

AA2013-1

**AIRCRAFT ACCIDENT  
INVESTIGATION REPORT**

**HELI-SYS japan, inc.**

**J A 7 1 0 H**

**January 25, 2013**

 **JTTSB** *Japan Transport Safety Board*

The objective of the investigation conducted by the Japan Transport Safety Board in accordance with the Act for Establishment of the Japan Transport Safety Board and with Annex 13 to the Convention on International Civil Aviation is to determine the causes of an accident and damage incidental to such an accident, thereby preventing future accidents and reducing damage. It is not the purpose of the investigation to apportion blame or liability.

Norihiro Goto  
Chairman,  
Japan Transport Safety Board

Note:

This report is a translation of the Japanese original investigation report. The text in Japanese shall prevail in the interpretation of the report.

# AIRCRAFT ACCIDENT INVESTIGATION REPORT

ROLL-OVER UPON TAKEOFF

HELI-SYS japan, inc.

EUROCOPTER EC120B (ROTORCRAFT), JA710H

KARIFURIDAKE TEMPORARY HELIPAD

MINAMI-FURANO TOWN, SORACHI-GUN

HOKKAIDO, JAPAN

AT ABOUT 13:25 JST, FEBRUARY 19, 2012

December 21, 2012

Adopted by the Japan Transport Safety Board

Chairman	Norihiro Goto
Member	Shinsuke Endoh
Member	Toshiyuki Ishikawa
Member	Sadao Tamura
Member	Yuki Shuto
Member	Toshiaki Shinagawa

## SYNOPSIS

### < Summary of the Accident >

On Sunday, February 19, 2012, a Eurocopter EC120B, registered JA710H, operated by HELI-SYS japan, inc., rolled over during takeoff from Karifuridake temporary helipad and sustained damage around 13:25 Japan Standard Time (JST: UTC + 9hrs, all times are indicated in JST on a 24-hour clock).

On board the helicopter was a pilot, but he suffered no injury.

The helicopter sustained substantial damage, but there was no outbreak of fire.

### < Probable Causes >

In this accident, it is highly probable that the helicopter rolled over in a state of dynamic roll-over during a liftoff, and sustained damage.

It is probable that the helicopter's continued liftoff sequence with the right skid caught by an obstacle lead to a dynamic roll-over.

It is highly probable that nobody on the ground noticed the degraded helipad conditions contaminated by the obstacles probably the branches of creeping pines which had protruded through the snow surface and they caught the helicopter before liftoff.

As the pilot lacked sufficient knowledge and skills for snow-covered mountain top operations, it is possible that he failed to: pay special attention to the obstacles on the ground; ask an escort to check the obstacles when he aborted the liftoff sequence; and resumed the liftoff sequence making sure that the helicopter would not roll again after he suspended the takeoff operation.

# **1. PROCESS AND PROGRESS OF THE ACCIDENT INVESTIGATION**

## **1.1 Summary of the Accident**

On Sunday, February 19, 2012, a Eurocopter EC120B, registered JA710H, operated by HELI-SYS japan, inc., rolled over during takeoff from Karifuridake temporary helipad and sustained damage at around 13:25 Japan Standard Time (JST: UTC + 9hrs, all times are indicated in JST on a 24-hour clock).

On board the helicopter was a pilot, but he suffered no injury.

The helicopter sustained substantial damage, but there was no outbreak of fire.

## **1.2 Outline of the Accident Investigation**

### **1.2.1 Investigation Organization**

On February 20, 2012, upon being notified of the occurrence of the accident, the Japan Transport Safety Board designated an investigator-in-charge and an investigator to investigate this accident.

### **1.2.2 Representatives of the Relevant State**

An accredited representative of France, as the State of Design and Manufacture of the helicopter involved in this accident, participated in this investigation.

### **1.2.3 Implementation of the Investigation**

February 21 and 22, 2012: On-site investigation, helicopter examination and interviews

June 4-6, 2012: Helicopter examination and document examination

### **1.2.4 Comments from the Parties Relevant to the Cause of the Accident**

Comments were invited from the parties relevant to the cause of the accident.

### **1.2.5 Comments from the Relevant State**

Comments on the draft report were invited from the relevant State.

## 2. FACTUAL INFORMATION

### 2.1 History of the Flight

On Sunday, February 19, 2012, a Eurocopter EC120B, registered JA710H, operated by HELI-SYS japan inc. (hereinafter referred to as “the Company”) transported skiers and guides to Karifuridake temporary helipad (hereinafter referred to as “Karifuri Helipad”) and disembarked them (This type of business in this report is referred to as “Heli-skiing”). The helicopter was about to take off at about 13:25.

The history of the flight up to the accident is summarized as follows, according to the statements of the pilot, an escort at Karifuri Helipad and witnesses.

#### a. Pilot

On the day of the accident, the pilot reported for duty at Shimukappu Heliport Office, Yufutsu-gun, Hokkaido, at around 07:50. He did a preflight inspection of the helicopter and found no anomalies.

11 skiers showed up at the Office at about 08:30 and received preflight briefings.

Morning heli-skiing flights to the top of Mt. Soshubetsudake started at around 09:05. He did six shuttle flights to the mountain airlifting an escort, ski guides, cameramen and skiers, and landed at Ochiai Helipad no. 2 (hereinafter referred to as “the Helipad no. 2) at the foot of the mountain. He ate lunch there.

He started afternoon flights at about 13:00. The first flight airlifted an escort, a ski guide and two cameramen from the Helipad no. 2 to Karifuri Helipad. The surface of Karifuri Helipad was covered with hardened snow with creeping pines\*<sup>1</sup> buried underneath. The escort was the first to disembark to check the helipad conditions. He sprayed a red circle on the helipad with a spray paint as a landing reference for the pilot.

The helicopter flew back to the Helipad no. 2 to pick up the first party: a ski guide and three skiers. After disembarking them at Karifuri Helipad, it flew back to the Helipad no. 2.

The helicopter took off from the Helipad no. 2 with the second party: a ski guide and three skiers. The pilot approached the Karifuri Helipad from southeast along the mountain ridge as he did previously. The weather he observed was: visibility more than 10 kilometers; overcast with high thin snow clouds; light snow. From the way the light snow was drifting, he judged that the wind was blowing from the west at 7-8 knots. The indicated outside temperature by onboard thermometer was -9°C.

He touched down in front of the red circle with the heading 290° and disembarked the passengers.

He confirmed the escort’s OK signal. When he pulled the collective pitch lever (hereinafter referred to as “CP”) a little for lift off, he felt uneasy about the uneven behavior of two skids; the right skid seemed to be caught by

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\*<sup>1</sup> “The creeping pine” (Pinaceae family) is a prostrate evergreen coniferous shrub which grows on high mountains in north-central Honshu and in Hokkaido.

something. He immediately lowered the CP and gave a small forward control input with the cyclic stick.

He felt that the helicopter slid forward a little to be cleared of the restraint. He pulled the CP again. Next moment the helicopter abruptly rolled over to the right, giving him no chance to counter the roll.

He dangled in the seatbelt. Although he thought that the engine had stopped, he heard a sound of possible rotating turbines so that he turned off the switches of battery, generator, master switch and others.

He unbuckled the seatbelt and evacuated from the helicopter climbing through the open left door. He confirmed that he was not injured. He also confirmed that all the persons near the Helipad were all safe.

He reported the accident to the Company with the mobile phone. He put on snowshoes and walked down the mountain with the escort and the cameraman who were at the site.

From the call log of the accident report left in the mobile phone, the pilot judged that the helicopter had rolled over at about 13:25.

No mechanical warnings or control anomalies were observed before the event.

b. Escort

The escort was airlifted to Karifuri Helipad in the first flight in the afternoon. His duties include assisting helicopter takeoffs/landings and escorting passengers out of the helicopter to the safe area. No branches of pine trees on the helipad caught his attention as possible obstacles for helicopter operation until the landing of the second party.

After the disembarkation of the second party, the escort confirmed the safety of the skiers, ground obstacles near the helicopter and signaled OK to the pilot. He watched the transition to a hovering. The left skid inched upward but the transition to a hovering terminated. He felt something caught the right skid. Next moment the left skid lifted up and the helicopter rolled over to the right. He thought that nothing could stop the rolling. The main rotor banged the ground and the helicopter mover forward to the left showing its belly.

He thought that he could have advised the pilot with a transceiver in his hand before the roll angle went larger.

c. Witness A

After the disembarkation Witness A was looking at the lower part of the helicopter squatting about 1 meter to the left of the helicopter.

When the helicopter moved a little, it looked like a branch of a pine tree as thick as a ballpoint pen had caught the inboard of the left skid snowshoe<sup>\*2</sup>. An instant later, the helicopter rolled over to the opposite side (to the right).

As very small amount of tree branches were protruding through the snow surface at the beginning, Witness A thought that the branch might have sprung up from beneath the snow at the moment of the helicopter movement.

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<sup>\*2</sup> A "snowshoe" is a helicopter version of snowshoe attached under the rear part of a skid to prevent the skid from sinking into the snow.

As Witness A did not look at the pivoting right skid, he was unaware of its conditions. Also, as his position was very close to the helicopter, he felt delayed scariness when he imagined the rolling helicopter to his side.

d. **Witness B**

Witness B was watching the helicopter taking off with his head down in a low posture on the immediate left side of the helicopter.

From the movement of the helicopter he thought it would take off to the right, but it rolled over to the right.

After the event Witness B found a broken branch of creeping pine as thick as about 10 cm lay 1.0-1.5 meters to the south of the triangulation point. He observed very few creeping pines protruding other than that. He thought that the location of the broken branch was almost consistent to where the right skid was planted.

The accident occurred at Karifuri Helipad (43°01'31" N, 142°42'33" E), at about 13:25.

(See Figure 1: Accident Site Layout, Photo 1: Accident Site)

## **2.2 Injuries to Persons**

Nobody was injured or killed.

## **2.3 Damage to the Helicopter**

### **2.3.1 Extent of Damage**

The helicopter sustained substantial damage.

### **2.3.2 Damage to the Helicopter Components**

- a. Fuselage: The cockpit windshield was damaged.
- b. Tail section: The tail boom was fractured with damaged horizontal stabilizers.
- c. Landing gear: The right snowshoe was deflected.
- d. Rotor blades: The main rotor blades were fractured.  
The Fenestron was partly damaged.  
The tail rotor drive shaft was fractured.

The control connectivity was established.

(See Photo 2: Accident Helicopter)

## **2.4 Personnel Information**

Pilot: Male, Age 40

Commercial pilot certificate (Rotorcraft)	April 11, 1996
Type rating for single-engine turbine (land)	May 16, 1997
Class 1 aviation medical certificate	
Validity	May 9, 2012
Total flight time	2,978 hr and 36 min
Flight time in the last 30 days	16 hr and 11 min
Total flight time on the type of aircraft	469 hr and 55 min
Flight time in the last 30 days	8 hr and 18 min

## 2.5 Helicopter Information

### 2.5.1 Helicopter

Type	Eurocopter EC120B
Serial number	1074
Date of manufacture	December 8, 1999
Certificate of airworthiness	No. Dai-2011-571
Validity	January 12, 2013
Category of airworthiness	Rotorcraft, Normal N
Total flight time	1,051 hr and 41min
Flight time since last periodical check (100 hours inspection, January 9, 2012)	20 hr and 37 min

(See Figure 2: Three Angle View of Eurocopter EC120B)

### 2.5.2 Weight and Balance

At the time when the accident occurred, the weight of the helicopter was estimated to have been 1,219 kilograms, and the position of the center of gravity (CG) was estimated to have been longitudinally 411 centimeters aft of the reference plane (400 centimeters ahead of the centerline of the main rotor head) and laterally 2 centimeters right of the airframe symmetry plane, both of which were estimated to have been within the allowable range (the maximum gross weight of 1,715 kilograms, the minimum gross weight of 1,035 kilograms, and the CG range of longitudinally 389 to 416 centimeters and laterally 90 centimeters to the left and 80 centimeters to the right in corresponding to the weight at the time of the accident).

## 2.6 Meteorological Information

The upper wind profiles at an altitude of about 1,300 meters observed at the wind profiler observation point (designated by the Japan Meteorological Agency) located about 41 kilometers east-southeast of Karifuri Helipad was as follows (the observed values are converted from meter per second to knot):

Time	13:00	13:10	13:20	13:30	13:40	13:50	14:00
Wind direction	284°	282°	285°	285°	286°	281°	277°
Wind velocity	15 kt	13 kt	15 kt	15 kt	13 kt	13 kt	15 kt

Also, the Agency's hourly analysis chart gives the following data about the 1,300-meter upper wind (the same unit conversion applies here) on 142°30' E longitude which runs 17 kilometers west of Karifuri Helipad as follows:

Time	13:00	14:00
Wind direction	280°	300°
Wind velocity	10 kt	20 kt

## **2.7 Accident Site Information**

### **2.7.1 Outline of Karifuri Helipad**

- a. The contents of the permission obtained pursuant to the proviso of article 79 of the Civil Aeronautics Act

The Company applied for the permission of Karifuri Helipad as a temporary helipad at the top of Mt. Karifuridake at an elevation of 1,323 meters located northeast of the Hidaka Mountain range. The permission was granted as applied for. The helipad is described as follows:

- ◆ The square helipad with a side length of 18 m;
- ◆ The snow covered surface with gradient of 0 percent;
- ◆ The approach surface<sup>\*3</sup> for takeoff/landing had a gradient of 1/8 in the east-west direction, while there was no obstacle protruding into the surface.

- b. Conditions of the accident site at the time of on-site investigation

Three days after the accident, the helipad was covered with new snow.

While the snow surface of the helipad was hardened, the snow in the perimeter area was so soft that covered branches of creeping pine sprang up if people walk there.

The helipad measured about 7 meters in the east-west direction, and about 9 meters in the north-south direction, assuming the pilot landed the helicopter placing himself in front of the painted red circle.

Karifuridake triangulation point sits at the northern corner of the helipad. No trees on surrounding downhill slopes protruded into the approach surface.

### **2.7.2 Conditions of the Accident Site**

The helicopter rested with its right side on the northwest slope of the helipad heading to the southwest. The trees on the slope held the helicopter in place.

On the surface of the helipad the investigators identified: the painted red circle; and two broken pine branches about 1.5 meters southwest of the triangulation point: one as thick as about 5 centimeters, the other as thick as about 2 centimeters.

Although other thin branches were lying on the snow surface, none of them were broken.

(See Figure 1: Accident Site Layout, Photo 1: Accident Site and Photo 2: Accident Helicopter),

## **2.8 Other Necessary Information**

### **2.8.1 Record of Heli-skiing**

The Company started Heli-skiing in 2011, and conducted Heli-skiing flights for 12 days from February 20 to March 20, the same year.

For the year 2012, the Company started the same flight on February 18, and the accident occurred the next day. The pilot started Heli-skiing flight in 2012.

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<sup>\*3</sup> “approach surface” means an area abutting on the shorter side of a landing strip and sloping upwards from the horizontal plane, the projection of which corresponds to the approach area.

### **2.8.2 Regulations for Training and Qualification Check, and Pilot Qualification**

- a. The pilot training is stipulated in the appendix “Training and Qualification Screening Manual” to the Company’s “Operations Manual.” Although the appendix includes promotion training, periodic training, refresher training, transition training to other types of helicopters and special training, it did not cover training for Heli-skiing operation which requires landing at and takeoff from snow-covered mountain helipad.

On the other hand, qualification checks involve promotion check, periodic check, transition check to another type of helicopter, special and extraordinary check. These checks did not either include Heli-skiing matters.

- b. The pilot joined the Company in November, 2010, and received pilot promotion training. After passing the promotion check, he was granted to perform the PIC (pilot in command) duties for aerial work services and air transport services boarding a Robinson R44 helicopter on November 20, 2010.
- c. He received periodic training as well as transition training to Eurocopter EC120B in April, 2011. After the checkride, he was assigned on April 16, 2011 to perform PIC duties for aerial work services and air transport services aboard above mentioned helicopter.

### **2.8.3 Given Training Provided for Heli-skiing**

The provided Heli-skiing training includes the following.

- a. Observation

Capitalizing on the Heli-skiing transportation on March 13, 2011, the pilot observed the operation (without flying it) boarding the helicopter left seat. At that time, the landing to and takeoff from Mt. Karifuridake was done only once.

- b. Preliminary Training

The pilot received terrain feature familiarization flights as a PIC on January 21 and February 2, 2012. He also received training of four takeoffs and landings at snow-covered mountain tops as a PIC on February 11, 2012, including only one landing at the top of Mt. Karifuridake.

### **2.8.4 Safety Measures**

The Company’s “Regulations for the Implementation of Flight Operations,” an appendix to “Operations Manual” includes the following description which is almost identical to what is stated in “Standard Administrative Processes at Regional Civil Aviation Bureau for Takeoff and Landing Permission for Temporary Helipads”:

- a. Helipad requirements (excerpt)

*When it is used for purposes other than passenger transportation along a specified route*

(1) General

<i>Helipad</i>	<i>Location and Direction</i>	<i>(omitted)</i>
	<i>Length and Width</i>	<i>The length shall be larger than the aircraft horizontal projection (hereinafter referred to as “the overall length”), and so shall be the width, (hereinafter referred to as “the overall width”).</i>
	<i>Surface</i>	<i>The surface shall be sufficiently flat, and its maximum longitudinal and lateral slopes shall be less than 5% of gradient. It shall have sufficient strength to withstand the operation of the aircraft.</i>

b. Necessary safety requirements (excerpt)

*The following safety measures shall be implemented. (omitted)*

*(2) Safety Measures at a Helipad*

*[1] Prohibit the unauthorized people’s access to the helipad and the adjacent area where such intrusion hamper the aircraft operations. In case of a gathering of many people, necessary measures shall be taken such as placing security guards, etc.). (omitted)*

**2.8.5 Regulations on Heli-skiing Procedures**

The Company prescribed “Work Standards” to standardize the procedures for Heli-skiing flight. The following descriptions are found in “Chapter 4: Operations in Snow-Falling Area.” (excerpt)

*4-6-1 Engine Start*

*(4) When a skid is frozen to the ground, a dynamic rollover may develop into a serious accident. In case of frozen skid, remove ice completely with a shovel and/or de-icing chemicals.*

*4-6-2 Takeoff*

*(2) When an assistant is on board, he/she should make sure before takeoff that skid skis or snowshoes are clear of obstacles (such as railroad ties) and check the condition of a ski rack.*

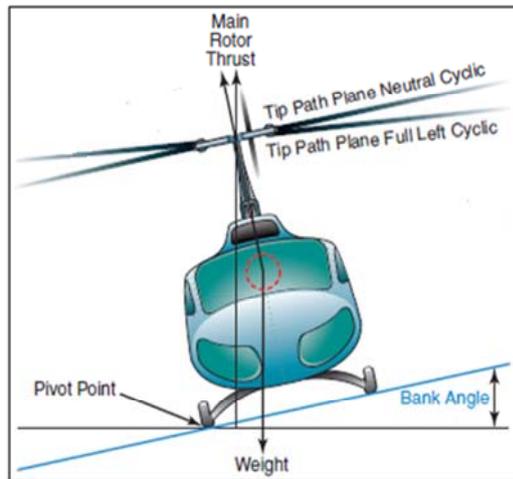
**2.8.6 Dynamic Roll-over**

a. “ROTORCRAFT FLYING HANDBOOK (2000)” compiled by the Flight Standard Service, Federal Aviation Administration (FAA), U.S. Department of Transportation includes the following description (on page11-7):

*A helicopter is susceptible to a lateral rolling tendency, called dynamic rollover, when lifting off the surface.*

*For dynamic rollover to occur, some factor has to first cause the helicopter to roll or pivot around a skid, or landing gear wheel, until its critical rollover angle is reached. Then, beyond this point, main rotor thrust continues the roll and recovery is impossible.*

*If the critical rollover angle is exceeded, the helicopter rolls on its side regardless of the cyclic corrections made. (omitted) Quickly applying down collective is the most effective way to stop dynamic rollover from developing. Dynamic rollover can occur in both skid and wheel equipped helicopters, and all types of rotor systems.*



(Prepared on the basis of FAA "ROTORCRAFT FLYING HANDBOOK" Figure 11-6)

b. Critical roll-over angle

Responding to the consultation of the French accident investigation agency (BEA: Bureau d'Enquêtes et d'Analyses pour la sécurité de l'aviation civile) on the critical roll-over angle for the helicopter, Eurocopter, the designer/manufacturer provided the following:

*The critical roll-over angle for EC120B depends on weight and balance parameters, but also on exterior conditions like wind or ground surface type.*

*Figures are based on the following hypotheses:*

- Full cyclic lateral deviations to compensate for the roll-over,
- Full collective pitch.

*If the right skid is considered stuck in the ground, the roll-over angle is between 15° to 20° roll, assuming there is no nose up or nose down attitude.*

*If the left skid is considered stuck in the ground, the roll-over angle is between 10° to 20° roll, assuming there is no nose up or nose down attitude.*

### **3. ANALYSIS**

#### **3.1 Qualification of Personnel**

The pilot held a valid airman competence certificate and a valid aviation medical certificate.

#### **3.2 Airworthiness Certificate**

The helicopter had a valid airworthiness certificate and had been maintained and inspected as prescribed.

#### **3.3 Effects of Meteorological Conditions**

According to the statement in 2.1 a and the Japan Meteorological Agency's observation data as described in 2.6, the weather conditions at Karifuri Helipad at the time of the accident was probably overcast with high clouds with a good visibility, while the west-northwesterly wind was blowing at about 15 knots.

As the pilot attempted to take off into the wind as described in 2.1 a, it is unlikely that the weather conditions had bearing on the accident.

#### **3.4 Damage to the Helicopter**

According to the condition of the damage to the helicopter as described in 2.3.2, the helicopter was damaged by external force accompanied by the accident. In addition, according to the statement in 2.1 (1), the helicopter was operational with no anomalies until the event.

#### **3.5 Development Up to Roll-over**

##### **3.5.1 Initiation of Takeoff Sequence**

According to the pilot statement, when he pulled the CP a little for lift off, he felt uneasy about the uneven behavior of right and left skids; the right skid was caught by something. He immediately lowered the CP and gave a small forward control input with the cyclic stick.

Given this statement, it is highly probable that when the pilot started a liftoff sequence, he very likely felt something was wrong with the right skid (compared to the left skid) as if it had been caught by something, and he immediately aborted takeoff.

##### **3.5.2 Takeoff Abortion to Roll-over**

- a. According to the statement in 2.1 a., after aborting the liftoff sequence, he gave a small forward control input and felt that the helicopter slid forward a little to be cleared of the restraint. He pulled the CP again. Next moment the helicopter abruptly rolled over to the right, giving him no chance to counter the roll.
- b. According to the Witness A's statement in 2.1 c., when the helicopter moved a little, it looked like a branch of a pine tree as thick as a ballpoint pen had caught the inboard of the left skid snowshoe. An instant later, the helicopter rolled over. He mentioned that as very small amount of tree branches were protruding

through the snow surface at the beginning, the branch might have sprung up from beneath the snow at the moment of the helicopter movement.

- c. According to the Witness B's statement in 2.1 d., after the helicopter rolled over, Witness B found a broken branch of creeping pine as thick as about 10 cm lay where the right skid had been planted. He observed very few creeping pines protruding other than the branch.

Judging from these statements combined, it is probable that the pilot judged that the restraint was cleared after the slight movement of the helicopter following the aborted liftoff sequence, and resumed the liftoff sequence while the helicopter was still caught by the branch. The helicopter rolled over to the right immediately after he resumed the sequence.

### **3.5.3 Probable Causes of the Roll-over**

- a. According to the Witness A's statement in 2.1 c., when the pilot aborted the takeoff and he moved the helicopter a little forward, the left skid was probably restrained by the thin branch which protruded from beneath the snow surface. Also, according to the witness B's statement in 2.1 d., the right skid was probably caught by the branch as thick as 5 centimeters as mentioned in 2.7.2.
- b. The helicopter probably resumed the liftoff sequence with both skids restrained by branches of creeping pines and continued the sequence; the thick branch kept catching the right skid while the thin branch snapped and released the left skid. The continued liftoff most likely caused abrupt right rolling pivoting over the right skid, exceeding the roll-over critical angle (mentioned in 2.8.6 b), resulting in a dynamic roll-over and damaged the helicopter.
- c. As described in 2.8.4 a, the Company prescribed that one of the helipad requirement was sufficiently flat surface, and also as described in 2.8.5 along with the assistant's duties: when on board, the assistant should make sure before takeoff that skid skis or snowshoes are clear of obstacles (such as railroad ties) and check the condition of a ski rack.

According to the statement in 2.1 b., at the time of the accident the assistant was not available; however, the escort was probably assisting the helicopter ground operation. Given this fact, the safety check against obstacles before takeoff was implemented as stipulated in the standards as described in 2.8.5. However, it is highly probable that the escort was unaware of the degraded helipad surface with the obstacles: possible pine branches protruded from beneath the surface. The following possible contributing factors are responsible for the escort's lack of attention to the ground obstacles:

- ♦ There were no possible obstacles when he checked the helipad after the landing;
- ♦ He was occupied to pay attention to disembarked skiers who were staying near the helicopter.

(See Figure 3: Chain of Probable Causes of the Accident)

### **3.5.4 Decisive Contributing Factor to Roll-over**

The helicopter rolled over to the right probably because the thin branch on the left skid snapped to release it while the thick branch on the right skid kept restraint acting as a roll-over pivot point.

As described in 2.7.1, the fact that Karifuri Helipad being established on the pressed snow with creeping pines underneath has the potential of degrading the helipad requirements in case of protruding tree branches for possible left roll-over pivoting over the left skid.

### **3.6 Involvement of Knowledge and Skills in the Roll-over**

- a. It is probable that temporary helipads established on mountain tops and ridges for Heli-skiing in general are such that grass fields and shrubs are covered with pressed snow. Accordingly, the helipad conditions change depending on the snow situation, repeated use of helicopters and passengers who stampede the surface, giving chances for underneath shrub to protrude its branches through the snow surface. It is probable that for the safety operation of helicopters under these circumstances, pilots are required to be adequately trained with ample knowledge before assuming their duties.
- b. As described in 2.8.3, the pilot boarded a Heli-skiing helicopter and observed Heli-skiing once in 2011 as observation. Also, before getting engaged in Heli-skiing in 2012, he received preliminary training for three days (two days for terrain features familiarization flights) as a PIC. However, as described in 2.8.2, with the absence of the Heli-skiing related contents in the regulations for training and qualification check, Company's instructors did not provide him with classroom lectures or actual flight training using snow-covered mountain tops.
- c. When a pilot aborts a liftoff sequence as in this accident, it is desirable to ask the ground crew to check the skid situation and carefully resume the sequence confirming no indication of roll-over. However, as described in 3.5.2, the pilot did not do so, and probably believed the skids were clear of obstacles just after he slid the helicopter a little forward, and pulled the CP without suspicion, and then it rolled over. The roll-over took place due to his lack of cautiousness against ground objects, with possible contributing factors of lack of knowledge and skills against: mountain top operations under snow covered conditions; and unexpected situation where skids are restrained by obstacles protruding from beneath the snow surface.

(See Figure 3: Chain of Contributing Factors to the Accident)

### **3.7 Prevention of Dynamic Roll-over**

The following are possible preventive measures against dynamic roll-over during takeoff from a snow covered helipad.

- a. Establish and maintain appropriate helipad
  - The shape, area and surface conditions of a helipad constantly change depending on the snow conditions.
  - The close coordination of a pilot and ground crew is indispensable to check the helipad's consistency with the requirements of the approved temporary

helipad. Paying special attention to obstacles and gradient which lead to dynamic roll-over is necessary.

b. Countermeasures against abnormal helicopter behavior during liftoff

In case of abnormal helicopter behavior such as unexpected skid liftoff, immediately lower the CP to abort the liftoff. Coordination with the ground crew is necessary to make sure the skids are clean and cautiously resume the liftoff sequence.

c. Takeoff and landing training on snow-covered mountain tops and others

Safe operation to and from snow-covered mountain tops require appropriate grasping of the changing situation of helipads and act accordingly.

The pilot who assumes the duties which include snow-covered mountain top operations must be properly trained and tested for required skills and knowledge.

The same is true for the ground crew who support Heli-skiing. They must be trained to be properly fit for the duties thereof.

## 4. CONCLUSIONS

### 4.1 Probable Causes

In this accident, it is highly probable that the helicopter rolled over in a state of dynamic roll-over during a liftoff, and sustained damage.

It is probable that the helicopter's continued liftoff sequence with the right skid caught by an obstacle lead to a dynamic roll-over.

It is highly probable that nobody on the ground noticed the degraded helipad conditions contaminated by the obstacles probably the branches of creeping pines which had protruded through the snow surface and they caught the helicopter before liftoff.

As the pilot lacked sufficient knowledge and skills for snow-covered mountain top operations, it is possible that he failed to: pay special attention to the obstacles on the ground; ask the escort to check the obstacles when he aborted the liftoff sequence; and resumed the liftoff sequence making sure that the helicopter would not roll again after he suspended the takeoff operation.

### 4.2 Other Safety-Related Findings

#### a. Skiers' stand-by position during liftoff

Judging from the statements in 2.1 b, c, and d, it is highly probable that the escort and both witnesses were waiting for the takeoff of the helicopter on the immediate left side of it.

It is understandable that skiers will have difficulty in moving away promptly from the helicopter after disembarking on a snow-covered mountain-top helipad. In a case like this accident where passengers and others remained within the adjacent area of a helicopter on a helipad, there was a possibility of a helicopter roll-over toward them as described in 3.5.4. If it had occurred, casualties could have been enormous.

In accordance with the safety requirements stated in the Company's "Regulations for the Implementation of Flight Operations," access to the helipad and adjacent area where such intrusion hampers the aircraft operations.

#### b. Area of Karifuri Helipad

It is probable that this accident was caused by protruded obstacles through the surface of the helipad and lack of requirements of sufficient flatness of the helipad; however, the lack of required area for the helipad was not responsible for the occurrence. As described in 2.7.1, three days after the accident the helipad measured about 7 meters in the east-west direction and about 9 meters in the north-south direction. As the shape of a helipad on a mountain top varies depending on the snow conditions, it was unable to clarify the helipad conditions at the time of the accident. It is probable that the discrepancy between the applied and approved dimensions (18 meters × 18meters) and the actual measurement suggest that at the time of the accident, the actual area did not meet the requirement of not only the officially approved measurements but also the Company requirement – the length and the width of the helipad for Heli-skiing as described in 2.8.4 a. (the length and width of the helicopter projected on the horizontal plane (11.5 meters × 10 meters)).

Because the area of a helipad is an important element which directly affects the safe operation of a helicopter, the required area shall be secured by proper maintenance.

## 5. Safety Actions

### 5.1 Safety Actions Taken by the Company

The Company has taken the following corrective actions, in accordance with the directions given during the special safety audit conducted by Tokyo Regional Civil Aviation Bureau, the Ministry of Land, Infrastructure, Transport and Tourism (MLIT).

#### a. Appropriate Management of Temporary Helipads

For appropriate management of temporary helipads, the Company has established the company rule of “Regulations for the Management of Temporary Helipads” to prescribe the details of “Regulations for the Implementation of Flight Operations,” an appendix to “Operations Manual,” while compiling a checklist for helipad use.

#### b. Safety management for Heli-skiing

To ensure the safety of Heli-skiing, the Company has revised “Chapter 4: Operations in Snow-Falling Area,” internal rule of “Work Standards.”

(1) The Company has inserted a section of “Heliport Examination” to deal with situational changes of temporary helipads. Detailed procedures were established for examining changes by snowfall and corresponding restoring actions. It also has revised the existing provisions to periodically check the approved temporary helipads on mountain tops for changes and, if any, to provide corrective works to meet the requirements.

(2) As the current before-takeoff safety procedures provide only assistant’s role, the Company has revised the procedures by adding provisions to clarify the escort’s role and coordination with the pilot.

#### c. Heli-skiing Training and Qualification Check

(1) The Company added training and their evaluation procedures for cold weather operations, flight operations in snowed area, mountain operations, and Heli-skiing to “Training and Qualification Manual,” an appendix to “Operations Manual” in order to ensure Heli-skiing pilots’ knowledge and skills.

(2) In order to have flight managers, mechanics, ground crew and escort familiarize themselves to their coordination and safety procedures (including passenger escort to safe area during Heli-skiing operation), the Company added training and check procedures for flight operations in snowed area and mountain operations, and Heli-skiing to “Chapter 4: Operations in Snow-Falling Area” to train above mentioned personnel.

## **5.2 Safety Actions Taken by Civil Aviation Bureau (CAB), Ministry of Land, Infrastructure, Transport and Tourism**

Based on the on-site safety audit for the Company, CAB has ordered its Regional CABs which have jurisdiction over business license to instruct applicants of temporary helipad for Heli-skiing about the safety measures to be taken to prevent the same failure in line with the safety audit results.

Figure 1 : Accident Site Layout

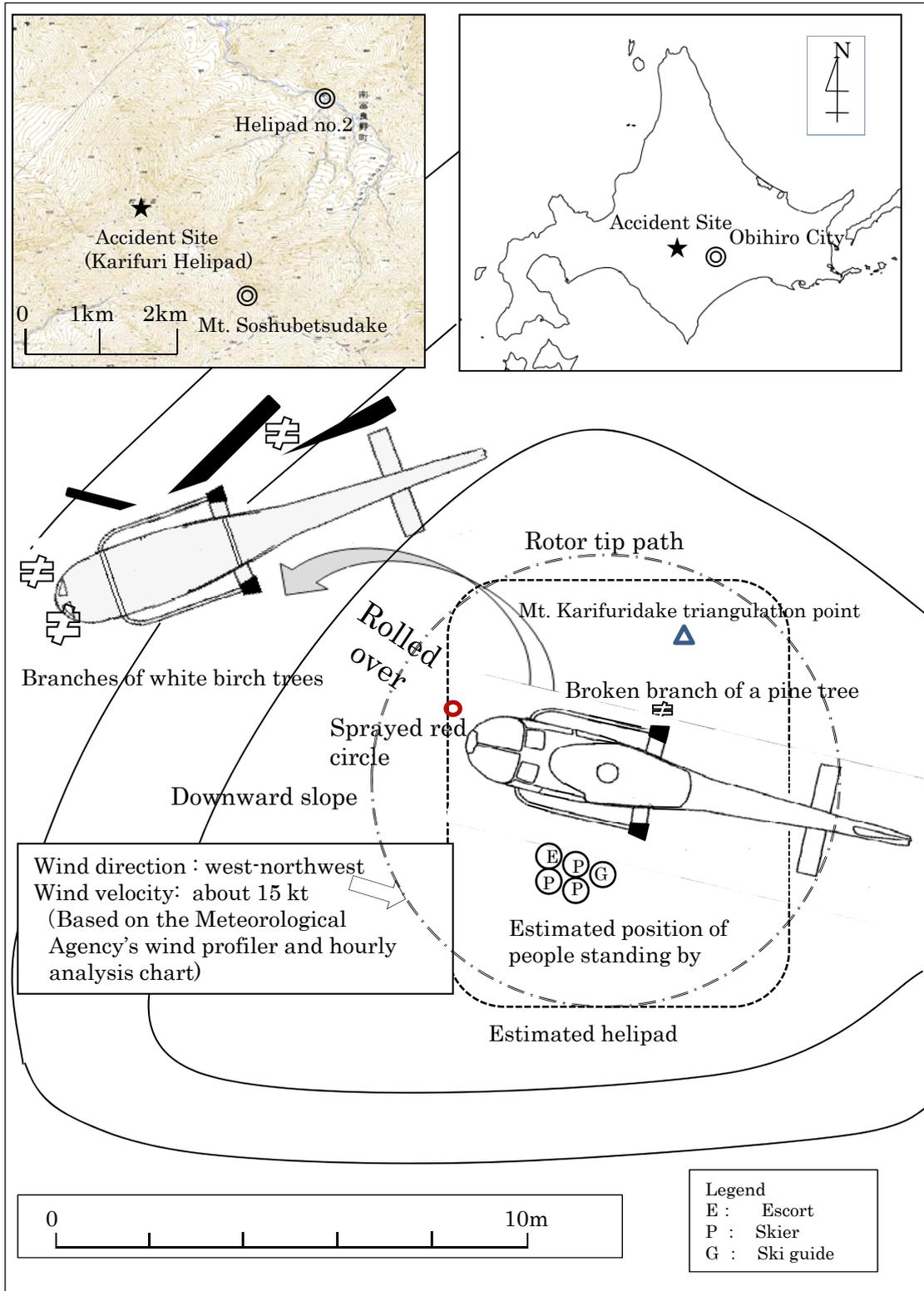


Figure 2: Three Angle View of Eurocopter E120B

Unit:m

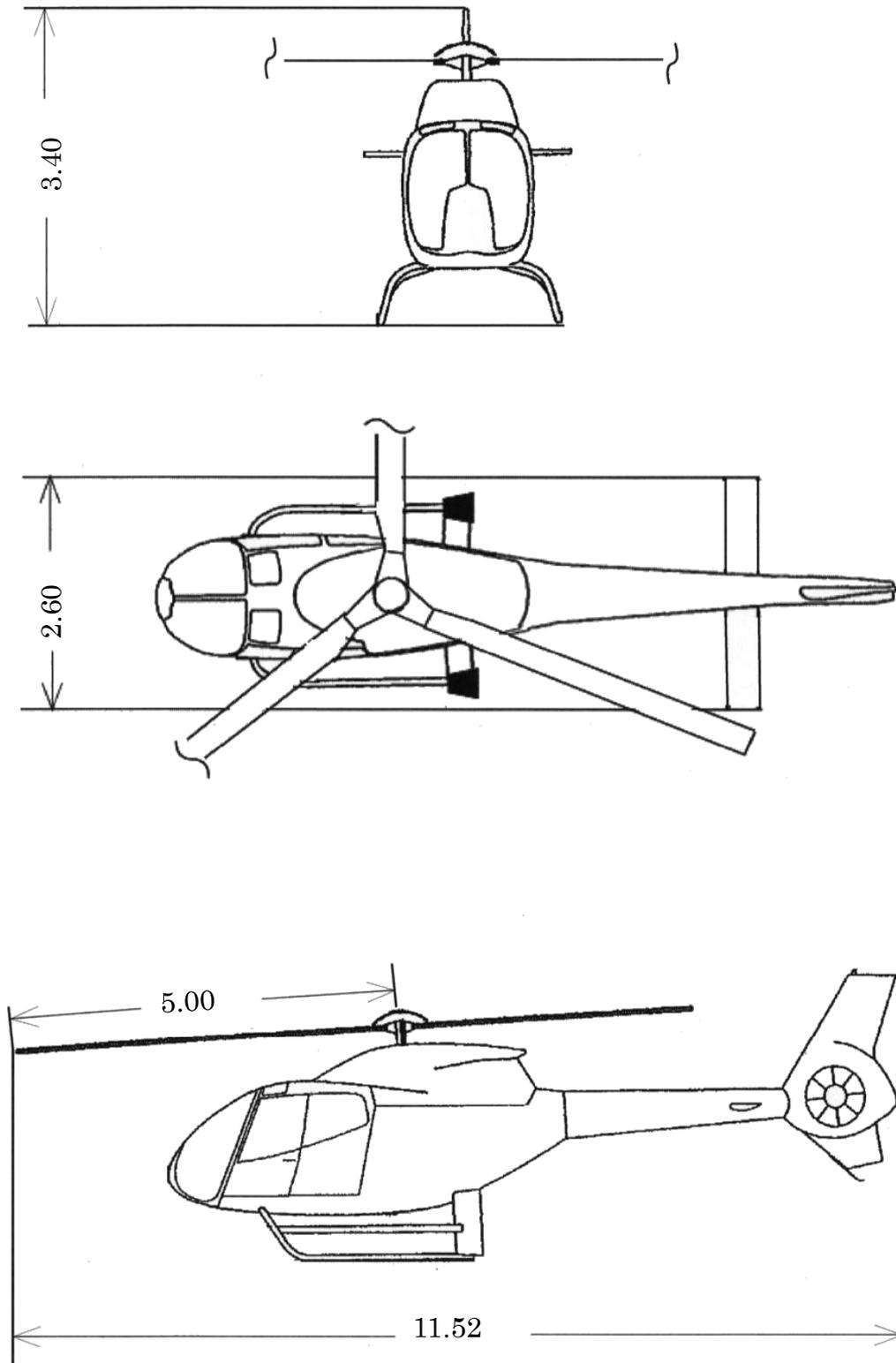
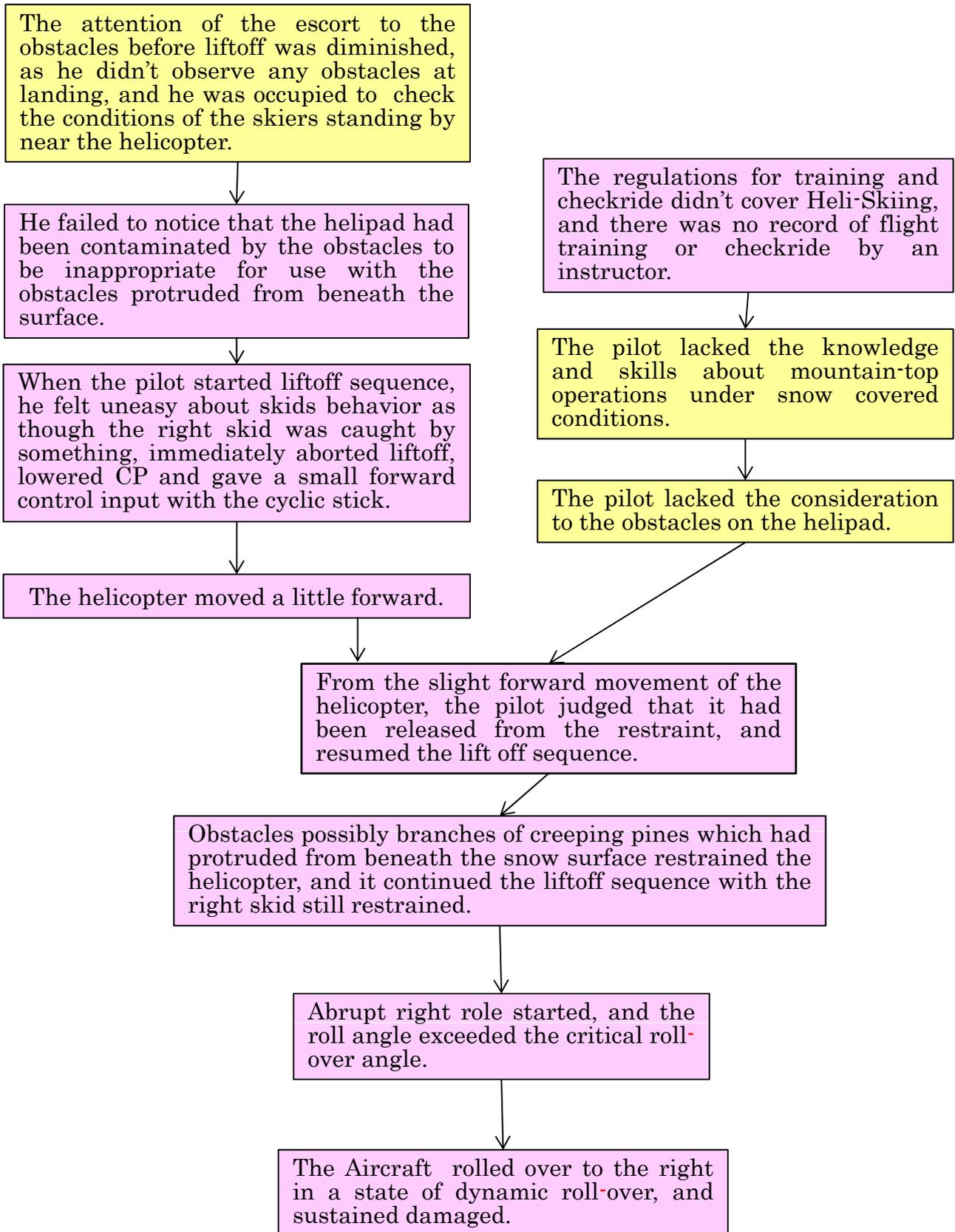
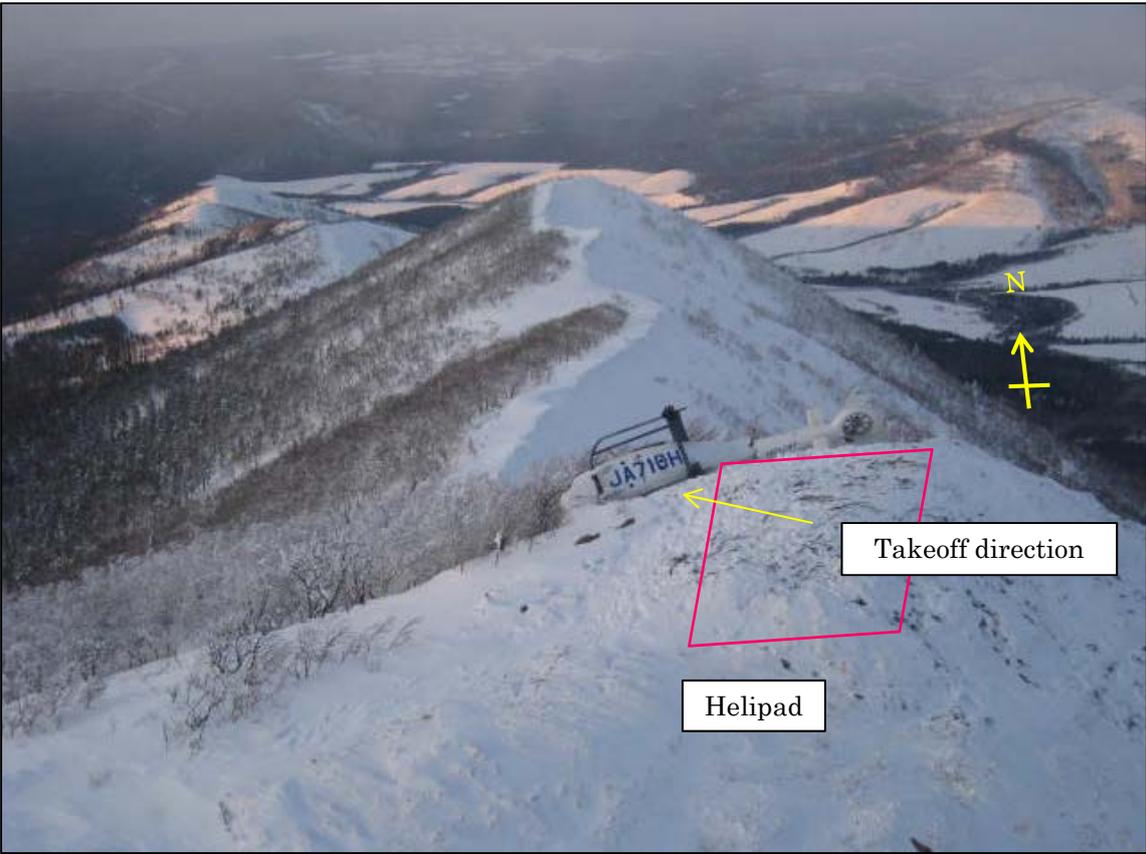


Figure 3: Chain of Probable Causes of the Accident

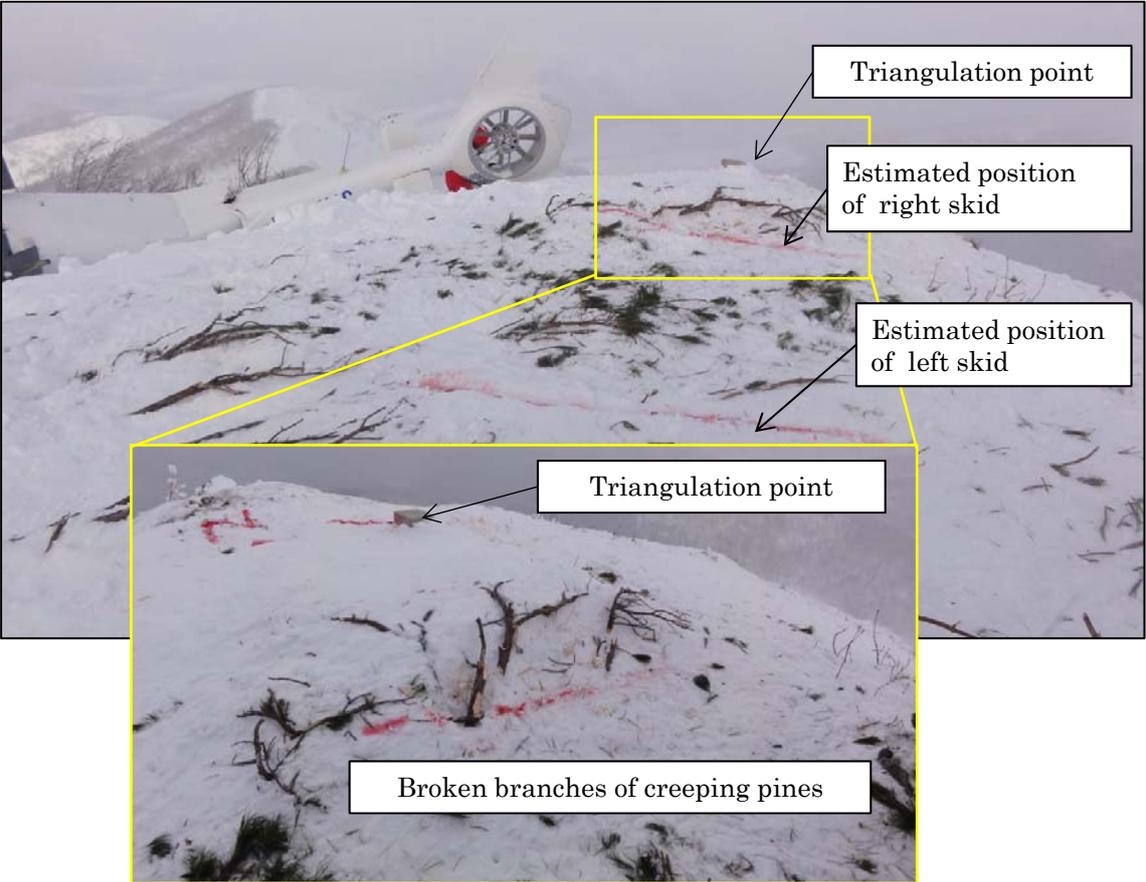


- Very probable events judging from the accident site and statements of persons concerned.
- Possible judging from the situation.

Photo 1: Accident Site



(Situation on the day of the accident)



(Situation three days after the accident)

Photo 2: Accident Helicopter

