AA2013-5

AIRCRAFT ACCIDENT
INVESTIGATION REPORT

SHIKOKU AIR SERVICE CO., LTD.

J A 6 5 2 2

June 28, 2013

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

FIRE FROM REAR HOLD
SHIKOKU AIR SERVICE CO., LTD
EUROCOPTER AS350B3 (ROTORCRAFT), JA6522
HIKETA, HIGASHIKAGAWA CITY, KAGAWA PREFECTURE
AT ABOUT 10:10 JST, SEPTEMBER 22, 2011

June 21, 2013

Adopted by the Japan Transport Safety Board

Chairman	Norihiro Goto
Member	Shinsuke Endoh
Member	Toshiyuki Ishikawa
Member	Sadao Tamura
Member	Yuki Shuto
Member	Keiji Tanaka

SYNOPSIS

<Summary of the Accident>

On Thursday, September 22, 2011, a Eurocopter AS350B3, registered JA6522, operated by Shikoku Air Service Co., Ltd., took off from Takamatsu Airport at around 09:23 for power transmission lines inspection flight. A burnt smell and white smoke rose in the cabin during this flight, and at around 10:10, the helicopter made a forced landing at a baseball field located at Hiketa, Higashikagawa City, Kagawa Prefecture.

On board the helicopter were a pilot and two passengers, but none of them suffered injury.

After the forced landing, the helicopter caught fire and was destroyed.

<Probable Causes>

In this accident, it is highly probable that a fire occurred in the rear hold of the Helicopter and the Helicopter made a forced landing.

Regarding a fire in the rear hold, it could not be identified the ignition source; nevertheless it is possible that a fire occurred from the wiring connected to the strobe light power supply, which was installed in the rear hold, and that it spread to inflammables placed around the power supply.

This is because the wiring was not designed and structured so that it was fully protected so as to prevent it from being damaged due to the movement of embarkation and preclude a risk of occurring a fire even if it was damaged or destroyed.

It is also possible that since it was not covered with nets to prevent its movement, embarkation in the rear hold damaged the wiring, which was not fully protected from damage due to the movement of the embarkation.

<Recommendations>

○ Recommendations Pursuant to the Act for Establishment of the Japan Transport Safety Board

In order to contribute to prevention of recurrence of similar accidents, based on the result of investigation of the accident, the Japan Transport Safety Board recommends, in accordance with the provisions of Article 27 Paragraph 1 of the Act for Establishment of the Japan Transport Safety Board, that Shikoku Air Service Co., Ltd. give careful consideration to the following and take necessary measures thereof:

(1) Embarkation on board

When having embarkation in the rear hold of Eurocopter AS350B3, the Company should take measures to prevent its movement using a net as provided in the Flight Manual in order to prevent an unforeseen event due to such movement. In addition, when transporting items that fall into the category of explosives and other goods, the Company should confirm the content of the pronouncement and meet the standards specified therein when transporting such items.

(2) Establishment of a system that enables pilots to perform emergency procedures of aircraft without failure

The Company should establish a system that enables pilots, when operating aircraft, to perform appropriate emergency procedures of aircraft swiftly and reliably in a state of emergency mainly by memorizing those which must be performed immediately.

○ Safety Recommendations

In order to contribute to the prevention of recurrence of similar accidents, based on the result of investigation of the accident, the Japan Transport Safety Board recommends that the European Aviation Safety Agency (EASA) take the following measures:

(1) Electrical equipment and its wiring in the baggage compartment

The EASA should make it mandatory to modify the rear hold of the Eurocopter AS 350 series so that electrical equipment and its wiring are fully protected.

(2) Manifestation of the matters which must be dealt with immediately by memory among the emergency procedures

In the Flight Manual of the Eurocopter AS350 Series, the EASA should urge the designer and manufacturer of the helicopter to specify the memory items among emergency procedures so that they can be performed immediately.

This report uses the following abbreviations:

AC: Advisory Circular
DGCA: Direction Générale de l'Aviation Civile (French)
ELT: Emergency Locator Transmitter
EASA: European Aviation Safety Agency
FAA: Federal Aviation Administration
FADEC: Full Authority Digital Engine Control
FAR: Federal Aviation Regulations
GPS: Global Positioning System
NTSB: National Transportation Safety Board

Conversion table

1 ft: 0.3048 m
1 kt: 1.852 km/h (0.5144 m/s)

1. PROCESS AND PROGRESS OF THE ACCIDENT INVESTIGATION

1.1 Summary of the Accident

On Thursday, September 22, 2011, a Eurocopter AS350B3, registered JA6522, operated by Shikoku Air Service Co., Ltd., took off from Takamatsu Airport at around 09:23 Japan Standard Time (JST: UTC + 9hrs, all time are indicated in JST on a 24-hour clock) for power transmission lines inspection flight. A burnt smell and white smoke rose in the cabin during this flight, and at around 10:10, the helicopter made a forced landing at a baseball field located at Hiketa, Higashikagawa City, Kagawa Prefecture.

On board the helicopter were a pilot and two passengers, but none of them suffered injury.

After the forced landing, the helicopter caught fire and was destroyed.

1.2 Outline of the Accident Investigation

1.2.1 Investigation Organization

On September 22, 2011, the Japan Transport Safety Board designated an investigator-in-charge and an investigator to investigate this accident.

1.2.2 Representatives of the Relevant States

An accredited representative and advisors of France, as the State of Design and Manufacture of the helicopter involved in this accident, and an accredited representative and an advisor of the United States of America, as the State of Design and Manufacture of the equipment of the helicopter, participated in the investigation.

1.2.3 Implementation of the Investigation

September 22-24, 2011	Interviews, helicopter examination and on-site investigation
October 5, 2011	Interviews
December 20, 2011	Investigation of the helicopter's equipment by the National Transportation Safety Board (NTSB)
February 16 and 17, 2012	Investigation of the equipment

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

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

1.2.5 Comments from the Relevant States

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

2. FACTUAL INFORMATION

2.1 History of the Flight

On September 22, 2011, with its pilot and two passengers on board, a Eurocopter AS350B3, registered JA6522, operated by Shikoku Air Service Co., Ltd. (hereinafter referred to as "the Company"), took off from Takamatsu Airport (hereinafter referred to as "the Airport") at around

09:23 for power transmission lines inspection flight.

The outline of the helicopter's flight plan reported to the Osaka Airport Office was as follows:

Flight rules: Visual Flight Rule (VFR)
Departure aerodrome: Takamatsu Airport
Estimated off-block time: 09:30
Cruising speed: 100 kt
Cruising altitude: VFR
Route: Ayagami - Shionoe - Tawa - Hiketa - Ochi
Destination aerodrome: Takamatsu Airport
Total estimated elapsed time: Two hours
Purpose of flight: Line Patrol
Fuel load expressed in endurance: Two hours and 40 minutes
Persons on board: Three

The history of the flight of the Helicopter up to the time of the accident was summarized as below, based on GPS data from the equipment fitted on the Helicopter as well as the statements of the pilot, a passenger, an eyewitness, and an aircraft mechanic.

2.1.1 Estimated Flight Route Based on GPS Data

The Helicopter equipped with had a device called the "Power Transmission Line Route Mapping System" with a built-in GPS receiver, which electronically recorded its location and altitude every second, and the data were retrieved from the system. The retrieved data recorded all locations and altitudes from the time when the Helicopter was parked at the Airport to 10:10:04 when it was flying at a location about 150 meters before the place where it made a forced landing (as shown in Figure 1, "Estimated Flight Route" based on the Radar data)).

2.1.2 Statement of the Pilot

On the day of the accident, at the time of pre-flight inspection, the pilot was confirmed only that a locked door without having to open rear hold (baggage compartment). Before taking off, the pilot switched on the strobe lights of the Helicopter.

The Helicopter flew eastward while inspecting the power transmission lines located to the south of the Airport, which extended from west to east, and then turned around at the prefectural border, moving toward another power transmission line extending to the northwest. One to two minutes after that, when it was flying at an altitude of about 1,000 ft, all occupants on board the Helicopter sensed a burnt smell. The pilot, who suspected that the smell had come from outside, separated the Helicopter away from the line and checked how things were on the ground, but did not see anything unusual, including smoke. At the same time, the pilot suspected a trouble in the electrical system and tried to open the checklist, which inserted into the knee board, for emergency procedures included in the Flight Manual, but it was unable to open. Therefore, the pilot switched the generator on and off and tried other operations. Since the smell in the cabin continued, however, the pilot decided to fly back to the Airport.

Immediately after the Helicopter turned its nose to the Airport, smoke started to rise from near the floor of the rear seats. The pilot attempted to increase speed and fly to the Toramaru Park, which has a spacious playground, but since the smoke increased its volume, the pilot decided to land as soon as possible at any place where it could. The pilot spotted a golf course and a schoolyard on the ground, but found a baseball field surrounded by fences, where there was no

single person, and decided to land there. The pilot decided to approach from the east because the wind was blowing from the west, but in order to lower the altitude of the Helicopter, the pilot performed a 360-degree clockwise turn. While descending, in order to discharge the smoke, the pilot completely opened the sliding window fitted on pilot door, which had been half open since the take-off. However, the discharge of the smoke did not catch up with its generation.

The Helicopter approached the baseball field at a steep angle than usual in order to avoid its night lighting facilities. The cabin had been filled with white smoke by the time when it touched the ground. The pilot could not see the instruments, but the ground was barely seen through the transparent panel beneath the pilot's right leg. As the ground was seen to come close gradually, the pilot approached it relying on its visibility. It took only one to two minutes from the time when the smoke started to rise to the time when the cabin was filled with it.

The rudder pedal was stuck at an altitude of one to two feet, but the pilot immediately lowered the collective pitch lever so that the Helicopter touched the ground safely. For that reason, it swung its nose slightly to the right when touching the ground.

The pilot heard one of the passengers, who had escaped from the helicopter immediately after the landing, shouting loudly, "The fire is going out." He lowered the collective pitch lever as far as it went, turned off the engine, put on the rotor brake, switched off all other systems, and saw the rotor stop completely before he opened the door to go out. When he looked behind, he saw flames in the rear of the helicopter and came outside the Helicopter with a fire extinguisher. But unable to fight the fire because the flames were furious, he left for the windward side of the Helicopter with the fire extinguisher in his hand. He immediately reported the status of the accident to the Company. It was around 10:13.

The Flight Manual provide that in the case of emergency procedures, a pilot shall turn the electrical master switch off if it is not clear where smoke arises, but the pilot of the Helicopter couldn't do so because he did not remember the procedures. Since the Flight Manual do not require pilots to remember the procedures, he, assuming that it would be sufficient to operate while looking at the checklist, did not remember emergency procedures that should be followed when smoke arises in the cabin. During the flight, the pilot did not detect any abnormality in the instruments and other devices and any unnatural noise in the intercommunication systems. Nor did he use a heating and demisting system. There was no abnormality in the flight control system until just before landing, but the rudder pedals became fixed just before the Helicopter touched the ground.

2.1.3 Statement of Passenger A

Passenger A took the rear right seat.

First it smelled as if rubber were burning. Immediately after that, white smoke began to rise from the area near beneath the rear seats. Soon thick black smoke started to come out, and therefore, Passenger A advised the pilot to land immediately. The pilot responded calmly to the situation and landed the Helicopter smoothly. The pilot said that there was no abnormality in the instruments.

Condition of the fire on the helicopter at around 10:12

Passenger B, who had taken the front left seat, opened the door and escaped from the helicopter

immediately after landing. Passenger A escaped through the front left door because he did not know how to open the rear door.

Both the main rotor and the tail rotor were turning immediately after the two passengers escaped from the Helicopter, but the tail rotor shortly stopped turning, followed by the main one. Passenger A took photographs of the fire on the Helicopter using the camera functions of his mobile phone. The photographs indicated that at around 10:12, immediately after landing, flames and gray smoke were arising from near the rear hold with the tail boom having already fallen off. At around 10:19, the flames and smoke became increasingly furious, and at around 10:23, wrapped in roaring flames and large amounts of black smoke, the Helicopter was no longer visible.

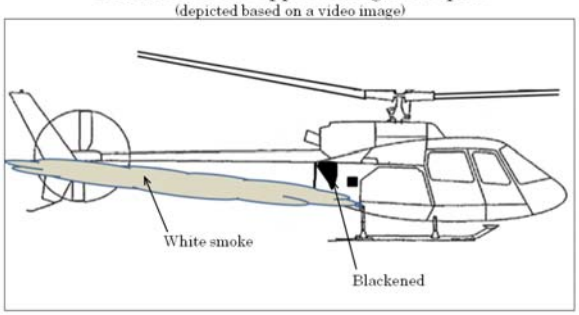
Condition of the fire on the helicopter at around 10:19

Condition of the fire on the helicopter at around 10:23

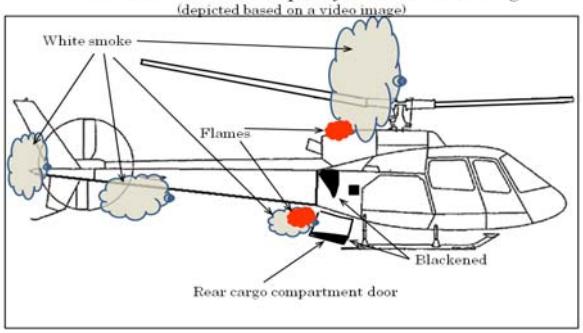
2.1.4 Statement of Eyewitness A

In a paddy field about 500 meters away from the location where the Helicopter made an emergency landing, Eyewitness A witnessed the Helicopter flying at low altitude while pouring out white smoke, and recorded the Helicopter on his video camera. Since the Helicopter turned and flew toward the residential area, the eyewitness did not see the Helicopter touch the ground because houses blocked his field of vision. A look at the video showed that a continuous wisp of white smoke was coming out from near the floor of the rear hold of the Helicopter approaching the baseball field, and that part of the right external plates of the hold had become black. Just before landing, the left door of the rear hold was open and dangling, and the hold was emitting white smoke upward with flames sometimes seen to come out. White smoke was blowing out from also the horizontal stabilizer and the back end of the tail boom. Part of the door of the rear hold also became black.

Condition of the approaching helicopter
(depicted based on a video image)



Condition of the helicopter just before landing
(depicted based on a video image)



This accident occurred at the baseball field in Hiketa, Higashikagawa City, Kagawa Prefecture (34°12'56" N, 134°23'38" E) at about 10:10.
(See Figure 1: Estimated Flight Route)

2.2 Injuries to Persons

Nobody was injured or killed.

2.3 Damage to the Aircraft

2.3.1 Extent of Damage

Destroyed

2.3.2 Damage to the Aircraft Components

Fuselage	Destroyed by fire
Main rotor blades	The major parts of all three blades were burnt down
Tail boom	Mostly destroyed by fire
Horizontal stabilizers	Mostly destroyed by fire
Tail rotor blades and vertical fins	Burned out

2.4 Personnel Information

Captain Male, Age 32

Commercial pilot certificate (Rotorcraft)	
Type rating for single-engine turbine (land)	May 10, 2005
Class 1 aviation medical certificate	
Validity	June 24, 2012
Total flight time	1,081 hr 40 min
Flight time in the last 30 days	1 hr 35 min
Total flight time on the type of aircraft	184 hr 00 min
Flight time in the last 30 days	1 hr 35 min

2.5 Aircraft Information

2.5.1 Aircraft

Type	Eurocopter AS350B3
Serial number	3559
Date of manufacture	June 27, 2002
Certificate of airworthiness	No. Dai-2011-337
Validity	September 6, 2012
Category of airworthiness	Rotorcraft, Normal N or Special X
Total flight time	3,395 hr 51 min
Flight time since last periodical check (500 hours inspection, August 26, 2011)	8 hr 21 min

(See Figure 2: Three Angle View of Eurocopter AS350B3)

2.5.2 Weight and Balance

When the accident occurred, the weight of the Helicopter was estimated to have been 1,877 kilograms, and that the position of center of gravity (CG) was estimated to have been at 331 centimeters aft of the reference plane. It is, therefore, highly probable that both the weight and the center of gravity were within the allowable range (the maximum take-off weight: 2,250 kilograms; the CG range that corresponds to the weight at the time of the accident: 317 to 341 centimeters).

2.6 Meteorological Information

The values observed by the Automated Meteorological Data Acquisition System (AMeDAS),

which is placed at Hiketa near the location of the forced landing, during the time period when the accident occurred were as follows:

10:10 Wind direction: 270 degrees; wind velocity: 5.5 m/s; maximum momentary wind velocity: 9.8 m/s; temperature: 22.5 degrees Celsius; precipitation: 0 mm; and average duration of sunshine: nine minutes per every ten minutes

10:20 Wind direction: 270 degrees; wind velocity: 6.4 m/s; maximum momentary wind velocity: 11.1 m/s; temperature: 22.1 degrees Celsius; precipitation: 0 mm; and average duration of sunshine: six minutes per every ten minutes

2.7 Accident Site and Wreckage Information

2.7.1 The Accident Site Description

With a small settlement to its north, the Hiketa baseball field run by Higashikagawa City, where the Helicopter made an emergency landing, was an entirely flat ballpark with night lighting facilities, which was surrounded by fields. The ground was all covered with earth and sand that drained well. The baseball field did not have a turf area, but part of the field from south to southwest was slightly covered with grass.

It was enclosed with nets about 10 meters high for the infield and fences about 2 meters high for the outfield. Six night lighting facilities were located at almost equal intervals, and their height from the ground to the tip was about 23 meters. When the Helicopter made an emergency landing, the baseball field was not being used.

Except the engine, skids, and the vertical fins, the Helicopter was almost entirely destroyed by fire beyond recognition. The wrecked helicopter remained nearly at the center of the baseball field with its nose turned to the direction of 280 degrees. In particular, the rear part of the body, which had a fuel tank and a rear hold, was severely destroyed by fire.

Traces of melting, which indicated the possibility that something in the wiring of equipment caught fire as in an electrical fire, were not identified.

(See Figure 3: The Condition of the Accident Site)

2.7.2 Detailed Information on Damages

(1) Fuselage

Almost all skins were destroyed by fire, and the entire fuselage was broken beyond recognition, but the damage caused to the engine by fire was relatively small. The rear hold also lost its original form, and around it there were cinders from embarkation and equipment in the hold.

(2) Main rotor blades

The major part of all three blades was destroyed. In particular, the portions of the blades that were close to the fuselage were seriously damaged with their external plates burnt down to the ground.

(3) Tail boom

Except its empennage, the tail boom's skins were almost entirely destroyed by fire beyond recognition. The tail rotor drive shaft and the control rod, both made of aluminum alloy, were also destroyed by fire.

(4) Horizontal stabilizers

About halves of the horizontal stabilizer were destroyed by fire beyond recognition.

(5) Tail rotor blades and vertical fins

The tail rotor blades and the vertical fins were all covered with soot. Parts of them were destroyed by fire, but almost retained its original shape.

2.8 Information on the Fire and Firefighting

At 10:11, Eyewitness B, who worked near the place where the accident occurred, made a report of the accident to a fire station. At 10:22, two fire engines arrived at the accident site, and then firefighters performed a fire fighting of the Helicopter fire with water cannon. At 10:39, the fire was extinguished.

2.9 Other Necessary Information

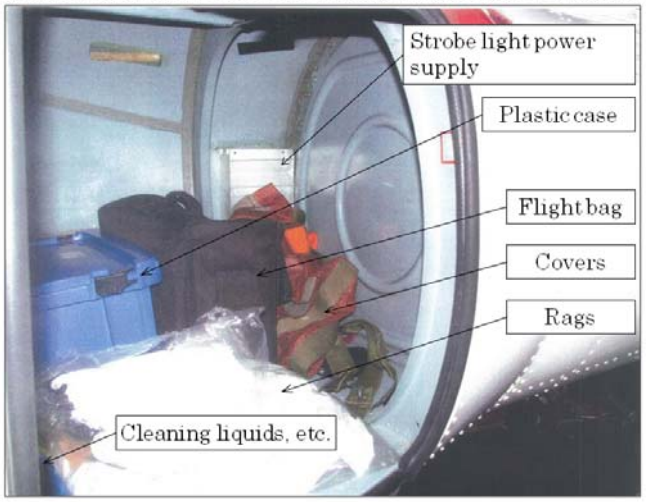
2.9.1 Cabin Ventilation System

The cabin ventilation system of the Helicopter consists of two parts: ram air ventilation and ceiling housing ventilation. The ram air ventilation takes air from the intake on the nose of the Helicopter, sends it through two ducts, and supplies it through two air nozzles located on right and left sides of the instrument panel. The ceiling housing ventilation takes air from the intake on the upper part of the airframe, sends it through the ceiling duct, and supplies it through air nozzles installed on the ceiling of the cabin.

2.9.2 Statement of Mechanic

Mechanic performed a pre-flight inspection of the Helicopter. As shown by the photograph to the right, deep in the front part of the rear hold was a plastic case that contained extra oils such as engine oil. Behind the case was a flight bag that included documents, and at the rearmost part of the hold were cloth covers used during parking. Near the door were rags, cleaning agents, and so forth. All these items were not covered with a floor tie-down net to prevent them from moving, but were kept tidy and in order. The mechanic confirmed that there was nothing abnormal and closed the door.

Condition of embarkation in the rear hold
(Reproduced based on the mechanic's memory using the type of helicopter)



The mechanic had a check the status illuminated of the light, and there was no abnormality. No abnormality had been detected in the previous inspections, either. There had been no particular abnormality found in the recent maintenance, nor had any parts of the Helicopter's equipment been especially replaced in recent months.

2.9.3 Condition of Embarkation in the Rear Hold

According to the materials submitted by the Company, details of embarkation in the rear hold are as shown in Table 1. The embarkation items numbered 5 to 23 in the Table 1 were stored in an outer container, the plastic case numbered 4, except those numbered 12, 17, 19, 20, and 21. Those numbered 20 to 23 fell into the category of "explosives and other goods*1" as stipulated in

*1 "Explosives and other goods." refer to objects that are explosive or highly combustible nature or any other things which are liable to injure persons or to damage objects. They are listed in Article 194 of the Ordinance

Article 86 of the Civil Aeronautics Act (Act No. 231 of July 15, 1952) and Article 194 of the Ordinance for Enforcement of the Civil Aeronautics Act (Ministry of Transport Ordinance No. 56 of July 31, 1952), but the volume of each item was less than one liter. The inner container of Item 20 was a plastic container, and those of Items 21, 22, and 23 were metal aerosol containers.

Table 1: List of Embarkation in the Rear Hold

Number	Item	Explosives and so on.		Remarks
		UN number	Classification number	
1	Flight bag	Not applicable	-	Containing the Flight Manual and other documents
2	Covers	Not applicable	-	Cloth covers used when the Helicopter is parked
3	Rags	Not applicable	-	Dustcloth for cleaning
4	Plastic case	Not applicable	-	Containing small items
5	Cotton work gloves	Not applicable	-	
6	Tie-wraps	Not applicable	-	
7	Tester	Not applicable	-	
8	Plastic tape	Not applicable	-	
9	Packing tape	Not applicable	-	
10	Plastic bags	Not applicable	-	
11	Oil drain hose	Not applicable	-	
12	Oil drain container	Not applicable	-	
13	Safety belt	Not applicable	-	
14	Raincoat	Not applicable	-	
15	Batteries	Not applicable	-	Two D size batteries for a waterproof portable flashlight
16	Switches	Not applicable	-	Three extra switches
17	Liquid wax	Not applicable	-	Designated inflammables and solid inflammables
18	Caulking material	Not applicable	-	Solid inflammables
19	Engine oil	Not applicable	-	Liquid inflammables
20	Silicon oil	UN1993	3	Other ignitable liquid
21	Cleaning agent	UN1950	2.1	Aerosol, high-pressure ignitable gas
22	Lubricant (WD-40)	UN1950	2.1	Aerosol, high-pressure ignitable gas
23	Lubricating and releasing agents	UN1950	2.1	Aerosol, high-pressure ignitable gas

2.9.4 Information on Pre-flight Inspection

for Enforcement of the Civil Aeronautics Act.

SECTION 4 "NORMAL PROCEDURES" of the Flight Manual for the Helicopter stipulates operation procedures as follows (excerpts):

1 EXTERNAL CHECKS

(Omitted)

— Rear hold---If applicable: open door, net hooked in place, close door.

(Omitted)

2.9.5 Information on Explosives and so on

The maximum permissible volume and standards for containers, etc. applicable when explosives and so on as provided in Article 194 of the Ordinance for Enforcement of the Civil Aeronautics Act are transported are prescribed in the pronouncement that laid down standards and other guidelines for transport of explosives and so on by aircraft (Ministry of Transport Pronouncement No. 572 of November 15, 1983). According to the pronouncement, the maximum permissible volume for Item 20 in Table 1 is ten liters if it is contained in a plastic container. That for Items 21, 22, and 23 is one liter or less if they are contained in a metal aerosol container, and the pronouncement stipulates that moreover they shall be stored in a plastic outer container.

2.9.6 Condition of Electrical Equipment in the Rear Hold and Its Vicinity

(1) Strobe light power supply

The strobe light power supply, which supplies power to the strobe lights, was installed at the back of the right side in the rear hold. The input and output wiring extended from the main body to beneath the floor.

(2) FADEC computer

The FADEC computer, which controls the engine, was installed at the upper part of the front center in the rear hold. The wiring extended from the computer to the front of the Helicopter.

(3) Emergency locator transmitter (ELT)

The emergency locator transmitter (ELT), which transmits distress signals when the Helicopter goes missing, was installed at the upper part of the front right in the rear hold. The wiring extended from the ELT to the front of the Helicopter.

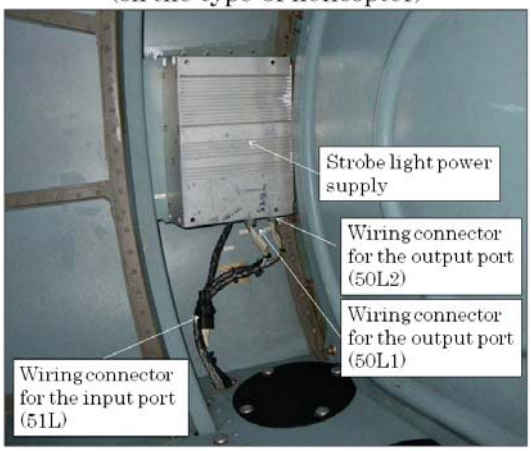
(4) Power supply for anti-collision light

The power supply for the anti-collision light, which supplies power to the light, was installed on the side in the tail boom at the back of the Helicopter, which was separated by a metal bulkhead from the rear hold.

(5) Main Switchboard

The main switchboard, which distributes electricity to each piece of electrical

Installation of the strobe light power supply (on the type of helicopter)



Installation of the FADEC computer (on the type of helicopter)

equipment, was installed at the other side of the floor of the rear hold.

2.9.7 Investigation of the Strobe Lights

(1) History of the Helicopter's strobe lights

The strobe lights were attached to the Helicopter by the manufacturer when its airframe was manufactured, and there was no history of the lights being repaired later.

(2) Specifications of the strobe light power supply

One set of input wiring and two sets of output wiring are connected to the main body of the strobe light power supply. The detailed specifications measured using a helicopter of the same type are as shown in Table 2.

Table 2: Specifications of the Strobe Light Power Supply

	Input port	Output ports (two lines on the right and left)
Voltage	DC 28 V	DC 400 V (maximum: 450 V)
Current	Maximum: 7.2 A	Maximum: 2.7 A
Power consumption	Maximum: 202 W	Maximum: 1,215 W (instantaneous)
Other	Protected by a fuse	Not protected by a fuse Electricity supplied instantaneously 42 times per minute.

(3) Investigation by NTSB

Strobe light power supply and its wires investigated by NTSB

The strobe light power supply and its wiring were sent to the NTSB, and the NTSB investigators investigated under the presence of the representatives of the manufacturer of the Helicopter and that of the strobe lights. The wiring sent to the U.S. are as shown in the photograph to the right. Whereas the external portions of the wiring connectors for the output ports (50L1 and 50L2) were lost except a wiring measuring about 13 centimeters, the wiring connector for the input port (51L) still had a wiring that measured about 30 centimeters.

The outline of the results of investigation is as follows:

a. The power supply did not experience an internal failure that led to the fire. It was a victim of the fire.

b. No evidence of major arcing to the external wire was found. Some very localized

melting of strands were found, which may have been from strobe operation as the wire was externally damaged. The localized melting may also have been created by localized oxygen depletion during the post-landing fire.

c. Localized flat spots on the normally unprotected external wires suggest possible pre-fire contact by hard items, such as oil cans, plastic boxes, suitcase, etc. However, there was nothing associating the flat spots with the fire.

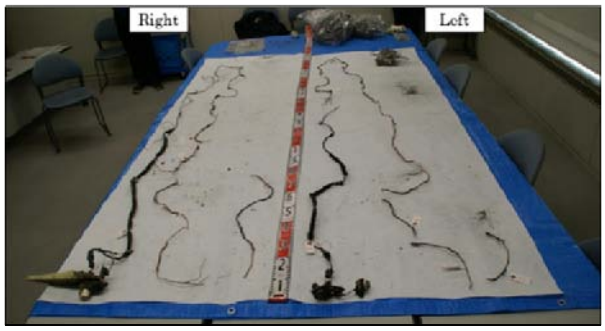
(4) Investigation of similar cases

According to the manufacturer, there was no case in which the main body or the wiring of the strobe light power supply installed in helicopters of the same type caught fire.

(5) Detailed investigation of the wiring for the output port

The wiring for the output ports of the right and left strobe lights were retrieved from the wrecked Helicopter, and the portion of the wiring that was close to the power supply was damaged by heat and fragile.

Condition of wires for the output port



As a result of detailed observation of the retrieved wiring, no event that could be used to identify the cause of the fire such as melting points was detected.

2.9.8 Requirements for Equipment in the Rear Hold

(1) Requirements for airworthiness

According to the Type Certificate Data Sheets, issued by the European Aviation Safety Agency (EASA), which has a responsibility for the airworthiness of the type of helicopters, the requirements for airworthiness applicable to type certificate for the type of helicopters are included in the Federal Aviation Regulations (FAR) Part 27, Amendments 1 to 10 included. Section 27.855(b) of FAR provides as follows:

FAR Section 27.855: Cargo and baggage compartments

(Omitted)

(b) No compartment may contain any controls, wiring, lines, equipment, or accessories whose damage or failure would affect safe operation, unless those items are protected so that:

(1) They cannot be damaged by the movement of cargo in the compartment; and

(2) Their breakage or failure will not create a fire hazard.

In addition, Section IV "Rotorcraft" (aircraft classified as "Rotorcraft Normal N" in terms of airworthiness) 4-7-2-2 of the Airworthiness Examination Procedures in Japan has similar provisions as follows:

Airworthiness Examination Procedures

4-7-2-2 The baggage compartment of rotorcraft must not store controls, operation systems, wiring, pipes, equipment, accessories, and so forth that hinder the safe operation of the aircraft if damaged or destroyed. This shall not apply, however, if such embarkation is protected so that it is not damaged when it moves and that it does not cause a risk of fire occurred if damaged or destroyed.

(2) AC of FAA

FAA has issued AC27-1B (Certificate of Normal Category Rotorcraft) to explain about how to conform to FAR Part 27. This AC gives item-by-item explanations about FAR Part 27, and FAR27.855 (Cargo and Baggage Compartments) describes as follows:

AC27.855 §27.855CARGO AND BAGGAGE COMPARTMENT

(Omitted)

b. procedures.

(Omitted)

(6) Controls, wiring, equipment, and accessories should not be routed through, mounted in, or exposed to the compartment. If these items,as described in § 27.855(b), are in the compartment, they should be protected by a cage or rigid housing adequate to protect the items. To maintain the compartment integrity for fire containment, it may be necessary to separate these items from the compartment by an appropriate fire resistant or flame resistant housing or enclosure.

The purpose of ACs is explained as follows:

1. PURPOSE

(Omitted)

c*. This AC does not change regulatory requirements and does not authorize changes in, or deviations from, regulatory requirements. This AC establishes an acceptable means, but not the only means, of compliance.* (Omitted)

2.9.9 Supplemental Type Certificate for the Helicopter's Strobe Lights

On December 4, 1980, the strobe lights of the Helicopter acquired supplemental type certificate for SH2934SW from the Federal Aviation Administration (FAA) under the category of Equipment OP-0811. On June 27, 2002, France's Direction Générale de l'Aviation Civile (Directorate General for Civil Aviation) issued a certificate of airworthiness for export for the Helicopter equipped with the additionally certified strobe lights, and then the Helicopter was exported to Japan.

2.9.10 Information on Emergency Procedures

(1) SECTION 3.1 "EMERGENCY PROCEDURES" of the Flight Manual for the Helicopter provides as follows:

1. INTRODUCTION

The procedures outlined in this section deal with the common types of emergencies; however, the actions taken in each actual emergency must relate to the complete situation.

(Omitted)

5. SMOKE IN THE CABIN

(Omitted)

5.2 If source of Smoke is not identified

— Shut off the heating and demisting system.*

If the smoke does not clear:

- *Switch off the electrical master switch ("ALL OFF")*
- *When the smell of smoke has cleared, set all switches to "OFF", including the generator and alternator (if installed), close the cabin ventilation*
- *Reset the battery switch to "ON" position.*

- *Reset the "ALL OFF" electrical master switch to normal position.*
- *Switch on the generator, check voltage and current.*
- *If everything is normal, switch on the circuits one by one until the malfunction is identified.*

Note: If the electrical power supply system is faulty, carry out the appropriate procedure, as detailed in SECTION 3.3.

** Optional*

(2) Shut off the *ELECTRICALAL MASTER SWITCH ("ALL OFF")* as mentioned in (1) above is an operation to shut down the power supply to all pieces of electrical equipment except those which receive power directly from batteries.

(3) The Flight Manual for the Helicopter do not specify emergency procedures that must be memorized so that they can be performed immediately.

3. ANALYSIS

3.1 Qualifications of the Personnel

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

3.2 Airworthiness Certificates

The Helicopter had a valid airworthiness certificate and had been maintained as required as required.

3.3 Relation to Meteorological Phenomena

It is highly probable that the meteorological conditions at the time of the accident had no bearing on the occurrence of the accident.

3.4 Conditions of the Flight Route of the Helicopter and the Fire

According to the estimated flight route described in 2.1.1 and the statement of the pilot described in 2.1.2, it is highly probable that the Helicopter took off from the Airport at around 09:23 and flew eastward while inspecting the power transmission line extending from west to east, which was located to the south of the Airport, and that at around 10:06, the Helicopter turned around at the prefectural border with Tokushima Prefecture and headed for another power transmission line extending to the northwest. According to the estimated flight route, it is highly probable that at around 10:07, all members on board sensed a burnt smell in the Helicopter as mentioned in the statements of the pilot, and that the Helicopter went away from the power transmission line. It is also highly probable that, at around 10:08, smoke started to rise immediately after the Helicopter turned its nose toward the Airport, and that, at around 10:09, the pilot decided to land at the baseball field where he made a forced landing, because the smoke started to increase its volume. The GPS data recorded the positions of the Helicopter until at 10:10:04 it passed a location about 150 meters before the place where it made a forced landing. It is highly probable that immediately after that the Helicopter, which was trying to land as soon as possible, made a forced landing. It is also highly probable that it took about three minutes from the time when the pilot sensed the smell from a fire to the time when the Helicopter landed.

As described in 2.1.2, given that the rudder pedals became fixed just before the Helicopter touched the ground, it is probable that, just before grounding, the rudder control system was damaged due to the fire. As described in 2.1.2, the pilot stopped the main rotor by applying the rotor brake after the landing, but as described in 2.1.3, the tail rotor stopped before the main rotor did, and it is probable that before the main rotor stopped, the tail rotor drive shaft was severed and became stuck. Judging from these events, it is probable that it would have been difficult to land safely if the landing had been delayed by several seconds.

3.5 Site Where the Fire Occurred and the Strength of the Force of the Flames

Based on the situation immediately after landing as described in 2.1.3 and the condition of the fire during the flight as described in 2.1.4, it is highly probable that the fire occurred at around the rear hold of the Helicopter.

As described in 2.9.1, the Helicopter's cabin had two ventilation systems, which supplied the air taken from the air intakes at the nose and the upper part of the airframe to the cabin through the nozzles installed on the instrument panel at the front and on the ceiling. As described in 2.1.2, it is highly probable that while the Helicopter was descending for landing, the pilot completely opened the sliding window fitted on pilot door, which had been half open since before take-off. Judging from these facts, it is probable that in the cabin, air was coming out from the air nozzles and was being discharged from the sliding window fitted on pilot door and other openings when the Helicopter was moving forward. Nevertheless, the smell and smoke from the fire in the rear hold spread to the cabin. Given these events, it is considered probable that by around 10:07, when all occupants sensed the burnt smell, the rear compartment had been filled with the smell and smoke.

3.6 Condition of Embarkation in the Rear Hold

As shown by the photograph in 2.9.2 and as described in 2.9.3, the rear hold was filled with so many inflammable items such as extra oils, plastic cases, documents, flight bag, covers, and rags that there was almost no room to stand, but they were not covered with a floor tie-down net to prevent them from moving. It is probable that they did not move unrestrictedly if the Helicopter swayed slightly, but that they did so if its airframe was vibrated or accelerated violently. It is highly probable that the fire spread to these items after it occurred, but that they did not catch fire spontaneously given their physical properties such as flash points.

As described in 2.9.4, SECTION 4 "NORMAL PROCEDURES" of the Flight Manual for the Helicopter provides procedures for inspection of the rear hold during the preflight inspection, providing that "*if applicable: open door, net hooked in place, close door*." As described in 2.1.2 and 2.9.2, the inspection of the rear hold during the pre-flight inspection was performed by the mechanic. It is highly probable that the net for embarkation was not fixed to prevent the movement of embarkation, but that the door was closed after it was confirmed that there was no abnormality in the embarkation, and that the pilot confirmed that the door was locked. Based on this, it is also highly probable that in reality, the actual pre-flight inspection was not performed as stipulated in the Flight Manual.

3.7 Transport of Explosives and Other Goods

As described in 2.9.3, in the rear hold of the Helicopter, there were four items which fell into the category of "explosives and other goods" as provided in Article 194 of the Ordinance for

Enforcement of the Civil Aeronautics Act, but the volume of each item was less than one liter, less than the maximum permissible volume set by the standards mentioned in 2.9.5. These standards provide, meanwhile, that objects like the Items numbered 21, 22, and 23 shall be stored in a plastic outer container, but as described in 2.9.3, it is probable that the Item numbered 21 was not contained in the plastic case numbered 4. From this, it is probable that the Item numbered 21 was not transported using the method prescribed by the standards.

3.8 Condition of Electrical Equipment (Other Than the Strobe Light Power Supply) in the Rear Hold and Its Vicinity

As described in 2.9.6, electrical equipment such as the strobe light power supply, FADEC computer, ELT, power supply for the anti-collision light, and main switchboard was installed inside and vicinity of the rear hold. It is highly probable that the possibility of electrical equipment other than the strobe light power supply causing a fire was less for the reasons specified below.

(1) FADEC computer

The FADEC computer was installed at the upper part of the front of the rear hold with its wiring extending from the front bulkhead to the front part of the Helicopter. It was positioned so that it did not easily come into contact with any of the embarkation placed on the floor. If the computer or its wiring short-circuited or other irregularities occurred, an abnormality sign would be occurred in the engine or the instrument panel, but such a situation did not occur.

(2) ELT

ELT was installed at the upper part of the front right in the rear hold with its wiring extending from the front bulkhead to the front part of the Helicopter. It was positioned so that it did not easily come into contact with any of the embarkation placed on the floor. ELT activates only when the Helicopter goes missing. Therefore, it is difficult to assume that a short circuit or other irregularities occurred to ELT.

(3) Power supply for the anti-collision light

The power supply for the anti-collision light was installed on the side in the tail boom, which was separated from the rear hold by a metal bulkhead. Therefore, it is not probable that it was affected by the movement of embarkation placed in the rear hold, and that if a fire occurred from the power supply, it might spread to the embarkation.

(4) Main switchboard

The main switchboard was installed at the other side of the floor of the rear hold. It is not probable that it was affected by the movement of embarkation placed in the rear hold, and that if a fire occurred from the main switchboard, it might spread to the embarkation. If the main switchboard or its wiring short-circuited or other irregularities occurred, an abnormality sign would be displayed in the instrument panel or others, but such a situation did not occur.

3.9 Condition of the Strobe Light Power Supply

(1) Installation

As described in 2.9.6, the strobe light power supply was installed at the back of the right side in the rear hold with its input and output wiring extending from the main body of the power supply to the floor. As shown by the photograph in 2.9.6, it is highly

probable that the wiring came into contact with embarkation when the latter was moved inside or brought into or out of the hold because they was not protected by rigid housing or similar goods from contact with the embarkation.

(2) Airworthiness of wiring

As described in 2.9.8(1), the certificate of the Helicopter's airworthiness is controlled by EASA; however, the standards applied when the Helicopter acquired type certificate are included in FAR Part 27, Amendments 1 to 10 included.

In addition, as described in 2.9.8(1), FAR Section 27.855(b) requires wiring in the baggage compartment to "*be protected so that it cannot be damaged by the movement of cargo in the compartment, and that its breakage or failure will not create a fire hazard*." Moreover, FAA's AC recommends specific protection methods, saying that "*wiring should be protected by a cage or rigid housing adequate to protect the items*." The wiring of the Helicopter's strobe light power supply, however, was not protected in a "*a cage or rigid housing*" as recommended by the AC.

The wiring of the Helicopter's strobe light power supply clearly did not conform to the method recommended by the AC, and there is also a possibility of the wiring failing to meet FAR's airworthiness standards. For this reason, the designer and manufacturer of the Helicopter should modify the design of the strobe light power supply in line with the method recommended by FAA's AC so that the modified one meets FAR's standards.

(3) Possibility of catching fire

As described in 2.9.7(2), 202 watts of electricity ran through the wiring for the input port of the strobe light power supply, but since the wiring was protected by a fuse, the possibility of the wiring catching fire was less even if it short-circuited. Electricity ran through the two wiring for the output ports 42 times per minute with the maximum momentary wattage at 1,215 watts. Since the wiring were not protected with fuses or similar, it is possible that there was a possibility of catching fire if the wiring short-circuited.

As described 2.9.7(3), investigation by NTSB indicates that the fire did not occur from the strobe light power supply of the Helicopter, and that there was no evidence of a short circuit in the wiring of the power supply. They also show that spot of the wiring was flattened, suggesting that they might have hit against something hard before the fire, but that none of the flat spot was involved in the fire. As described in 2.9.7(4), there was no similar case in which a fire had occurred from a strobe light power supply or its wiring. Nor was any event discovered that could be used to identify the cause of the fire in the wiring for the output ports of the Helicopter's strobe light power supply retrieved as described in 2.9.7(5). There is a possibility, however, that due to its exposure to high temperatures during the fire, which caused it to be deformed, and water doused during the firefighting and other factors, portions of the wiring for the output ports were lost. It is possible that this portion not retrieved include the portion of the wiring that would lead to identification of the cause of the fire.

Based on these, it is highly probable that the fire occurred neither from the strobe light power supply nor from its wiring, which was investigated by NTSB, but there is possible that it did from other parts.

(4) Possibility of the fire spreading to other inflammables

As described in 2.9.2 and 2.9.3, there were many inflammable items in the rear hold.

Therefore, if the fire occurred from the wiring of the strobe light, there is possible that it spread to such inflammable items.

3.10 Pilot's Response

(1) Emergency procedures of the Helicopter

As described in 2.1.2, the pilot perceived an emergency because he sensed a burnt smell. It is highly probable that later smoke arose in the cabin, but that the pilot could not clearly identify the source of smoke. This emergency is considered to fall into the category of the case "5. SMOKE IN THE CABIN: 5.2 If source of smoke is not identified," included in the Flight Manual described in 2.9.10(1). Since the Helicopter did not use the heating and demisting system, the pilot was supposed to first *switch off the electrical master switch ("ALL OFF")* according to the Flight Manual. As described in 2.9.10(2), this operation involves shutting down the power supply to all pieces of electrical equipment except those which receive power directly from batteries, an operation that should be completed as soon as possible to prevent an electrical fire from spreading if it breaks out.

As described in 2.1.2, the pilot tried to perform an emergency procedure of the Helicopter, but did not have enough time to confirm its procedure with the emergency procedures checklist inserted into the knee board. Later, when smoke arose, he failed to perform further emergency procedures just as stipulated in the Flight Manual because he gave priority to landing as soon as possible and because he did not remember the emergency procedures included in the Flight Manual. It is highly probable that before operating the Helicopter, by memorizing emergency procedures that he was expected to have no sufficient time to confirm with the checklist, the pilot needed to ensure that he could perform such operations swiftly and reliably in case of emergency.

However, in the case of this accident, however, as described in 3.5, it is probable that the fire had increased its force in the rear hold by the time when the smell was sensed in the cabin. For this reason, even if the pilot had switched off the electrical master switch *("ALL OFF")* in accordance with the Flight Manual, it is possible that the fire might not have been prevented from spreading to other inflammables.

(2) Flight route and landing

As described in 2.1.2, in response to the smell and smoke that arose in the Helicopter, the pilot decided to make a forced landing, and while paying attention to people on the ground and wind conditions despite the emergency, he succeeded in landing at an appropriate place safely even in an environment that was so harsh that he could not even see the instruments. It is possible that in a state of emergency, the pilot made decisions and took actions calmly and appropriately.

3.11 Description of Emergency Procedures in the Flight Manual

As described in 2.1.2, it is probable that the pilot did not remember the procedures he should follow when it was not identified where the smoke arose because he assumed that it would be sufficient to look at the checklist for necessary operations. As described in 2.9.10(3), meanwhile, the Flight Manual do not specify emergency procedures that should be memorized so that they can be performed immediately. If the Flight Manual had specified such procedures, the pilot would have memorized them and could have performed appropriate procedures swiftly and

reliably in the state of emergency he experienced.

4. CONCLUSION

4.1 Probable Causes

In this accident, it is highly probable that a fire occurred in the rear hold of the Helicopter and the Helicopter made a forced landing.

Regarding a fire in the rear hold, it could not be identified the ignition source; nevertheless it is possible that a fire occurred from the wiring connected to the strobe light power supply, which was installed in the rear hold, and that it spread to inflammables placed around the power supply.

This is because the wiring was not designed and structured so that it was fully protected so as to prevent it from being damaged due to the movement of embarkation and preclude a risk of occurring a fire even if it was damaged or destroyed.

It is also possible that since it was not covered with nets to prevent its movement, embarkation in the rear hold damaged the wiring, which was not fully protected from damage due to the movement of the embarkation.

4.2 Other Safety Related Findings

(1) Transport of explosives and other goods

In this accident, it is probable that one of the embarkation items on the Helicopter that fell into the category of explosives and other goods was not transported using the method provided in the notification that laid down the standards for the transport by aircraft of explosives and other goods. If these items are transported, the relevant standards should be followed after confirming what is prescribed in the notification.

(2) Emergency procedures of the Helicopter

In this accident, the pilot tried to attempt emergency procedures of the Helicopter when smoke arose in the cabin, but failed to do so as stipulated in the Flight Manual because he had not enough time to confirm procedures with the emergency procedures checklist inserted into the knee board and because he did not remember necessary emergency procedures.

The Flight Manual for the Helicopter did not specify the emergency procedures that should be remembered so that they can be performed immediately.

5. SAFETY ACTIONS

5.1 Safety Actions Taken by the Civil Aviation Bureau of the Ministry of Land, Infrastructure, Transport and Tourism

On December 26, 2011, in accordance with EASA Emergency AD2011-0244E, the Civil Aviation Bureau of the Ministry of Land, Infrastructure, Transport and Tourism issued a technical circular directive TCD-7982-2011 to improve airworthiness, instructing all parties concerned to visually

and repeatedly inspect strobe light wiring and unit in the rear hold and repeatedly examine the insulation of strobe light wiring and the mechanical strength of their connectors. It also advised them that such inspections and examinations do not need to be conducted if the strobe lights are not activated.

5.2 Safety Actions Taken by the Manufacturer

On December 22, 2011, the manufacturer issued a technical advisory, ASB Eurocopter AS350-05.00.66, to instruct all parties concerned to periodically inspect the strobe light power supply unit installed in the rear hold, measure the insulation of its wiring, and confirm the strength of its connectors. It also instructed them to prohibit the activation of the strobe lights if these actions were not taken.

The manufacturer modified the design to add a guard to protect of the wiring connected the strobe light power supply and approved by EASA as MAJOR CHANGE APPROVAL 10043337 on January 21, 2013.

5.3 Safety Actions Taken by the Company

Based on the statements of the pilot and the eyewitnesses, and the situation of the rear hold of the Helicopter, the Company considered that the fire occurred because the strobe light power supply or its wiring caught fire for some reason and that the fire spread to the embarkation in the rear hold. Hence, it and prohibited aircraft equipped with a strobe light power supply of the same part number as that for the Helicopter from using its strobe lights and banned the loading of baggage onto the rear hold. Following these actions, in order to cope with the lower visibility of helicopters of the same type from other aircraft, the Company decided to have a mechanic board together as a watch when necessary and require the helicopters to keep the navigation lights and anti-collision lights on at all times and switch on the landing light if it is deemed as necessary.

The Company also decided to prepare specific pre-flight explanations to be given by the pilot to passengers about actions taken in the case of emergency during the inspection of power transmission lines and require the pilot to give explanations to passengers in accordance with these materials.

5.4 Safety Actions Required

5.4.1 Safety Actions Required for the Company

(1) If baggage is loaded in the rear hold, the Company should take measures to prevent the movement of the baggage using net as provided in the Flight Manual in order to preclude an unforeseen event due to the movement of embarkation. When transporting items that fall into the category of explosives and other goods, the Company should do so using the method provided in the standards for the transport of such goods.

(2) The Company needs to establish a system that enables pilots to perform emergency procedures of helicopter swiftly and reliably even in a state of emergency mainly by memorizing those which must be performed immediately.

5.4.2 Safety Actions Required to be Taken by the EASA, Designer and Manufacturer

(1) The EASA should make it mandatory to modify the rear hold of the Eurocopter AS 350 series so that electrical equipment and its wiring are fully protected.

(2) In the Flight Manual, the designer and manufacturer of the helicopter should specify the

memory items among emergency procedures so that they can be performed immediately.

6. RECOMMENDATIONS

6.1 Recommendations Pursuant to the Act for Establishment of the Japan Transport Safety Board

In order to contribute to the prevention of recurrence of similar accidents, based on the result of investigation of the accident, the Japan Transport Safety Board recommends, in accordance with the provisions of Article 27 Paragraph 1 of the Act for Establishment of the Japan Transport Safety Board, that Shikoku Air Service Co., Ltd. give careful consideration to the following and take necessary measures thereof:

(1) Embarkation on board

In this accident, it is possible that since measures were not taken to prevent the movement of embarkation in the rear hold using a floor tie-down net, the embarkation moved during the flight, and then damaged the wiring of electrical equipment in the hold, causing a fire.

When having embarkation in the rear hold of Eurocopter AS350B3, the Company should take measures to prevent its movement using a net as provided in the Flight Manual in order to prevent an unforeseen event due to such movement. In addition, when transporting items that fall into the category of explosives and other goods, the Company should confirm the content of the pronouncement and meet the standards specified therein when transporting such items.

(2) Establishment of a system that enables pilots to perform emergency procedures of aircraft without failure

In this accident, when smoke arose in the cabin, the pilot attempted to perform emergency procedures, but could not do so as stipulated in the Flight Manual because he had not enough time to confirm procedures with the emergency procedure checklist inserted into the knee board and because he did not remember necessary emergency procedures.

The Company should establish a system that enables pilots, when operating aircraft, to perform appropriate emergency procedures of aircraft swiftly and reliably in a state of emergency mainly by memorizing those which must be performed immediately.

6.2 Safety Recommendations

In order to contribute to the prevention of recurrence of similar accidents, based on the result of investigation of the accident, the Japan Transport Safety Board recommends that the European Aviation Safety Agency (EASA) take the following measures:

(1) Electrical equipment and its wiring in the baggage compartment

In this accident, the wiring connected to the strobe light power supply, installed in the rear hold of the Helicopter where a fire occurred, were not protected in a cage or rigid housing.

The airworthiness standards: FAR 27.855(b) stipulates as follows:

(b) No compartment may contain any controls, wiring, lines, equipment, or accessories

whose damage or failure would affect safe operation, unless those items are protected so that:

(1) They cannot be damaged by the movement of cargo in the compartment; and

(2)Their breakage or failure will not create a fire hazard.

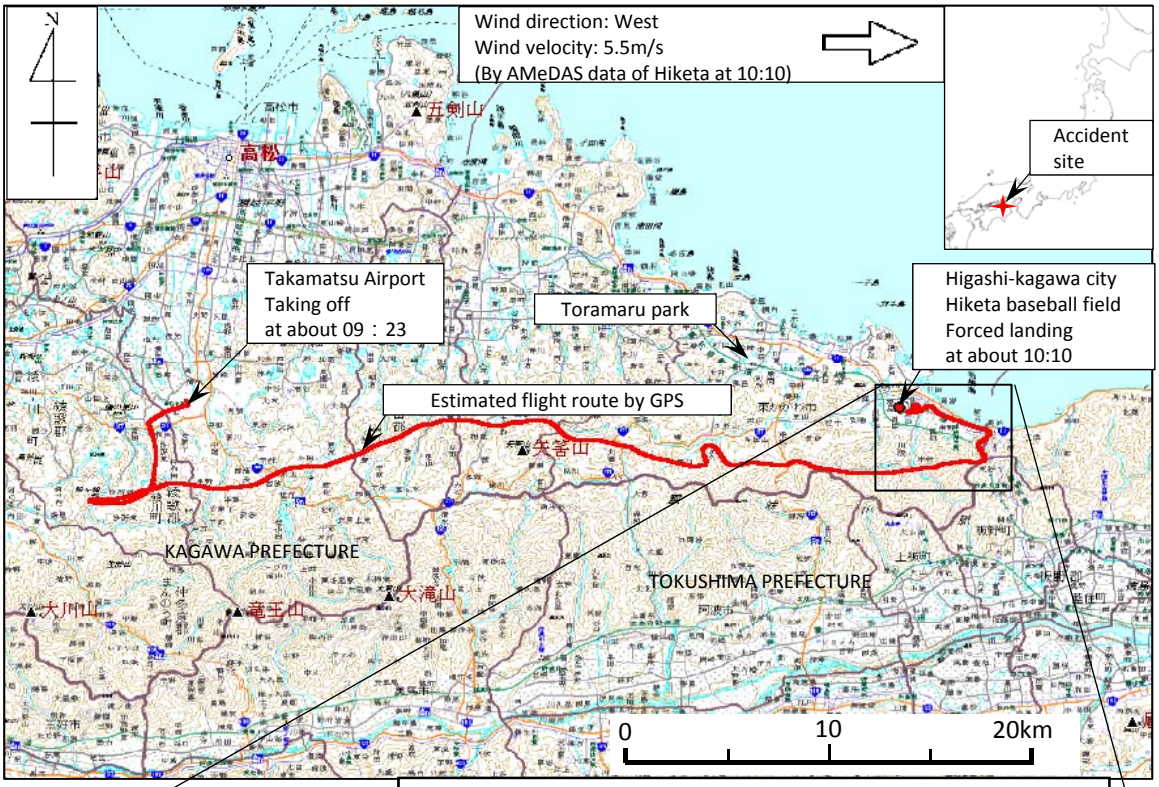
Therefore, the EASA should make it mandatory to modify the rear hold of the Eurocopter AS 350 series so that electrical equipment and its wiring are fully protected.

(2) Manifestation of the matters which must be dealt with immediately by memory among the emergency procedures

In this accident, when smoke arose in the cabin, the pilot attempted to perform emergency procedures of aircraft, but failed to do so as provided in the Flight Manual because he had not enough time to confirm procedures with the emergency procedures checklist inserted into the knee board and because he did not remember necessary emergency procedures. The Flight Manual did not manifest the emergency procedures that must be dealt with immediately.

Therefore, in the Flight Manual of the Eurocopter AS350 Series, the EASA should urge the designer and manufacturer of the helicopter to specify the memory items among emergency procedures so that they can be performed immediately.

Figure 1: Estimated Flight Route



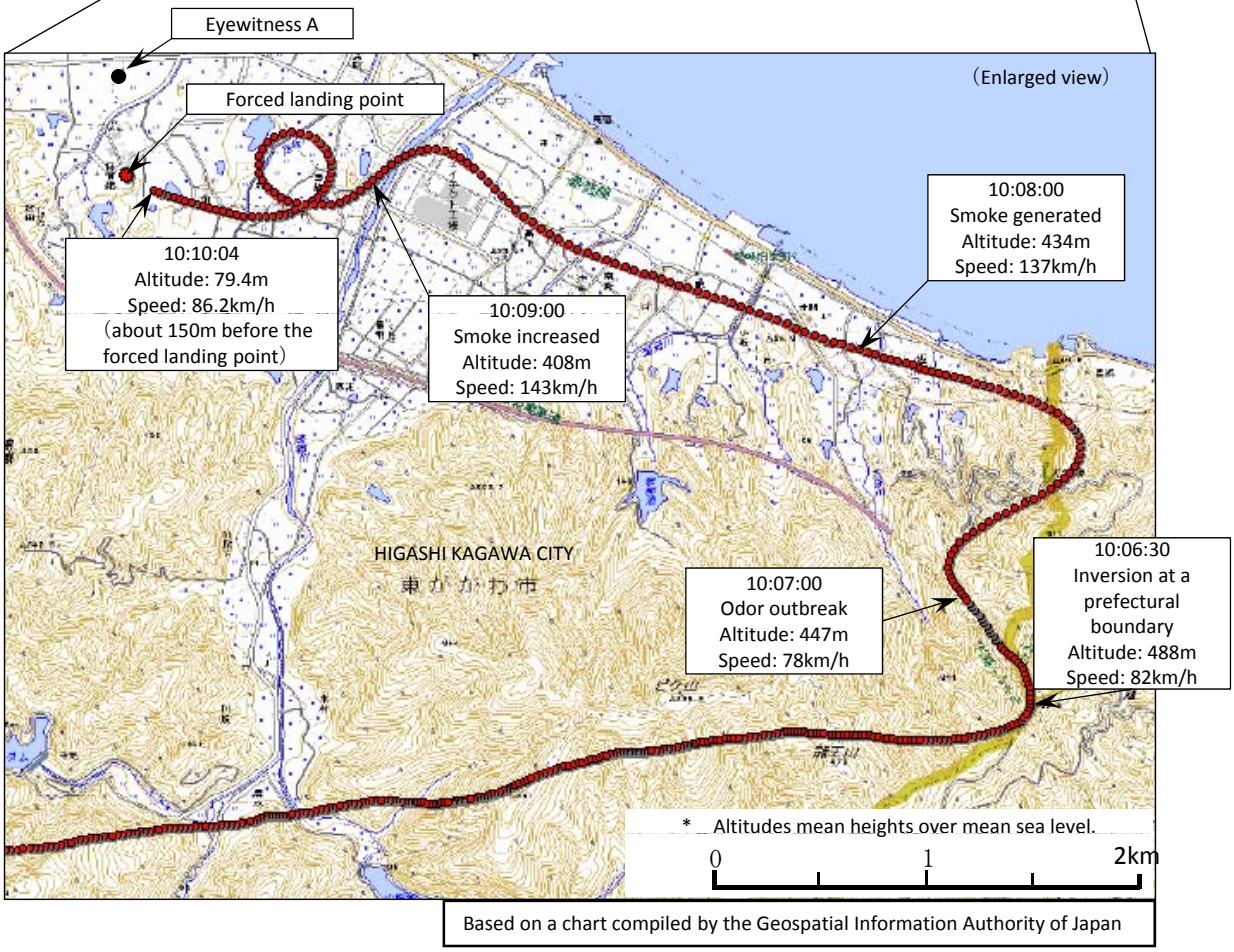


Figure 2: Three Angle View of Eurocopter AS350B3

Unit：m

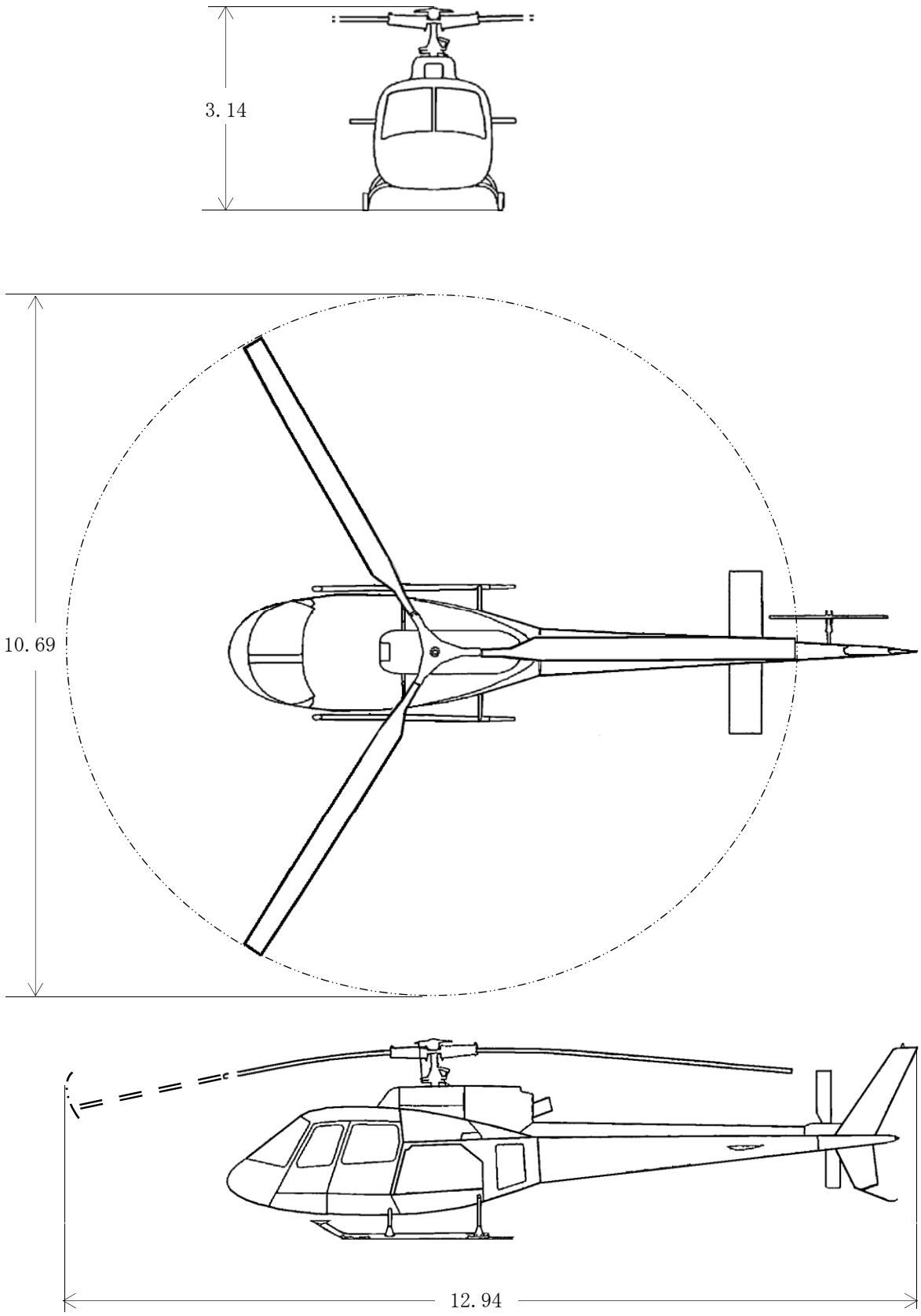
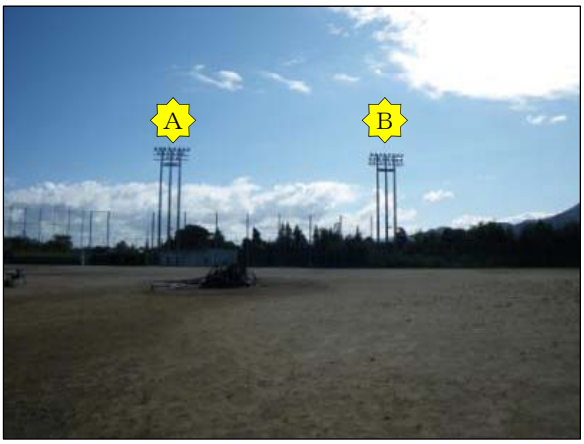


Figure 3: Accident Site Layout

Photo 1

Photo 2



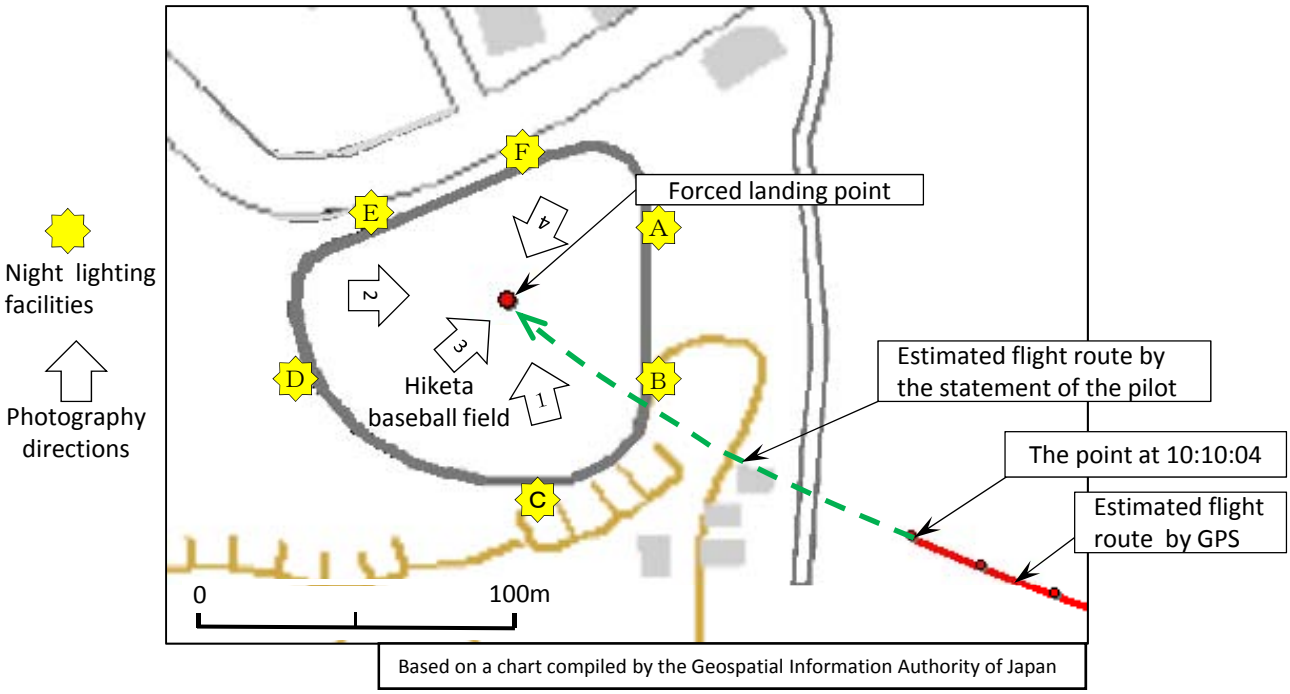


Photo 3

Photo 4