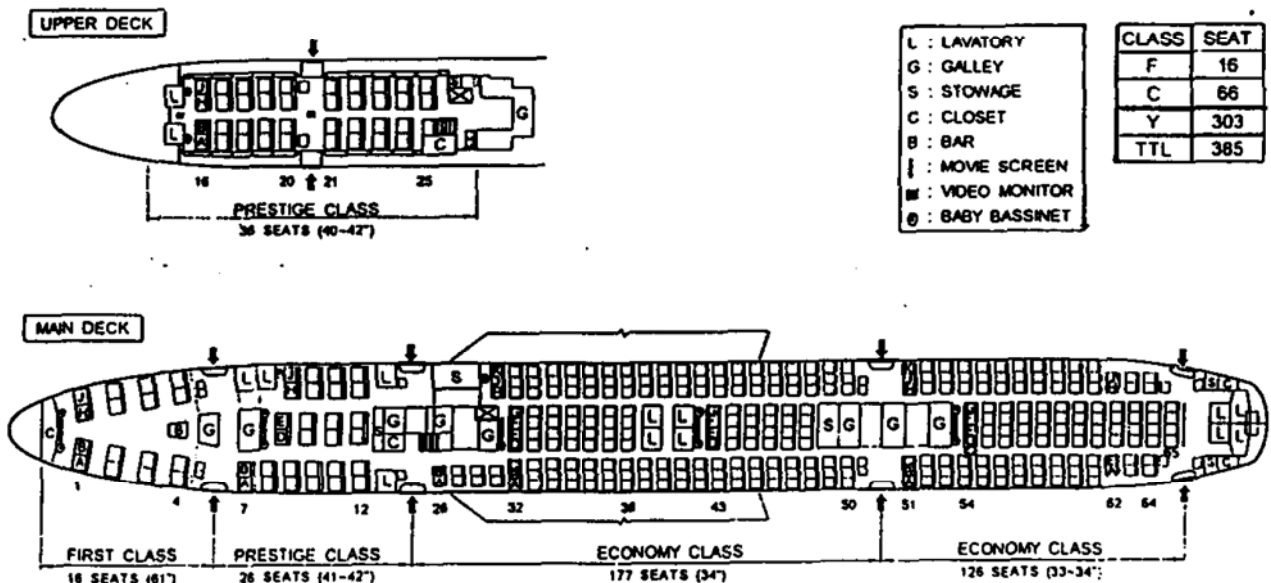


Figure 1

Cabin Configuration

The cabin also had bassinets for infants for in-flight use only, and not for takeoff and landing. The bassinets could be installed on the aft wall of the closet in first class; on the aft wall of the galley's near rows 7, 32 and 54, seats E and D, and seats D, E, F, and G respectively; and on the aft wall of the lavatory in front of row 43, seats D, E, F, and G as required. A diagram of the basset is shown in Figure 2 below:

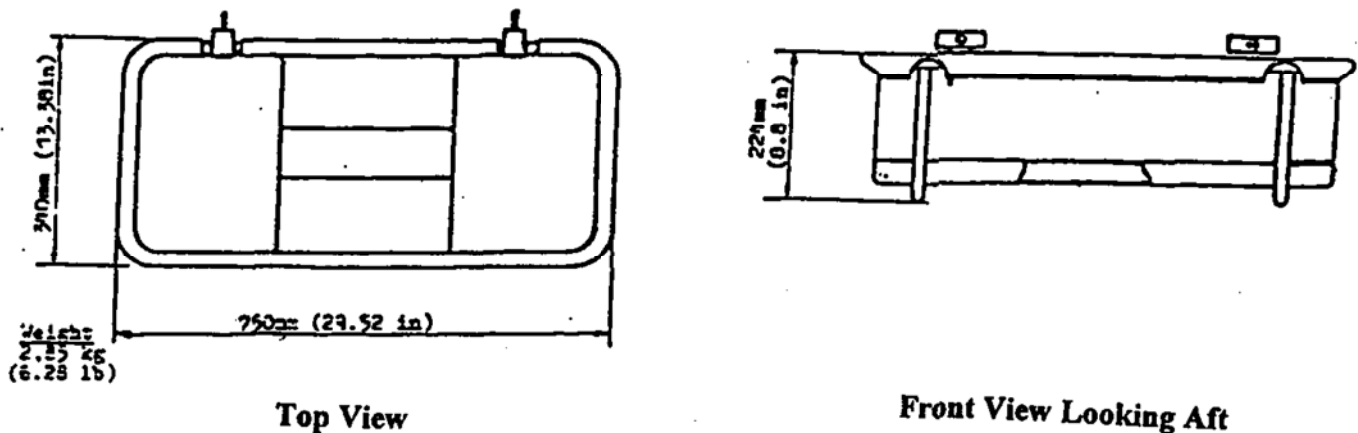


Figure 2
Baby Bassinet

2.0 Crew Information

2.1 Cabin Crew

Two of the surviving flight attendants were transported to the Guam U.S. Naval Hospital, and one was taken to Guam Memorial Hospital. Following their admittance to the hospitals two of the flight attendants who had serious burns to their faces and extremities were medevaced to Seoul, Korea, before they could be interviewed by the Survival Factors Group.¹ The fourth flight attendant, (an off-duty

¹ The Survival Factors Group also prepared and sent interview questions to the surviving flight attendants and passengers who had returned to Seoul, Korea, through the Korean Ministry of Transportation. The results of those interviews are included in Appendix B of this report. Appendix A includes: a diagram of the Survivor Seat Locations, a Cabin Configuration & Emergency Equipment Diagram, the KAL Flight 801 Flight Attendant Basic & Recurrent Training dates, a Diagram of the Body Locations Removed by Guam Rescue Personnel, and the KAL Flight 801 General Declaration.

flight attendant), Han, Kyu-hee, sustained burns over 80% of her body was medevaced to the Brooke Army Medical Center (BAMC) Burn Unit in San Antonio, Texas, where she later died on August 30, 1997.

Prior to the NTSB's arrival on Guam and the Medevac of the flight attendants to Seoul, Korea, representatives from the Federal Bureau of Investigation (FBI), the Federal Aviation Administration (FAA), and a Special Agent with the FAA's Honolulu Civil Aviation Security Field Office interviewed one of the flight attendants who was transported to the Guam Naval Hospital. According to the interview, Ms. Oh, Sang Hee had occupied the L2 flight attendant seat prior to the accident. Ms. Oh stated that KAL FLT 801 was delayed in Seoul, Korea, for approximately 45 to 50 minutes due to transfers from other connecting flights, and it was the fourth airplane waiting to depart. Although Ms. Oh stated she felt there was a little more vibration during the flight than usual, she was not alarmed. Prior to the final moments before the accident, Ms. Oh stated that she observed the seatbelt light come on, indicating preparation for landing. She said she assumed her position in seat L2 and fastened her restraint system, but she did not recall any other details thereafter. Ms. Oh stated that there was no warning given by the pilot to prepare for a crash landing.

Flight attendant, Ms. Son, Seung Hee, was interviewed at the Guam Memorial Hospital on August 9, 1997. Initially, Ms. Son declined to be interviewed by the Survival Factors Group because she stated that she had already been interviewed by Korean authorities and the FBI; she subsequently agreed to be interviewed by Mr. Byeon, Soon Cheol, of the Korea, Ministry of Transportation, and provided the following account:

According to Mr. Byeon, Ms. Son stated she was not aware that there were any problems prior to the accident. The flight crew did not make an announcement of a problem. She stated that she was seated in the 1R flight attendant seat, her restraint system was fastened and the fasten seat belt sign was illuminated. She said that at first she thought the airplane was landing "normal" but very hard. She heard a loud "boom" and the airplane shook violently from left to right for 3 to 4 seconds, and then it started breaking apart. She said after the impact she found herself outside the airplane and it was calm and dark. She

unfastened her restraint system and walked about 10 meters beyond the right side of the airplane. She said she assisted a 17 year old female passenger who had survived and who was crying. She said that it was raining heavily; soaking her clothing. She also said there was a strong wind during the approach to land.

2.2 Flight Attendant Training

The flight attendant initial and recurrent training records were obtained for the flight attendants from the airline. Korean Air training records showed the following dates of training that had been completed by the cabin crew of Flight 801:

<u>Name</u>	<u>Date of Birth</u>	<u>Hire Date</u>	<u>Basic Training</u>	<u>Recurrent Training</u>
1. Im, Su Hyeok**		07/18/88	08/28/88	12/10/96
2. Cho, Dae Sik		08/31/81	10/11/81	12/11/96
3. Han, Kyung Jin		11/09/92	12/20/92	10/25/96
4. Son, Seung Hee*		06/19/95	12/10/95	10/03/96
5. Oh, Sang Hee *		01/09/95	05/06/95	07/22/96
6. Choi, Son Hui		04/27/95	07/08/95	10/07/96
7. Kim, Yean Hee		05/30/94	10/29/94	09/19/96
8. Jung, Hye Won		06/24/96	01/15/97	03/31/97
9. Huh, Se Kyung		04/29/96	07/20/96	06/07/96
10. Seo, Mi Sil		03/08/95	05/22/95	10/07/96
11. Lee, Youn Ji*		06/23/95	12/16/95	07/18/96
12. Hong, Young Mi		12/12/94	03/25/95	10/23/96
13. Son, Mi Ra		02/26/96	06/26/96	12/30/96
14. Cho, Mun Sun		03/17/97	06/26/97	04/11/97

Off-Duty Flight Attendants

15. Kang, Mee Ra		06/19/95	12/16/95	10/10/96
16. Lee, Hyang Mi		11/13/95	02/24/96	07/25/96
17. Park, Eun A		10/24/94	07/15/95	09/23/96
18. Lee, Seung Won		11/11/96	03/06/97	11/28/96
19. Han, Kyu Hee		12/12/94	03/25/95	11/30/96
20. Oh, Ju Eun		12/12/94	03/25/95	08/15/96

** Purser

* Survivor

3.0 Passenger Interviews

There were 231 passengers on board; 3 of which were children (from 2 to 12 years old), and 3 of which were infants (under 2 years old.) Twenty five passengers survived the crash with minor to serious injuries, but 2 passengers succumbed to their injuries during the 30 days following the accident. Many of the passengers who survived were interviewed by the FBI, FAA and HNL CASFO and later were Medivaced to Seoul, Korea, prior to the NTSB's arrival on Guam. Copies of those interviews are in Appendix B of this report. Six survivors who remained at the Guam Memorial Hospital and the Guam Naval Hospital were interviewed by the Survival Factors Group. The interviews were as follows:

SEAT 59G

Male

Age: 55

He stated the accident happened four minutes before the scheduled landing according to a sign in the cabin. He said the airplane swayed back and forth, from side to side, prior to the airplane hitting the ground. He reported that it was raining heavily and there was a strong wind during the approach to land. He did not see any other passengers nearby his seat following the accident. He unfastened his seatbelt and moved clear of the wreckage. He said he waited about 1 hour in the rain before rescue and emergency teams arrived at the site.

SEAT 4H

Male

Age: 35

He stated he was seated in seat 4H and he said the flight crew announced that they would be landing soon and the accident happened shortly after he heard the landing gear extend. He said he felt like the approach was different but he wasn't sure why he felt it was different. He said the impact felt like they were landing without the wheels extended. He said he noticed a little girl and her mother in front of him. After the impact he tried to get out of his seat but his injuries prevented him from standing. He found himself outside the airplane in

his seat, and his seat belt was still fastened. He waited approximately 1 hour before he was rescued. He stated that it was raining during the approach to land but he could see the Guam city lights. He said it was also raining after the crash.

SEAT 57K

Male

Age: 28

He stated that the flight was delayed for takeoff in Seoul because of other airport traffic. He stated that there was turbulence in-flight; so much so that the in-flight meal service was stopped until the turbulence subsided. He thought the approach was a normal landing; he thought the airplane was actually landing when it began shaking from side to side for about 3-4 seconds before he lost consciousness. When he awoke he unfastened his seat belt and called out. His seat remained attached to the floor and there was luggage on top of him. He saw no one else nearby until he climbed out of the wreckage. He said he had to climb upwards to get out of the airplane. Once out of the airplane there were flames and airplane wreckage on fire, and explosions from the wreckage.

SEAT 34K

Female

Age: 38

She stated that the flight was delayed for takeoff in Seoul but she was unsure why it was delayed. She said that there was a lot of thunder and lightening that shook the airplane during the flight from Seoul to Guam. She said a lot of passengers were screaming and the meal service was stopped until the turbulence subsided. She said that prior to the accident the cockpit crew announced that they would be landing and that the passengers should fasten their seat belts. She heard a big bang and then saw fire and the airplane structure collapsing around her. She stated her seat belt was fastened very tight. She said that her husband in seat 34J had fire all over him and his clothes were burned off. She said there was a lot of fire behind her seat and less fire in front of her. She said that she unfastened her seatbelt after hearing a man

behind her telling his wife to unfasten her seatbelt. She said she had to push debris out of her way so that she could escape. After she escaped from the wreckage she moved 40 to 50 meters from the wreckage, and she waited a long time. She said that it was raining lightly during the impact and rained harder following the accident.

SEAT 58K

Male

Age: 60

He stated that he was seated near the tail on the right side of the airplane by the window. He said there was in-flight turbulence during the flight from Seoul to Guam. He said that during the turbulence drinks were spilled and the flight crew activated the "Fasten Seatbelt" sign. He said that there was no prior warning before the accident. He said that he had been traveling with many companions and after the accident he unfastened his seatbelt and escaped from the wreckage with one of his companions (who he stated was his in-law.) He stated that there was a "lot of fire" after the accident.

SEAT 36K

Male

Age:

He stated that his occupation is a helicopter pilot and he also holds an Airframe/Powerplant Mechanics Certificate. He said that there was constant [engine] power on descent with a level attitude during the approach. There was no sudden [engine] power applications or was there any sudden changes in [the airplane's] attitude. On the approach there was no turbulence and there were no great changes in the [airplane's] rate of descent. He stated that he was leaning over [forward] to put his shoes on when the impact occurred. He normally removes his shoes during flight and replaces them during the early stages of the approach. He was replacing his shoes when he felt the airplane 'land'. His initial thought was that the landing was earlier than he expected. It felt like a hard landing, but the airplane started to roll and then break apart. After the accident, he did not lose consciousness; he was in his seat when the airplane stopped moving and sensed that the fire was getting hotter so he escaped. He said he got out of his seat

and headed towards the isle towards the rear where there was a great gapping hole. He said there was a ball of flame going down the center of the airplane [cabin] and passengers were screaming and that [overhead] luggage bins were caving in on passengers. He said that the airplane appeared to be disintegrating in the center of its fuselage. He said that there were no [verbal] directions from flight attendants and everyone had to look after themselves. There were a number of people in the center [cabin] seats who survived but the overhead lockers and roof panels were falling on them. They were yelling for help as the fire spread. He could see an [airplane] engine to the rear [of the fuselage] with fire around it. He had to climb over a 'box' to escape, but first had to push a Korean man over the box, as he appeared to be very slow in moving. After he climbed over the box, he could not stand and realized that his leg was broken. He crawled away from the airplane in company with the Korean man and waited for rescue (about 60 meters from the fuselage). He also spoke with a Japanese girl and told her to get further away from the fire as he was worried that there may be explosions. He told the girl that her mother may be [found] higher up the hill.

He said there was a lot of fire and smoke surrounding the wreckage. He stated he did not think it was raining when he first escaped from the wreckage, but noticed some rain was falling when he was waiting on the hill to be rescued. He said he waited about 2 hours until he was found by rescue workers and about 5 to 6 hours until he was removed from the site. He said the airplane's wreckage was still on fire while he was being removed from the site. He also stated that 2 or 3 airplanes flew directly over the crash site while he was waiting to be rescued. He suggested that there could have been up to 50% more survivors if there had been no fire.

4.0 Airplane Damage

4.1 Interior Damage

The airplane was found separated into five major sections (See the Structures Group Field Report for the documentation of the airplane's structure.) To assist the Survival Factors Group to identify flight attendant and passenger seat locations, the

locations of the separated sections of fuselage were obtained from the Structures Group Factual Report of Investigation (see the Structures Group Factual Report of Investigation for fuselage station locations) and then were correlated to the locations of the cabin seats. The following bullets note the relative locations that the fuselage separated relative to the seat locations from the aft to forward fuselage/cabin:

- **Tail Section** - separated between fuselage stations (FS) 1980 thru 2320 with irregular separations around the fuselage body
- **Aft Fuselage** - (Boeing production 46 skin section) separated at FS 1820 on the left side of the fuselage, and at FS 1480
- **Center fuselage** - separated at FS 1500 along the left side of the fuselage and at about FS 1664 on the right side of the fuselage, and at FS 1120 on the left side of the fuselage and at FS 1320 on the right side of the fuselage
- **Forward Fuselage** - separated between FS 1120 and FS 400
- **Cockpit and First Class** - separated at about FS 400

The cockpit and first class cabin section were found inverted and the nose of the airplane was crushed inward. The captain, flight engineer and observer seats were found suspended from the inverted structure and the captain and flight engineer's seatbelts had been cut. The first officer's seat was found adjacent to the cockpit wreckage. The following seat identification was provided by KAL representatives for the cockpit seats:

	<u>Captain's Seat</u>	<u>First Officer's Seat</u>	<u>Flight Engineer's Seat</u>	<u>1st OBS Seat</u>	<u>2nd OBS Seat</u>
Manufacturer:	Weber	Weber	Weber	AMI	AMI
Part Number:	811369-621	811370-617	811372-621	1052-3	1075-1

The fuselage surrounding the cockpit and first class section was fractured and peeled open exposing the lower first class section. Several first class cabin seats

were found adjacent to the separated section of center and aft fuselage; their seat attachments were intact and the seat frames were bent in the aft direction and fractured. No seat number identification was found on the seats.

The fuselage exterior skin and cabin interior of the forward, center, and aft fuselage sections were consumed by fire. The main cabin seats and connoisseur (business class) seats were consumed by fire. The L-3 exit door on the left side of the fuselage was found in the closed position and it was burned on it's outer face. The top 6 inches of the L-3 door was consumed by fire. The G4B Galley (the forth galley from the front of the airplane on the right side of the fuselage) was found adjacent to the right forward side of the aft fuselage section. The G1A (the first galley from the front of the airplane on the left side of the fuselage) galley was found laying upside down near the forward side of the forward fuselage section. An unidentified double flight attendant seat and some overhead storage bins were found adjacent to the forward fuselage, to the left of the forward fuselage along the hillside, (as viewed looking forward along the wreckage path.) The R1 door and the L1 and R1 slide rafts (the cabin doors are numbered consecutively from the nose of the airplane to the tail with R designating the right and L designating the left side of the airplane as viewed looking forward) were found un-inflated and adjacent to the double flight attendant seat.

The interior of the forward tail section was consumed by fire. The R5 door remained attached to the fuselage. The R5 door slide was found adjacent to the tail section and was not inflated.

The following information was provided for the passenger seats by KAL representatives:

	<u>First Class Seats</u>	<u>Connoisseur Seats</u>	<u>Coach Seats</u>
Manufacturer:	Koito	Koito	Weber Aircraft
Model Number:	ARS311	ARS311	Weber 4000

5.0 Medical and Pathological

5.1 Injury Table

Table 1
Injury Table

	Flight Crew	Cabin Crew	<u>Passengers</u>			Totals
			Adults	Children	Infants	
Fatal²	3	17	203	1	3	228
Serious		3	21*	2		26
Minor						
None						
Totals	3	20	225	3	3	254

* A seriously injured passenger died at the Brooke Army Medical Center Burn Unit in San Antonio, Texas, on October 10, 1997.

5.2 Survivor Injuries

Thirty-one passengers were found alive and were transported from the scene to the Guam Memorial Hospital and the U.S. Naval Hospital. Two adult passengers died en route to or shortly after arriving at the hospitals. The 29 remaining survivors included four flight attendants and 25 passengers. One flight attendant, an adult passenger, and one child died during the month of August, and in accordance with 49 CFR Part 830.2 these persons are included under "Fatalities" in Table 2 above.

Injury information was not available at the time this report was completed and will be added to the docket when it is received.

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

5.3 Fatal Injuries

On August 6, 1997, 225 persons died: 19 crew members and 206 passengers. As stated in paragraph 5.2, one flight attendant and two passengers died during the month of August bringing the total to 228. A summary of the injuries sustained by the victims will be placed in the docket pending receipt of medical information.

5.4 Toxicological Analysis

The Disaster Mortuary (D-MORT) Team in Guam processed 300 total sets of remains; greater than the number of individuals on the aircraft because many of the remains were fragmentary. Complete autopsies and toxicology evaluation were performed on the 3 cockpit crew members, the results of which are described in the Human Performance Group Factual Report of Investigation. The passengers and cabin crew were evaluated in an attempt at identification and general description of body condition and major injuries. In 145 cases, the condition of the remains did not permit evaluation for soot in the airways. In 41 of the cases, the evaluations specifically noted no visible soot in the airways, however, in 20 cases the evaluations found soot in the airways. In the 76 remaining cases no definitive observations were made regarding soot in airways (in many of these latter cases obvious traumatic injuries were described which would have precluded survival following the major crash impact.) The D-MORT has yet to complete their evaluation of 15 of the sets of remains, despite repeated requests, this information has not been supplied by the Chief Medical Examiner of Guam.

The FAA Civil Aeromedical Institute's (CAMI) Forensic Toxicology Research Unit examined specimens taken by the Guam's Medical Examiner. Due primarily to extensive thermal damage, it was not possible for appropriate toxicology specimens to be retrieved from the majority of the passengers' bodies. Specimens were obtained from the bodies of 28 passengers and 3 crew members. The specimens were suitable for carbon monoxide analysis in only two of the crew members' samples and two of the passengers' samples. In each of these four cases, no carboxyhemoglobin was detected in the blood with a 10% cut off. The specimens were suitable for hydrogen cyanide analysis in all of the crew members' samples and in 15 of the passengers' samples. In each of these 18 cases, no hydrogen cyanide was detected in the blood at a limit of quantitation of 0.25 ug/ml.

6.0 Crash/Fire/Rescue (CFR) Response

See the Airport/Emergency Management Specialist's Factual Report of Investigation.

7.0 Survival Aspects

Eight of the survivors were seated in the first class section, 10 were seated near the rear cabin, and 13 were seated on the right side of the airplane (See Appendix C for the Surviving Passenger Seat Locations Diagram.) According to the survivor's interviews and flight attendant interviews the survivors were either thrown clear of the wreckage during the impact sequence, or had walked or crawled free of the wreckage.

The Survival Factors Group provided questionnaires to the thirteen survivors who were airlifted to Seoul, Korea (see Appendix B for the "NTSB Survivor Questionnaire".) Eleven of the thirteen survivors responded to the questionnaire at the time that this report was completed. Some of the survivors stated that they found themselves in their seats, outside the airplane, and on the ground after the accident. Other survivors stated that they released their seatbelts and escaped from the burning wreckage. One passenger stated she walked out of the airplane and found fire outside, so she went back into the airplane and escaped [through another gap in the wreckage.]

The survivors described the condition of the airplane's interior as follows: oxygen masks had fallen from the ceiling, baggage had fallen from the overhead stowage bins and had piled up on the floor, red flames and heat were inside the cabin, the cabin was destroyed, and looked like a "construction site". When asked if the survivors were aware of passengers who were unable to escape, the survivors stated that either they could not remember or they did not see anyone (who was unable to escape.) The questionnaire also asked if the survivor's injuries were a result of the impact or were they injured as they were trying to escape. The majority of the survivors stated they were injured during the impact, however, two survivors stated they were injured by the fire, and one survivor stated they received a head injury from an overhead bin as they were trying to escape. The survivors stated they encountered seats, overhead bins, and other unidentifiable obstacles during their escape from the airplane cabin wreckage.

The survivors were asked if they had moved from their assigned seats or had witnessed other passengers who had moved from their assigned seats. The majority of the survivors stated they witnessed other passengers move from their seats, however, only two survivors stated that they, themselves had moved to another seat before the accident. None of the survivors was aware of any child restraint being used for an infant (age newborn to 24 months) passengers.

A handwritten signature in black ink, appearing to read "Cynthia L. Keegan".

Cynthia L. Keegan
Survival Factors Engineer *MC*