AA2010-9

AIRCRAFT ACCIDENT
INVESTIGATION REPORT

Japan Coast Guard

J A 6 7 1 3

December 17, 2010

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.

Note:

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

Norihiro Goto
Chairman,
Japan Transport Safety Board

AIRCRAFT ACCIDENT INVESTIGATION REPORT

JAPAN COAST GUARD
BELL – 412 (ROTORCRAFT), JA6713
ON THE SEA ABOUT 8km EAST-NORTHEAST OFF IKEMA ISLAND LIGHTHOUSE, MIYAKOJIMA CITY, OKINAWA PREFECTURE, JAPAN
AT ABOUT 19:41 JST, DECEMBER 1, 2008

November 19, 2010

Adopted by the Japan Transport Safety Board

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

1. PROCESS AND PROGRESS OF THE INVESTIGATION

1.1 Summary of the Accident

On December 1 (Monday), 2008, the Bell 412, registered JA6713, operated by the Japan Coast Guard, took off from Ishigaki Airport for patrol and picture-shooting training at about 18:11 Japan Standard Time (JST: UTC+9h, unless otherwise stated, all times are indicated in JST and 24-hour clock). While conducting the picture-shooting training in an area about 8km east-northeast off the Ikema Island lighthouse, Miyakojima City, Okinawa Prefecture, the aircraft ditched and damaged itself at about 19:41.

There were 5 crew members on board, consisting the captain and 4 crew members, but nobody was dead or injured.

The aircraft was destroyed, but there was no outbreak of fire.

1.2 Outline of the Accident Investigation

1.2.1 Investigation Organization

On December 2, 2008, the Japan Transport Safety Board designated an investigator-in-charge and another investigator to investigate this accident.

1.2.2 Representatives and Advisors from Foreign Authorities

An accredited representative of Canada, as the State of Manufacture of the aircraft involved in this accident, participated in the investigation. Although this accident was notified to the United States of America, as the State of Design of the aircraft, the State did not designate its accredited representative.

1.2.3 Implementation of the Investigation

December 3 and 4, 2008	Aircraft examination and interviews
December 5, 2008	Aircraft examination
December 6, 2008	Interviews

1.2.4 Interim Report

On February 26, 2010, an interim report based on the results of the fact-finding investigation up to that date was submitted to the Minister of Land, Infrastructure, Transport and Tourism, and made public.

1.2.5 Comments from Parties Relevant to the Cause of the Accident

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

1.2.6 Comments from the Participating State

Comments were invited from the participating State.

2. FACTUAL INFORMATION

2.1 History of the Flight

On December 1, 2008, the Bell 412, registered JA6713 (hereinafter referred to as "the Aircraft"), operated by 11th Regional Coast Guard Headquarters Ishigaki Air Station (hereinafter referred to as "the Station") adopted by the station, Japan Coast Guard (hereinafter referred to as "JCG") took off from Ishigaki Airport for patrol and a picture-shooting training at about 18:11 and was flying in the area east-northeast of Miyakojima City, Okinawa Prefecture.

The outline of the flight plan submitted to the Tokyo Airport Office was as follows:

Flight rules:	Visual Flight Rules (VFR)
Departure aerodrome:	Ishigaki Airport
Estimated off-block time:	18:00
Cruising speed:	110kt
Cruising altitude:	VFR
Destination aerodrome:	Ishigaki Airport
Total estimated elapsed time:	2 h and 30 min
Fuel load expressed in endurance:	3 h and 30 min
Persons on board:	5

At the time of the accident, the captain sat in the right seat as the PF (pilot flying: pilot in charge of flying) and the copilot sat in the left seat as the PNF (pilot not flying: pilot assisting PF in flying the aircraft[*1]).

The history of the flight up to the time of the accident was summarized below, based on the statements of the captain, copilot and mechanics, as well as the statements of the captain and crew of the Patrol Boat (20m type, hereinafter referred to as "the Boat") registered in Miyakojima Coast Guard Station, Ishigaki Coast Guard Office of JCG 11th Regional Coast Guard Headquarters.

(1) Captain

On the day of the accident, a night patrolling flight and picture-shooting training were planned. On the day, the wind was from the north at 10 to 15kt; visibility was good, and there was no problem with the weather condition. Sunset was at about 18:00 and the age of the moon was about 3. So, I recognized that it was going to be a dark night condition by the time of arrival at about 20:30. We departed the Station at about 18:00 and it was a smooth flight until we reached the Miyako Island area. Since there were no ships sailing around the area and we had a time on our side for our flight, we started to approach a small uninhabited island called Fude-Iwa and began hovering and a picture-shooting training.

The Aircraft's autopilot system (as described in 2.9) provides SAR mode, for a low altitude flight. So, I decelerated to 60kt and descended to 200ft with APPROACH 1 (hereinafter referred to as "APR1") of the auto approach. Then, I selected APPROACH 2 (hereinafter referred to as "APR2") of the auto approach for further deceleration and descent, and then, I shifted to the auto hovering at 100ft.

After that, when I accelerated to 60kt and climbed to 200ft with CLIMB of the

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*1 "pilot not flying: pilot assisting PF for flying of the aircraft" is extracted from the statement described in the Aircraft Operation Manual (Bell 412) of JCG.

autopilot and broke out of the approach, I saw a ship at 2 to 3nm away. In addition, there were no boats and ships sailing around the area other than the ship which I saw.

On the accident day, I already knew that the Boat had been on a night patrol mission by the time of the Aircraft's takeoff. So, I contacted the Boat by radio and confirmed the present location of the Boat before we start picture-shooting training of Fude-Iwa during the flight. Therefore, when I saw the ship, I confirmed by radio once again that the ship was the Boat itself, and agreed with the Boat that we approach the Boat and carry out the picture-shooting training. Just like the approach to Fude-Iwa, when I approached the back-left of the Boat with the autopilot and tried to decelerate with the speed of the Boat, the Boat changed its course by 90 degrees to the left. Thus, I aborted the approach and broke out with CLIMB. I requested the Boat to maintain its course to the northerly direction and decided to start an approach again. It was about 19:38 and I realized that there was no enough time left before the arrival time. So, I think I was getting nervous. When I approached the back of the Boat again, I made a small turn without enough downwind distance because I was getting concerned that the time was running out. While I made a final turn at 200ft with 60kt, I saw lights on the Boat and its white bridge in lighting by the searchlight looked like halation. From this distance, I judged that there was no enough distance to shift to hovering at the backside of the Boat by continuing the autopilot.

I wanted to decelerate the Aircraft by adding manual control, so I pulled the nose up and lowered the collective lever down slightly while pushing the FTR button on the cyclic stick and the collective lever. As I had already checked that RADIO ALT (an automatic altitude maintaining control using radio altimeter measurements, hereinafter referred to as "RADALT") was on during the base turn, I instructed the copilot to turn on VELOCITY HOLD (an automatic speed maintaining control using Doppler speed measurements, hereinafter referred to as "VELHLD") in order to maintain reduced airspeed. In the corner of my field of vision, I saw the copilot pushing the switch and I received "VELHLD on" call. But, if I think now, it appeared that the copilot was looking down for a relatively long period of time at the center pedestal installed with these autopilot switches and a display panel after the call "VELHLD on".

I remember that, since I vaguely felt something unusual while decelerating, I lowered the nose down and pulled the collective lever up to increase the power to start a break out maneuver. There were splashes of down blow winds (hereinafter referred to as "the Down wash") generated by the main rotor (hereinafter referred to as "the MR"), I felt by intuition that the altitude must have fallen to about 30ft with the airspeed reduced. In addition, while I was trying to recover the Aircraft's attitude by raising the collective lever and maintaining the cyclic stick around what is believed to be the hovering position, the Aircraft dived into the splashes at the next moment. Because of the halation induced by the searchlight and other lights. I felt like being inside a white ball and could not see the horizon. While having no sense of the attitude or the altitude, I felt a "bang" impact from the bottom and heard something had broken. I felt only a very short interval between the time when the helicopter started descending and the time when it ditched, after seeing the splashes and noticing the low altitude and the low speed. Because we

were initially flying at 200ft, I believe that the rate of descent was considerably high.

As we ditched, I pulled a lever to inflate emergency floats (gas-inflated floats which are installed in the landing gear, hereinafter referred to as “the Floats”) and the Floats were inflated. There was no feeling of the rotor rotating but instruments indicated the engines were running, and the engine fire warning lights were not illuminated. I heard a “fire” call by the mechanic at the aft seat, so I instantly pulled the fire-extinguishing handles. As a result, the engines stopped and the inside of the Aircraft became quiet.

The Aircraft inclined slightly to the left after ditching. The correspondent at the aft seat made a request for rescue to the Boat, and the mechanic and other crew on board took out a lifeboat from the right cabin door and inflated it. I was at the right pilot’s seat, while all other crew members moved to the right cabin of the Aircraft. At that time, the center float of the three floats attached to the right skid ruptured. So the crew members moved to the lifeboat through a right cabin door. The right front float ruptured later while I was finally trying to get onto the lifeboat. The Aircraft started leaning to the right just after I moved to the lifeboat. After that, the Boat arrived and our lifeboat was carried into the Boat.

After we were rescued, I heard from the copilot that RADALT was off when he turned VELHLD on. I tried to push the FTR button located in the middle of the cyclic stick to add the manual control, but I might have momentarily pushed a standby button on the top of the cyclic stick before pushing the FTR button. The standby button is used for canceling all modes set by the autopilot, and this means RADALT will be turned off.

I have rarely pushed the standby button instead of the FTR button by mistake, while I operated buttons during ground function checks and during flight

(2) Copilot

A pre-flight briefing started at 17:40 confirming the weather and the condition of the Aircraft as well as points for our monitoring duty. The captain and I made the pre-flight inspection of the outside of the Aircraft. The engine started normally and the Aircraft departed with no problems. After the picture-shooting training toward Fude-Iwa, we started the same training toward the Boat because we found it near Fude-Iwa. We made an approach in the same manner as we did toward Fude-Iwa, and I believe that as for the hovering altitude, RADALT was set to 100ft. While we were approaching the hovering point, the Boat changed its course to the left. So we aborted the approach and climbed to 200ft with 60kt using CLIMB and broke out. We requested the Boat to redirect to the north and asked the Boat to slow down, and we approached again with autopilot. The Aircraft started to descend from 200ft and I was able to see the Boat clearly by the searchlight although the horizon was not in my sight. Judging from the visibility of the Boat, I thought that the altitude was at least 150ft. By the time when the Aircraft appeared to have caught up with the Boat, the Aircraft became nose up by the captain’s control and the Boat got out of my sight from the left seat.

When the Aircraft took an attitude for decelerating, I received the instruction “VELHLD” from the captain, so I turned on the switch on the center pedestal. At this

stage in which the Aircraft shifts to hovering on autopilot, RADALT on the center pedestal is usually “ON”. However, I noticed that RADALT was not “ON”, so I paid a closer attention to it. When I am watching the panel of the center pedestal, I cannot see the altimeter because it is on the instruments panel. I saw water splashes when I looked up to confirm with the captain that RADALT was not “ON”, and I have to turn on RADALT. The indicator of the barometric altimeter on the instruments panel in front of my face was indicating almost an upright direction near “zero (0)”. I saw the Boat ahead and I felt an impact and at the same time, we ditched with splashes. I believe that the MR blades hit the sea surface immediately after ditching. There was no sound from the top of the Aircraft because MR appeared to have stopped rotating. Only the running sound of the engine was heard.

Soon after the Aircraft ditched, we said to each other “Are you all right?” The Aircraft was floating stably until just before the floats burst.

(3) Mechanic

There were no malfunctions until the Aircraft ditched.

In the first approaching training toward the Boat, we aborted and broke out with CLIMB.

I visually checked the instruments to confirm that RADALT and IAS (an automatic speed maintaining control using an air-data sensor measurement) were set automatically by selecting CLIMB with 60kt and 200ft maintained. I was in charge of operating the searchlight at the aft seat. When I lit the searchlight on the Boat, I felt that the approach distance was short. We had a conversation saying “the distance is approximately 0.8nm”. As there were no particular instructions from the captain about my operation of the searchlight, I moved the searchlight downward and continued tracking the Boat. In my feeling, I thought that the Aircraft’s nose up to decelerate was excessive. When I looked ahead to check the instruments, the front area of the Aircraft had got white-bright because of the halation effect, and I felt a “banging” impact shortly after a minor impact. But there was no shaking or major impact. I felt that we ditched as I heard sounds with the floats inflated. I heard a voice “fire” from the flight crew in the aft cabin, who may have seen a light around the engines. Thus I informed the captain and the copilot so. As far as I saw, the engine fire warning lights had not turned on. A hydraulic pump stuck out of the ceiling of the cabin. The right door of the Aircraft was able to open smoothly and all the three floats on the right side were inflated. Once after we took out a lifeboat and inflated it, I leaned out from the cabin and took a look at the MR hub on the upper side of the Aircraft with a portable light. Two of the four blades were missing. One blade of the two remaining blades was bent in the middle, and nothing but the root of the other blade remained. I thought the blades would have hit the sea surface. Because the transmission was displaced forward, I thought that the drive shaft would have broken apart and the tail rotor (hereinafter referred to as “the TR”) would have stopped. When I looked at the tail of the Aircraft, the TR blades had retained their shape. The skylights above the cockpit were broken.

(4) The Captain and a Crew member of the Boat

The Boat received an inquiry about its actual position from the Aircraft by radio while sailing east of Miyako Island to the north. We found a light from the Aircraft ahead in the north direction. As we were told that the Aircraft would conduct a close distance picture-shooting training, the Boat was lit by the searchlight from the Aircraft overhead. When we changed the course to 270 degrees because we came to the point to change the course to the west, we received a request from the Aircraft by radio to slow down the Boat and maintain the direction to the north. When the Boat reset the speed to 8kt and redirected the course to the north, the Aircraft flew from a position above the Boat to a position 1nm ahead of the Boat and it turned to the left and flew to behind the Boat. When I went to the deck and looked at the left aft, I saw the searchlight, which the Aircraft lit, coming toward the Boat. So I recognized that the Aircraft was chasing the Boat from behind. A few seconds later, the Aircraft quickly descended and then, it appeared to be keeping an altitude just above the sea level. Soon after that, the lights of the Aircraft were in and out of the shadow of the waves and they were not moving, so I judged that the Aircraft ditched. The distance to the point was about 1nm and it was about 19:41.

At about 19:43, we received a rescue call from the Aircraft by radio with a message that all the members on board were safe. The Boat went for rescue immediately and at about 19:45, when we got as close as 50m to the accident site and lit the Aircraft, we saw it drifting on the floats and a lifeboat floating at the right side of the Aircraft. After that, a float on the right ruptured and after the last person jumped onto the lifeboat, we saw the Aircraft inclined to the right and overturned.

At about 19:50, the Aircraft rolled over and fully submerged under water with its parts of the floats and skids floating on the sea surface.

There was no other ship sailing nearby besides the Boat.

The accident occurred at about 19:41, on the sea about 8km east-northeast off the Ikema Island lighthouse in Miyakojima City (Latitude 24°57'48" N, Longitude 125°18'42" E).

(See Figure 1 Estimated Flight Route, Figure 2 Three Angle View of Bell 412, Figure 3 Float Equipped Location, Photo 1 Accident Aircraft (Just after Ditched), Photo 2 Accident Aircraft (Transporting on Ishigaki Port), Photo 3 Cyclic Stick, Photo 4 Instruments Arrangement of the Same Type and the Same Equipped Aircraft)

2.2 Injuries to Persons

There was no dead or injured person.

2.3 Damage to the Aircraft

2.3.1 Extent of Damage

Destroyed

2.3.2. Damage to the Aircraft Components

MR blades: Broken

Transmission supporting structural parts:	Broken
Main drive shaft and TR drive shaft:	Broken
Tail boom and elevator:	Damaged
Fuselage:	Damaged
Floats:	Damaged

2.4 Personnel Information

(1) Captain	Male, Age 42
Commercial pilot certificate (Rotorcraft)	March 30, 1993
Type rating for Bell 212	March 30, 1993
Class 1 aviation medical certificate	
Validity	March 7, 2009
Total flight time	3,668 h 33 min
Flight time in the last 30 days	17 h 20 min
Total flight time on the type of aircraft	970 h 15 min
Flight time in the last 30 days	15 h 20 min
(2) Copilot	Male, Age 37
Commercial pilot certificate (Rotorcraft)	
Type rating for Bell 212	December 24, 2002
Class 1 aviation medical certificate	
Validity	June 3, 2009
Total flight time	875 h 03 min
Flight time in the last 30 days	1 h 55 min
Total flight time on the type of aircraft	141 h 50 min
Flight time in the last 30 days	1 h 55 min

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2.5 Aircraft Information

2.5.1 Aircraft

Type	Bell 412HP
Serial number	36052
Date of manufacture	April 29, 1992
Certificate of airworthiness	*Tou-Dai*-20-396
Validity	November 24, 2009
Category of airworthiness	Rotorcraft, Transport TA, TB or Special X
Total flight time	7,455 h 15 min
Flight time since last periodical check (1A Check on November 27, 2008)	13 h 50 min

(See Figure 2 Three Angle View of Bell 412)

2.5.2 Weight and Balance

When the accident occurred, the Aircraft's weight was estimated to have been 10,573lb and the center of gravity was estimated to have been 138.76in in longitudinal direction and 0.15in left in lateral direction, both of which were estimated to have been within the allowable range (maximum

takeoff weight of 11,900lb, and 133.0 to 142.5.0in in longitudinal direction, 4.5in left to 4.5in right in lateral direction of range of the center gravity corresponding to the weight at the time of the accident).

2.6 Meteorological Information

According to the observation records of the Boat, meteorological phenomena and marine phenomena at about 20:30 of the day of the accident were as follows:

Weather Fine, North wind 5m/s, Wave height 0.5m, Heave None,
Visibility Good

2.7 Information about the Accident Site

2.7.1 Condition of the Accident Site

The accident site was located on the sea about 8km east-northeast off the Ikema Island lighthouse in Miyakojima City. While there were city lights of Miyakojima about 7km southwest, there was no light in other directions except for the Fude-Iwa lighthouse located 5km northeast.

The time of sunset around the accident site on the day of the accident was 17:49, the age of the moon was 2.9, the time of moonset was 20:39, and the direction of moonset was west-southwest. (See Figure 1 Estimated Flight Route, Photo 1 Accident Aircraft (Just after Ditched))

2.7.2 Details of the Damage

On December 2, at about 16:00, the Aircraft was salvaged from the sea as being rolled over and it was rested on a salvage barge with a crane. The Aircraft was transported on land to the Station after unloading from the salvage barge and turning over from the rollover condition.

(1) MR blades

Two MR blades among the four blades were separated from the hub and any pieces which can be identified as those of these two blades were not recovered.

The other two blades were broken and one of them was fractured.

(2) Transmission

The supporting structure part of the transmission was broken and, together with the MR mast and the flight control system, tilted and displaced forward.

(3) Main drive shaft and the TR drive shaft

The main drive shaft located behind the transmission was separated from the transmission. The TR drive shaft located also behind the transmission was fractured at a front part where the tail boom is attached to the fuselage.

(4) Tail boom and Elevator

There was a gap in the lower part of the portion where the tail boom was attached to the fuselage. The left elevator was damaged but the right elevator was not. There was no damage in the TR.

(5) Fuselage

The skylights of both right and left pilot seats were broken. In addition, there was damage like dents made during the crane lifting operation to transport the Aircraft.

(6) Engines

There was no trace of fire in engines.

(7) Floats

On the front and middle floats of the right side were partially torn and holed.

2.8 FTR Button and Standby Button

The FTR button is used to change the attitude of the aircraft with manual control by temporarily disengaging FLIGHT DIRECTOR (hereinafter referred to as “the FD”) MODE, which is controlled with autopilot, while the button is pushed. The FTR button for the pitch and roll system is located near the center on the left side of the cyclic stick so that it can be pushed with a thumb while holding the stick. The FTR button for the collective and pedals control system is located in the upper part of the collective lever, therefore it can be pushed with a thumb while holding the collective lever. When the FTR button is released, it returns to the autopilot.

A standby button is used to cancel all FD modes of the autopilot which are set at that time. It is located in the upper part of the cyclic stick, therefore it can be pushed with a thumb while holding the stick.

The Aircraft is equipped with no annunciator light or sound device which works when the standby button is pushed and the FD mode of autopilot is canceled.

The Aircraft usually operates using the FD mode of autopilot during the night flight except for takeoff and landing. The FTR button can be pushed while flying on autopilot, but the standby button is not usually pushed except for takeoff and landing with all canceled FD modes of autopilot.

(See Photo 3 Cyclic Stick)

2.9 Additional Information

The Aircraft Operations Manual (hereinafter referred to as “the Manual”) of JCG has been made based on the Flight Manual to provide duties, procedures and guidelines for crew when JCG operates aircraft and carries out its duties.

According to JCG, the Manual is characterized as follows:

> The manual is to establish standard procedures for flight operations and duties with basic points provided. In actually, the points in the Manual may allow for broader applications than described in the Manual to take timely and appropriate responses to various conditions such as the condition of marine accident, the aircraft weight, the meteorological phenomena and marine phenomena, and the obstacles around the site where an aircraft does hoist mission.

The Manual (Bell 412) includes the following descriptions. (Excerpt)

3-13-1 AUTOPILOT

(Omitted) *Two autopilot systems have two different basic modes as follow:*

(1) ATT (ATTITUDE RETENTION)

: To provide control stability for a long time in hands-off flights or in flights with FD coupled.

(2) SAS (STABILITY AUGMENTATION SYSTEM)

: To reduce the work load of manual controlled flights for a short period of time.

AP engagements are: ① AP1 AP2 ———— BOTH ON

② SAS / ATT ———— ATT

③ FD SEL ———— FD2 (M/P sides)

1. ATTITUDE RETENTION

ATT MODE is a mode to maintain an attitude of an aircraft on the pitch, roll and yaw axes, and to be basically used in the hands-off flights by a pilot. It detects the pitching and rolling attitudes by vertical GYRO, whose difference from the engaged attitude activates the linear actuator to set the attitude back to the original attitude.

(Omitted)

There are two attitude variation commands in ATT mode: CYCLIC 4-WAY BEEP S/W and manual controls of the stick by pushing the FTR SW.

(2) Pushing the FTR button

This is most effective in making a big attitude variation. When changing the attitude with this method, one shall keep pushing the FTR button on CYC until flying of the aircraft in the new attitude.

During the use of the FTR button, one can release the magnetic brake on the force trim temporarily, and freely move the control stick (Omitted)

3-13-4 FLIGHT DIRECTOR MODES

10. INDICATED AIRSPEED HOLD MODE: IAS

c). (Omitted)

(NOTE)

(Omitted) *The indicated speed is a value of the signal from the air-data sensor and is slightly different from an indication of the airspeed indicator.*

16. RADIO ALTITUDE HOLD MODE: RADALT

Used to maintain the RA on an aircraft of four-axis autopilot equipped. (Omitted)

(1) How to use

a) Push the RADALT button on the AUTOPILOT CONTROLLER.

b) (Omitted)

(NOTE)

The RADALT mode is incorporated beforehand when any of the SAR modes is engaged.

17. VELOCITY HOLD MODE: VELHLD

When the VELHLD mode is engaged on an aircraft four-axis autopilot equipped, one shall maintain the speed below 60kt and adjust the speed in the longitudinal and horizontal directions for low-altitude flights and hovering.

The performance and procedures of the mode depend on the validity of the Doppler as well as the accelerometer equipped in the aircraft.

(1) How to use

Push the VELHLD button on the AUTOPILOT CONTROLLER.

(NOTE)

② *If there is no Doppler or a Doppler is invalid, VELHDL automatically uses the accelerometer equipped on the aircraft to control the speed.* (Omitted)

(2) How to change the speed indication in the horizontal or longitudinal directions

(NOTE)

① *The speed indication on the Doppler*
Front direction: 60kt, horizontal and back directions: limited to 10kt

② *The operation of the VELHLD mode is programmed when APR2 or MOT on SAR mode engaged.*

3-13-5 SAR OPERATION

4. SAR DAFCS & MODE OF OPERATION

Types of the SAR MODES are consists of as follow:

a) APPROACH STAGE 1 (APR 1)
b) APPROACH STAGE 2 (APR 2)
c) MARK-ON-TARGET (MOT)
d) AUTOMATIC CLIMBOUT (CLIMB)

(1) APPROACH STAGE 1 (APR 1)

APR1 automatically makes a level-linear descent to 200ft (RA), at the same time slowing down to approximately 60kt, and sets the HDG MODE to ON with the speed maintained at 60kt and changes to a given course.

It is used in making initial approach to ships. After that, one shall make an aircraft's heading directs to the wind by using the HDG BUG, and shift to hovering by applying the AP2, stated below, when shifting to hovering investigation.

e) Points of attention in APR1 operations

(NOTE)

5. The heading can be changed by turning on the HDG switch on the mode selector and by selecting the desired heading with the heading control. It can also be changed manually by using the cyclic beep on either side.

(2) APPROACH STAGE 2 (APR 2)

In APR2, an aircraft makes a level-linear descent to the RA selected by a pilot and slowly decelerates to a ground speed of 0kt. APR2 will not necessarily be used after APR1 is in use. (APR2 mode will be activated when the engage requirements are met at the start.)

When the APR button is pushed based on the current altitude and the speed of an aircraft, the mode is activated to meet the requirements of each mode.

a) Requirements to engage the APR2 mode

① *The RA must be between 20 and 250ft.*
② *The speed must be between 0 and 65kt when the Doppler is valid.*
③ *The speed must be between 55 and 65kt with the Doppler is invalid.*

(4) CLIMB MODE

CLIMB MODE is used to automatically climb from hovering. When this mode is engaged, the helicopter ascends to 200ft at 60kt speed.

d) Points of attention in CLIMB operations

③ *At the start of the CLIMB mode, the aircraft shall be set back to maintain the 200ft RADALT and 60KIAS.*
④ *Check CLIMB indication on EADI.*

a. When the aircraft reaches 60KIAS, the IAS maintaining mode is engaged.

b. When it reaches 200ftAGL, the RADALT mode is engaged.

7-2-6 Outlines of the Flight Control System

1. CYCLIC STICK CONTROL

(Omitted)

The FORCE TRIM REL BUTTON is to be on the left side (Omitted) of the control stick (Omitted)

7-10-3 DIGITAL AUTOMATIC FLIGHT CONTROL SYSTEM (DAFCS)

2. MS-700 FLIGHT DIRECTOR MODE SELECTOR

(12) SBY (STAND BY) MODE

When this button is pushed, all the FD modes will be canceled to set to the standby status.

8-2-2 Guidelines on low-altitude flights

4. Normal operation procedures

The operation procedures on AP are primarily defined.

(6) Compliance with the callout provision

The PF shall steadily call the used mode and its captured and engaged status while the PNF calls out and checks the mode.

8-2-3 Guidelines on night flights

1. General information (on night flights)

(4) The minimum hovering altitude for picture-shooting activity during a night patrol flight shall be 100ft if visual cues like lights are available to ensure the horizontal attitude (Omitted)

(5) In principle, the autopilot system shall be used when the outside-view information is not available to maintain the horizontal attitude by the visual cues like horizon or the lights of ships during a night flight.

4. Normal operation procedures

In principle, a flight shall be done on AP.

(Omitted) *It is in accordance with the normal operation procedures for low-altitude flights.*

(3) Descent to low altitudes

a) The captain shall inform the copilot about the level-off altitude when descending to low altitudes from the cruising altitude, including hovering for ships investigation.

b) The copilot shall call out the indication on the radio altimeter like 500, 400, 300, 200, 150, 100, 75, and 50ft, when the captain starts descending to lower altitudes and passes 500ft.

c) The captain shall instruct the copilot to turn on the landing light and to adjust the lighting angle if the aircraft reaches the altitude at which a landing light could be expected to adequately light the sea surface, based on the altitude and the conditions of the atmosphere when descending to lower altitudes.

(4) Approach to ships

a) When approaching ships to investigate it during a night flight, it shall make an approach with a greater distance than taken during the daytime flight while visually watching the sea surface.

b) When approaching ships, the aircraft shall irradiate the beams of the landing light at the sea surface and keep the altitude distance, based on the reflections from the sea surface and the lights from the boat.

A searchlight shall be used with care in lighting the sea surface, because it may cause halation and dazzle the eyes.

3. ANALYSIS

3.1 The captain and the copilot had both valid airman competence certificates and valid aviation medical certificates.

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

3.3 Relations to Meteorological Condition

It is considered highly probable that the weather condition at the time of the accident did not have any relations to the occurrence of the accident.

3.4 Disengagement of the FD mode on Autopilot

According to the statements in 2.1, when the captain made a second approach on autopilot, he had confirmed the setting of RADALT at base turn while the copilot had been aware of RADALT being disengaged before the Aircraft ditched. The captain also stated that he had possibly pushed the standby button by mistake and that he had very occasionally pushed also by mistake the standby button instead of the FTR button while operating buttons during ground function check and during flight. As described in 2.8 and 2.9, RADALT is functionally canceled when the standby button is pushed.

Based on the above mentioned points, it is considered highly probable that the captain momentarily pushed the standby button on the cyclic stick by mistake when he tried to push the FTR button for the pitch and roll system on the same cyclic stick in an attempt to disengage the FD mode on autopilot temporarily to add manual control.

3.5 Captain's Control by Adding Manual Control and Altitude Confirmation

Based on the descriptions in 2.7.1, the accident occurred one hour and fifty minutes after sunset, with the moon age of 2.9, and about one hour before the moonset in the direction of west-southwest. Regarding the north direction, toward the approach heading to the Boat, it is considered highly probable that the horizon was not visible, as the copilot stated, and the night flight made it difficult to confirm the altitude by outside landscapes.

Judging from the statements in 2.1 and the descriptions in 3.4, the captain was not aware that he had pushed the standby button and canceled the FD modes in his control involving the autopilot system. Therefore, it is considered highly probable that he instructed the copilot to set VELHLD in order to release the FTR button and set it back to RADALT after he manually controlled to override the deceleration of the Aircraft while pushing the FTR button.

As stated in 2.1(1), regarding the point that the captain had been unaware of the lowered altitude until the water splashed by the Downwash as he was decelerating and descending on manual control, it is considered probable that he misjudged from the visibility of the distance toward the Boat due to the following reasons:

(1) As stated in 2.1(1), although the captain was clearly in visual contact with the Boat during deceleration and descent, it is considered highly probable that there were no other clearly visible objects in a situation where confirmation of the altitude by outside landscapes was difficult at night.

(2) As stated in 2.1(1), the captain stated that he was in a condition close to halation by the

searchlight. Therefore, it is considered probable that the degree of the halation became strong because of the lowered altitude, and his eyes were dazzled.

The captain stated that the water splashes by the Downwash made him realize the lowered altitude, and he tried to pull the collective lever up to recover the attitude of the Aircraft. Therefore, it is considered highly probable that the Aircraft was in a heightened halation by the splashed water, which made it even more difficult to confirm the altitude by outside landscapes, and the captain pulled up the collective lever, but failed to prevent the Aircraft from descending before it ditched.

3.6 Cooperative Operation between the Captain and the Copilot

(1) Call by the Captain

As described in 2.9, the Manual for the operation procedures in low-altitude flight describes “PF shall steadily call the used mode and its captured and engaged status while PNF calls out and checks the mode”. Judging from the statements in 2.1, it is considered probable that the captain, who was PF, did not make a call for this operation when he tried to disengage the autopilot to add manual control temporarily.

When PF pushes the FTR button to disengage the autopilot to add manual control temporarily, such as operating like an approach to the Boat on the sea at night, it is desirable for PF to make a call so that PNF and other crew members can confirm adding manual control.

(2) Callout by the Copilot for the Altitude

As described in 2.9, the Manual for the operation procedures in low-altitude flight describes “The copilot shall call out the indication on the radio altimeter like (omitted) 150, 100, 75, and 50ft, when the captain starts descending to lower altitudes (omitted)”. Judging from the statements in 2.1, it is considered highly probable that the copilot did not call out the indication on the radio altimeter in a final approach to the Boat.

The copilot needed to call out for the altitude to prevent the Aircraft from making an unintended ditching by affirming the altitude in a proper cooperation between the captain and the copilot.

Regarding the point that the copilot did not call out, judging from the statements in 2.1(2), it is considered probable that the copilot thought RADALT had been set to 100ft, but visually made sure RADALT was not “ON” when he turned on “VELHLD” switch on the center pedestal on instructions from the captain, and that while he tried to confirm with the captain that RADALT was not “ON” and it was to be turned on, he missed the opportunity to check the altitude by the radio altimeter on the instruments panel.

3.7 Descent of the Aircraft

As stated in 2.1(1), the captain tried to decelerate by pulling up the nose of the Aircraft slightly and lowering down the collective lever also slightly, during which he vaguely felt something unusual while decelerating. He also stated that he felt the Aircraft ditched in a very short period of time after the start of the decelerating operation and that he thought it must have been a considerably steep rate of descent. In 2.1(3), on the other hand, the mechanic stated that he directed the searchlight downward to follow the Boat, but he felt the nose up of the Aircraft was bigger than normal for deceleration.

Judging from the above points, it is considered probable that the captain mistakenly recognized the nose of the Aircraft as being not in the “UP” position, in view of the beam of the searchlight, which was not directed upward as he pulled the nose up during the deceleration operation, and that he continued pulling the cyclic stick aft, consequently forcing the Aircraft into an unintended excessive position with its nose up and causing it to lose speed and descend.

3.8 Decision whether to Continue the Training

As stated in 2.1, when the Aircraft made a second approach after the Boat changed its course during the first approach, it made a small turn without enough downwind distance. Therefore, the captain found the distance was not enough to shift to hovering by continuing on the autopilot, and he added manual control to decelerate. With regard to the small turn, he stated that he felt impatient after realizing there was no enough time left before the expected time of arrival.

It would have been necessary for the captain to decide whether the training should be continued when he realized he did not have much time.

3.9 Damage Process of the Aircraft at Ditching

Judging from the statements in 2.1, it is considered highly probable that the Aircraft had been flying normally until ditching and that it had no malfunctions.

Judging from the statements in 2.1 and the details of damage on the Aircraft described in 2.7.2, it is considered highly probable that it sustained damage at ditching in the following sequences:

(1) The rotating direction of the MR blades, which was damaged, was rotated in a counterclockwise as viewed from above of the Aircraft. The supporting structure part of the transmission was damaged, and together with the MR mast, tilted and displaced forward. The elevator on the left was also damaged. Based on these findings, it is considered highly probable that, when the Aircraft ditched in a position tilted to the left, its supporting structure part of the transmission was damaged, and then tilted and displaced forward together with the MR mast, due to the reaction force generated when the MR blades hit the sea surface on the left side and resulted in a sudden stop.

(2) Judging from the transmission being tilted and displaced forward, it is considered highly probable that because the main drive shaft was separated from the engines and the transmission stopped rotating, the MR stopped rotating, and in the same time, the TR drive shaft fractured and the TR stopped rotating. Additionally, judging from the stopped rotation of the rotor, it is certain that, as stated in 2.1, there were no abnormal vibrations or impacts generated by rotation of those.

(3) Judging from the statements in 2.1 and the descriptions in 2.7.2, with regard to the engines that is considered highly probable to have been separated from the transmission, it is considered highly probable that the engines continued running until the stop operation after the Aircraft ditched, and that no fire broke out.

3.10 Rupture of Floats and Evacuation

Judging from the statements in 2.1, it is considered highly probable that with the floats inflated when the Aircraft ditched, it was almost stably floating on the sea until the floats ruptured.

As stated in 2.1 and described in 2.7.2, it is considered highly probable that the Aircraft suffered damage at ditching and the pieces of its damaged parts were floating around it. Therefore, it is considered probable that contacts with these fragments punctured holes in the floats.

As stated in 2.1, it is considered highly probable that all of the crew members successfully took to the lifeboat during the period between the rupture of the floats after the Aircraft's ditching and its turnover on the sea, because no one was injured by the impact from the Aircraft's ditching, and because the crew members were quick to get out of the lifeboat and to make preparations for evacuation after ditching.

If an aircraft ditches, one must confirm the condition of injured persons and whether there is a fire, as well as the condition of the airframe and the sea surface, and make swift preparations and proper judgments for evacuation. These steps were properly implemented in the accident.

4. PROBABLE CAUSES

It is considered highly probable that the accident occurred when the Aircraft descended and ditched as it shifted to hovering in a low-altitude flight with its MR blades hitting the sea surface, whose impact damaged its airframe, while it was conducting a picture-shooting training toward at the Boat on the sea at night.

It is considered probable that the Aircraft descended and ditched because the captain did not recognize the descent of the Aircraft in a timely manner due to his misjudgment from the visibility of the distance toward the Boat in a situation where confirmation of the altitude by outside landscapes was difficult at night, and due to the insufficient cooperation between the captain and the copilot in confirming the altitude.

5. ACTIONS TAKEN

Following the accident, JCG took the following measures:

(1) Reconfirmation of the Manual

On December 2, 2008, JCG provided instructions on necessary guidance on safe flights including reconfirmation of the Manual.

(2) Revision of the Manual (Bell 412)

In order to enhance measures of safe operations for the aircraft belonging to JCG, it decided to include the following items, which had not been clearly defined, in the previous manual, and revised the manual on February 23, 2009, and conducted trainings to make sure steady compliance to the Manual.

① Informing of the switching of the autopilot control system
② Standardizing deviation calls and clarifying takeovers
③ Thoroughly conducting mission checklist and pre-flight briefings
④ Clarifying the division of roles among crew members in low-altitude flights
⑤ Preparing notes which must be observed when using searchlight at low altitudes during the night

(3) Safety guidance for the aviation personnel across the country

On March 31, 2009, JCG provided the following instructions for the aviation personnel across the country regarding the safety measures following this accident.

① Recognition of vertigo and reconfirmation of measures to be taken when it happens
② Reconfirmation of emergency operations procedures and emergency evacuation procedures
③ Promotion of monitoring operations by managers and others in compliance with the Operation Manual

Figure 1　Estimated Flight Route

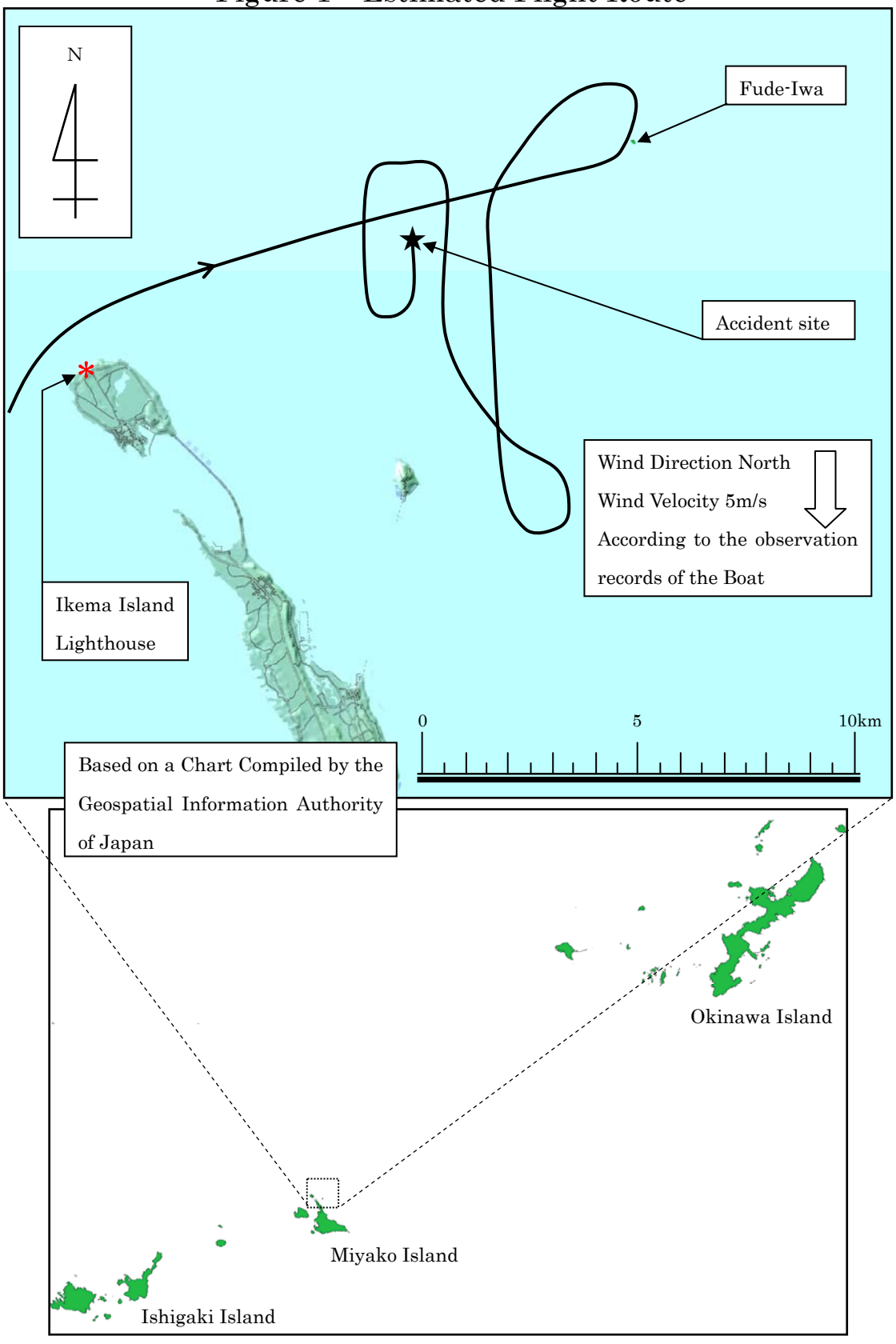

Figure 2　Three Angle View of Bell 412

Unit: m

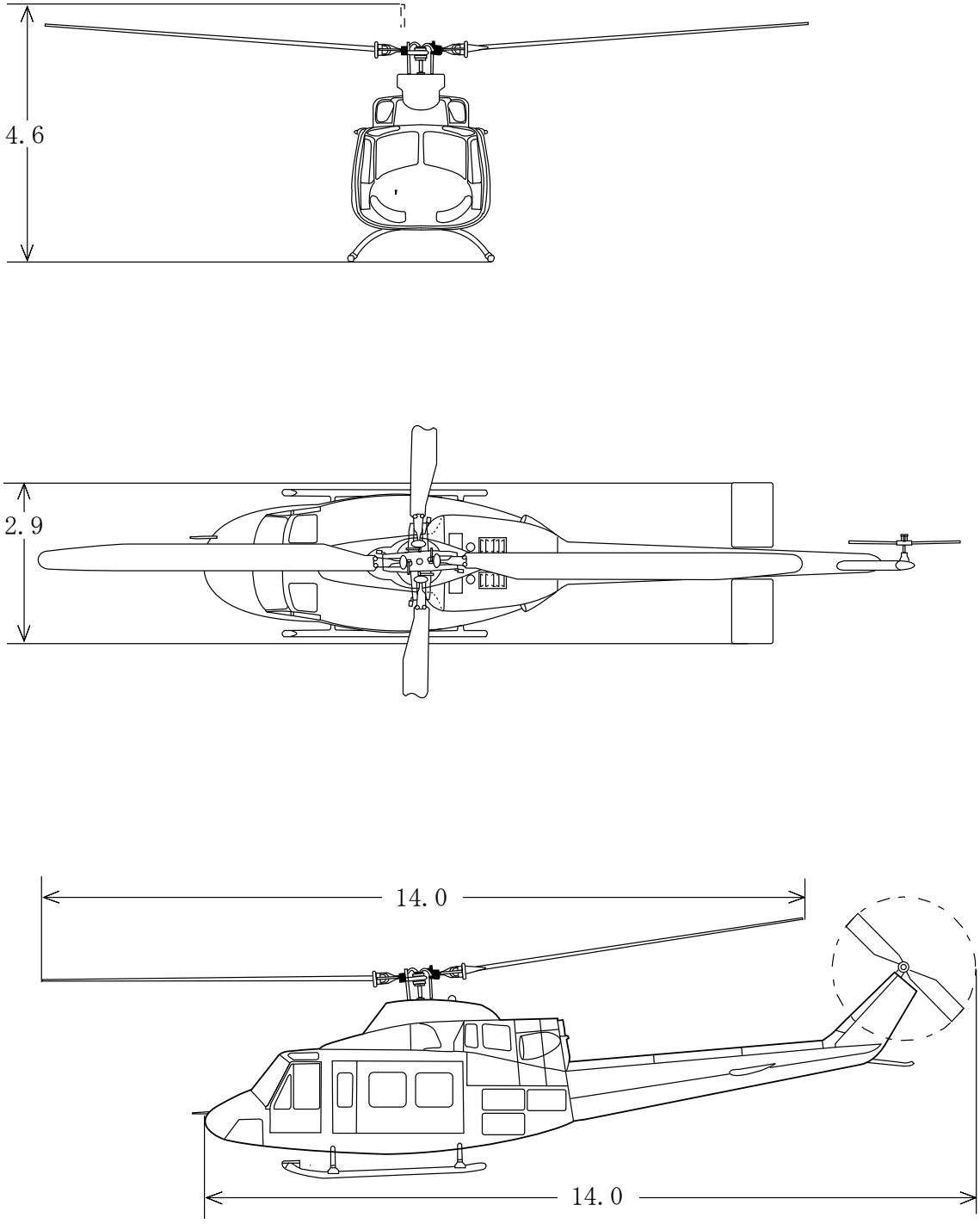

Figure 3　Floats Equipped Location

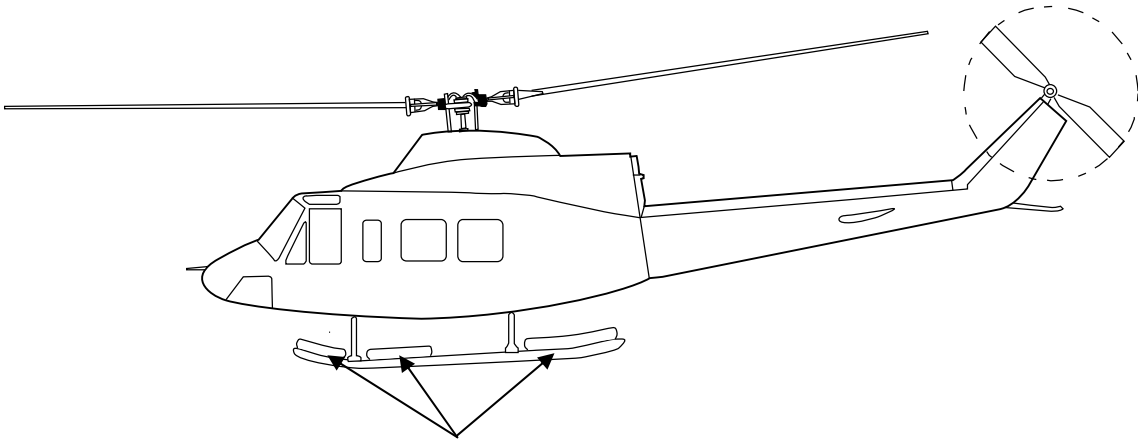

Photo 1　Accident Aircraft (Just After Ditched)

Photo 2　Accident Aircraft
(Transporting on Ishigaki Port)

Photo 3　Cyclic Stick

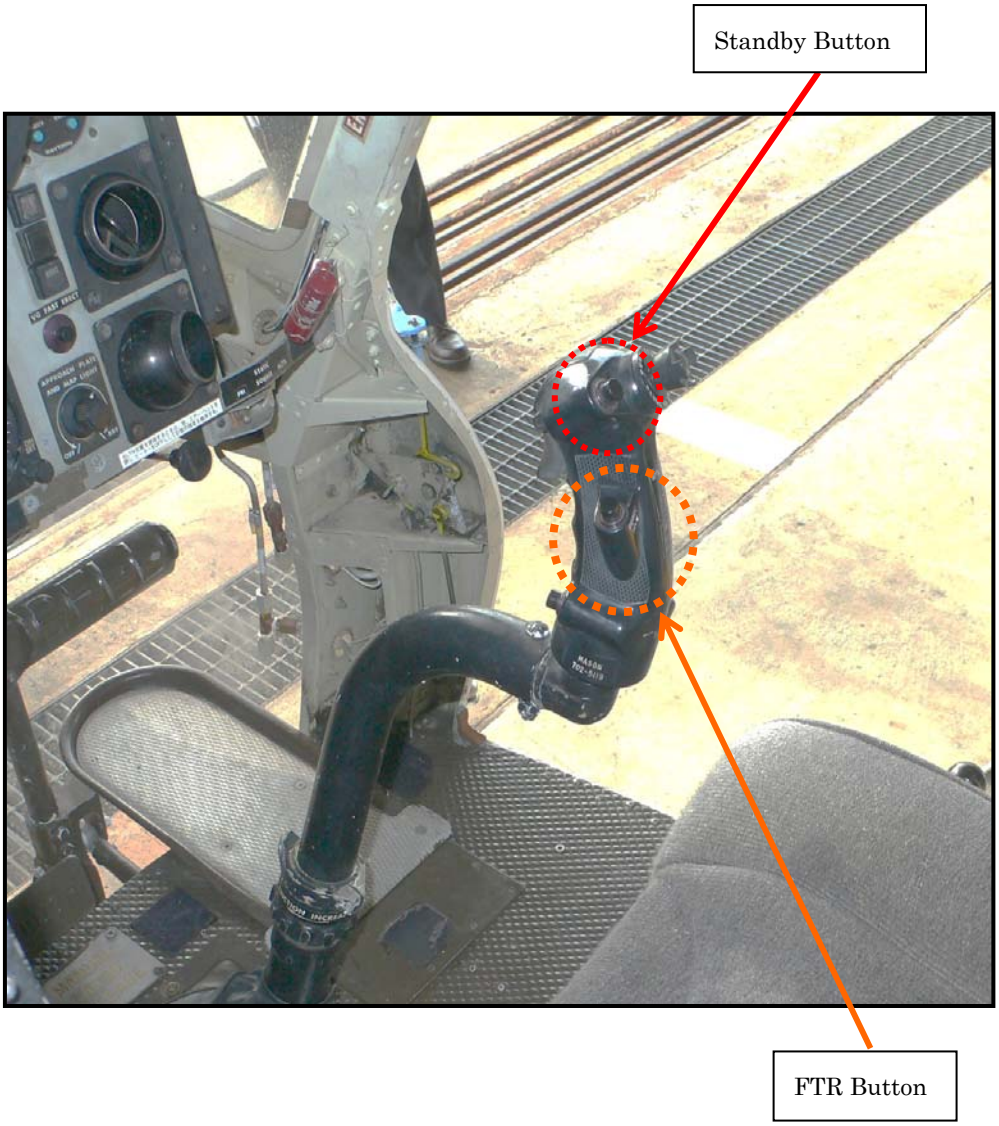

Photo 4　Instruments Arrangement of the Same Type and the Same Equipped Aircraft