

AIRCRAFT ACCIDENT REPORT

CRASH INTO A OBSTACLE DURING A DESCENT FOR LANDING
LG ELECTRONICS

S-76C⁺⁺, HL9294

SAMSEONG-DONG, GANGNAM-GU, SEOUL

16 NOVEMBER 2013



MAY 2015



AVIATION AND RAILWAY ACCIDENT INVESTIGATION BOARD

This aircraft accident report has been prepared in accordance with the Article 25 of the Aviation and Railway Accident Investigation Act of the Republic of Korea.

According to the provisions of the Article 30 of the Aviation and Railway Accident Investigation Act, it is stipulated;

The accident investigation shall be conducted separately from any judicial, administrative disposition or administrative lawsuit proceedings associated with civil or criminal liability.

And in the Annex 13 to the Convention on International Civil Aviation, Paragraphs 3.1 and 5.4.1, it is stipulated as follows:

The sole objective of the investigation of an accident or incident shall be the prevention of accidents and incidents. It is not the purpose of the activity to apportion blame or liability. Any investigation conducted in accordance with the provision of this Annex shall be separate from any judicial or administrative proceedings to apportion blame or liability.

Thus, this investigation report shall not be used for any other purpose than to improve aviation safety.

In case of divergent interpretation of this report between the Korean and English languages, the Korean text shall prevail.

Aircraft Accident Report

Aviation and Railway Accident Investigation Board. *Crash Into A Ground Obstacle During A Descent For Landing, LG Electronics, S76C⁺⁺, HL9294, Condominium A in Samseong-dong, Gangnam-gu, Seoul, 16 November 2013.* Aircraft Accident Report ARAIB/AAR-1307. Sejong Special Self-Governing City, Republic of Korea.

The Aviation and Railway Accident Investigation Board (ARAIB), Republic of Korea, is a government organization established for independent investigation of aviation and railway accident, and the ARAIB conducts accident investigation in accordance with the provisions of the Aviation and Railway Accident Investigation Act of the Republic of Korea and Annex 13 to the Convention on International Civil Aviation.

The objective of the investigation by the ARAIB is not to apportion blame or liability but to prevent accidents and incidents.

The main office is located in Sejong Special Self-governing City.

Address: #94, Dasom 2-ro, Sejong Special Self-governing City, 339-012

Tel.: (82)-44-201-5447

Fax: (82)-44-201-5698

e-mail: araib@korea.kr

URL: <http://www.araib.go.kr>

Contents

Title	1
Synopsis	1
1. Factual Information	3
1.1 History of Flight	3
1.2 Injuries to Persons	8
1.3 Damage to Aircraft	9
1.4 Other Damage	9
1.5 Personnel Information	10
1.5.1 The Captain	10
1.5.2 The First Officer	11
1.6 Aircraft Information	12
1.6.1 General	12
1.6.2 Aircraft Maintenance	13
1.6.3 Weight and Balance	14
1.7 Meteorological Information	14
1.7.1 General	14
1.7.2 Weather Conditions Confirmed by the Pilots before Flight	15
1.7.3 Weather Conditions Confirmed by the Pilots During Flight	16
1.7.4 Weather-related Regulations	18
1.8 Aids to Navigation	19
1.9 Communications	21
1.10 Heliport Information	23
1.11 Flight Recorders	24
1.12 Wreckage and Impact Information	27
1.12.1 Terrain of the Crash Site	27
1.12.2 Wreckage Distribution	28
1.12.3 Impact Point of the Condominium Building	28
1.12.4 Wreckage Examination Results	29

1.13 Medical and Pathological Information	30
1.14 Fire	30
1.15 Survival Aspects	31
1.15.1 General	31
1.15.2 Emergency Response	31
1.16 Tests and Analysis	32
1.17 Organization and Management Information	32
1.17.1 General	32
1.17.2 Pilot Staffing of the Helicopter Team	34
1.17.3 Go/No-go Decision of the Helicopter Team	34
1.18 Additional Information	36
1.18.1 Statements of Witnesses	36
1.18.2 Flight Procedures in the Vicinity of P73	38
1.18.3 Installation/Management Regulations Regarding Aviation Obstruction Lights and Markings	40
1.18.4 Installation/Management of Obstruction Lights on Condominium A	43
1.18.5 Clearance of Flight Plan and Warning by the CDC	45
1.18.6 EGPWS	46
2. Analysis	48
2.1 General	48
2.2 Meteorological Factors	48
2.3 Helicopter Team's Decision-making Process for Flight	50
2.4 Analysis of the Captain's Flight	52
2.5 Organization Management	54
2.6 Aviation Obstruction Lights	57
2.7 Flight Control According to Weather Conditions	58
2.8 GPWS	60

3. Conclusions 62

3.1 Findings 62

3.2 Causes 66

4. Safety Recommendations 68

To LG Electronics 68

To the Office of Civil Aviation 69

Abbreviations

AFTN	Aeronautical Fixed Telecommunication Network
AGL	Above Ground Level
AOC	Air-defence Operation Center
CCTV	Closed-Circuit Television
CDC	Capital Defense Command
CRM	Cockpit Resources Management
CVR	Cockpit Voice Recorder
DISP	Display
EGPWS	Enhanced Ground Proximity Warning System
FAX	Facsimile
FDR	Flight Data Recorder
FOIS	Flight Operation Information System
GPS	Global Positioning System
ICAO	International Civil Aviation Organization
IMC	Instrument Meteorological Condition
MCRC	Master Control Reporting Center
MPFR	Multi Purpose Flight Recorder
NOTAM	Notice to Airman
NTSB	National Transportation Safety Board
SM	Statute Miles
NM	Nautical Miles
TSN	Time Since New
TSO	Time Since Overhaul
VFR	Visual Flight Rule
VMC	Visual Meteorological Condition

Crash Into A Ground Obstacle During A Descent For Landing

- Operator: LG Electronics Inc.
- Manufacturer: US Sikorsky
- Type: S76C⁺⁺ (Rotorcraft)
- Registration Mark: HL9294
- Location: Condominium A in Samseong-dong, Gangnam-gu, Seoul
(N 37°31'06.60", E 127°03'33.50", 49 m ASL)
- Date & Time: 16 November 2013, approximately 08:54 (KST¹⁾)

Synopsis

On 16 November 2013, approximately 08:54, a S76C⁺⁺ helicopter, HL9294 (hereafter referred to as "HL9294"), operated by LG Electronics Inc. (hereafter referred to as "LG Electronics"), crashed into Condominium A while approaching to land at a nearby heliport. HL9294 was a private aircraft, operated under VFR. Aboard the aircraft were one captain and one first officer (FO), who were fatally injured, and the aircraft was destroyed.

The Aviation and Railway Accident Investigation Board (ARAIB) determines that the causes of this accident were ① While flying in Hangang Corridor, the flight crew failed to return and proceeded with the flight in adverse weather conditions, where they were unable to identify the ground due to a dense fog; and ② The flight crew crashed into a ground obstacle during a descent although they should not have descended due to their inability to identify their location and the ground in adverse weather conditions. Contributing to the accident were ① the captain's go decision although weather conditions failed to meet the allowable limits; ② the flight crew's inadequate CRM skills, including a failure of the captain and the FO to discuss a return, and the flight crew's inadequate

1) Unless otherwise indicated, all times stated in the report are Korean Standard Time (UTC +9).

communication, evidenced by the fact that the FO and the Helicopter Team's pilot in charge of operation failed to suggest no-go to the captain in his decision-making process although they became aware of a no-go situation after checking out weather conditions.

Regarding this accident, the ARAIB addresses safety recommendations to LG Electronics and the Ministry of Land, Infrastructure and Transport (Office of Civil Aviation).

1. Factual Information

1.1 History of Flight

On 16 November 2013, approximately 08:45, HL9294 took off from Gimpo International Airport to pick up LG Electronics' executives and about 08:54, crashed into a condominium building²⁾ while approaching to land at Jamsil Heliport.³⁾

HL9294 was a private aircraft operated by LG Electronics, and the flight crew piloted the aircraft after filing a VFR flight plan. Aboard the aircraft were one captain and one FO, who were fatally injured, and the aircraft was destroyed.

HL9294 was scheduled to pick up a total of six passengers, including a vice chairman and CEO of LG Electronics and other senior officials,⁴⁾ at Jamsil Heliport at 09:00 and take them to the company's chiller manufacturing factory⁵⁾ in Jeonju-si, Jeollabuk-do by 09:50.

For this flight, a staff member from LG Electronics' Vice Chairman & CEO's Office called LG Electronics Helicopter Team's (hereafter referred to as the "Helicopter Team") pilot who was in charge of operation⁶⁾ (hereafter referred to as the "pilot in charge of operation") on 15 November, about 09:57 and informed him of a flight schedule.⁷⁾

The pilot in charge of operation reported the flight schedule to the

2) The north side of building 102 of the Condominium A in Samseong-dong, Gangnam-gu, Seoul.

3) A heliport at the riverside of the Hangang (river) in the north of the Olympic Main Stadium in Jamsil-dong, Songpa-gu, Seoul (ICAO code RKSJ).

4) 5 passengers: 1 president, 2 senior managing directors, 1 managing director, and a person concerned.

5) A factory which manufactures cooling facilities and structures for the machinery of large-scale industrial complexes.

6) One of the pilots from the Helicopter Team is designated as a person in charge of operation.

7) Departure from Jamsil (09:00); arrival at the destination (09:50); and a total of 6 passengers (CEO and 5 senior officials).

"Helicopter Team leader (captain)," and on 15 November at 10:26, made a request of the "AOC under the Republic of Korea (ROK) Army CDC" to issue a clearance to fly near a "prohibited area, RK P73" (hereafter referred to as "P73"). Approximately 10:37, the AOC issued a clearance over the telephone to the FO on one condition that the aircraft should fly along the south edge of the Hangang (river).

Yet on 16 November, about 06:06 and 06:08, the captain called Gimpo Airport Weather Office and Seoul Airport Weather Office at home and checked out weather conditions, respectively. About 06:25, he made a no-go decision, but when he talked with the Vice Chairman & CEO's Office's deputy general manager over the telephone at 07:12, he overturned his initial decision and deferred it until 07:40, the time when weather conditions were to be checked out.

When the time for a decision, agreed between the deputy general manager and him, has come, the captain decided to go forward with the operation as originally scheduled and notified this to the deputy general manager by telephone about 07:38 as well as the pilot in charge of operation through the FO.

About 07:52, the captain went to work and personally checked out⁸⁾ weather conditions at his office (the office of the Helicopter Team leader).

About 07:51, the FO submitted, to Gimpo Airport AIS Office through FOIS, the flight plan⁹⁾ which was disseminated to relevant agencies¹⁰⁾ through AFTN about 07:54.

8) He observed outside visibility looking out the window of his office, checked out CCTV images of Olympic Expressway using his mobile phone, and finally checked with Seoul Airport Weather Office for weather conditions about 08:16.

9) Gimpo Airport (takeoff at 08:35) ⇒ Jamsil Heliport (08:50/09:00) ⇒ Jeonju (09:50/12:30) ⇒ Yeouido (13:20/13:25) ⇒ Gimpo Airport (14:00).

10) ATC, AOC, and Air Force MCRC.

The FO checked with Jamsil Heliport's manager¹¹⁾ for weather conditions at the heliport about 07:08, 07:10, 07:52, and 08:13 by his mobile phone. According to the statement of the manager, he replied to the FO, "Due to fog, Cheongdam Bridge (about 1.1 km) is not visible from the heliport, and nor is the Hangang's water (about 90 m)."

About 08:16 and 08:17, the captain and the FO each called Seoul Airport Weather Office and finally checked out weather conditions.¹²⁾ At that time, the person concerned from the Office officially informed them that the weather at Seoul Airport was the IMC.

About 08:20, the captain went to the ramp for flight where the FO was standing by after the preflight inspection. He and the FO took the right and left seat, respectively, and started the aircraft about 08:36. At 08:43:47, the captain made first contact with the Gimpo Control Tower.

At 08:43:53, on the west ramp #915 pad¹³⁾ at Gimpo Airport, the captain requested the Tower to clear the flight for takeoff to the east by overpassing the runway, and at 08:44:01, the controller advised him that visibility was 700 m. Accordingly, the captain made a request for Special VFR¹⁴⁾ at 08:44:10, and the clearance for takeoff was issued at 08:45:17.

As shown in [Figure 1], at 08:45:31, HL9294 took off from the west ramp H-3¹⁵⁾ at Gimpo Airport on a heading of about 30°, overpassed two runways,

11) Seven companies shared cost and concluded a contract for heliport operation with Yunse Trade Inc. which performed the management of heliport facilities and safety by hiring a manager.

12) Jamsil Heliport is located on the edge of Seoul Airport's air traffic control zone (5 NM radius). Weather: wind at 3 kt, prevailing visibility due to fog 400 m/900 m in the direction of runway 20, ceiling broken at 1,000 ft (cloud cover 5/8 - 7/8), temperature 3°C.

13) A helipad in front of LG Electronics' hangar at the west ramp at Gimpo Airport.

14) Special VFR flight is a flight cleared by air traffic control to operate within the permitted control zone (Class B, C, D, and E) in meteorological conditions below VMC. In helicopters, a pilot should operate an aircraft at a speed at which he can avoid ground obstacles, observing the ground or water surface.

15) A helipad at the west ramp at Gimpo Airport, used for rotorcraft to take off to the north or west.

and flew towards Gaehwasan¹⁶⁾ (Mt.).

At 08:46:33, the controller asked, "How's flight visibility?" The captain said to the FO, "Tell him over 500 is 7 miles!" The FO replied to the controller, "7 is maintained over 500," adding "We are heading to Jamsil Heliport along the Hangang."

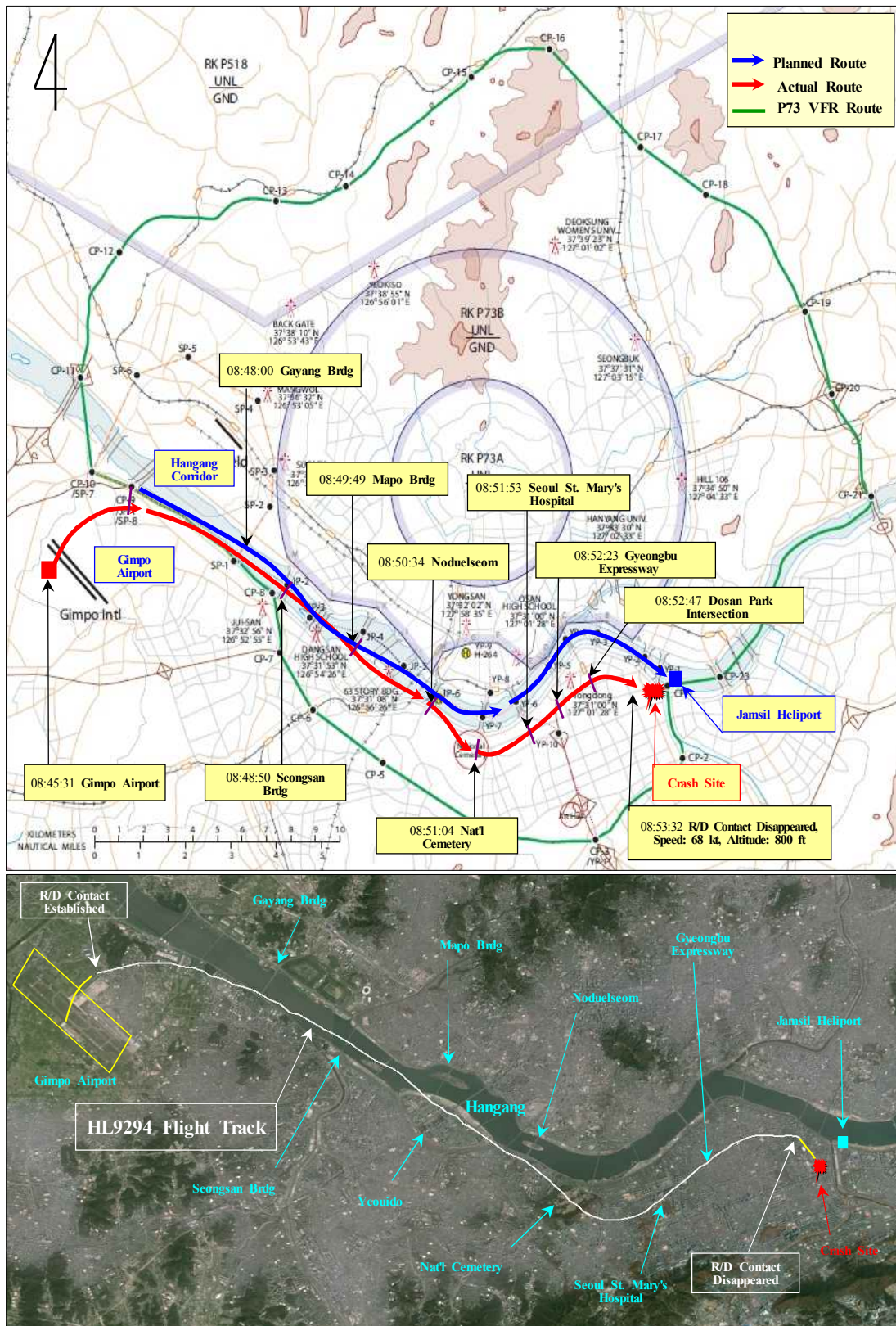
From then on, the captain and the FO sustained a conversation like "Hangang in sight?," "Not in sight," etc. and piloted the aircraft at about 1,170 - 1,350 f t¹⁷⁾ at a speed of about 130 kt on a heading of 120° in the autopilot mode, to Nodulseom (Isl.), along the Hangang.

According to Seoul Airport's radar data, however, HL9294 started to fly straight after passing by Nodulseom at 08:50:34, instead of flying along the south edge of the Hangang, and overpassed the National Cemetery at 08:51:04. Then, it turned left and flew in parallel with the Hangang, about 1 km south of the south edge.

As the captain decreased speed for landing, about 3.6 km west of Jamsil Heliport, the FO ran the before-landing checklist and extended the landing gear at 08:52:15.

16) Located 2.4 km northeast of Gimpo Airport at an elevation of 132 m MSL, Gimpo Airport CP "N".

17) Flight parameters stated in this report are from the FDR data.



[Figure 1] Flight Route and Crash Site (Seoul Airport Radar Data)

At 08:52:47, HL9294 subsequently overpassed Dosan Park Intersection,¹⁸⁾ maintaining at 1,360 ft at a speed of 97 kt. From this moment on, the captain, with the landing point not in sight, asked the FO repetitively, "Hangang in sight?," and the FO advised, "Not yet, and if we fly to the right (south) a bit, the Hangang will be in sight."

After that, the captain gradually decreased speed while lowering the altitude, then turned right and headed to Condominium A, crash site, and at 08:53:32, the flight track of HL9294, maintaining at 800 ft¹⁹⁾ at a speed of 68 kt, disappeared from the radar screen of Seoul Airport.

Then, 11 seconds later at 08:53:43 (based on FDR data), the left side of HL9294 crashed into the north side of the 25th floor (97 m) of Condominium A's building 102.

1.2 Injuries to Persons

Injuries	Crew	Passenger	Others
Fatal	2	0	0
Serious	0	0	0
Minor/None	0/0	0/0	0/0
Total	2	0	0

18) Dosan Park Intersection is located in Sinsa-dong, Gangnam-gu, Seoul, and an intersecting point between Dosandae-ro and Eonju-ro, 1.3 km south end of Seongsu Bridge.

19) They are flight parameters displayed on the radar screen, different from those recorded by the FDR (speed: 68 kt, altitude: 448 kt).

1.3 Damage to Aircraft

As shown in [Figure 2], HL9294 was destroyed by the crash impact. HL9294 was insured against hull damage,²⁰⁾ crew and passenger injury,²¹⁾ and bodily injury and property damage,²²⁾ effective²³⁾ at the time of the accident.



[Figure 2] Wreckage of the Event Aircraft

1.4 Other Damage

Apart from HL9294's damage, a total of 13 households²⁴⁾ sustained damage in the accident since livingroom windows of 11 households between the 2nd and 28th floor of building 102,²⁵⁾ and of 2 households on the 34th floor of building 101²⁶⁾ were broken.

20) USD 11,058,509 (KRW 11.5 billion).

21) 2 crew members (USD 200,000/person), 6 passengers (USD 300,000/person).

22) Bodily injury and property damage: USD 10 million.

23) LIG Insurance Co., Ltd., term of validity: 1 Sep. 2013 - 31 Aug. 2014.

24) A total of 13 households including 11 households (203, 603, 1803, 2103, 2203, 2303, 2403, 2503, 2603, 2703, 2803) in building 102 and 2 households (301, 3404) in building 101.

25) 39-story building, 179 m high.

1.5 Personnel Information

1.5.1 The Captain

The captain (male, age 57) had accumulated 6,516.1 total flight hours, including 3,757.1 hours²⁷⁾ during military service. Since hired by LG Electronics on 1 August 1999, he had accumulated 2,759 hours.²⁸⁾

The captain had accumulated 2,759 hours²⁹⁾ on the same type aircraft. He had flown 0 hour and 77.8 hours in 24 hours and 90 days, respectively, before the event flight. He held all qualification certificates³⁰⁾ required for operation.

After hired by LG Electronics, the captain completed his type transition training³¹⁾ offered by Flight Safety International Inc.³²⁾ in the US and obtained the type rating of the same aircraft on 12 November 1999. He received a total of five recurrent training³³⁾ as of 31 December 2012.

According to the statements of his fellow captains, in the 72 hours before the accident, the captain and the pilot in charge of operation were on a roundtrip from Gimpo Airport to Jinju back on 14 November, from about 15:30 to about 18:00. On 13 and 15 November, he performed ground duties without flight.

The captain's last arrival at/departure from Jamsil Heliport took place on 13

26) 46-story building, 199 m high.

27) Total 3,757.1 hrs: O-1G (2.3 hrs), RC-800 (13.1 hrs), T-37C (287.3 hrs), UH-1B/H (654.4 hrs), HH-60P (153.8 hrs), B-412 (2,643.2 hrs), HS-748 (1.2 hrs), and C-54D (1.8 hrs).

28) S76C (2,759 hrs).

29) Total 2,759.0 hrs: PIC: 1,562.3 hrs, SIC: 702.5 hrs, IP: 452.1 hrs, and SP: 42.1 hrs.

30) Commercial Pilot License: No. 12-003565 (27 Aug. 1998), Class Rating: Rotorcraft/MEL (27 Aug. 1998), Type Rating: S76 (12 Nov. 1999), Pilot Training Certificate (Airplane, 6 Jul. 2000), Instrument Flight Rating (Airplane, 6 Jul. 2000), Radio Operator License: No. 89-34-0-0296 (28 Jul. 1989).

31) Related data including training hours, training subjects and flight hours could not be confirmed. The record of the "pilot training log" was only restrictively confirmed.

32) Flight Safety International Inc. is located in West Palm Beach, Florida, US.

33) S76C+ (US FSI): 15 - 28 Aug. 2013, 3 - 5 Mar. 2006, 16 - 18 Jul. 2007, 14 Jul. 2007 (difference). S76++ (US FSI): 31 Dec. 2012 - 4 Jan. 2013.

October 2013, and in the 3 month before the accident, he had accumulated a total of 6 arrivals at/departures from the heliport, including 5 on HL9294 (#1, S76C++) and 1 on HL9252 (#2, S76C+).

1.5.2 The First Officer

The FO (male, age 36) had accumulated 3,310.7 total flight hours, including 3169.6 hours³⁴⁾ during military service. Since hired by LG Electronics on May 2 2013, he had accumulated 141.1 hours.³⁵⁾

The FO had accumulated 141.1 hours on the same type aircraft. He had flown 0 hour and 85 hours in 24 hours and 90 days, respectively, before the event flight. He held all qualification certificates³⁶⁾ required for operation.

After hired by LG Electronics, the FO completed S76 simulator training³⁷⁾ at Xiangyi Aviation Technology Company Ltd. in Zhuhai, China, from 12 August until 27 August 2013.

According to the statements of his fellow pilots, in the 72 hours before the accident, the FO was on a roundtrip from Gimpo Airport to Jamsil to Gumi back on 13 November, from 08:40 to 10:50 and from Gimpo Airport to Gumi to Jamsil back on 14 November, from 14:50 to 17:20, then had dinner with his colleagues from 18:30 to 20:00.

On 15 November, he performed ground duties without flight and left work for home about 17:20.

34) Total 3,169.6 hrs: T-41B (29.1 hrs), T-38 (117.5 hrs), T-37C (134.6 hrs), VH-92 (1,555.2 hrs), HH-60P (1,176.3 hrs), B-412 (119.2 hrs), AS-332L (6.5 hrs), VCN235 (13.3 hrs), B737/B747 (17.9 hrs).

35) S76C++ (141.1 hrs).

36) Commercial Pilot License: No. 12-004531 (7 Dec. 2001), Class Rating: Airplane/MEL (7 Dec. 2001), Rotorcraft/MEL (5 Feb. 2013). Airplane/Instrument Flight Rating (31 Dec. 2001), Radio Operator License: No. 11-34-1-0092 (25 Apr. 2012).

37) A training course required by the Civil Aviation Administration of China consists of 10 hrs of simulator training and 4 hrs of evaluation.

1.6 Aircraft Information

1.6.1 General

HL9294 was manufactured³⁸⁾ by the US Sikorsky on 23 January 2007. The aircraft was delivered to LG Electronics on 24 August 2007, which first registered it with the Korea Office of Civil Aviation of the Ministry of Land, Infrastructure and Transport on 10 September 2007. Its TSN was 1,334.8 hours between the registration and the day of the accident.

HL9294 was equipped³⁹⁾ with two ARRIEL 2S2 type turbo-shaft engines⁴⁰⁾ manufactured⁴¹⁾ by the French TURBOMECA, which used Jet A-1 fuel. Their total service time before the day of the accident was 1,334.8 hours each.

General specifications of HL9294 are shown in [Table 1].

Category	Specification	Category	Specification
L/W/H	16/2.58 (13.41)/4.42 m	Fuel Consumption/hr	82 gal (553 lb)
Max. Takeoff Weight	5,307 kg	Empty Weight	3,641 kg
V _{ne} /Cruising Speed	155/145 kt	Fuel Capacity	281 gal (1,897 lb)
Seat	2 (cockpit), 6 (cabin)	Rotor	4 (main), 4 (tail)

[Table 1] General Specifications of HL9294

HL9294 held a valid aircraft registration certificate,⁴²⁾ airworthiness certificate,⁴³⁾ radio station license,⁴⁴⁾ aircraft noise certificate,⁴⁵⁾ and operating limitations specification.⁴⁶⁾

38) Serial No.: 760650.

39) Installation date: 23 Jan. 2007 (No. 1 Engine), 28 Dec. 2006 (No. 2 Engine).

40) Serial No.: 42081 (No. 1 Engine), 42082 (No. 2 Engine).

41) Manufacture Date: 17 Nov. 2006 (No. 1 Engine), 29 Nov. 2006 (No. 2 Engine).

42) Certificate No.: 2013-003 (Registration Date: 2 Jan. 2013), Registration Mark: HL9294.

43) Certificate No.: AS13090 (Issue Date: 11 Sep. 2013).

44) License No.: 46-2007-10-0000014 (Issue Date: 12 Sep. 2007).

45) Certificate No.: KNC929400 (Issue Date: 14 Sep. 2007).

1.6.2 Aircraft Maintenance

According to LG Electronics Maintenance Regulations⁴⁷⁾ (hereafter referred to as "Maintenance Regulations"), scheduled maintenance of HL9294 shall be performed at regular intervals of aircraft operation hours⁴⁸⁾ and date.⁴⁹⁾ Review of its maintenance history during the last 6 months before the event revealed that the scheduled maintenance was normally performed according to Maintenance Regulations and the manufacturer's maintenance manual.

Scheduled maintenance perform after HL9294's airworthiness inspection on 11 September 2013 is shown in [Table 2], and review of the aircraft journey log revealed no unresolved defects.

Category	Insp. Date	Flight Hrs	Next Insp.		Round
			Hrs	Date	
Air fra me	25-hour Insp.	‘13.09.16	1,335:15	1,360:15	3
		‘13.10.19	1,357:55	1,382:55	
		‘13.11.11	1,382:00	1,407:00	
	50-hour Insp.	‘13.10.23	1,361:00	1,411:00	1
60-day Insp.	‘13.10.05	1,347:25		‘13.12.05	1
3-month Insp.	‘13.10.15	1,352:40		‘14.01.15	1
Eng ine	20-hour Insp.	‘13.09.16	1,335:15	1,355:15	3
		‘13.10.16	1,352:40	1,372:40	
		‘13.11.01	1,370:15	1,390:15	
	30-hour Insp.	13.10.16	1,352:40	1,382:40	2
13.11.09		1,381:30	1,411:30		

[Table 2] Scheduled Maintenance After Airworthiness Inspection

46) Issue No.: ABOL13090 (Issue Date: 12 Sep. 2013).

47) Regulations made and imposed by LG Electronics Helicopter Team.

48) Inspection Interval: every 25 hrs, 50 hrs, 100 hrs, 300 hrs, and 1,250 hrs (airframe)/20 hrs and 30 hrs (engine).

49) Inspection Interval: every 60 days, 3 months, 12 months, 2 years, and 3 years.

1.6.3 Weight and Balance

HL9294 was equipped with no special equipment, let alone cargo shipments inside and outside of the aircraft. Aboard the aircraft were only two pilots.

As HL9294's landing weight and the maximum takeoff weight were 4,846 kg⁵⁰⁾ and 5,307 kg, respectively, there was still a weight margin of 461 kg. Thus, the flight was carried out within the proper limits of weight and balance.

1.7 Meteorological Information

1.7.1 General

On the day of the accident, the captain and the FO called Gimpo Airport Weather Office,⁵¹⁾ Seoul Airport Weather Office,⁵²⁾ ROKAF Operations Command Osan Weather Office,⁵³⁾ and Jamsil Airport's manager⁵⁴⁾ and checked out weather conditions to decide whether to fly or not. In addition, they referred to Internet weather data provided by the Korea Aviation Meteorological Agency (KAMA) and the CCTV traffic information covering Olympic Expressway between Gimpo Airport and Jamsil Heliport.

According to their check results, weather at Gimpo Airport, Seoul Airport, and Jamsil Heliport was IMC, whereas en-route weather between Osan and Jeonju, except for the metropolitan area, was VMC.

50) Empty weight 8,100 lbs + 2 pilots 360 lbs + main fuel 1,884 lbs + auxiliary fuel 340 lbs = 10,684 lbs = 4,846 kg.

51) Called twice (at 06:06 and 07:33) to check out weather conditions at Gimpo Airport's takeoff point.

52) Called four times (at 06:08, 06:40, 08:16 and 08:17) to check out weather conditions in the vicinity of Jamsil Heliport.

53) Called once (at 06:51) to check out weather conditions en route.

54) Called four times (at 07:08, 07:10, 07:52, 08:13) to check out weather conditions at Jamsil Heliport.

1.7.2 Weather Conditions Confirmed by the Pilots before Flight

METARs for Gimpo Airport and Seoul Airport at the time of the accident are shown in [Table 3].

Cat.	Time	Weather Conditions
Gimpo Airp.	08:00	METAR 0800 24001KT 0700 0100NW 32L/1900D 32R/1700D FG FEW005 00/M01 Q1020MB A3014 NOSIG=
		Wind 240 at 01 kt, Visibility 700 m/100 m (northwest), RVR 32L 1,900 m/32R 1,700 m, Few at 500 ft , Temperature 0°C Dew Point -1°C, Altimeter Setting 3014, No Significant Weather
Seoul Airp.	07:56	METAR 2256 21003KT 400 R20/650 FG SCT000 03/02 A3016 RMK FG SCT000 SLP216=
		Wind 210 at 03 kt, Visibility 400 m/RVR 20 650 m (fog), Scattered⁵⁵⁾ at 0 ft, Temperature 3°C/Dew Point 2°C, Altimeter Setting 3016

※ Jamsil Heliport is located within Seoul Airport's control zone.

[Table 3] Weather Conditions at Gimpo and Seoul Airports Prior to Takeoff

CCTV images showing the visibility of the major points⁵⁶⁾ on Olympic Expressway about 08:30, viewed by the captain at his office before takeoff, are shown in [Figure 3].

55) Scattered means that 3/8 - 4/8 of the sky is occupied by cloud.

56) Gyeonggi High School (upper left), south end of Seongsu Bridge (bottom left), Yeongdong Bridge (upper right), Cheongdam Bridge (bottom right).



※ CCTV Height (about 30 m), Visibility (about 100 - 200 m)

[Figure 3] CCTV Images of Olympic Expressway about 08:30 on the Event Day

According to the statement of Jamsil Heliport's manager, when the FO called him to check out weather conditions, he replied, "Due to a dense fog, Cheongdam Bridge (1.1 km) is not visible from the road next to the heliport, and nor is the Hangang's water (about 90 m)."

1.7.3 Weather Conditions Confirmed by the Pilots During Flight

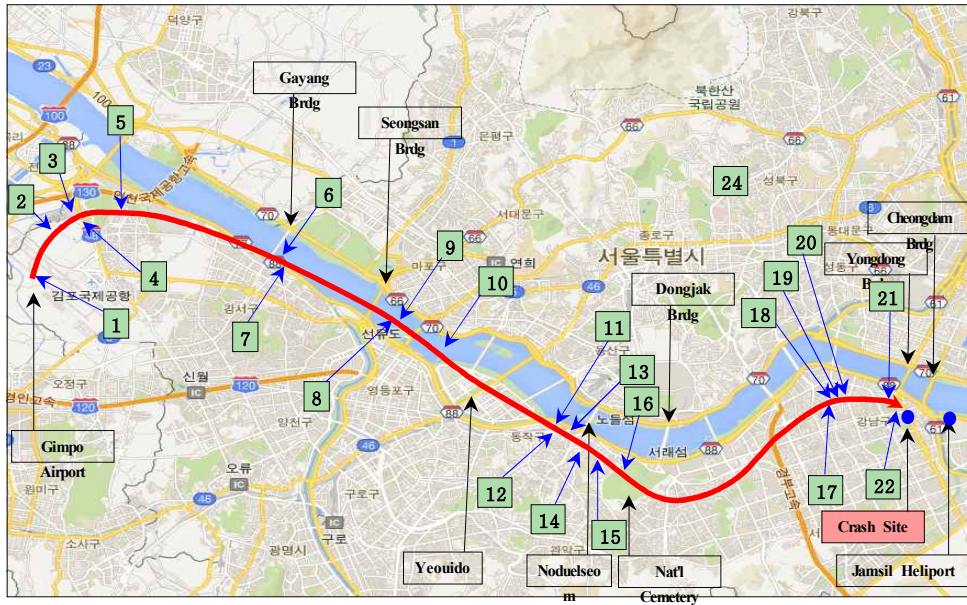
Weather conditions confirmed by the pilots during flight were deduced from official weather conditions provided by the controller during takeoff and the CVR Transcript during the event leg.

According to the CVR transcript, the pilots of HL9294 operated the aircraft, unable to identify the ground from takeoff to crash, and the weather-related content of their in-flight conversation is shown in [Table 4].

Time		Speaker	Content	Flight Track No.
KST	Inversed Time			
08:46:03	H-07+40	TWR	• HL9294, official visibility is 700 m. Sky condition few at 500.	①
08:46:33	H-07+10	TWR	• HL9294, how's the flight visibility?	②
08:46:36	H-07+07	CAP	• Ah, tell him over 500 is 7 miles.	③
08:46:38	H-07+05	FO	• Yes, 7 is maintained over 500.	④
08:47:02	H-06+41	FO	• I set waypoints along Hangang, Dongjak Bridge, Cheongdam Bridge, then Jamsil.	⑤
08:48:04	H-05+39	CAP	• Take a good look at Hangang on your side.	⑥
08:48:06	H-05+37	FO	• Yes, I will.	⑦
08:49:04	H-04+39	CAP	• Now Hangang. Anything in sight?	⑧
08:49:06	H-04+37	FO	• Now right above Hangang. If you fly a bit to the south...	⑨
08:49:25	H-04+18	FO	• If you fly a bit to the south from the displayed route, we can maintain the south edge of Hangang.	⑩
08:50:22	H-03+21	FO	• A bit... now the north edge of Hangang. Fly a bit to the south, please.	⑪
08:50:23	H-03+20	CAP	• Hangang in sight?	⑫
08:50:29	H-03+14	FO	• If you see here, now...	⑬
08:50:37	H-03+06	CAP	• Um... this keeps changing...	⑭
08:50:44	H-02+59	FO	• Now, not in sight due to cloud. A bit more.	⑮
08:50:59	H-02+44	FO	• Yes, we flew down to the south of Hangang again.	⑯
08:52:50	H-00+53	CAP	• Above Hangang? In sight?	⑰
08:52:52	H-00+51	FO	• Not in sight yet.	⑱
08:52:57	H-00+46	CAP	• Now... Hangang, we seem to enter Hangang.	⑲
08:53:00	H-00+43	FO	• Yes, we seem to enter Hangang, but have yet to confirm... a bit more...	⑳
08:53:21	H-00+22	FO	• Yes, it will be Hangang if flying a bit further to the south.	㉑
08:53:31	H-00+12	CAP	• Visibility is poor...	㉒
08:53:41	H-00+03	CAP	• Oh!! (condominium in sight, first impact sound)	
08:53:44	H-00+00		• Crash (second impact sound)	

[Table 4] Major Content of the CVR Transcript

The major content of the CVR transcript in [Table 4] was numbered and marked on HL9294's flight track in [Figure 4] to match flight conditions with weather conditions recognized by the pilots during flight.



[Figure 4] Flight Track and the Major Content of the CVR Transcript

1.7.4 Weather-related Regulations

The Ministerial Regulation of the Aviation Act, [Appendix 8] stipulates the term "good visual meteorological condition," as shown in [Table 5].

Altitude	Airspace	Visibility	Distance From Cloud
An altitude of 900 m (3,000 ft) or 300 m (1,000 ft) from an obstacle, whichever is higher	B, C, D, E	5,000 m	Horizontally 1,500 m, vertically 300 m (1,000 ft)
	F, G	5,000 m	Distance where the ground can be visually identified and clouds are avoidable
Remarks 2. Rotorcraft can be operated in a flight visibility of less than 1,500 m when flying at a speed at which a pilot can see and avoid other aircraft or obstacles.			

[Table 5] Good Visual Meteorological Condition in [Appendix 8]

According to Article 9 (Hangang Corridor Flight Procedures)⁵⁷⁾ of the Ministry of National Defense's Flight Procedures in the Vicinity of P73, which is a weather criterion the flight crew shall comply with when flying in Hangang Corridor, flights in Yongsan Corridor are permitted under the condition of not less than 2,000 ft ceiling and 3 statute miles visibility in the daytime (from sunrise to sunset).

In addition, it specifies that any aircraft flying along Hangang Corridor must maintain not less than 1,500 ft in Nodulseom Corridor, and that in this corridor, flights in cloud and on top are not permitted.

According to [Attachment-1] (Weather Criteria for Group Helicopter Operation) to LG Electronics' Helicopter Operations Regulation, flights from Gimpo Airport⁵⁸⁾ and in nearby areas⁵⁹⁾ are permitted under the condition of not less than 450 m (1,600 ft) ceiling and 1,600 m visibility, and not less than 600 m (2,000 ft) ceiling and 3,200 m visibility, respectively.

1.8 Aids to Navigation

On the day of the accident, HL9294 did not use any radio aids to navigation. However, the aircraft was detected by the ATC radars of Seoul APP and Seoul Airport, and the air defense radars of the MCRC and Army CDC, and was operated under the radar surveillance of and in communication with the MCRC.

The pilots operated the aircraft, using the GPS⁶⁰⁾ mounted on HL9294.

57) Paragraph 3 (Flight Procedures Between Gimpo Airport, Nodulseom Helipad and Jamsil Heliport), Item 1 (Flight Policy), page 16.

58) Including LG Headquarters (Twin Towers), Nodulseom, Gasan, and Seocho R&D Campus.

59) Including Seoul, Gyeonggi-do, and Chungcheong-do.

60) GARMIN GMX 200, able to be used only for reference and unusable as navigation equipment during flight.

According to the CVR data, they entered Dongjak Bridge, Cheongdam Bridge, and Jamsil Heliport, as waypoints along Hangang Corridor, into the GPS.

As the GPS was destroyed by the crash impact, its data could not be restored. Instead, [Figure 5] shows a screen of the same model GPS on the same type aircraft which exhibits three waypoints and P73.



[Figure 5] Screen of the Same Model GPS on the Same Type Aircraft

Among the flight track data of the ATC radars and the air defense radars, that of Seoul Airport's ATC radar was utilized for accident investigation. The coordinates of the major locations from the data are shown in [Table 6].

Time		Location	Coordinates		Remarks
KST	Inversed Time		Lat. (N)	Long. (E)	
08:45:29	H-08+15	H-3 Helipad	37.555913	126.787103	Gimpo Airport

Time		Location	Coordinates		Remarks
KST	Inversed Time		Lat. (N)	Long. (E)	
08:46:38	H-07+06	North End of North Ramp	37.57273176	126.7990697	R/D Contact Established
08:46:48	H-06+56	Banghwa Subway Station	37.57768257	126.8100988	Subway Station
08:47:59	H-05+45	South End of Gayang Brdg.	37.56657385	126.8589258	
08:48:48	H-04+56	Center of Seongsan Brdg.	37.55118586	126.8907867	
08:49:17	H-04+27	Center of Dangsang Railway Brdg.	37.54161268	126.9089129	
08:49:38	H-04+06	South End of Seogang Brdg.	37.53165415	126.9213554	Yeouido
08:50:22	H-03+22	South End of Hangang Railway Brdg.	37.51579954	126.9478326	
08:51:04	H-02+40	Center of National Cemetery	37.49926458	126.9724715	Dongjak-dong
08:52:12	H-01+32	South End of Hannan Brdg. (1.8 km)	37.50825975	127.0162778	Gyeongbu Expwy.
08:52:47	H-00+57	Dosan Park Intersection	37.52011796	127.034589	
08:53:32	H-00+12	Cheongdam Subway Station	37.52084108	127.055822	R/D Contact Disappeared
08:53:44	H-00+00	Condominium A	37.51849685	127.0592268	Crash

[Table 6] Major Locations from Seoul Airport's Radar Data

1.9 Communications

On the day of the accident, HL9294 made contact with the Gimpo Control Tower and the MCRC mainly about a clearance to take off and weather conditions, and about flight in P73 Hangang Corridor, respectively.

The major content of the ATC/pilot communications is shown in [Table 7].

Time		Speaker	Content	Remarks
KST	Inversed Time			
08:43:47.9	H-09+55.8	CAP	• Gimpo Ground, HL9294.	Initial Contact

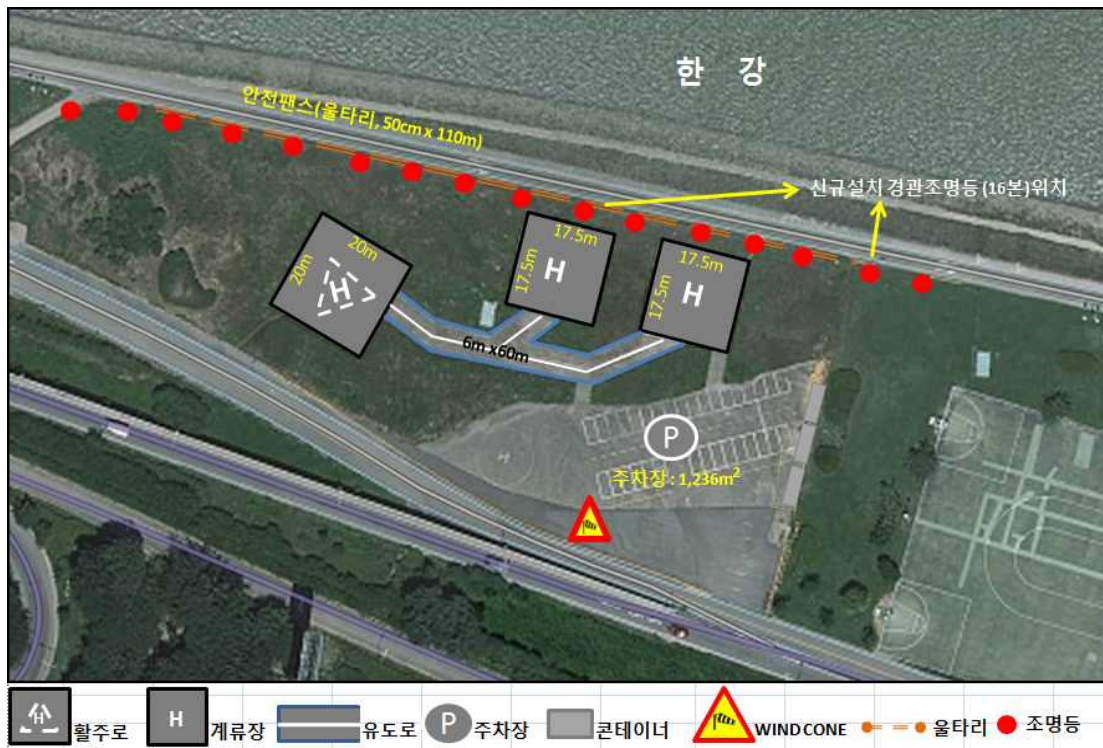
Time		Speaker	Content	Remarks
KST	Inversed Time			
08:43:51.0	H-09+52.7	Ground Controller	• HL9294 Ground, Go ahead.	
08:43:53.7	H-09+50	CAP	• HL9294 spot 915. Taxi for take-off runway cross to east take off.	
08:44:01.3	H-09+42.4	Ground Controller	• Roger HL9294, advise visibility 700 m. Taxi to H3. Altimeter 3013.	
08:44:10.1	H-09+33.6	CAP	• 3013, H3, Special VFR.	
08:44:48.0	H-08+55.7	FO	• Gimpo Tower, HL9294 H3. Ready for takeoff.	
08:45:17.0	H-08+26.7	TWR	• HL9294, H3 wind calm cleared for takeoff after departure right turn approved and cross both runway.	
08:45:25.0	H-08+18.7	FO	• Roger, 9294.	
08:46:03.2	H-07+40.5	TWR	• HL9294, official visibility 700 m. Sky condition few at 500.	
08:46:15.6	H-07+28.1	FO	• Roger, 9294.	
08:46:33.8	H-07+09.9	TWR	• HL9294, how's the flight visibility?	
08:46:38.9	H-07+04.8	FO	• Yes, 7 is maintained over 500.	
08:46:45.7	H-06+58	TWR	• Roger, thank you.	
08:46:46.9	H-06+56.8	TWR	• Heading to Yeouido?	
08:46:49.0	H-06+54.7	FO	• Plan to fly to Jamsil along Hangang.	
08:46:52.2	H-06+51.5	TWR	• Roger, report leaving CP7.	
08:46:55.0	H-06+48.7	FO	• Roger, 9294.	
08:47:12.3	H-06+31.4	FO	• Watchman, HL9294.	
08:47:23.4	H-06+20.3	Air Defense Controller	• HL9294, ACACIA Squawk IDENT.	
08:47:26.1	H-06+17.6	FO	• IDENT 9294.	
08:47:37.6	H-06+06.1	Air Defense Controller	• HL9294, ACACIA, radar contact maintain VFR.	
08:47:41.5	H-06+02.2	FO	• Roger, 9294.	
08:48:14.0	H-05+29.7	TWR	• HL9294, maintain VFR condition frequency change to Watchman, goodbye.	
08:48:19.7	H-05+24	FO	• Roger, 9294.	
09:03:27.0	H+10+43.3	Air Defense Controller	• HL9294, ACACIA.	After Crash

[Table 7] ATC/Pilot Communications

1.10 Heliport Information

Jamsil Heliport where HL9294 was scheduled to pick up LG Electronics' executives on the day of the accident was located in the riverside⁶¹⁾ between the north of the Olympic Main Stadium and the Hangang, 1,200 m in 085° direction from Condominium A or 1,100 m in 135° direction from the center of Cheongdam Bridge.

The heliport is equipped with three helipads, taxiway, parking lot, one wind sock, and one mobile management office. Their locations and sizes are shown in [Figure 6]. One manager was working⁶²⁾ in the management office equipped with one radio used to communicate between air and ground for takeoff and landing.



[Figure 6] Jamsil Heliport

61) A riverside park where recreational facilities and amenities are established along the raised banks of the Hangang.

62) Two managers take turns working on 24-hour shifts, in charge of safety control and facility management. Working hours are 08:00 - 18:00 (weekdays) and 08:00 - 14:00 (Sat).

Jamsil Heliport was established and operated⁶³⁾ by the Unscheduled Air Operators Association⁶⁴⁾ on 4 December 1992 to provide rapid means of air transport between downtown Seoul and provincial cities and to secure a takeoff and landing site for rescue activities in case of emergency such as fire and accident. From April in 1999 to the day of the accident, it was operated autonomously by its users⁶⁵⁾ in accordance with "Metropolitan Land Heliport Operation Procedures/Guidelines."⁶⁶⁾

1.11 Flight Recorders

HL9294 with the maximum takeoff weight of 5,307 kg was manufactured on 23 January 2007, and was equipped⁶⁷⁾ with the CVR/FDR in accordance with paragraph (1)-3 of Article 135-2 (Accident Prevention Equipment) of the Ministerial Regulation of the Aviation Act, as well as the EGPWS⁶⁸⁾ for flight safety, though not compulsory.⁶⁹⁾ The event aircraft was equipped with the MPFR⁷⁰⁾ combination cockpit voice/flight data recorder (CVR/FDR) manufactured by the UK Penny & Giles.

The CVR/FDR and the EGPWS were collected immediately after the accident and, for safe data retrieval from the damaged devices, sent to the US NTSB, which later retrieved initial data. The ARAIB received both CVR/FDR data and EGPWS data on 25 November 2013 and made use of them for investigation.

63) Jamsil Heliport was donated to national property on 19 Oct. 1995 and was operated by the SRAA between Dec. 1998 and Apr. 1999.

64) The Association was established by the unscheduled air transport operators to achieve their business goals (dissolved in Nov. 1998).

65) Seven companies: LG Electronics, Samsung, POSCO, SKT, Hyundai Motor Company, Hanwha Corporation, Unification Mission.

66) The document was produced after consultation between heliport users and the SRAA.

67) Rotorcraft exceeding the max. takeoff weight of 3,180 kg, manufactured after 1 Jan. 2005.

68) Enhanced Ground Proximity Warning System, P/N: 965-1595-024, S/N: 5243 (Honeywell).

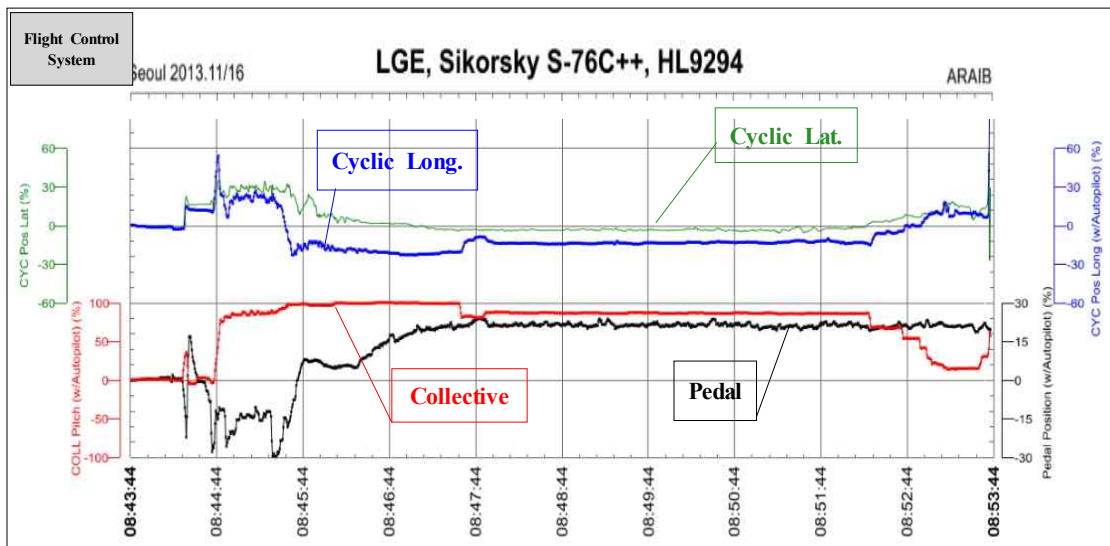
69) In accordance with the proviso of Article 135-2 (1) of the Ministerial Regulation of the Aviation Act, rotorcraft which is not operated on international routes is exempt from the mandatory installation of EGPWS.

70) Multi Purpose Flight Recorder, P/N: D51615-102, S/N: 002071-003

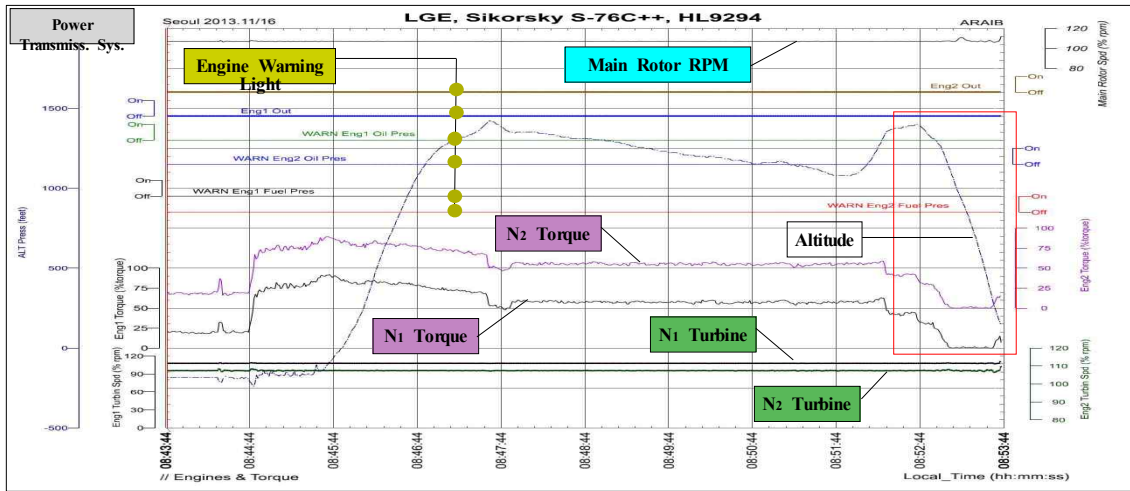
The FDR recorded the last 25 hours of HL9294 including about 18 minutes and 30 seconds of the event flight (from Gimpo Airport to the crash site), and the FDR data (77 parameters) covering the event flight were used for investigation.

Analysis of the FDR parameters related to engines, flight control system, and power transmission system revealed that there was no evidence of defects in them. Review of the CVR transcript also failed to find that the pilots detected any failures with the aircraft.

As shown in [Figure 7], on the flight leg before the accident, HL9294's engine turbine RPM (green box) and main rotor RPM (light blue box) were maintained normal, and engine N1 and N2 torques (pink box) decreased (red box) due to power decrease caused by altitude drop. No engine-related warning lights⁷¹⁾ were illuminated.

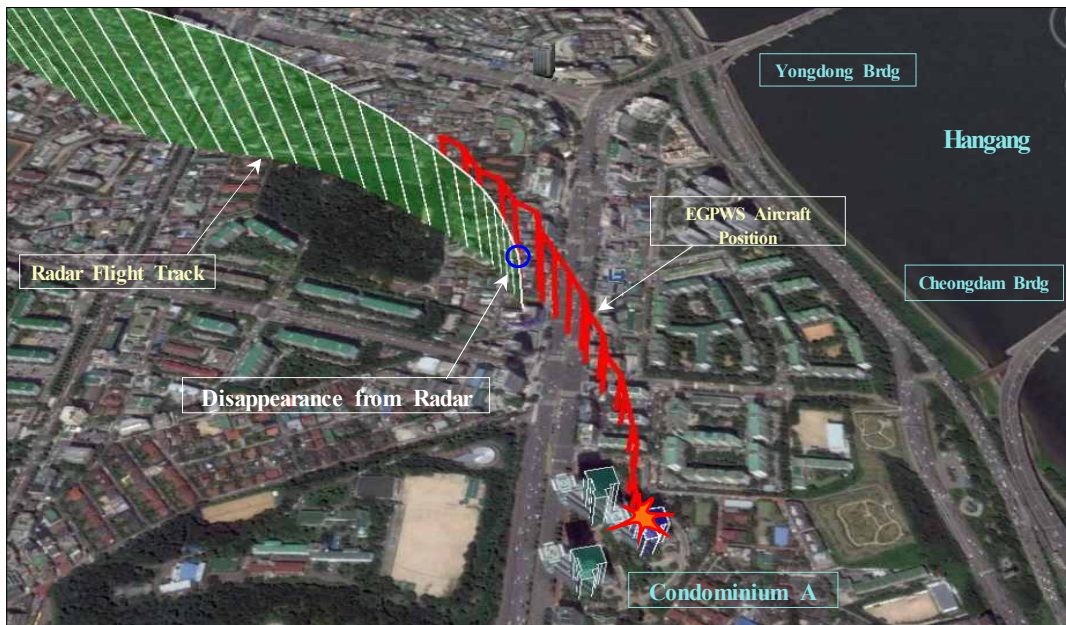


71) Engine 1, 2, fuel/oil pressure and engine shutdown warning lights.



[Figure 7] FDR Parameters

Using Seoul Airport's radar data⁷²⁾ and the EGPWS aircraft position information,⁷³⁾ HL9294's flight track was generated as shown in [Figure 8] since the FDR data did not contain its route information.



[Figure 8] Radar Flight Track and EGPWS Aircraft Position

72) From the disappearance of HL9294 from the radar screen to the crash, there is no information on HL9294's flight track (which, the ARAIB concluded, is caused by a shielding effect of ground obstacles close to the radar).

73) Aircraft position information between 22 seconds prior to impact and impact. The event aircraft crashed 2 seconds after a "Bank Angle" warning (20 seconds before warning, 10 seconds after warning).

1.12 Wreckage and Impact Information

1.12.1 Terrain of the Crash Site

As shown in [Figure 9], Condominium A, the crash site, is located about 540 m south of the south end of Cheongdam Bridge, about 600 m south of the Hangang, and about 650 m west of Tancheon that flows from south to north to join the Hangang.

South of the condominium is a downtown area crowded with high-rise buildings, and there is no higher building between the condominium and the Han River.



[Figure 9] Terrain in the Vicinity of Condominium A

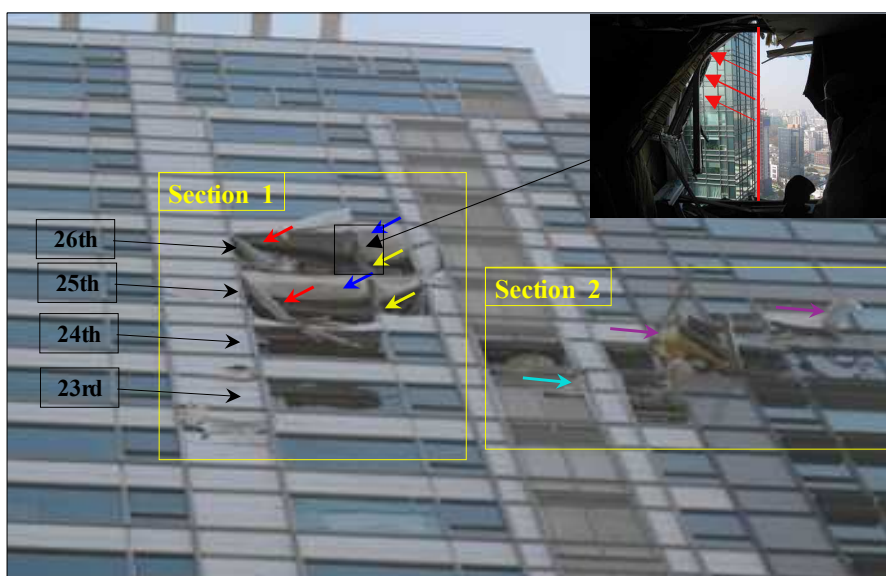
1.12.2 Wreckage Distribution

After the crash, HL9294 fell down to the ground, and most of the wreckage were discovered on scene. Part of the main rotor blades and the fuselage were found inside residences on the 24th, 25th, and 26th floors of building 102 (East Wing) of Condominium A.

HL9294 fell to the ground, right down from the final impact point, with a 20° pitch down attitude on a heading of about 50°, and fragments of the fuselage and the building generated from the impact were scattered around the main fuselage.

1.12.3 Impact Point of the Condominium Building

The area damaged by a direct impact with HL9294 mainly contained the 23rd, 24th, 25th and 26th floors on the north side of building 102, and it is divided into two sections as shown in [Figure 10]. Apart from this area, other damages to the building were caused either by fragments of the main rotor blades generated by the initial impact or by fuselage debris scattered during the crash into the ground.



[Figure 10] Condominium Building Damage

As shown in [Figure 10], the lower part of the window frames (red arrow) in Section 1 was bent from left to right and fractured, and centerline window frames (yellow arrow) were bent from bottom left to upper right. Exterior panels (blue arrow) on the 25th and 26th floors were compressed and bent upwards from the bottom.

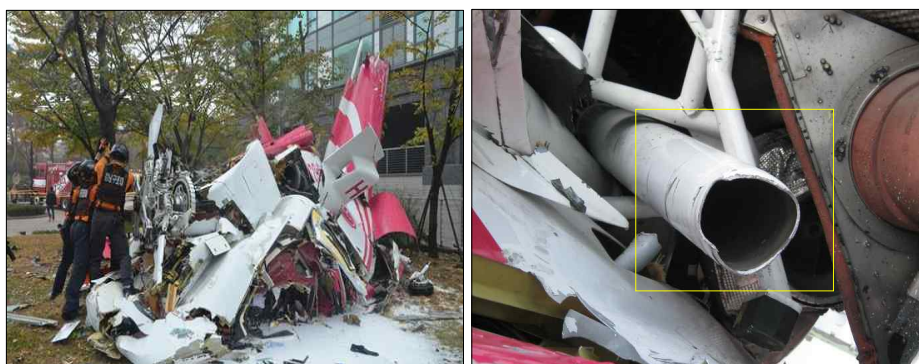
In Section 2, mainly exterior panels or window frames (light blue arrow) were torn out from left to right, and some window frames (purple arrow) sustained damage when pushed to the right.

Judging from the damage to the condominium building, the left side of the climbing aircraft initially crashed into Section 1, then, as its tail boom was rotated by inertial force, the aircraft impacted Section 2 for the second time.

1.12.4 Wreckage Examination Results

Both main and tail rotor blades of HL9294 were found on scene. While impacting outside obstacles due to a strong rotational force, all main and tail rotor blades were fractured into debris of about 1 m or so.

As the main fuselage fell to the ground, right down from Section 2 shown in [Figure 10], the upper and lower sections of the main fuselage were crushed in, and the gearbox with its middle portion broken was separated from its assembled position and placed on top of the cockpit along with the hub. Please, refer to [Figure 11].



[Figure 11] Compressed Fuselage and Damaged Tail Rotor Driveshaft

The tail boom was fractured at the junction with the main fuselage and the horizontal stabilizer. The tail rotor driveshaft was fractured by a strong rotational overload, and damage from rotation (scratches) was found around its fracture surface.

1.13 Medical and Pathological Information

Any of the pilots' medical and pathological evidence, including ethanol, drugs, fatigue, illness or stress, that could have affected this accident was not found. The captain⁷⁴⁾ and the FO⁷⁵⁾ received the airman medical examination in accordance with the provisions of the Aviation Act, Article 31 (Airman Medical Certificate).

1.14 Fire

After crash, a fire broke out at the back of HL9294's pilot seats, but it was

74) Term of validity: 14 Oct. 2013 - 31 Oct. 2014, Issue No.: 122-6830, Limitation: must wear corrective glasses; possess a reserve pair of corrective glasses.

75) Term of validity: 1 Apr. 2013 - 30 Apr. 2014, Issue No.: 122-5308, Limitation: must wear corrective glasses; possess a reserve pair of corrective glasses.

immediately put out by firefighters responding to the scene upon the receipt of the notification by a witness.

1.15 Survival Aspects

1.15.1 General

At the time of the accident, the captain and the FO with their seat belt⁷⁶⁾ fastened took the right⁷⁷⁾ and the left⁷⁸⁾ seat, respectively. HL9294 were equipped with a total of 8 seats, 2 pilot seats with 4-point seat belts and 6 cabin seats with 3-point seat belts.

1.15.1 Emergency Response

On 16 November 2013, at 08:54:45, Seoul Emergency Operations Center received an accident report from a witness,⁷⁹⁾ and at 08:55:18, gave a dispatch order to Gangnam Fire Station. Accordingly, about 08:58, the rescue team of Gangnam Fire Station arrived on scene, about 1.75 km from the Station.

On the rescue team's arrival, no fire occurred to HL9294, but its cockpit was crushed in. Thus, the rescue team first sprayed the extinguishing agent onto the wreckage to prepare for a possible fire and cut the trees obstructing rescue activities.

Rescue workers cut the part of the fuselage and recovered the bodies of the pilots. The FO and the captain were transported to the nearby hospital⁸⁰⁾ about

76) Manufacturer: Belt Master Corporation, P/N: N6570-A, Manufacture date: Jun. 2007 TSO C22f.

77) Manufacturer: Martin Baker Aircraft Co, S/N: 0309, P/N: MBCS 3310-1. TSO C39B.

78) Manufacturer: Martin Baker Aircraft Co, S/N: 0329, P/N: MBCS 3310-1. TSO C39B.

79) A resident in room 1501, building 101.

10:00 and about 10:17, respectively. It was confirmed that the cause of death was multiple fractures.

About 09:30, the head of Seoul Metropolitan Fire and Disaster Headquarters established a command post on scene and led all dispatched departments,⁸¹⁾ mobilized personnel,⁸²⁾ and equipment.⁸³⁾ After emergency response was completed about 16:20, he left the scene about 16:30.

1.16 Tests and Analysis

On 16 July 2014, the ARAIB conducted a flight test, using the same model GPS equipment mounted on the same type aircraft, to determine whether there were errors or not. Also, the Board verified input data to determine why EGPWS failed to provide an aural alert when HL9294 was approaching the condominium just before the accident.

According to the test result, exact locations and a margin of error could not be determined since the terrain displayed on the GPS screen was not precise. The information on the Korean Peninsula's terrain and power lines was entered into the EGPWS, but obstacles⁸⁴⁾ like buildings were excluded.

1.17 Organizational and Management Information

1.17.1 General

As shown in [Table 9], under LG Electronics' Business Support Department is

80) Konkuk University Medical Center.

81) Seongsu, Gwangjin, Samseong, and Yongdong 119 Safety Centers, 119 Special Rescue Service, the 211st Regiment, 52nd Division, Police, District Office, etc.

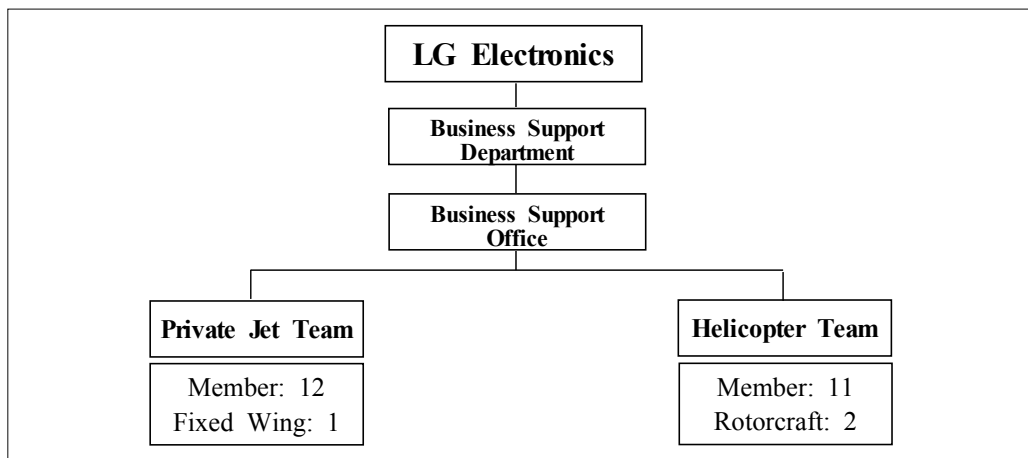
82) 98 firefighters, 120 police officers, 30 personnel from District Office, 15 soldiers and 30 others.

83) 1 command, 2 pump, 1 tank, 5 rescue, 6 emergency, and 2 other vehicles.

84) Obstacles except for high-voltage power lines or (some of) wireless towers.

the Business Support Office, under which are the Private Jet Team and the Helicopter Team. The Private Jet Team and the Helicopter Team consist of 1 fixed wing aircraft⁸⁵⁾ and 12 members,⁸⁶⁾ and 2 rotorcraft⁸⁷⁾ and 11 members,⁸⁸⁾ respectively.

Their main duty is to transport the management and buyers of the LG headquarters (LG Electronics), affiliated companies (LG Display, LG Chem, and LG Innotek), subsidiaries, and major subcontractors. In addition, they conduct flights for the purposes of business liaison, patient transportation, community service, and emergency relief. They are under the control of the head of the Business Support Office.



[Table 7] Organization of LG Electronics' Private Jet Team and Helicopter Team

The Private Jet Team is staffed by a flight dispatcher and a safety officer who do not provide support to the Helicopter Team. Thus, two pilots in the Helicopter Team perform their roles instead.

85) 10-seat Gulf Stream (G-550).

86) 3 flight crew, 4 aircraft mechanics, 2 cabin crew, 1 safety officer, 1 flight dispatcher, and 1 administrative staff.

87) S76C++ (HL9294), S76C+ (HL9252).

88) 5 flight crew, 4 aircraft mechanics, 1 driver, and 1 administrative staff.

1.17.2 Pilot Staffing of the Helicopter Team

Five pilots of the Helicopter Team all accumulated flight experience during military service and graduated from the same school. From the Team leader to the most junior pilot, they were bonded together based on the senior-junior relationship such as 9, 4, 4, and 5 years gap.

According to the statement of the head of the Business Support Office, if the Team leader interviews a pre-selected candidate and recommends him, he will be normally hired as long as there are no special reasons for disqualification.

1.17.3 Go/No-go Decision of the Helicopter Team

Any department which desires to use a helicopter operated by LG Electronics' Helicopter Team should check with the Team first whether helicopters are available or not, then make its request via Fax or e-mail. Upon request, the Helicopter Team obtains the necessary permissions from relevant agencies and prepares the aircraft for operation.

For operation support, potential passengers are classified into LG Corp. and other companies.⁸⁹⁾ The former is given priority for the use of helicopters, whereas the latter should have a prior consultation with LG Electronics' Vice Chairman & CEO's Office to get the support on one condition that passengers should consist mainly of chairmen and buyers.

Aircraft operation approvals⁹⁰⁾ for LG Corp. and other companies are earned separately. In case of LG Corp., the right of approval given to the head of the

89) Initially included in LG Corp. but, during the split-up, separated from it.

90) The Helicopter Team has prepared a related document in 2009, obtained an approval, and implemented it.

Business Support Department is delegated to the Helicopter Team leader according to regulations on approval by delegated authority, and in case of other companies, to the head of the Business Support Office.

Although not specified in Helicopter Operations Regulation, a final go/no-go decision lies with the captain. The head of the Business Support Office stated that after weather conditions are considered, the captain makes a final go/no-go decision which he fully respects and follows.

On the day of the accident, passengers were actually considering two transportation options, a high-speed train (KTX) and a helicopter, but as the captain made a go decision, the latter was finally selected.

On the day of the accident, about 06:06 and 06:08, the captain called Gimpo Airport Weather Office and Seoul Airport Weather Office, respectively, and checked out weather conditions. About 06:25, he called⁹¹⁾ the FO and said, "Let's cancel the flight because it will be difficult."

Subsequently, about 06:30, the FO called LG Electronics' Vice Chairman & CEO's Office and notified no-go due to bad weather conditions, and according to the statement of the Office, about 06:32, the Office called the Helicopter Team's pilot in charge of operation and said, "The FO notified no-go, so please, accurately assess a situation once again."

Accordingly, while checking with Seoul Airport Weather Office for weather conditions, the pilot in charge of operation had a telephone conversation⁹²⁾ with

91) Stated by the pilot in charge of operation after he heard from the captain's family who had listened to a telephone conversation between the captain and the FO in the morning on the day of the accident.

92) Conversation regarding HL9294 (#1): checked with Seoul Airport for weather conditions to make a go/no-go decision; and notified situations to the captain and the FO; Conversation regarding HL9252 (#2): had a talk with a senior pilot (captain of HL9252) about flight mission.

the captain, senior pilot, FO, and Vice Chairman & CEO's Office's deputy general manager, whom he recommended, "How about taking off at Gimpo Airport if the weather conditions are poor since takeoff is possible (at Gimpo Airport)," and whom he told the captain's phone number so that the captain and the deputy general manager could have a direct talk.

Then, the captain deferred a go/no-go decision according to weather conditions until 07:40 while having a telephone conversation with the Vice Chairman & CEO's Office's deputy general manager, and about 07:38, he called the deputy general manager to notify his go decision based on weather conditions confirmed by himself. He also notified the decision to the pilot in charge of operation through the FO.

Despite the captain's go decision, the FO called Jamsil Heliport and found out the weather conditions were not good, but this was not taken into account in the captain's decision-making process.

1.18 Additional Information

1.18.1 Statements of Witnesses

After the event, verbal statements were taken from witnesses near the accident site, including Condominium A's security office, on 16 November 2013. Other witnesses additionally identified were separately interviewed face to face or by phone. With low visibility, most of the witnesses recognized by hearing a sound that the accident had occurred, and one⁹³⁾ of them stated relatively specifically what she witnessed. The following is the main content of her statement.

93) A resident on the 41st floor of building 103.

- When looking down to the ground from the 41st floor (about 159 m high), she could not identify the roads, and the fog was so thick that she could identify only the contour of the buildings 101 (66 m away) and 102 (54 m away).
- A little later, when she went out for a sauna and looked up at the buildings 101 and 102 at the entrance of her building, they were seen clearly (though floors could not be identified).
- When looking up, she heard the sound of a helicopter, which was flying between the buildings 101 and 102. Shaking up and down, the aircraft crashed into building 102 on its side and fell right down to the ground.

On 20 November 2013, and 6 and 7 January 2014, the persons affiliated with LG Electronics were interviewed face to face, and additional details were questioned and confirmed over the telephone. The following is the main content of their statements.

- On the day of the accident, about 07:52, the captain went to work and did not ask other pilots to have a weather-related discussion with him or to report weather conditions to him.
- Before the event, the captain had past experience of flying below the allowable limits of weather conditions before the accident.
- When other pilots found that the captain decided to fly below the allowable limits of weather conditions before the event, they thought that "the Team leader (captain) was able to conduct a flight under these weather conditions since he had more flight experience and better pilot proficiency than other pilots."

- When LG Electronics' Vice Chairman & CEO's Office asked the pilot in charge of operation to reassess a no-go situation, he checked out weather conditions for his flight on HL9252 (#2).
- A final go/no-go decision lies with the captain, and the captain's decision is fully followed.
- The reason why LG Electronics' Vice Chairman & CEO's Office asked the pilot in charge of operation to reassess a no-go situation is that there was time before the departure of an alternative transportation means, KTX, and that the pilot in charge of operation usually did this job whereas the FO was newly hired.

1.18.2 Flight Procedures in the Vicinity of P73

According to the decision by the Korea Airspace Committee, the Ministry of Defense established⁹⁴⁾ 「Flight Procedures in the Vicinity of RK P73」 to prevent all aircraft from violating P73 when flying nearby, and this guide is applicable to all agencies, organizations, and individuals that conduct air activities in the vicinity of P73.

P73 is divided into P73A⁹⁵⁾ and P73B.⁹⁶⁾ R75 Restricted Area is established on the outskirts of P73 to prevent flight violations, and a VFR route⁹⁷⁾ is established within the R75 Restricted Area.

Within the R75 Restricted Area is Hangang Corridor divided into Yongsan

94) Contained in Aeronautical Information Publication for Specimen (section ENR 1.2) and released.

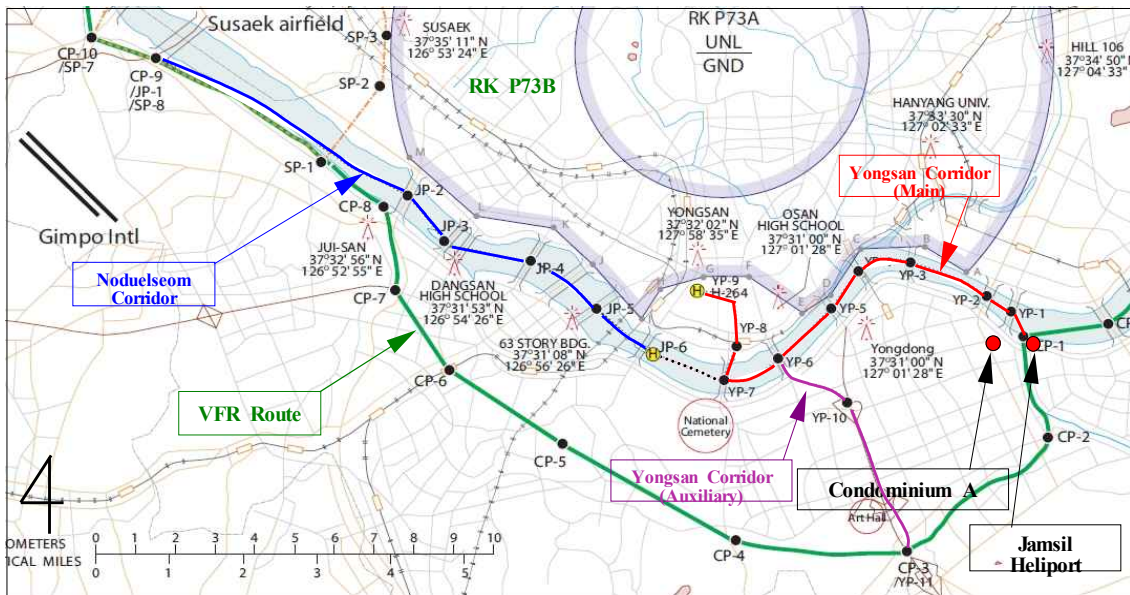
95) The area within a radius of 2 NM (3,704 m) of 37-35N 126-59E.

96) All the area of P73 with the exclusion of P73A.

97) A VFR route established to prevent helicopter flight which violates P73, connecting well-known terrain features on the ground for a visual flight in the vicinity of P73.

Corridor and Nodulseom Corridor. Hangang Corridor is established for the in/out-bound traffic of Yongsan Heliport (US Armed Forces) and for unscheduled air transport and private helicopters' in/out-bound traffic of Nodulseom and Jamsil Heliport, which were approved by the Minister of Land, Infrastructure and Transport.

As shown in [Figure 12], Yongsan Corridor consists of a main corridor (red line) that is from YP-1 to YP-9 and an auxiliary corridor (purple line) that is from YP-11 to YP-6 through YP-10. Any aircraft flying in this corridor should maintain 1,000 ft or above. In addition, Nodulseom Corridor (blue line) is between JP-1 (south end of Gayang Bridge) and JP-6 (Nodulseom), and any aircraft flying in this corridor should not fly in cloud and on top, maintaining 1,500 ft or above.



[Figure 12] VFR Route Between Gimpo Airport and Jamsil Heliport

To fly from Gimpo Airport to Jamsil Heliport using Hangang Corridor, the flight crew shall comply with Article 9 (3) of the same regulation (Flight

Procedures Between Gimpo Airport, Nodulseom Helipad and Jamsil Heliport), communicate with and make a radar contact with the MCRC before entering CP-9/JP-1, and pilot the aircraft by visually verifying the banks along the south and north edges of the Hangang.

According to this procedure, aircraft shall enter JP-1 (south end of Gayang Bridge), fly along Nodulseom Corridor to JP-6 (Nodulseom), fly directly to YP-7 (midpoint of Dongjak Bridge), fly along Yongsan Corridor, then depart from/arrive at Jamsil Heliport via YP-1 (midpoint of Cheongdam Bridge) or YP-2 (midpoint of Yongdong Bridge).

To avoid mid-air collision, the west-bound aircraft flying along Hangang Corridor shall fly between the centerline and the north edge of the Hangang, whereas the east-bound between the centerline and the south edge of the Hangang.

1.18.3 Installation/Management Regulations Regarding Aviation Obstruction Lights and Markings

The purpose of installing aviation obstruction lights is defined in ICAO Annex 14, 6.1's Note, and the Ministerial Regulation of the Aviation Act, [Appendix 44], subparagraph 1, in this language: "The marking and/or lighting of obstacles is intended to reduce hazards to aircraft by indicating the presence of the obstacles. It does not necessarily reduce operating limitations which may be imposed by an obstacle."

In accordance with the Aviation Act, Article 83 (4) (Installation of Aviation Obstruction Lights), effective⁹⁸⁾ at a time when Condominium A was designed,

⁹⁸⁾ Act and Regulations cited in this section were those effective at a time when Condominium A was designed and constructed (2001 - 2004).

"Any person who installs a structure with a height of 60 m or more above the land or water surface shall install aviation obstruction lights and/or markings⁹⁹⁾ under the conditions as set forth by the Ordinance of the Ministry of Land, Infrastructure, and Transport. This shall not apply in the case of such structures as set forth by the Ordinance of the Ministry of Land, Infrastructure, and Transport."

The Ministerial Regulation of the Aviation Act (Ordinance of the Ministry of Land, Infrastructure and Transport), Article 252 (Installation of Aviation Obstruction Markings) prescribes that structures, except the following structures,¹⁰⁰⁾ do not require the installation of aviation obstruction markings. According to this regulation, Condominium A did not require the installation of aviation obstruction markings when it was designed and constructed.

The Ministerial Regulation of the Aviation Act, Article 250 (1) (Installation of Mid-intensity Aviation Obstruction Lights) prescribes that "structures whose height is not less than 150 m require the installation of mid-intensity aviation obstruction lights."¹⁰¹⁾

In accordance with subparagraph 6 of [Appendix 28-4] in relation to Article 247-1 of the Ministerial Regulation of the Aviation Act, which was revised on 3 July 2004 after the construction of Condominium A and went into effect on 1 July 2005, "An object located in an area other than the obstacle limitation zone¹⁰²⁾ and whose height is more than 150 m, provided that the head of the Regional Aviation Administration or a mayor/provincial governor acknowledges that there is concern over a hindrance to the aircraft's navigation safety, shall be

99) Visual markings such as colored markings, markers, and flags, except for lights, that are installed to inform pilots during flight in the daytime that obstacles are present.

100) ① Chimney, steel tower, pillar, and other structures of similar forms and attached lines; ② Structures consisting only of frames; ③ Overhead wires and towers supporting them; and ④ Mooring structures and attached lines.

101) More than 1,600 cd (according to the Ministerial Regulation of the Aviation Act, Article 247).

102) Areas vertically under an approach surface, transitional surface, horizontal surface, and conical surface.

equipped with aviation obstruction markings and lights. Except, in case an obstacle is operated with high-intensity aviation obstruction lights in the daytime, aviation obstruction markings may not be installed." In addition, [Appendix 28-5] in relation to Article 248 of the Ministerial Regulation of the Aviation Act specifies that the maximum intensity of mid-intensity aviation obstruction lights is $2,000 \pm 25\%$ cd.

In accordance with subparagraph 6 of [Appendix 28-4] in relation to Article 247-1 of the Ministerial Regulation of the Aviation Act, which was revised on 10 September 2009, "An object located in an area other than the obstacle limitation zone and whose height is no less than 150 m shall be equipped with aviation obstruction markings (except, in case an obstacle is operated with high-intensity aviation obstruction lights in the daytime) and lights. Except, in case the head of the Regional Aviation Administration or a mayor/provincial governor acknowledges that there is no possibility the obstacle will hinder the aircraft's navigation safety.

In accordance with subparagraph 6, Article 254 (Management Method of Aviation Obstruction Lights) of the Ministerial Regulation of the Aviation Act, "When visibility is less than 5,000 m during daytime, and during nighttime, aviation obstruction lights shall be lighted at all times. Note, however, that high-intensity aviation obstruction lights under Article 250-2 shall be lighted only during daytime."

On the other hand, Chapter 6 (Visual Aids for Denoting Obstacles) of ICAO Annex 14 and regulations on "Obstacle Denotement" of the US Federal Aviation Administration contained no requirement to light aviation obstruction lights in a daytime visibility of less than 5,000 m.

1.18.4 Installation/Management of Obstruction Lights on Condominium A

Condominium A is located in an area other than the obstacle limitation zone and consists of the following three buildings: 199-meter-high building 101; 179-meter-high building 102; and 197-meter-high building 103.

Post-accident on-scene investigation revealed that 12 mid-intensity and 24 low-intensity aviation obstruction lights were installed¹⁰³⁾ on Condominium A, as shown in [Table 10] and in the installation diagram for aviation obstruction lights which a construction firm had registered¹⁰⁴⁾ with the supervisory office¹⁰⁵⁾ when constructing the condominium.

Operation and management of aviation obstruction lights on Condominium A has been carried out by the management office's disaster prevention team, and their configuration, operating method, and the use of switches were specified in the "Manual for Operation of Aviation Obstruction Light Control Panel," according to which managers have operated and managed the lights.

The disaster prevention team was able to visually monitor the operating status of the aviation obstruction lights through the aviation obstruction light monitoring panel installed in the team's office.

103) Installed by Hyundai Development Company and supervised by Environmental Professionals Group, Korea.

104) Registered on 6 Jan. 2004.

105) Gangnam-gu Office, Seoul.

Category	West Wing (#101)			East Wing (#102)			South Wing (#103)			Total
	Qty.	Floor	Location	Qty.	Floor	Location	Qty.	Floor	Location	
Mid-Intensity	1	43	Rm. 2	1	32	Rm. 2	1	45	Rm. 1	12
	1	45	Rm. 3	1	38	Rm. 1	1	46	Rm. 4	
	1	47	Rm. 4	1	40	Rm. 4	1	47	Rm. 3	
	1	48	Rm. 4	1	41	Rm. 4	1	48	Rm. 3	
Total	4			4			4			
Low-Intensity	3	13	Rm 2, 3, 4	3	13	Rm 1, 2, 4	3	13	Rm 1, 3, 4	24
	3	22	Rm 2, 3, 4	3	28	Rm 1, 2, 4	3	25	Rm 1, 3, 4	
	3	34	Rm 2, 3, 4				3	35	Rm 1, 3, 4	
Total	13			10			13			36

[Table 10] Aviation Obstruction Lights of Condominium A

According to the "Manual for Operation of Aviation Obstruction Light Control Panel," illumination intensity of a mid-intensity aviation obstruction light (flash lamp) is 1,600 cd, and the lights are automatically turned on/off when the photo cell detects¹⁰⁶⁾ the intensity of ambient light or manually turned on/off by switches.

Apart from automatic illumination and lights-out according to the intensity of ambient light, the Manual failed to specify that, when visibility is less than 5,000 m during daytime, aviation obstruction lights shall be lighted, and all personnel from the disaster team were neither aware of this regulation nor trained or supervised on how to measure visibility by the supervisory office.

According to the statement of a night-shift worker from the team on the day of the accident, "aviation obstruction lights of buildings 101 and 103 were automatically turned off by the aviation obstruction light illuminance sensor about 07:10 - 07:15 on the day of the accident. He found about 19:00 on the day

106) Nighttime: 50±15LUX, Daytime: 90±15LUX.

before the accident that the aviation obstruction light illuminance sensor of building 102 was out of order, so he manually turned on the lights, then turned them off at 08:00 at the change of shift on the day of the accident after he confirmed that the lights of buildings 101 and 103 were automatically turned off.

1.18.5 Clearance of Flight Plan and Warning by the CDC

Investigation during a visit to the Army Capital Defense Command (CDC) on 25 June 2014 revealed that clearance of LG Electronics' flight along Hangang Corridor was immediately given since it was not subject to flight restrictions.¹⁰⁷⁾

According to the statement of the person concerned, he, though he knew visibility was poor due to fog on the day of the accident, did not control the flight for the following reasons: ① HL9294 was not subject to flight restrictions since there were no NOTAM or military operation in the metropolitan area; ② the pilot has the authority to decide between go and no-go according to weather conditions; ③ as far as he knows, a departure airport is in charge of flight control¹⁰⁸⁾ according to weather conditions; ④ the main duty of the CDC is not the control of civil aircraft but the capital defense, so if the CDC excessively controls civilian aircraft for reasons other than capital defense, civil complaints are likely to be filed; and ⑤ when asked in a telephone conversation in the morning on the day of the accident, "Are you going to fly as planned when other scheduled flights¹⁰⁹⁾ are all cancelled?," the FO replied to the effect that his flight mission would be carried out as planned.

In addition, under relevant regulations, a warning shall be given on

107) Military operation, NOTAM, etc.

108) If visibility in the controlled airspace after takeoff from a departure airport does not meet weather conditions prescribed in [Table 5], flights are restricted.

109) On the day of the accident, two of the three flight plans, except that of HI9294, were cancelled due to low visibility.

emergency frequency when an aircraft deviates from its route about 500 m, but although HL9294 deviated from its planned route, the warning was not given for the following reasons: ① there was no possibility of a violation of P73 since the aircraft was on a heading towards Jamsil Heliport; and ② he concluded that the aircraft was flying directly to Jamsil Heliport.

1.18.6 EGPWS

Although a rotorcraft which is not operated on international routes does not require the installation of EGPWS, HL9294 was equipped with it. The EGPWS map data used for the rotorcraft divides the world into nine areas, and out of the two types of data maps, one locating the Korean Peninsula in the Asian area and the other in the Pacific area, the EGPWS of HL9294 has the former.

Since the installation of EGPWS, HL9294 has obtained data updates twice,¹¹⁰⁾ including an update on high-voltage power line towers, which was performed by the EGPWS manufacturer on 9 October 2006 and was stored in the EGPWS by LG Electronics on 14 June 2008.

Accordingly, at the time of the accident, HL9294's EGPWS data contained only high-voltage power line towers, not high-rise buildings,¹¹¹⁾ including Condominium A, accident site.

EGPWS displays terrain and obstacles in proximity of the aircraft, in a grid shape, on the cockpit instrument panel. It denotes,¹¹²⁾ in colors, the difference between height of the highest obstacle in a grid and aircraft altitude.

110) On 14 June 2008 and 12 April 2010, data on high-voltage power line towers and changes to Busan, Ulsan, and Pohang airports were updated, respectively.

111) The EGPWS manufacturer's database did not contain obstacle data on buildings on the Korean Peninsula.

112) Aircraft altitude: more than 500 ft (red), up to 500 ft (yellow), up to -250 ft (light yellow), up to -500 ft (green), up to -1,500 ft (light green), less than -1,500 ft (black).

Obstacles of the EGPWS data are marked by different colors according to their heights, on the cockpit instrument panel, i.e. an obstacle higher than the aircraft is displayed in red. EGPWS provides an aural alert to flight crews when the aircraft reaches a distance in danger of crash.

In addition, the computer installed on EGPWS compares its 3D terrain and obstacle data with the aircraft's altitude, speed and direction, thereby predicting a danger area, and 20 seconds before the aircraft reaches the danger area, it provides aural and visual alerts by changing colors on the panel.

2. Analysis

2.1 General

The flight crew of HL9294 held all qualification certificates required for operation, and any of the pilots' medical and pathological evidence that could have affected the flight was not found in the course of the investigation.

The HL9294 aircraft was legally certified for aircraft registration, airworthiness, operating limitations, and radio station operation in accordance with the procedures prescribed by the Aviation Act of the Republic of Korea.

There was no evidence of any defects in the aircraft engines, the flight control system, and the power transmission system before and during flight, and the aircraft was operated within the allowable range of weight and balance.

2.2 Meteorological Factors

To make a go/no-go decision on the day of the accident, the pilots referred to various weather information as follows: weather data from Gimpo Airport Weather Office, Seoul Airport Weather Office, and KAMA; CCTV traffic information covering Olympic Expressway; visual weather observation at the office; and visual weather observation by Jamsil Heliport's manager.

To put all the information above together, visibility at Gimpo Airport, a takeoff point, was 700 m, while that of Seoul Airport was 800 m, and 900 m in the direction of runway 20. In addition, according to the weather information provided by Jamsil Heliport's manager, a VFR flight was impossible since Cheongdam Bridge (about 1.1 km) and the Hangang's water (about 90 m) were

not visible from the heliport.

Like the above, poor visibility caused by fog was confirmed by the post-accident interview with witnesses, an in-flight conversation between the captain and the FO, and CCTV traffic information covering Olympic Expressway.

HL9294 neither reached a speed at which a pilot can see and avoid other obstacles, which is specified in the proviso¹¹³⁾ of [Appendix 8] in the Ministerial Regulation of the Aviation Act, nor complied with the minimum weather requirements prescribed both by Flight Procedures in the Vicinity of RK P73 and by LG Electronics' Helicopter Operations Regulation.

Immediately after takeoff, however, when asked by the Gimpo Control Tower about weather conditions, the captain advised the FO at 08:46:36, "Tell him over 500 is 7 miles." and the FO replied at 08:46:38, "Yes, 7 (miles) is maintained over 500 (ft)." It is possible that the pilots said so since they had the will to perform their flight mission although actual weather conditions did not coincide with what they said.

The grounds for the possibility above are as follows: if horizontal visibility had been as good as 7 miles at an altitude of 500 ft (about 160 m), the pilots could have identified high-rise buildings, more than 500 ft tall, and terrains that are in the vicinity of Hangang Corridor and exposed above fog.

In addition, analysis of the CVR transcript revealed that, unlike the transcribed communication, the pilots had a hard flight under such a poor visibility that they could identify neither the Hangang nor their position during flight.

113) Rotorcraft can be operated under flight visibility of less than 1,500 m when flying at a speed at which a pilot can see and avoid other aircraft or obstacles.

2.3 Helicopter Team's Decision-making Process for Flight

Generally, the pilots should make a final go/no-go decision before a passenger initiates the transfer to other means of transportation in case of a no-go decision because they should consider their travel time by other means of transportation. When the time has come, they decide between go and no-go in consideration of weather conditions confirmed by the time, as far as there are no other anomalies in the aircraft.

On the day of the accident, the captain called Gimpo and Seoul Airport Weather Offices and checked out weather conditions about 06:06 and 06:08, respectively. About 06:25, he made a "no-go" decision on a telephone conversation with the FO. Accordingly, the FO notified this decision to LG Electronics' Vice Chairman & CEO's Office about 06:30.

According to the statement of the Office, however, about 06:32, the Office, which was notified of "no-go," called the pilot in charge of operation and made a request of "checking out weather conditions again, citing the FO's notification of no-go." The Office's excuse for this was that "because the Office did not know the FO well, it intended to check with the person who has been usually in charge of operation for weather conditions once again."

If so, what the pilot in charge of operation had to do was just to ask the captain or the FO about the grounds (weather conditions) for the no-go decision and relay them to the Office, but on the contrary, he checked out weather conditions all over again.¹¹⁴⁾

At the time, because passengers already purchased tickets for a high-speed train and thus, were all prepared for a no-go situation, this contingency plan

114) Telephone call records of the FO and the pilot in charge of operation.

could have been naturally carried out.

Eventually, the captain deferred a final go/no-go decision until 07:40 while having a telephone conversation with the Vice Chairman & CEO's Office's deputy general manager, and although visibility has not improved enough to warrant "go" due to fog at 07:38, he made a "go" decision. Also, he did not take into account weather information¹¹⁵⁾ additionally confirmed by the FO or the pilot in charge of operation when making the decision.

According to the statement of the pilot in charge of operation, seeing this development at the time, he thought that "the Team leader (captain) was able to conduct a flight under these bad weather conditions since he had more flight experience and better pilot proficiency than us (Helicopter Team's other pilots)."

In addition, the head of the Business Support Office stated that "the captain makes a final go/no-go decision, and that he respects and fully accepts it."

In reality, however, when the captain made a no-go decision in consideration of weather conditions at the time and notified it to LG Electronics' Vice Chairman & CEO's Office, ① the Office did not implement the contingency plan of transporting passengers by land; ② the Office, notified of "no-go" by the FO, requested the pilot in charge of operation to reassess a no-go situation; ③ when asked to reassess a no-go situation by the Office, the pilot in charge of operation personally checked weather conditions, instead of asking the captain or the FO about the grounds for the "no-go," and recommended a takeoff at Gimpo Airport; and ④ although the captain already made a no-go decision, he reversed it and decided to go over a telephone conversation with the Vice Chairman & CEO's Office's deputy general manager. In light of these factors, it seems that ①, ②, and ③ exerted an influence on the captain and finally

115) Weather conditions additionally checked out before the final decision was made.

resulted in ④. However, it cannot be verified how much influence was exerted since the captain and the FO were fatally injured.

At that time, LG Electronics' Vice Chairman & CEO's Office stated that it made a request of reassessing a no-go situation since some time was left before the departure of a high-speed train.

In accordance with Helicopter Operations Regulation, 3.2.1, "all flights shall obtain an approval from the Helicopter Team leader, who shall reach an agreement in advance with other pilots and aircraft mechanics."

Judging from the fact that the persons concerned with the Helicopter Team stated that "they had experiences of conducting flights under bad weather conditions in the past," and from that the FO and the pilot in charge of operation failed to exert their influence with the captain to make a no-go decision, the ARAIB concludes that the FO failed to perform his role properly due to a rigid atmosphere in the Helicopter Team.

Therefore, to ensure safe flights in the future, LG Electronics is necessary to designate a flight dispatcher in the Business Support Office, thereby placing him in charge of flight control including the provision of weather information to pilots, and to consider the adoption of a process in which the pilots make a go/no-go decision in consideration of weather conditions after consultation with a dispatcher. It is also necessary to create an atmosphere in which weather information confirmed by the FO can be considered in a decision-making process.

2.4 Analysis of the Captain's Flight

Review of the CVR transcript revealed that the flight crew piloted the aircraft

although they were unable to identify their location and the ground in adverse weather conditions. Also, the captain likely knew the minimum weather requirements for Hangang Corridor flight since he had a lot of experiences of such a flight. Nevertheless, the pilots failed to return.

According to the statements of the Helicopter Team's pilots, procedures for recovering from an encounter with clouds or low visibility during a VFR flight are as follows: change a heading in a safe direction; climb until obstacles are avoided; request the ATC to give radar vector for an alternative airport under good weather conditions if the avoidance of obstacles is fully ensured; and deviate from the course.

As shown in [Figure 4], however, although the pilots neither identified the ground due to poor visibility nor noted their deviation from the planned route, they continued to fly.

Also, when the captain proceeded with the flight, the FO failed to advise him to return and just gave him navigational advice based on the aircraft position displayed on the cockpit GPS equipment although he could not identify the outside terrain.

Yet the GPS equipment used only for reference during flight does not support accurate identification of the aircraft position including waypoint since it displays only topographical characteristics of the terrain in colors on the screen, without showing in detail the Hangang and its tributaries, buildings, roads, and bridges.

Thus, the ARAIB concludes that it was an inadequate operation for the pilots to depend on this equipment under low visibility conditions with the ground out of sight and use location pinpointing to navigate when flying over close-packed high-rise buildings or obstacles scattered in the downtown area.

Yet it is determined that the pilots, without knowing that the aircraft was deviating from its planned route and approaching close-packed high-rise buildings, made their flight, dependent on the GPS equipment, and that, as the aircraft on the monitor was approaching Jamsil Heliport, they ran the before-landing checklist, lowered the altitude, and finally crashed into Condominium A.

Although regulations are well established and the pilots are well aware of them, if they do not comply with them, risks will not be mitigated. Thus, rather than controlling flights with tighter regulations, it is necessary to establish a safety culture in which the pilots voluntarily follow them.

LG Electronics should realize that fostering a safety culture within the pilots is a way to ensure the safety of its CEO and main customers and thus, should do its best to establish it. To this end, first of all, safety consciousness of the CEO (including the management and the Vice Chairman & CEO's Office) should be raised, the importance of regulation compliance rather than convenience should be stressed to airmen, and the related system needs to be reinforced so that regulation violation can be impossible.

2.5 Organization Management

Under the Business Support Office are the Private Jet Team and the Helicopter Team, which transport passengers via fixed wing aircraft and rotorcraft, respectively, and give aviation support to LG Group.

On the surface, two Teams perform a similar function, except only for the aircraft category, but the Private Jet Team is additionally staffed by a flight dispatcher and a safety officer, whereas the Helicopter Team assigns the same

tasks to its pilots.

Although two Teams belonging to the same organization were stationed in the same airport, they have been independently operated without supporting each other in terms of flight control or safety management.

Private aircraft are subject to less regulations than aircraft for air transport business (including small-sized air transport business) or aircraft for aerial work. In addition, private aircraft operators may neglect flight control and safety management since they own just one or two aircraft. However, considering their main duty of transporting big shots and great social repercussions which can be caused by the occurrence of an accident, flight control and safety management should not be neglected.

Accordingly, it is necessary that LG Electronics should have a function of professionally supporting the two Teams in terms of flight control and safety management. However, it is concluded that the two Teams have been operated without outside interference or supervision since their flight control and safety management have been completely independently carried out.

In light of the following, the ARAIB concludes that, when the Helicopter Team made a go/no-go decision in consideration of weather conditions, it failed to perform flight control and safety management properly: ① Weather conditions confirmed by the FO and other pilots in the Team were not considered in the decision-making process; ② There was nobody who advised no-go although all pilots were aware of weather-related regulations or the minimum weather requirements for Hangang Corridor flight; and ③ There was an organizational culture in which the captain's initial go/no-go decision was not accepted.

Also, it is probably difficult for the Helicopter Team's pilot given an

additional role of safety management to carry out safety inspection of his affiliated organization, report inspection results to his boss, the Team leader, and eliminate risk factors.¹¹⁶⁾ For example, as shown in the aforementioned decision-making process, although the person concerned identified a risk factor in a rigid organizational culture where weather information confirmed by the FO was not considered in the decision-making process, it would be probably difficult for him to recommend the Team leader to correct it.

In particular, as the Team leader exerts a decisive influence on the recruitment of pilots, and as the Helicopter Team consists of the pilots who were juniors and seniors from the same school as well as from the same unit in the military, a strong bond and reinforced hierarchy may naturally exist in the Team. However, it is not probably easy for them to make a suggestion about correcting wrong practices or risk factors.

A rigid organizational culture likely resulted in the following: weather conditions confirmed by the FO were not considered in the captain's decision-making process; the pilots failed to suggest no-go under no-go weather conditions; the FO failed to advise the captain to return in a no-go situation; and the pilots have customarily conducted flights under low visibility conditions.

Therefore, it is necessary for LG Electronics to implement a flight control system and a safety management system, which support both Private Jet Team and Helicopter Team under the Business Support Office. In particular, the organization of the Business Support Office needs to be strengthened in such a way that a safety officer independently performs his duty but reports directly to the head of the Business Support Office.

116) Risk factors developed by the Team leader's personality or practices.

2.6 Aviation Obstruction Lights

In accordance with the Aviation Act and the Ministerial Regulation of the same Act, effective when Condominium A was designed and constructed, the condominium is a structure requiring the installation of mid-intensity aviation obstruction lights. In addition, at the time of the accident, 12 mid-intensity and 24 low-intensity aviation obstruction lights were legitimately installed on the condominium.

Illumination intensity and installation locations of the mid- and low-intensity aviation obstruction lights were also compliant with relevant regulations, and the lights were adequately operated and controlled. From the completion of the condo construction until the day of the accident, the lights were turned on and off in the daytime and nighttime by an automatic light control system.

In accordance with subparagraph 6, Article 254 (Management Method of Aviation Obstruction Lights) of the Ministerial Regulation of the Aviation Act, aviation obstruction lights shall be lighted even during daytime when visibility is less than 5,000 m. Although daytime visibility on the day of the accident was less than 5,000 m, however, lights on buildings 101 and 103 were automatically turned off, and the condominium manager who found this turned off the lights on building 102 manually.

Though, it seems that there is a limit when it comes to the enforcement of the regulation above because it is difficult for building managers not only to verify a visibility of 5,000 m but also to constantly observe and confirm it.

Therefore, it is necessary to reverify the effectiveness of subparagraph 6, Article 254 of the Ministerial Regulation of the Aviation Act because the effects of mid- and low-intensity aviation obstruction lights intended to be used during

nighttime are expected to be not that strong during daytime and because the regulation is not included even in the Standards recommended by the ICAO.

Yet judging from the fact that Condominium A is in the vicinity of Jamsil Heliport and that Jamsil Heliport is frequented by helicopters, the ARAIB determines that measures need to be considered to reinforce structures in the vicinity of Hangang Corridor with safety facilities like aviation obstruction markings.

2.7 Flight Control According to Weather Conditions

Weather-related regulations the pilots could refer to when they submitted their flight plan were the Ministerial Regulation of the Aviation Act, [Appendix 8], the Ministry of National Defense's Flight Procedures in the Vicinity of RK P73, and [Attachment-1] (Weather Criteria for Helicopter Operation) to LG Electronics' Helicopter Operations Regulation.

According to the proviso of [Appendix 8] in the Ministerial Regulation of the Aviation Act, "when flying at a speed at which a pilot can see and avoid other aircraft or obstacles in airspace G,¹¹⁷⁾ rotorcraft can be operated in a flight visibility of 1,500 m or less." This proviso is based on the precondition that a pilot can see and avoid other aircraft or obstacles during flight, aiming to guarantee the operation proper for the characteristics of rotorcraft.

In this regard, LG Electronics, despite the aforementioned proviso, has applied stricter weather requirements¹¹⁸⁾ reinforced by its own Operations Regulation.

117) Airspace, other than Class A, B, C, D, E, and F, which is announced to provide only flight information to all aircrafts if demanded.

118) ① Gimpo Airport and Nodeulseom (Including Gasan and Seocho R&D Campus): flight is possible in case of more than 1,600 m visibility and 450 m ceiling (1,600 ft) ② Flights within a short distance: flight is possible in case of more than 3,200 m visibility and 600 m ceiling (2,000 ft).

Also, there are weather requirements for Hangang Corridor flight, which fulfill the purpose of establishing P73, and if the flight crew had complied with each requirements during flight, therefore, there would have been no problem at all.

Yet if the Helicopter Team does not have a function - i.e. demand from the pilot in charge of operation or the FO for no-go - of controlling a pilot who tries to conduct a flight against regulations despite weather conditions failing to meet the requirements, there is always a good possibility that an accident might occur.

In reality, weather conditions like fog frequently change, so the applicable pilots themselves have no choice but to check out the latest weather conditions on their route. Also, it is too much to ask the department giving a flight clearance to check out and analyze weather conditions in many aircrafts' operation areas in realtime and conduct flight control based on them. That is why ATCs control flights based on weather conditions in the applicable controlled airspace.

Therefore, it is necessary that an organizational culture where the pilots voluntarily follow regulations should be established, that companies employing the pilots should supervise them to ensure they operate aircraft in compliance with regulations, and that the department in charge of protocol should first consider the safety of the CEO and major customers.

In addition, the proviso of [Appendix 8] in the Ministerial Regulation of the Aviation Act means that there is no limit on visibility as long as a pilot operates the rotorcraft at a speed at which he can see and avoid other aircraft or obstacles, however, this may make it difficult to legitimately control pilots whenever they become overconfident or try enforcing a flight according to outside opinions. Therefore, measures to tighten flight visibility regulations for

rotorcraft by revising the proviso should be considered.

Also, it is necessary to consider measures to install a visibility measuring device in heliports, like Jamsil Heliport, which are located in a downtown area, frequented by rotorcraft and stationed by managers, and provide pilots with visibility values measured in realtime, and to store the measured weather data for a certain period of time and utilize it to monitor whether they comply with weather restrictions.

2.8 GPWS

Rotorcraft is mostly operated under the visual flight rule at a low speed at a low altitude due to its characteristics. In this case, if a rotorcraft equipped with GPWS¹¹⁹⁾ is operated at a relatively lower altitude than obstacles,¹²⁰⁾ GPWS will provide a repetitive aural alert¹²¹⁾ to the flight crew and display a dangerous area in red on the cockpit instrument panel.

These kinds of frequent aural alerts issued when a pilot operates a rotorcraft under VFR, observing obstacles, can hinder the safety of the flight since they can decrease the pilot's awareness or distract his attention.

That is why GPWS for rotorcraft is installed on rotorcraft operating mainly under IFR, and the proviso of Article 135-2 (1) of the Ministerial Regulation of the Aviation Act also does not require the installation of EGPWS on rotorcraft which is not operated on international routes.

119) Instead of EGPWS, GPWS which has the same function as EGPWS is used in legislations.

120) 20 seconds before the aircraft reaches a dangerous area, calculated by the EGPWS computer in consideration of aircraft speed, altitude, and direction.

121) Repetitive aural alerts, stating "Warning terrain, warning terrain" or "Warning obstacle, warning obstacle."

At the time of the accident, HL9294 was operating under VFR, with GPWS on, but its aural alert was not issued since Condominium A was not included¹²²⁾ in the GPWS map data.

Therefore, considering the fact that ICAO Annex 14 (Aerodromes) and Aviation Act classify structures not less than 150 m high as obstacles, it is necessary to consider measures to enter data on high-rise buildings into GPWS and update the GPWS data regularly.

122) The manufacturer incorporates information on buildings and high-voltage power lines in obstacle data as demanded by users.

3. Conclusions

3.1 Findings

1. The flight crew of HI9294 held all qualification certificates required for operation.
2. The HL9294 aircraft was legally certified for aircraft registration, airworthiness, operating limitations, noise standards, and radio station operation in accordance with the procedures prescribed by the Aviation Act of the Republic of Korea.
3. Any of the pilots' medical and pathological evidence that could have affected the flight was not found in the course of the investigation.
4. At the time of the accident, the aircraft was operated within the allowable range of weight and balance.
5. At the time of the accident, the captain and the FO took the right and the left seat, respectively.
6. There was no evidence of any defects in the airframe and the flight control system before and during flight.
7. According to the Ministry of National Defense's "Flight Procedures in the Vicinity of RK P73," flights in Hangang Corridor are permitted under the condition of more than 2,000 ft ceiling and more than 3 statute miles (SM) visibility. It also specifies that in Nodeulseom Corridor, flights must maintain 1,500 ft, and that flights in cloud and on top are not permitted.

8. According to LG Electronics' Helicopter Operations Regulation, flights from Gimpo Airport and in nearby areas (metropolitan area and Chungcheong-do) are permitted under the condition of more than 450 m (1,500 ft) ceiling and 1,600 m (1 mile) visibility, and more than 600 m (2,000 ft) ceiling and 3,200 m (2 miles) visibility, respectively.
9. According to the statement of the AOC under the ROK Army CDC, the AOC, though aware of poor visibility in downtown Seoul due to fog before HL9294's flight, did not control the flight for the following reasons:
 - ① HL9294 was not subject to flight restrictions since there was no NOTAM or military operation in the metropolitan area at that time;
 - ② the pilot has the authority to decide between go and no-go in consideration of weather conditions;
 - ③ as far as the CDC knows, a departure airport is in charge of flight control according to weather conditions;
 - ④ the main duty of the CDC is not the control of civil aircraft but the capital defense, so if the CDC excessively controls civilian aircraft for reasons other than capital defense, civil complaints are likely to be filed;
 - ⑤ when asked in a telephone conversation in the morning on the day of the accident, "Are you going to fly as planned when other scheduled flights are all cancelled?," the FO replied to the effect that his flight mission would be carried out as planned.
10. At the time of the accident, visibility at Gimpo Airport and Seoul Airport was 700 and 900 m, respectively, which were limiting, and visibility in Hangang Corridor was assumed to be 90 m - 200 m, judging from the fact that the ground could not be identified at an altitude of 600 - 1,400 ft and from the statement of the witness.
11. On the day of the accident, about 06:25, no-go was decided, and about 06:30, the decision was notified to LG Electronics' Vice Chairman &

- CEO's Office, but the captain deferred a final go/no-go decision according to weather conditions until 07:40 while having a telephone conversation with the Vice Chairman & CEO's Office's deputy general manager, and about 07:38, he made a go decision although weather conditions failed to meet the allowable limits.
12. Weather conditions confirmed by the FO and the pilot in charge of operation, besides the captain, did not warrant a VFR flight in Hangang Corridor, but this was not taken into consideration in the captain's go/no-go decision-making process. Also, the pilot in charge of operation, in a telephone conversation with the Vice Chairman & CEO's Office's deputy general manager, recommended to "get on board at Gimpo Airport since takeoff was possible there," but this recommendation was not implemented due to the captain's go decision.
 13. When HL9294 took off, visibility at Gimpo Airport was 700 m which was below VMC, but as the flight crew made a request for Special VFR, the Gimpo Control Tower notified related weather conditions to them and issued a takeoff clearance.
 14. Although the pilots failed to identify the ground at their flight altitude while flying in Hangang Corridor, they did not give up and proceeded with the flight.
 15. As the flight crew piloted the aircraft under VFR in Hangang Corridor, dependent on the GPS equipment supposed to be used only for reference during flight, they deviated south from the planned route and headed to Condominium A.
 16. The AOC under the ROK Army CDC was supposed to give a warning

- when there is concern that an aircraft deviates from its route more than 500 m and violates P73, but the Center did not so for the following reasons: ① in the case of HL9294, there was no concern about a violation of P73; and ② HL9294 was on a heading towards Jamsil Heliport.
17. Unaware of the deviation from the route and approach to Condominium A, the pilots lowered the altitude when the aircraft on the GPS monitor was approaching Jamsil Heliport, then finally crashed into the north side of building 102 of the condominium.
 18. The left side of HL9294 initially crashed into the north side of building 102 of Condominium A when it was climbing up from the 23rd to the 26th floor. Then, when its tail boom was rotated by inertial force, the aircraft impacted the right side of the initial crash point and fell right down to the ground.
 19. Although the Private Jet Team and the Helicopter Team under the Business Support Office, which are stationed in the same airport, perform similar duties, their flight control and safety management have been independently carried out.
 20. Countermeasures were needed to establish a safety culture in which the pilots voluntarily follow regulations and to create an environment in which the pilots can easily ask the Helicopter Team leader to comply with regulations since the Helicopter Team has a rigid organizational culture in which the pilots failed to demand (suggest) no-go when the captain made a go decision in violation of the regulations on weather restrictions.
 21. Mid- and low-intensity aviation obstruction lights on Condominium A

were automatically turned on and off by an automatic light control system, and on the day of the accident, the condominium manager, who saw the lights on buildings 101 and 103 automatically off, manually turned off the lights on building 102 whose automatic light control system was inoperative.

22. It is necessary to consider measures to install aviation obstruction markings or high-intensity aviation obstruction lights on high-rise buildings in the vicinity of Hangang Corridor in order to assure safety.
23. In accordance with subparagraph 6, Article 254 of the current Ministerial Regulation of the Aviation Act, aviation obstruction lights shall be lighted even during daytime when visibility is less than 5,000 m.
24. Considering the fact that ICAO Annex 14 (Aerodromes) and Aviation Act classify structures not less than 150 m high as obstacles, it is necessary to consider measures to enter data on high-rise buildings into GPWS and update the GPWS data regularly.

3.2 Causes

The Aviation and Railway Accident Investigation Board determines the causes of the HL9294 accident as follows:

1. While flying in Hangang Corridor, the flight crew failed to return and proceeded with the flight in adverse weather conditions, where they were unable to identify the ground due to a dense fog.
2. The flight crew crashed into a ground obstacle during a descent although

they should not have descended due to their inability to identify their location and the ground in adverse weather conditions.

Contributing to this accident was as follows:

1. the captain's go decision although weather conditions failed to meet the allowable limits; and
2. the flight crew's inadequate CRM skills, including a failure of the captain and the FO to discuss a return, and the flight crew's inadequate communication, evidenced by the fact that the FO and the Helicopter Team's pilot in charge of operation failed to suggest no-go to the captain in his decision-making process although they became aware of a no-go situation after checking out weather conditions.

4. Safety Recommendations

As a result of the investigation of the accident that occurred to HL9294 on 4 November 2013, the Aviation and Railway Accident Investigation Board issues the following safety recommendations.

To LG Electronics

1. Adopt an independent flight control and safety management system which supports both your Private Jet Team and Helicopter Team under the Business Support Office. (AAR1307-1)
2. Seek measures to improve your rigid safety culture in the following ways: enhance your training for and supervision over airmen affiliated with the Business Support Office so that they can voluntarily comply with regulations; and institutionalize measures to let the department in charge of protocol to actively accept pilots' go/no-go decision for the purpose of assuring passenger safety. (AAR1307-2)
3. Consider measures to combine and apply Operations Regulations of the Private Jet Team and the Helicopter Team and revise them by adding the following content: (AAR1307-3)
 - The roles and responsibilities of related departments and the persons concerned when a go/no-go decision is made
 - When, how, and who to make a go/no-go decision, what to consider in a decision-making process, and notification procedures, etc.

- Detailed implementation procedures for ensuring airmen's good communication

To the Office of Civil Aviation

1. Make regulations restricting the operation of rotorcraft under limited visibility conditions due to a dense fog. (AAR1307-4)
 - * [Appendix 8] in the Ministerial Regulation of the Aviation Act: Measure already taken to set the minimum flight visibility as 1,500 m on 15 July 2014.
2. Supervise rotorcraft owners' (including airlines) development and the implementation of in-house regulations including a specific method of checking out weather conditions. (AAR1307-5)
3. Seek measures to install and utilize an automatic meteorological measurement system in heliports, like Jamsil Heliport, which are located in a downtown area, frequented by helicopters, and stationed by safety guards. (AAR1307-6)
 - * The meteorological measurement system installed in Jamsil Heliport in February 2014.
4. Considering the fact that ICAO Annex 14 and the Korean Aviation Act classify structures not less than 150 m high as obstacles, consider measures to enter data on high-rise buildings into GPWS and update the GPWS data regularly. (AAR1307-7)

5. Examine the effectiveness of subparagraph 6, Article 254 of the Ministerial Regulation of the Aviation Act, and if it is still necessary to maintain this regulation, develop detailed guidelines on how to prepare and utilize a visibility chart which can be utilized by owners (managers) of buildings subject to the installment of mid- and low-intensity aviation obstruction lights when they turn them on in a daytime visibility of 5,000 m or less, and strengthen supervision over the implementation of the guidelines. (AAR1307-8)

6. Consider measures to install aviation obstruction markings or high-intensity aviation obstruction lights on structures which might affect the safe operation of the aircraft, out of those which were constructed before the year 2004, are located in an area other than the obstacle limitation zone, and are more than 150 m high. (AAR1307-9)