



**ARAIB**

**Report No. ARAIB/AAR0904**

# **AIRCRAFT ACCIDENT REPORT**

HELICOPTER CRASH DURING AIRLIFTING OF CARGO  
THE CHANGWOON AVIATION, REPUBLIC OF KOREA  
KA-32A, HL9405  
MT. JEOMBONG, INJE-GUN, GANGWON-DO  
6 NOVEMBER 2009



**16 November 2011**

**AVIATION AND RAILWAY ACCIDENT INVESTIGATION BOARD**  
**MINISTRY OF LAND, TRANSPORT AND MARITIME AFFAIRS**  
**REPUBLIC OF KOREA**

**According to the provisions of the Article 30 of the Aviation and Railway Accident Investigation Act of the Republic of Korea, 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 issued as the result of the investigation on the basis of the Aviation and Railway Accident Investigation Act of the Republic of Korea and the Annex 13 to the Convention on International Civil Aviation, 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 Investigation Report

Aviation and Railway Accident Investigation Board, Helicopter crashed on the Jeombong Mt. during air transport of cargo and a fire broke out, the Changwoon Aviation Co. Ltd, KA-32A helicopter, HL9405, Inje-gun, Gangwon-Do, Nov 6, 2009. Aircraft Accident Investigation Report ARAIB/.AAR0904 Seoul, 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.

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**Helicopter crash during airlifting of cargo**

The Changwoon Aviation, KumApe Company

KA-32A rotorcraft. HL9405

9/10th ridge (1,200 m above sea level) of Mt. Jeombong, Inje-gun, Gangwon-do

6 November 2009 at 11:07 (Korea Standard Time)<sup>1)</sup>

**Synopsis**

On 6 November 2009 at about 11:07, a KA-32A (HL9405) rotorcraft (hereinafter referred to as "HL9405") of the Changwoon Aviation Co. Ltd. (hereinafter referred to as "the Changwoon Aviation") flying to the unloading point after picking up the lumbered trees at the power line construction work<sup>2)</sup> site between Inje and Yangyang, Gangwon-do, crashed onto the 9/10th ridge of Mt. Jeombong located in Girin-myeon, Inje-gun, Gangwon-do and it was completely destroyed by a fire immediately after crash.

The HL9405 was a rotorcraft-using business in accordance with the Aviation Act of the Republic of Korea and was flying under visual flight rules. At the time of the accident, one captain and one co-pilot were aboard the aircraft, and both of them were killed.

The ARAIB determined the cause of the HL9405 accident: "Entering into clouds and losing the sense of direction during climbing turn, the cargo was caught in trees to cause crash and then a fire." And contributing factors were: "①HL9405 did not have fuel resupplied in time during the mission, was not prepared for bad weather, and failed to take proper escape procedures in clouds. ② the Changwoon Aviation's education and training system was not satisfactory for pilots including CRM education.

On the basis of the findings from the accident, the ARAIB issued safety recommendations to the Changwoon Aviation and the helicopter manufacturer.

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1) Unless otherwise indicated, all times in this report are Korea Standard Time.

2) Doosan, Ltd. took the order of the work from Korea Electric Power Corporation and subcontracted it to the Samyoung Enterprise, Ltd. The Changwoon Aviation supported airlift of cargo using aircraft from August 2008 in accordance with a "Helicopter Cargo Transport Service Contract" with the Samyoung Enterprise.

## 1. Factual Information

### 1.1 History of Flight

On 6 November 2009 at about 11:07, HL9405 crashed on the 9/10th ridge of Mt. Jeombong located in Girin-myeon, Inje-gun, Gangwon-do, while it was airlifting lumbering trees in the power line construction site between Inje and Yangyang, Gangwon-do and the aircraft was completely burned by a fire that occurred just after the crash.

The HL9405 was flying under visual flight rules, and at the time one captain and one co-pilot were aboard the aircraft, and both the captain and co-pilot were dead in the accident.

The the Changwoon Aviation was supporting the work by dispatching<sup>3)</sup> its own rotorcraft to the Inje-Yangyang power line construction work site in accordance with a contract with the Samyoung Enterprise Co. Ltd. (hereinafter referred to as "the Samyoung Enterprise") from August 2008, and from 22 October 2009 until the day of accident, it was carrying out the cargo lift mission by dispatching two KA-32As (HL9404 and HL9405) at the request of the Samyoung Enterprise.

On the day of the accident, a mission, in which HL9405 carry up the compressor from the pickup point<sup>4)</sup> to the installation point of power line steel towers No. 36 and No. 37-1, and lift down lumbered trees from the same point to the unloading point<sup>5)</sup> (hereinafter referred to as "pickup and unloading point"), was planned<sup>6)</sup>. See Photo 1.

According to the statements by the HL9405 maintenance person, the party of HL9405 left their lodgings<sup>7)</sup> at about 07:00<sup>8)</sup> and at about 08:00 arrived at the temporary helicopter

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3) For one aircraft, a team composed of two pilots, one maintenance person, one tanker driver and two load masters carries out the mission.

4) A place such as a vacant lot by a road where equipment and material necessary for steel work construction work are gathered and lifted up by helicopter and transported to the construction site as necessary. "Pickup and unloading point" in Photo 1.

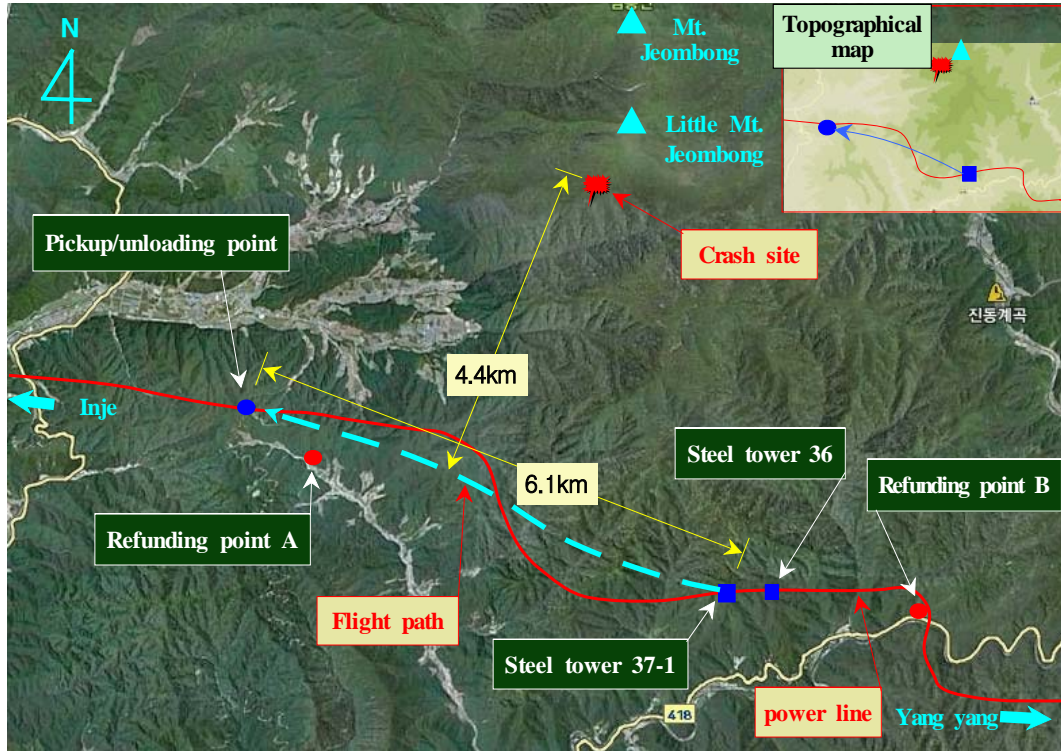
5) The place where the trees lumbered in the steel installation place are gathered. A pickup point and unloading point are operated separately if the place is too small, but on the day of accident it was operated in the same place.

6) HL9404 carried out the cargo airlifting mission in the point of No. 19 steel tower construction; it operated the pickup point and unloading point differently from HL9405.

7) Lodgings in Naksan Beach, Yangyang-gun, Gangwon-do; it takes about 40 to 50 minutes by car from the lodgings to the temporary helicopter parking place.

8) Hours after this are based on the statements by related personnel.

parking place<sup>9)</sup>, and after completing preparations<sup>10)</sup> for mission, started the first aircraft mission at about 09:00.



[Photo 1] Mission area map and flight path of HL9405

Around 09:00~10:00, HL9405 carried up one compressor from the pickup and unloading point to No. 36 steel tower, and lifted down lumbered trees six times from No.36 steel tower to the pickup and unloading point. And at about 10:10 it moved to No. 37-1 steel tower and lifted down lumbered trees three times.

According to the statements by the senior maintenance person and junior maintenance person A<sup>11)</sup>, before HL9405 lifted the compressor from the pickup and unloading point at about 10:30, the captain said, "I will have it refueled after I get back," and after he unloaded the compressor at the No. 37-1 steel tower point at about 10:35, he lifted 3.5 tons of lumbered trees<sup>12)</sup> at about 10:40 and took off from the No. 37-1 steel tower point.

9) The place where aircraft are parked temporarily during the construction period; usually a container-type office and tanker are arranged to be used as a place for cooperation between construction company and pilot and aircraft refueling. In Photo 1, it is marked "Refueling point A".

10) Preflight check on aircraft, weather check, cooperation for construction work.

11) Junior maintenance person A was positioned at the pickup and unloading point to carry out the mission of checking the safety condition when cargo was lifted or unloaded.

12) Five birch trees and pine trees (diameter 20~40cm, length 7m)



After a while they heard HL9405 approaching the pickup and unloading point, and the captain called the senior maintenance person by radio and he responded by radio but contact was not made; at about 10:45 the captain questioned, "(We) are locked up in clouds, how is the weather like over there (the pickup and unloading point)?". So the senior maintenance person replied, "the weather here (the pickup and unloading point) is the same as before." And there were no more communications made.

After a while at about 11:05, the senior maintenance person heard the helicopter sound momentarily from the Mt. Jeombong (crash point), but since he could not hear the helicopter sound any more, he called the pilots of HL9404 by radio asking for the situation of HL9405.

But no more communications with HL9405 were made, and at about 11:07 the EL T<sup>13)</sup> was received at the search and rescue section of the Korea Coast Guard.

## 1.2 Injuries to Person

Injury	Crew	Passenger	Other	Total
Fatal	2	0	0	2
Serious	0	0	0	0
Minor/no injury	0	0	0	0
<b>Total</b>	2	0	0	2

## 1.3 Damage to Aircraft

HL9405 was completely destroyed by a fire at the time of crash. HL9405 subscribed<sup>14)</sup> to hull insurance<sup>15)</sup> and accident insurance<sup>16)</sup>, and at the time of accident, the insurance was within expiry.

Photo 2 shows the helicopter wreckage after the fire was extinguished, and Photo 3

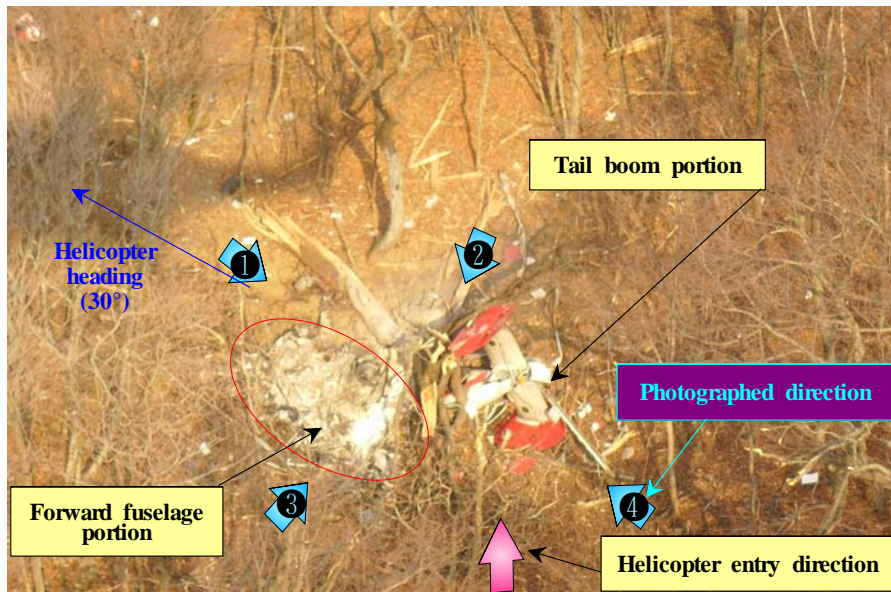
13) Emergency Locator Transmitter

14) Dongbu Fire and Marine Insurance: 26 November 2008 ~ 25 November 2009

15) 4 billion won

16) 250 million won per pilot, 250 million won per passenger, liability insurance 1 billion won

shows the wreckage taken from each direction based on Photo 2.



[Photo 2] Helicopter wreckage after fire was extinguished



[Photo 3] Wreckage immediately after accident, photographed from each direction, Also see Photo 2

## 1.4 Other Damage

As HL9405 was advancing along the entry direction<sup>17)</sup> about 40 meters before crashing on ground, it cut the top end portions of 8 to 9 trees<sup>18)</sup> about 30 to 40 year old with the fuselage, main rotor blades and cargo. And at the final crash point, the bottom end of a tree with a diameter of about 60 cm was broken by impact, and the upper portion of the broken tree fell over the fuselage and a fire broke out.

The fire did not spread around the area due to rains that fell on the day before the accident, so there was no additional damage.

## 1.5 Personnel Information

### 1.5.1 The Captain

The captain (male, age 62) served as a military pilot for about 18 years, and flew a total of 5,521 hours<sup>19)</sup> during the military service, and after retiring from the military service he flew 6,880.4 hours<sup>20)</sup> in civil aviation. And his flying time on the relevant type of aircraft was 361.7 hours including 202,3 hours as instructor pilot, 99.3 hours as captain and 0 hours<sup>21)</sup> for instrument flight.

The captain was employed by the Changwoon Aviation on 15 January 2003 and had been working for about six years and ten months until the day of accident, and flew 0 hours for the latest 24 hours and 112.2 hours for the latest 90 days.

The captain obtained<sup>22)</sup> instructor pilot qualifications for the relevant type of aircraft on 22 May 2006, and the certificates that the captain held were all valid.

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17) Magnetic north 89 degrees

18) Oriental oaks with diameters of about 30cm~40cm

19) O-1: 846 hours, OH-23: 2,872 hours, 500MD: 1,803 hours; total 5,521 hours (instructor: 503 hours, full pilot: 4,388 hours)

20) B206: 301.5 hours, B412: 4.7 hours, SA365: 475.1 hours, BK117: 132.7 hours, B214: 3.9 hours, H369D: 5,580 hours, KA-32A: 361.7 hours, AS350: 20.8 hours; total 6,880.4 hours (instructor: 503.2 hours, 5,734.5 hours)

21) At the time when he obtained the commercial transport pilot license in 1979, instrument flight experience was not required. (Ministry of Transportation Order No. 599 dated 1 July 1978)

22) Changwoon Personnel Order No. 06-09 (2006.5.21), Instructor: The Changwoon Aviation Representative Director, Duration of Training: 2006.5.1~5.21

### 1.5.2 Co-Pilot

The co-pilot (male, age 47) served as a military pilot for about 22 years, during which he flew a total of 2,751.7 hours<sup>23)</sup>, after retiring from the military service, he flew 325.4 hours<sup>24)</sup> in civil aviation.

His flying time on the relevant type of aircraft was 265.3 hours including 0 hours as instructor pilot, 40.2 hours as captain and 90.6 hours<sup>25)</sup> for instrument flight.

The co-pilot was employed by the Changwoon Aviation on 1 November 2007, and worked for about two years until the day of accident, and flew 0 hours for the latest 24 hours and 15.5 hours for the latest 90 days.

The co-pilot obtained<sup>26)</sup> captain qualifications for the relevant type of aircraft on 20 December 2007, and qualifications certificates the co-pilot held were all valid.

### 1.6 Aircraft Information

HL9405 was manufactured<sup>27)</sup> by KumApe of Russia on 29 April 1989. LG International Corporation introduced it on 19 November 2007 and the Changwoon Aviation leased and registered<sup>28)</sup> it on 26 November 2007 for aircraft-using business.

HL9405 was in service for a total of 3,090.3 hours from manufacture until the day of accident. It was mounted with two engines of a TB3-117BMA type manufactured by Ukraine Mortosich, and the total hours of service until the day of accident was 1,078 hours for the left engine and 1007.5 hours for the right engine.

HL9405 was maintained according to the method and procedures as specified by the manufacturer, and 25H/50H checks were made recently on 26 June 2009.

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23) OH-23: 40hours, 500MD: 1,427.8hours, UH-1H: 1,207.5hours, SFTS:76.4hours; total 2,751.7hours (instructor: 523.2 hours, full pilot: 1,09 2hours)

24) H369D: 60.2 hours, KA-32A: 265.3 hours; total 325.5 hours (instructor: 0 hours, 95.4 hours)

25) Actual instrument flight: 14.2 hours, simulator instrument flight 76.4 hours

26) Changwoon Personnel Order No. 08-UN02호(2008.1.29), Instructor: Captain of accident aircraft, Duration of Training: 2007.11.15~12.19

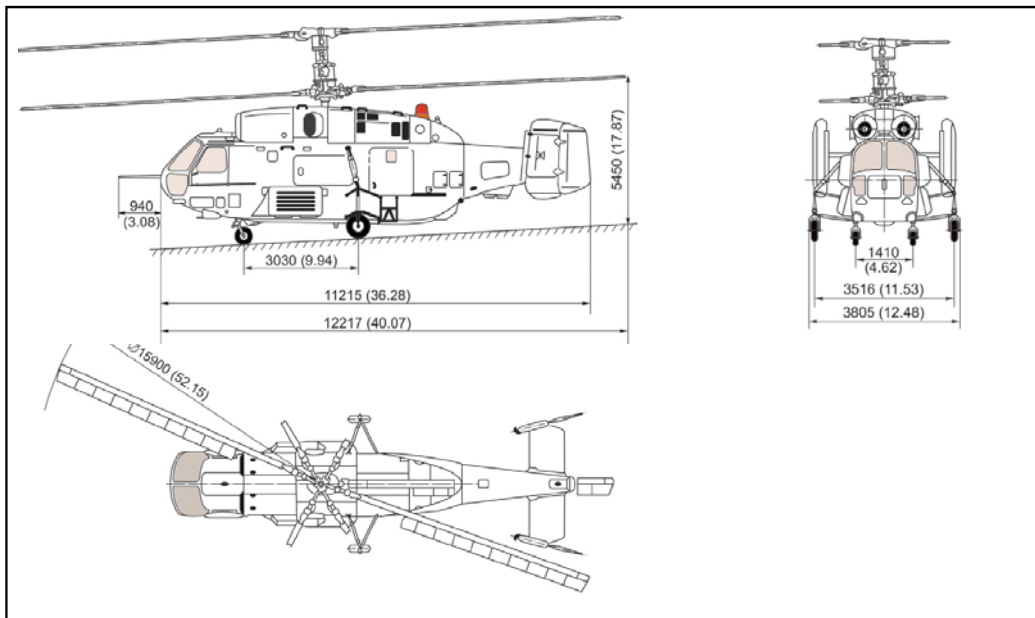
27) Type: KA-32A, Manufacture serial number: 60-06/013

28) Initial registration: 2007. 8. 27

The Changwoon Aviation performed only before/after flight checks and maintenance check of less than 100H for HL9405, and the maintenance beyond the above categories has been performed by LG International Corporation. There were no special defects recorded in the maintenance log before the accident happened.

The registration certificate<sup>29)</sup>, airworthiness certificate<sup>30)</sup>, operation limit designation<sup>31)</sup>, noise certificate<sup>32)</sup>, and radio station permit<sup>33)</sup> of HL9405 were all valid.

### 1.6.1 Aircraft specification



- Size (Length/width/height)
  - Length: 15.9m
  - Width: 3.8m
  - Height: 5.45m
  
- Engine
  - Power output: 2,200 SHP × 2
  - Fuel: Jet A-1, load: 2,180 liters (1,744kg)

29) Registration certificate number: 2007-071(2007. 11. 26)

30) Airworthiness certificate number: AS0809(2008. 11. 27)

31) Designation number: ASOL08090, date of issue: 2008. 11. 27

32) Certificate number: KNC940500, date of issue: 2007. 11. 28

33) Permit number: 46-2007-10-0000025, date of issue: 2007. 11. 28

- Performance
  - Speed: 200~220km/h (cruising), 260km/h (maximum)
  - Weight: (Maximum takeoff) 12,700kg, (tare) 6,800kg
  - Endurance: 3 hours and 35 minutes
  - Cargo pickup ability: 5 tons (11,023Lbs)

### 1.6.2 Aircraft Maintenance Discrepancies

According to the statements by the pilots of HL9404 and the senior maintenance person of HL9405, the HL9405 captain and co-pilot had not mentioned anything unusual before flight or during the flight.

But because the flight recorders were destroyed by the fire, it could not be confirmed whether there were any abnormalities recorded in the FDR/CVR.

### 1.7 Meteorological Information

Weather information as observed by the aviation weather office of Yangyang International Airport of the site and the Inje Weather Station which are nearest to the point where HL9405 crashed on 6 November 2009 is as follows.

Location	Observation time	Wind direction/speed	Visibility	Cloud amount	Ceiling	Temperature	Atmospheric pressure
Yangyang Airport (21.5km E of the site)	10:00	260/ 08kt	10km	1/8	3,000ft	16.6℃	1017hPa
	11:00	220/ 07kt	10km	2/8	4,000ft	18.2℃	1017hPa
Inje, Gangwon (22km W of the site)	10:00	Northeast 0.6ms	Not observed	Not observed	Not observed	7.1℃	1020.3hPa
	11:00	Southwest 1.1ms	Not observed	Not observed	Not observed	8.8℃	1019.7hPa

※ **Gangwon Inje Weather Station:** Unmanned observatory for observing only air temperature, precipitation, wind, humidity, and sunshine hours

The HL9404 captain who was flying in the area of steel tower number 19<sup>34)</sup> at the time of accident stated, "The sky condition at the time was BROKEN<sup>35)</sup> and there were

clouds hanging over the hill side (about 1,180 m above mean sea level). It was not a thick cloud and the visibility was good."

The junior maintenance person B who was at steel tower number 37-1 stated, "When the aircraft was flying from the number 37-1 steel tower point to the pickup and unloading point, it was not in clouds until it flew over the ridge." The junior maintenance person A stated, "The sky over the accident point is an area that can be seen from the pickup and unloading point. At the time it was covered with fog, and the mission area was covered overall with hazy mountain fog."

And according to the statements by the senior maintenance person and junior maintenance person A, the captain called at the final flight section by radio, "We are in clouds, what is the weather like over there?"

### **1.8 Aids to Navigation**

HL9405 did not use aids to navigation when it was flying on the day of accident.

### **1.9 Communications**

When the HL9405 captain called the junior maintenance person A of the pickup and unloading point or the senior maintenance person at the refueling point A at the final flight section immediately before the accident, the senior maintenance person responded immediately but contact was not made, and also when he made the last call to ask the weather condition of the pickup and unloading point, senior maintenance on the ground responded to this call but contact was not made. See Photo 1.

Judging from such statements, there is a possibility that HL9405 had trouble with radio reception, but it was not confirmed whether the radio operated normally or not because the radio was completely destroyed by fire.

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34) About 8 km southeast of steel tower number 37-1

35) A unit for measuring cloud amount at which the amount of cloud is 5/8~7/8 of the whole sky.

### 1.10 Heliport Information

The heliport that HL9405 used in the mission area for refueling and pickup/loading was an open area by a paved road newly constructed between Yangyang and Inje. It did not give any limitations to flight except for dust scattering<sup>36)</sup> due to downdraft during aircraft take-off and landing.

### 1.11 Flight Recorder

The flight recorder mounted on HL9405 is a FDR/CVR combination type of ZBM-2M<sup>37)</sup> manufactured by Izeritel of Russia.

Immediately after HL9405 crashed a fire occurred, so when the fire fighters and rescue staff arrived at the scene, most of the wreckage was so burnt down that it was hard to figure out the shape.

So by the time when the investigators arrived at the scene, the case, mounting pad, fixing clips, wires, etc. of the flight recorder were completely burned out, and only the protective container (ZMP4-192) was collected from a heap of ashes.

The ARAIB reckoned it would be difficult to extract data because the protective container was exposed to flames for a long time, so it was sent to the flight recorder manufacturer located at Smolensk, Russia and the work of extracting stored data was done jointly by Korea and Russia on 10 December 2009.

Exterior check was done on the protective container (ZBN4-192) before data extraction work to find that the outer metal case of the protective container was exposed to heat of high temperature so that the color and shape of the outer appearance were deformed.

Subsequently the protective container was opened to take out the memory card storage container (MP4-192)<sup>38)</sup> for exterior check, and it was found that the color and shape of the outer titanium case of the storage container were also deformed by heat.

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36) On the day of accident, the ground was wet because it had rained on the previous day, so there was less spattering.

37) Serial number: 0874337

38) Serial number: 0773665



Finally the titanium case of the storage container was cut by using lathe, but the flight data memory card (PP4-48) was already burned inside the storage container to be transformed into black fragments and powder, so the extraction of the flight data was failed.

Photo 4 shows the protective container before opening and the burned memory card.



[Photo 4] Protective container collected from the site and the oxidized memory card

## 1.12 Wreckage and Impact Information

### 1.12.1 General Description

The crash point of HL9405 is in a mountainous area with an elevation of about 1,200 m to which access by people was restricted. It is in the Sorak Mountain National Park where about 30 to 40 year old broad-leaved trees grow densely in the vicinity.

The crash point was on the south ridge of Mt. Jeombong (1,403 m) the main peak. The terrain around it is a slope of about 36 degrees and the ground is formed of soil composed of little rocks and sands so that it drains well.

At the time of accident, HL9405 was carrying external load in which 3.5 tons of lumbered trees were tied with two magic ropes<sup>39)</sup> and hooked to the wire rope<sup>40)</sup> that is connected to the cargo hook under the fuselage as shown in Photo 5.



[Photo 5] HL9405 at external pickup

The wreckages of the aircraft left at the crash point were damaged by fire to the extent that they were hardly identifiable, so they were described by components as far as identifiable and the traces remaining on trees and ground are as follows.

### 1.12.2 Traces on the Site

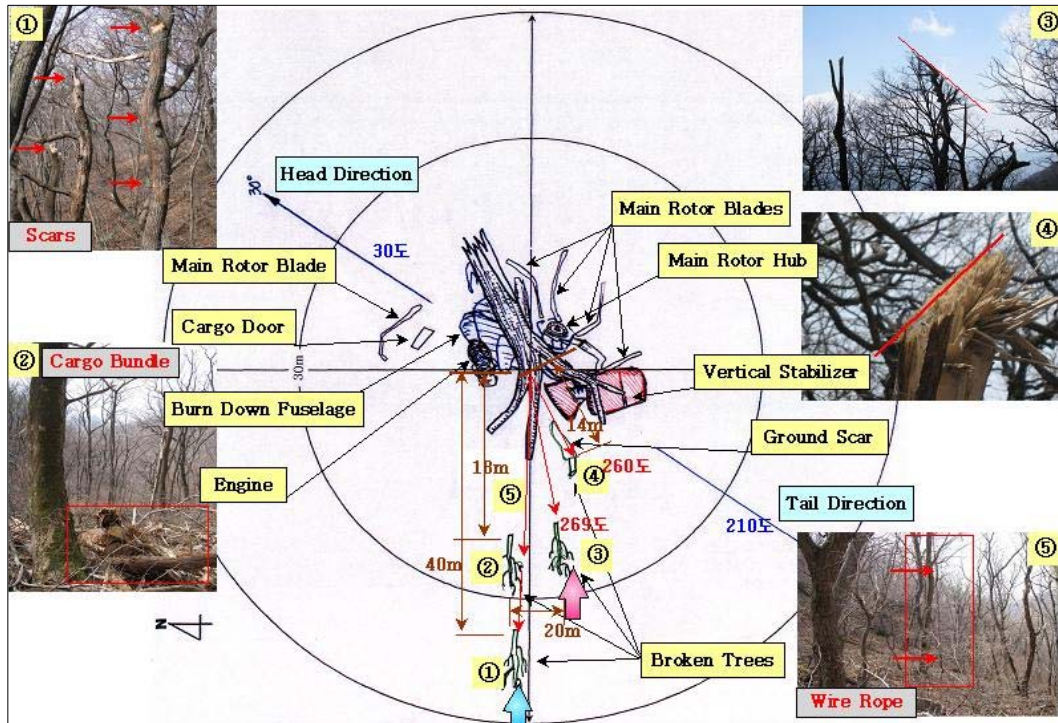
The HL9405 collided with trees that grew thick around the site to crash, which left traces as follows on trees and ground. See Photo 6.

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39) Made of synthetic resin, length 7.5 cm, width 7.5cm, tensile force 2,400kg

40) Diameter 2cm, length 20m

- On the accident site, there were two rows<sup>41)</sup> of tree damage by cargo and aircraft, and the traces were formed in parallel toward the crash point in a width of about 20 m.
- The trees that the cargo being loaded by hook hit first were at the point (①) in the direction of 273 degrees and 40 m from the crash point, and the lastly dropped position was at the point (②) in the direction of 273 degrees and about 18 m from the aircraft crash point.
- The pickup wire rope remained connected to the aircraft until after crash, and the wire end to the cargo was separated<sup>42)</sup> from the cargo and put on tree branches (⑤) about 11 m away from the crash point.
- The position at which the aircraft hit the trees first was in the direction of 269 degrees and 22 m (③) from the crash point, and the upper portion of the trees were cut by the lower main rotor blades in an about 30 degree left inclined form.

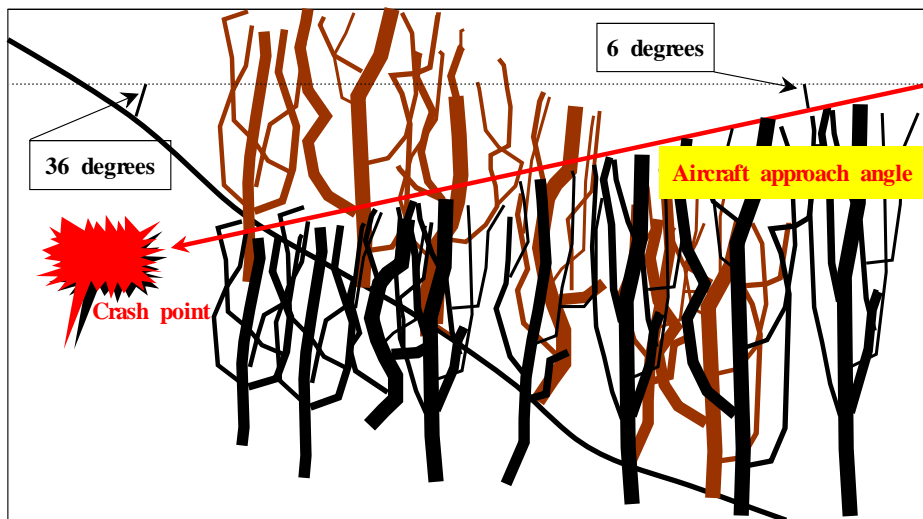


[Photo 6] Wreckage distribution and photos of major points

41) The red arrow (aircraft) and blue arrow (cargo) marked in Photo 6 above

42) The magic rope was cut by a strong tensile force to be separated.

- The trees (diameter about 12 cm) that the aircraft hit lastly was the point (④) in the direction of 260 degrees and about 14 m from the crash point, and the height about 30 cm from ground was cut by the lower main rotor blades and the cross-section of the tree was in a 40 degree right inclined form.
- The ground scar that the main rotor blades left first on the ground was formed in an about 40 cm wide and about 2.5 m long size in the direction of crash point from the lastly cut trees.
- The ground impact angle of the aircraft reckoned by the extended line drawn from the top end of the tree cut by the aircraft is -6 degrees of the horizon and the direction is 89 degrees of the magnetic north. See Fig. 1.



[Fig. 1] Approach angle when aircraft collided with ground

### 1.12.3 Fuselage

As shown in Photo 3, HL9405 was driven into ground to a depth of about 1.2 m after it hit the bottom end portion of a tree with a diameter of about 60 cm that was at the crash point, and the cockpit and cargo compartment were completely destroyed<sup>43)</sup> to an unidentifiable extent by a fire that broke out

43) The aluminum material was melted to a lump condition and the wires had the sheath burned so the inside lines remained in a bundle.

subsequently.

But the tail boom was separated from the forward fuselage and was overturned to right, and the skin was torn or bent due to impact on crash, but they were not burned as they were off from the burning point.

And the transmission, main rotor hub, mast, etc. were separated from the fuselage by a severe external shock along with physical damage, and the transmission outer case was partly damaged by heat, as shown in photo 6.



[Photo 6] Damaged portions of the transmission and mast

All the six main rotor blades were found around the crash point and the spars of the leading edge were broken or bent and the composite materials of the trailing edge were broken and scattered around the crash point.

#### 1.12.4 Engines

As shown in photo in photo 7, the left engine that was first found at the accident site

was exposed outside, and the right engine was buried in the heap of wreckage. The left engine had the appearance preserved relatively well and the right engine was severely damaged by the impact on crash.

The throttle position of the left engine was at the 103% position, and the front portion of the compressor was under the horizontal forward force to be bent rearward. The right engine had all the root portion cut as the rotor blades of the compressor had rotation damage.



[Photo 7] Damage to left and right engines

### 1.13 Medical and Pathological Information

The HL9405 flight crew members held valid airmen medical certificates and no medical and pathological evidence that could affect this accident was found.

**1.14 Fire**

On-site investigation of the accident found no evidence that a fire had occurred before it crashed. There were a lot of fallen leaves heaped around the crash point of HL9405, but the fire did not spread around it as it had rained on the day before the accident.

**1.15 Survival Aspects****1.15.1 Search and Rescue Activity**

The Search and Rescue Section of the Korea Coast Guard that received the ELT signals of HL9405 sent from the Inje area<sup>44)</sup> at about 11:07 on the day of accident forwarded the distress signal to the Flight Information Center of the Air Traffic Center around 11:14.

The Flight Information Center of the Air Traffic Center that had been notified of the distress signal requested the Master Control and Reporting Center (MCRC) to confirm the position of HL9405 at about 11:17, but they could not confirm the position because the track of HL9405 was not captured on radar. So the Flight Information Center forwarded the above fact to the National Emergency Management Agency (NEMA) Control Center and the Changwoon Aviation at about 11:26, and the NEMA issued an emergency rescue order<sup>45)</sup> to the Fire Department 119 Monitoring Center of the Gangwon Fire Headquarters at about 11:29.

Following the NEMA order, the Fire Department 119 Monitoring Center of the Gangwon Fire Headquarters ordered search and rescue to the Hongcheon Fire Station and the departments under its jurisdiction, and the major actions taken by the hour are as follows;

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44) Coordinates 3758N12827E

45) Emergency rescue number (JY4201115637)

- 11:29 Air Rescue Team 1 mobilized a helicopter<sup>46)</sup> and started the first air rescue
- 11:37:16 Inje Rescue Team ordered to mobilize
- 11:38:22 Girin Regional Unit ordered for additional mobilization, arrived at the site access road (Guidun-ri) (11:57:09)
- 13:04:18 confirmed the accident helicopter position (found and notified by the Changwoon Aviation HL9404)
- 13:32:51 Inje Rescue Team was deployed to the site by helicopter
- 14:48:27 Fire fighting helicopter unable to approach the site due to bad weather, returned to base
- 17:55:49 Inje Rescue Team controlled the fire

Immediately after being notified of the reception of the distress signal by the Flight Information Center, the Changwoon Aviation forwarded the fact to the senior maintenance person of HL9405. He requested the captain of HL9404 that was airlifting cargo nearby and the captain started to search HL9405, and around 12:50 it spotted HL9405 burning on the 9/10th ridge of the Mt. Jeombong.

## **1.16 Tests and Research**

No tests and research were conducted in connection with the accident.

## **1.17 Organizational and Management Information**

### **1.17.1 Organization of the Changwoon Aviation and Formation to HL9405 Pilots**

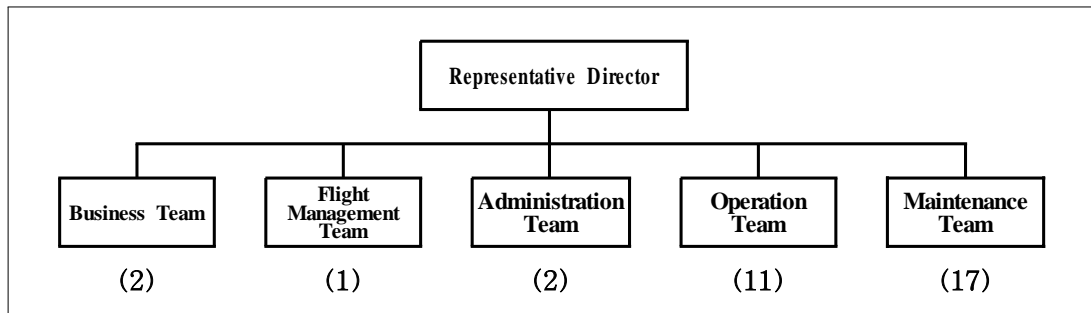
The Changwoon Aviation is organized into five Teams under the Representative Director as shown in Table 2. If the Business Team finalizes a plan for aircraft support, the Flight Management Team notifies it to the head of the Flight Maintenance Team to confirm formation of pilots and maintenance personnel and determine flight duty personnel and equipment according to the work site.

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46) Identification code: GW702, type of aircraft: AS365



For a flight mission, a team composed of the pilots, maintenance personnel, tanker driver, aircraft, tanker and other factors is formed and dispatched to the work site. Usually a senior pilot becomes the flight duty team leader, who takes command over all personnel and equipment and takes responsibility for the mission.



[Table 2] The Changwoon Aviation organization chart

At the time of the accident, the Changwoon Aviation decided to dispatch two KA32 aircraft<sup>47)</sup> to the Inje work site, forming a flight mission team and appointing the captain of HL9405 as the team leader.

In the formation of pilots at the work site, each of the two aircraft was operated by the pilots in exclusive charge<sup>48)</sup>. But because the co-pilot of HL9404 complained of a backache<sup>49)</sup>, the captain of HL9405 (the flight mission team leader) had him replaced on 4 November (three days before the accident) by the co-pilot of HL9405 who had relatively less time of flight duty.

### 1.17.2 Pilot Training

The instructor pilot qualification training and transition training of the HL9405 captain and co-pilot were conducted in accordance with the procedures as specified in the

47) HL9404, HL9405

48) The pilot formation on the day of accident was the HL9404 co-pilot as the HL9405 co-pilot and the HL9405 co-pilot as the HL9404 pilot. This formation had been made three days before the accident occurred.

49) It was not a backache requiring a surgical treatment, but a backache due to a pain caused by flying in a rigid attitude for a long time every day. After the flying time decreased, the pain was alleviated.

Changwoon Aviation Operations Regulation. And in the Operations Regulation, the instrument flight for pilots was specified as a ground school course of two hours per year.

The Chngwoon Aviation being provided to their own pilots the 10 hours of instrument flight training in the flight simulator of domestic university. But the crew of HL9405 never had any actual instrument flying training by the rated instrument flying instructor or training in the flight simulator which it was provided by Company.

The captain had any of an instrument flight experience in the military or civil aviation. All of the co-pilot's instrument flying experience was what he had in his military career.

And there were safety activities, adverse weather procedure, aviation meteorology, weather limitations included in the operation regulation and in-house training and education program also training record was conformed to be maintained. However, it was hard to expect to achieve a substantial outcome of training and education duo to its lack of quality in the content and practical application measure.

## **1.18 Additional Information**

### **1.18.1 Fuel Consumption by HL9405**

According to the KA-32A Flight Manual, the maximum fuel load is 2,180 liters and hourly fuel consumption is about 700 liters. And the low fuel warning light comes on when the total fuel is less than 250 liters<sup>50</sup>). So it is possible to fly for three hours and 35 minutes if the maximum fuel is supplied.

But according to the statements by the HL9404 pilots, they start cargo airlift flight at 1,400~1,600 liters and have fuel resupplied after flying for about one hour and 20 to 30 minutes, and at this time the fuel remaining is about 400 to 600 liters.

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50) When fuel is down below 125 liters in each of the left and right fuel tanks, the low fuel warning light comes on, and it is possible to fly for about 15 minutes with the aircraft attitude stabilized after the low fuel warning light came on.

The senior maintenance person of HL9405 said HL9405 started the flight mission after having fuel of only 1,600 liters supplied. Excluding 250 liters at which the low fuel warning light comes on, 1,350 liters was the fuel available, and considering the hourly fuel consumption, it was possible to fly for maximum about two hours.

But HL9405 started flight at 09:00 on the day of accident, and at 11:07 the ELT signal was received, so it flew for about two hours and 7 minutes until it crashed.

The senior maintenance person of HL9405 said it is usually the pilot that finally determines the refueling time, and he just checks the take-off time and fuel remaining.

And the senior maintenance person stated that he thought the present fuel was enough for one round-trip flight because it takes about three minutes<sup>51)</sup> by aircraft to fly the flight section and the captain said at about 10:30 "I will have fuel supplied after this flight."

### **1.18.2 Rotorcraft Pilot Training Regulations**

The current Flight Safety Regulation 8.3.4. (Crew Member and Flight Operations Officer Qualifications) specifies training subjects and detailed training hours and courses for rotorcraft pilots for Aircraft Use Business.

And Flight Safety Regulation 8.3.4.13 (Recurrent Training: Flight Crew Members) specifies on-ground training including periodical cockpit resource management (CRM) training, and 8.3.4.17 (Maintaining for Flight · Flight dispatcher Instructor Qualifications) of the same regulation specifies making and implementing periodical training programs for maintaining knowledge and qualifications of flight instructors.

Since such training and education is to be conducted autonomously, the Changwoon aviation have the instructor pilots educate and cross check each other

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51) One way flight time from pickup point to steel tower number 37-1

## **2. Analysis**

### **2.1 General**

The certification held by the HL9405 flight crews met the requirements of the Republic of Korea Aviation Act and the Changwon Aviation Operation Regulation, and the flight crew had qualifications necessary for the flight. And they took a sufficient rest before the flight, and no medical factors that could affect the accident were found.

The HL9405 aircraft was lawfully registered in accordance with the procedures specified in the Republic of Korea Aviation Act and received an airworthiness certificate, operation limit designation, noise certificate and radio station permit, and the flight was legally approved.

According to the fuel consumption and the on-board maintenance person's statement, the aircraft weight and balance were within the specified limits, and any evidence that the aircraft had defects in the control system, power transmission system or engines before the accident was not shown.

This report has analyzed by classifying into weather factors, flight procedures taken by HL9405, CRM and pilot training and other factors.

### **2.2 Weather Factors**

For the weather of the mission area at the time of accident, the ARAIB referred to the weather data of the weather observation facilities<sup>52)</sup> that were nearest to the accident point and the testimony by the witnesses.

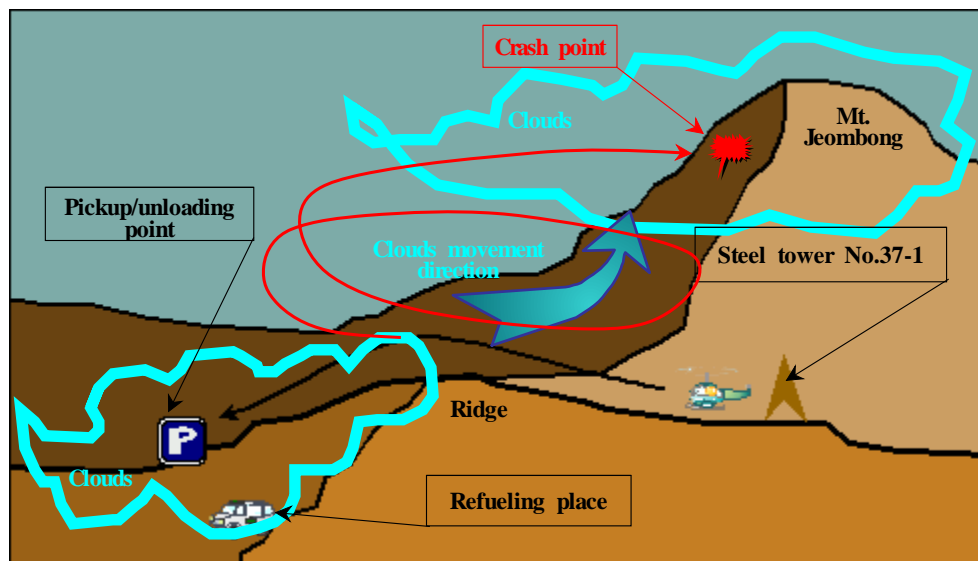
The terrain of the accident point is centered on the 700 to 900 m high ridge of the Taebaek Mountain Range with Inje located west and Yangyang east of the ridge. So HL9405 flew on the west side and HL9404 on the east side of the Taebaek Mountain

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52) Inje Weather Station (22 km west of the crash point), Yangyang International Airport (21.5 km east of the crash point)

Range.

And the Mt. Jeombong ridge passes north to south of the central point from the steel tower number 37-1 position to the pickup and unloading position, so the pickup and unloading point and crash point are not seen from the position of the steel tower. See Fig. 2.



[Fig. 2] Mission area terrain and cloud movement direction

According to the weather data of the weather observation facilities, a southwest wind of 1.1 m/s (2.4 kts) blew at Inje before and after 11:00, the point of time of the accident, and a southwest wind of 7 kts blew at Yangyang Airport.

And according to the statements by the senior maintenance person and junior maintenance person A, hazy mountain fog was over the pickup and unloading point from before the flight mission started, and according to the statement by junior maintenance person B, there were lots of clouds over the steel tower number 37-1 position but the horizontal visibility was good without fog.

At the pickup and unloading point, where the elevation is about 500m to 700m higher than the Inje Weather Station, there is a possibility<sup>53)</sup> that winds stronger than the

53) The fire fighting helicopter that participated in search and rescue withdrew around 14:48 due to

wind observed at the Inje Weather Station blew. And based on such a fact, the ARAIB can reckon that low clouds made in the west of the mission area were moving to the northeast at a fast speed.

Therefore, at the time when HL9405 took off from steel tower number 37-1, the clouds covering the pickup and unloading point were not directly observed, but at the moment that the helicopter flew over the ridge in hazy fog, there is a possibility that the helicopter advanced into clouds embedded in mountain fog.

Subsequently the clouds should have climbed while moving continuously in the direction of Mt. Jeombong, and HL9405, which had already entered into clouds, might have made climbing turns continuously to get out of the clouds. But HL9405, which failed to get out of the clouds, could have crashed on the 9/10th ridge of Mt. Jeombong while the lumbered trees at external load collided with the trees around the crash point.

The statements by the HL9404 captain who was flying at steel tower number 19 located in the west of the Taebaek Mountain Range at the time of accident: "The sky condition at the time was "BROKEN" with a lump of clouds hanging on the heel side (about 1,180 m above mean sea level)," and "The clouds were not so thick and the visibility was good." are judged to be because there were weather differences between the east side of the Taebaek Mountain and the west side over which HL9405 was flying.

### **2.3 Flight Procedures Taken by HL9405**

The weather of the pickup and unloading point at the time when HL9405 decided on the flight mission was not a big obstacle for performing the flight mission, but as time passed the weather was gradually changing to a weather which was improper for carrying out the flight mission.

In such a case, pilots should be prepared for a worsening weather while continuously

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worsening weather of winds and low clouds.

observing the change of weather, but according to the statement by the senior maintenance person of HL9405, the captain did not make any order or mention regarding the weather other than the fact that he asked "What is the weather like over there" in his last contact after he entered into clouds.

And viewed from the fact that he continued to carry out the flight mission without fuel supply unlike the HL9404 pilots when the flying time had passed one hour and 20 minutes, it is presumed that he did not take proper action on weather change as he was absorbed in the work.

On the basis of the findings confirmed from on-site investigation, the ARAIB judged that while HL9405 was making a right turn<sup>54)</sup> in clouds at a speed of more than about 80 km/h<sup>55)</sup> it tried to make a fast left turn<sup>56)</sup> on sighting a mountain on the right side, but due to the tensile force generated when the pickup wire rope was caught on trees, the aircraft changed rapidly into a right-bank attitude<sup>57)</sup> and crashed on ground.

And considering that the ground collision entry angle of the aircraft was -6 degree, that rotation damage appeared on the engine compressor, and that the aircraft attitude changed rapidly at the short moment of crash, ARAIB considered<sup>58)</sup> that the engines did not stop.

These evidences show that the HL9405 pilots lost the sense of direction in clouds and continued climbing turns, and did not take proper procedures<sup>59)</sup> to get out of the clouds.

HL9405 took off from steel tower 37-1 at 10:40, and even if it landed at the refueling place normally, it would be about 10:50. Considering that the engine start-up

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54) The cargo being picked up was about 20 m off to left of the aircraft.

55) If the aircraft makes a 15 degree slow turn, the cargo is about 20 m off at a speed of about 90 km.

56) The main rotor blades of the aircraft cut the tree at ③ of the wreckage distribution at a 30 degree left inclination

57) The external pickup wire is mounted on the bottom of the aircraft, so if the external wire is pulled left downward, the aircraft that is trying to advance has its attitude rapidly changed into a right inclined attitude.

58) If engines stopped and the pilot tried autorotation landing, the above-mentioned evidences could appear.

59) After straight climb flying until the highest nearby obstacle is avoided, move to a nearby airfield assisted by air traffic control center or land safely by visual flight when weather improves.

was made at 09:00, the total flight time might have been one hour fifty minutes<sup>60</sup>).

Therefore, the HL9405 pilots could have had the low fuel warning light come on in clouds or, even if it did not come on, the fuel depletion time was imminent, so it is possible that they could not make straight climbing flight keeping their composure in a situation where engines could stop any time soon.

Therefore, it is necessary for the Changwoon Aviation to improve the regulations and procedures and strengthen supervision so that all aircraft can be refueled without being pressed for time in preparation for the unexpected prolonged flight endurance, and weather changes are carefully observed to avoid running into bad weather especially when flight mission is carried out under ambiguous weather condition.

#### **2.4 CRM and Pilot Training**

There was a possibility that the weather could be worsened by mountain fog in the flight section even before HL9405 started the flight mission, so if the captain and the co-pilot had discussed<sup>61</sup>) the procedures in case they encountered adverse weather or divided up the work to do in advance, they could have gotten out of the cloud area effectively in case they had entered into clouds.

But the facts that the HL9405 pilots continued to make turning flight in clouds with cargo picked up until the moment of crash, that they did not give any instructions to ground staff for weather observation although the mission area was covered with fog even before they started the flight mission, that after they entered into clouds they deviated from the normal flight path and flew toward Mt. Jeombong, which is the highest in the vicinity, and that they made turning flight<sup>62</sup>) in clouds until they crashed, show that training was insufficient for the procedures to be taken in case of

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60) Maximum time that can be flown with the 1600 liter fuel supplied before flight until the low fuel warning light comes on.

61) Captain's intentions, actions to be taken by the co-pilot, the location and elevation of the highest obstacle in the vicinity, get-away direction in case of entry into clouds, attitude flight method, weather condition in the vicinity and lookout for obstacles, etc.

62) Witnesses reckoned hearing the sound of the aircraft in clouds.



encountering adverse weather and that the captain and co-pilot were not prepared for adverse weather in advance through CRM.

The Changwoon Aviation Operations Regulation, Chapter 4 (Accident Prevention and Safety Programs), Paragraph 4-1 (Safety Policy) specifies "smooth CRM should be made between flight crew members." but there are no specifications in detail as to what kind of contents should be applied in what way between flight missions and the ARAIB could not confirm any records of training about them.

In 1979 when the captain obtained the certificate for commercial pilot, the instrument flight experience was not required, so he was able to obtain the certificate, and even after he obtained it, he has not received instrument flight training nor experienced it.

And pilot training of the Changwoon Aviation contains a subject<sup>63)</sup> for the procedures to be taken on encountering adverse weather, but lacks specific details on how to get away from clouds in case of sudden entry into clouds. Most of training details were prepared by the dispatchers and signed by pilots later.

The HL9405 captain obtained the type rating of KA-32A on 15 March 2006, received instructor upgrade training from 1 to 21 May 2006, and was appointed as the Changwoon Aviation's own instructor pilot on 22 May 2006.

The captain was examined his qualification by MLTM Qualifying Instructor pilot two times after obtained instructor pilot qualifications. However, he had a plenty of flight experience, he had no opportunity to have systematic re-education, and in-house training was provided as a mere formality, so it cannot be deemed that he sufficiently acquired the training details for coping with emergency situations such as various emergency procedures, risk assessment and management procedures and CRM procedures.

Therefore, the ARAIB has concluded on the basis of the examples mentioned above that the accident happened because the HL9405 captain failed to cope with weather change in time, failed to secure reserve fuel properly in preparation for an emergency,

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63) Contained as part of seasonal safety training.

and failed to take proper escape procedures after entering into clouds suddenly without practicing CRM in advance.

## **2.5 Other Factors**

The flight data recorder mounted on HL9405 was completely destroyed by a fire that broke out after crash. There is a factor that it was difficult for the fire fighting staff to access quickly because the crash point was in highlands with an elevation of about 1,200 m, but it is judged that the FDR was not protected against fire as it was installed close to the fuel tank.

Despite that the forward fuselage was completely destroyed by a fire after crash, the tail boom was not damaged by the fire. Therefore, if the FDR had been installed toward the tail boom, it could have been protected against the fire. So it is necessary for the manufacturer to re-consider the installation location of FDR and improve on the problem.

**3. Conclusions****3.1 Findings**

1. The certificates held by the HL9405 captain and co-pilot met the requirements of the Aviation Act and the Changwoon Aviation Operations Regulation and the flight crew held qualifications necessary for flight operation.
2. The HL9405 aircraft was lawfully registered in accordance with the procedures specified by the Aviation Act and had an airworthiness certificate, operation limit designation, noise certificate and radio operator permit.
3. The HL9405 maintenance log had no specific defects recorded and no evidence that there were abnormalities in the fuselage, control system, engines or power transmission system in preflight check and during flight was found.
4. At the time of crash the pickup and unloading point was covered with mountain fog and it was moving to northeast together with clouds made in the southwest.
5. The refueling of HL9405 was not conducted with in sufficient margin for time refueling interval during cargo airlifting flight, and the time of fuel low warning reached after entering the clouds.
6. Even though the visibility was not good due to mountain fog covering the cargo pickup and unloading point, the pilots were considered not to be prepared for the worsening weather.
7. HL9405 was making external pickup of lumbered trees until it crashed, and the cargo first impacted on the trees on the 9/10th ridge of Mt. Jeombong, and then the fuselage hit trees at a 30 degree left bank, and the fuselage became a 40 degree right bank attitude by the tensile force of pickup wire rope as the cargo was caught on trees to cause the aircraft to crash.

8. The ground entry angle when HL9405 crashed was -6 degrees based on the horizon, and a fire broke out after crash.
9. The fire spread to the remaining fuel and oil, concentrating on the forward fuselage and did not spread to the surroundings, but the flight data recorder was destroyed by the fire so the data could not be extracted.
10. The co-pilot had experience of instrument flight but the captain had no experience of instrument flight. The Changwoon Aviation provided some of the pilots who would be dispatched overseas the instrument flight training by a flight simulator, but the pilots of HL9405 had not been provided with instrument flight training.
11. The detailed application schemes of CRM were not established in the Changwoon Aviation's regulations and syllabus.
12. It could not be ruled out the possibility of poor reception of radio at the time when HL9405 tried to contact the senior maintenance in clouds, however it was not possible to confirm whether it operated normally or not because the radio was burnt down by post crash fire.

### **3.2 Causes**

The ARAIB determines the causes of the HL9405 accident as follows:

1. The HL9405 entered into clouds and lost the sense of direction and during climb turning the cargo being picked up was caught on the trees of Mt. Jeombong to cause the aircraft to crash.

The contributing factors of the accident are as follows:

1. The HL9405 captain did not have fuel resupplied in time while carrying out the duty, was not prepared for adverse weather, and failed to take proper procedures to get out from clouds.
2. The CRM training of the Changwoon Aviation was not enough.

#### 4. Safety Recommendations

The Aviation and Railway Accident Investigation Board issues safety recommendations as follows based on the findings from investigation of the HL9405 accident that occurred on 6 November 2009.

##### To the Changwoon Aviation Co. Ltd.

1. Complement the Operations Manual including the followings: (AAR0904-1)
  - A. A scheme for applying CRM details during flight duty
  - B. A scheme for securing refueling interval during a cargo airlifting flight
  - C. A scheme for providing a training for those who do not have instrument flight experience
  - D. Establish a defence procedure for risk prior to and during flight as follows:
    - prior to flight: identifying, avoiding or coping with the anticipated risk factors,
    - during flight: making vigilance for the anticipated risk factors
  - E. Make details for dividing up the duties between captain and co-pilot in an emergency
2. Require a discipline for the instructor pilots, especially the senior pilots to observe the regulations, as for an example, and to study through for the mission and participate the in-house education voluntarily, and enhance the supervisory activities for them. (AAR0904-2)

##### To KumApe Co.

1. Review a scheme for relocating the flight data recorder of the KA-32 type to the portion of tail boom that is away from the aircraft fuel tank (AAR0904-3)