Aviation Safety Council

Accident Investigation Report

ASC-AAR-00-10-001

CRASH IN WATER DURING AIRBORNE SPRAYING OF INSECTICIDE

EMERALD PACIFIC AIRLINES B31007
UH12E HELICOPTER

WATER RESERVOIR NEAR SAND-RETAINING DAM AT KAOPING STREAM, CHISHAN, KAOHSIUNG COUNTY
Nov. 29, 1999

Aviation Safety Council

16th Floor Fu-Hsing North Road

Taipei 105,Taiwan, R.O.C.

EXECUTIVE SUMMARY

At 0600 on Nov. 29 1999[Note1], EMERALD PACIFIC AIRLINES UH12E helicopter Registration No. B31007 took off from Chishan on assignment to spray insecticide over the Liukwaitsuo banana plantation west of Pingtung Airport (hereinafter referred to as airborne spraying). It flew southward along Kaoping Stream and in 30 minutes began operations at the assigned site. During the operation, the pilot handled the spraying while the mechanic handled refueling and refilling the helicopter. Following the mission, mechanic went on board for the flight back to Chishan.

The aircraft made a total of 7 airborne sprays, each for roughly 15 minutes. The aircraft landed in Fengshan for refueling and refilling of insecticide during the operation. It also stood by a few moments because of rain. As a regular mission, it was Day 11 of the assignment.. The pilot, substituting for another pilot who was on leave, carried the assignment out starting Nov. 26. After the airborne spray, the aircraft landed in the Fengshan operational area to pick up the mechanic and then headed back to Chishan Base. Flying northward along Kaoping Stream, the aircraft made a request to Pingtung Control Tower to pass through the glide path of Pingtung Airport, ascend to 200 feet over the high-voltage power cable tower, and then descend back to approximately 50 feet for a 5-minute flight just above the water. The mechanic stated that despite the rain, visibility was fair and he could see the buildings and trees along the stream. However, visibility through the front windshield was limited because of the rain.

The aircraft went down at approximately 1008 which is about 2 to 3 minutes after the aircraft reported to have passed the water reservoir near the sand-retaining dam on Kaoping Stream,. The helicopter crashed in an nearly horizontal attitude with a last registered speed of 60Kts and altitude of roughly 50 feet.

The cockpit immediately filled with water after the aircraft went

[Note1] All time given in this report is using a 24-hour clock.

down. The aircraft tilted toward the right and the left door bounced open. The A/E mechanic abandoned the cockpit first, followed by the pilot. The pilot was not injured in the crash, however though the A/E mechanic suffered a minor bruise to the right side of his forehead.

The pilot drowned when he tried to swim ashore and was pronounced dead on arrival to the hospital. The A/E mechanic was taken to the hospital and was discharged the following day. On the day of the accident, the Aviation Safety Council under the (hereinafter referred to as ASC) initiated its investigation under Article 84 of the Civil Aviation Law, the Aircraft Accidents and Serious Incidents Investigation Regulations, and the Aviation Accidents Investigation Standard Operating Procedure. This investigation was completed on Oct. 5, 2000 and published after its submittal to the Executive Yuan. The following is the findings, probable causes and factors contributing the accident and the safety recommendations：

Findings

1. The applicable civil aviation laws and the company regulations duly certify the crew.
2. The aircraft had met all airworthiness requirements and airworthiness certificate was issued accordingly.
3. No irregularities were shown in the maintenance records of the aircraft, as its weight and balance were kept within the allowable range.
4. When B31007 was heading base after a successful aerial crop dusting mission, visibility in the control zone of Pingnan Airport was 3,200 meters, which was below the minimum of visual meteorological conditions - 5kms.
5. The northbound return flight the aircraft took along the Kaoping Stream just above the water does not meet Art. 54 of the Visual Flight Rules which prohibits flights under 500 feet.
6. Due to the lack of a flight dispatcher, who would otherwise authorize a flight back to the base from the operation site in an ordinary aerial dusting operation, the pilot in this case made the decision to fly based on the weather conditions provided by

ground personnel at Fengshan. It was drizzling when the accident occurred and visibility on the return flight was below visual flight rules minimum. Without checking first, the pilot decided to fly without sufficient weather information.

7. Both the ceiling and visibility at the time of the accident met the standards for special visual flight rules as stipulated in Art. 56 of the Visual Flight Regulations. The regulations state that there is a ceiling of 500 feet and visibility must not be less than 1.5kms for visual flights. The pilot, without complete or accurate weather information, did not request for a special visual flight from the ATC unit, thereby disregarding Art. 92 of the. This article states that it is mandatory that the captain is fully aware and has all meteorological information before a flight.
8. The Civil Aeronautics Administration under the Ministry of Transportation & Communications had given written approval for the flight that day (to be carried out between Oct. 15, 1999 and Jan. 15, 2000) but no flight plan was filed. This is a violation of Art. 91 of which states 7. Successful flight plan before the flight. (this sentence is missing something after the word “states”).
9. As a crewmember, the mechanic should have been on alert as well. The pilot failed to brief the mechanic who could have alerted the pilot that the aircraft was in close proximity to the ground.
10. The Excessive external forces which overloaded the airframe destroyed the aircraft. Additionally, the aircraft apparently had sufficient power when it crashed into the water.
11. Crew resources management was not effectively used due to incomplete pilot training, as the annual recurrent training stipulated in the Training Manual is not included in the Crew Resource Management course, the resources in the cockpit were not in effective use.
12. While results of blood and alcohol tests conducted on the mechanic after the accident showed a level which exceeded limits, stated in interviews that they did not believe that the mechanic was an alcoholic nor had consumed any alcohol before the flight. The different blood alcohol reading from the one taken just after the accident points to an inaccurate testing method. A blood alcohol level of 56mg/dl would not significantly effect normal thinking and behavior.

13. Clause 3, Art. 35 of the Helicopters Aviation Management Procedure is vague.

Probable causes

The aircraft flew in poor visibility, and failed to maintain safe altitude; there was a lack of situational awareness of ground (water) obstruction. The aircraft struck the water because it was flying at an altitude too low for the pilot to take corrective actions.

Contributing factors

1. Noncompliance with regulations to file a flight plans.
2. Failure to follow.visual flight rules.
3. Lack of training and ignorance of potential danger when conducting visual flights..

Recommendation

To EMERALD PACIFIC AIRLINES

1. Aircraft shall carry proper safety equipment for onboard personnel when flying over water. (ASC-ASR-00-10-001)
2. Aviators shall attend visual flight safety courses from the training manual. (ASC-ASR-00-10-002)
3. Regular on-duty training courses shall include Crewmember Resources Management. (ASC-ASR-00-10-003)
4. Air crew shall undergo training and performance examinations. (ASC-ASR-00-10-004)

To Civil Aeronautics Bureau under Ministry of Transportation & Communications

1. To ask the airline industry to abide by Art. 91 of Helicopters Aviation Management Procedure and assessthe applicability of Art. 35.[Note] (ASC-ASR-00-10-005)

[Note] 1. The Ministry of Transportation & Communication renamed the Helicopters Aviation Management Procedure as Flight Operations Management Procedure in October 2000.

2. Art. 225 of Aircraft Flight Operation Regulations have revised the regulations governing the life vest available on Class 3 helicopters.

2. To confirm that the industry is following visual flight weather and minimum altitude standards. (ASC-ASR-00-10-006)
3. To increase industry inspections to determine if Crewmember Resources Management plans are adequate and followed. The industry is hereby requested to have Crewmember Resources Management be included in the regular on-duty training courses and in the training manual. (ASC-ASR-00-10-007).

CONTENTS

Chapter 1 Factual Information

1.1 History of flight

At 0600 on Nov. 29 1999 [Note 1], EMERALD PACIFIC AIRLINES UH12E helicopter Registration No. B31007 took off from Chishan on assignment to spray insecticide over the Liukwaitsuo banana plantation west of Pingtung Airport (hereinafter referred to as airborne spraying). It flew southward along Kaoping Stream and in 30 minutes began operations at the assigned site. During the operation, the pilot handled the spraying while the mechanic handled refueling and refilling the helicopter. Following the mission, mechanic went on board for the flight back to Chishan.

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The aircraft went down at approximately 1008 which is about 2 to 3 minutes after the aircraft reported to have passed the water reservoir near the sand-retaining dam on Kaoping Stream,. The helicopter crashed in an nearly horizontal attitude with a last recorded speed of 60Kts and altitude of roughly 50 feet.

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down. The aircraft rolled to the right and the left door bounced open. The mechanic abandoned the cockpit first, followed by the pilot. The pilot was not injured in the crash, however though the mechanic suffered a minor bruise to the right side of his forehead.
The pilot drowned when he tried to swim ashore and was pronounced dead on arrival to the hospital. The mechanic was taken to the hospital and was discharged the following day.

1.2 Injuries to Persons

Injuries	Flight crew	Passengers	Others	Total
Fatal	1	0	0	1
Serious	0	0	0	0
Minor	1*	0	0	1
None	0	0	0	0
Total	2	0	0	2

*Ground mechanic aboard.

1.3 Damage to Aircraft

The aircraft was completely destroyed, with the engine offset and the airframe deformed and broke up.

1.4 Other Damage

None.

1.5 Personnel Information

1.5.1 Pilot

- Age: 36 years old (Born on Oct. 25, 1963)
- Valid licenses:
  1. Service certificate (Issued on July 17, 1998)
  2. Certificate (UH-12E, to expire on July 13, 2000)
  3. Physical examination certificate (Class B pilot, to expire on Nov. 30, 1999)

4. Airman credential (destroyed)

- Before admission to EMERALD PACIFIC AIRLINES, the pilot was flying Hughes 500's in the Navy and was qualified to conduct instrumental flights.
- Hired by EMERALD PACIFIC AIRLINES on March 16, 1998.
- Training for UH-12E helicopter began on May 28, 1998.
- Successful certification for UH-12E helicopter on July 14, 1998.
- Training for additional assignment on BELL206B-3 helicopter began on July 1, 1999.
- Successful certification for additional assignment on BELL206B-3 helicopter began on Aug. 11, 1999.
- In the annual on-duty training of ground courses for UH-12E helicopter on June 7, 1999 and the regular on-duty training conducted by the company on June 16 the same year, the check airman gave the following comments: "Further training needed on identification of landmarks and objects, the check ride met the requirements. "
- Total flying hours: 1490 (As of Nov. 3, 1999)
- Total flying hours on the same type of aircraft: 200
- Flying hours in last 90 days before the accident: 93
- Flying hours in last 60 days before the accident: 73
- Flying hours in last 30 days before the accident: 46
- Living and working conditions of last 72 hours before the accident: Airborne spray of insecticide in Dahsu on Nov. 26, in Fengshan on Nov. 27 and no duty on Nov. 28 because of thick fog. When assigned, the pilot would be conducting airborne spray of insecticide between 0530 and 1030 in the morning.
- Living in Tsuoying, the pilot would go home after an assignment. When there is an assignment the next day, the pilot would be back to Chishan by 11:00 P.M. the night before. The pilot maintained a normal lifestyle and was not an alcoholic.

1.5.2 A/E Mechanic

- Age: 36 years old (Born on Jul. 19, 1963)
- Valid licenses:
  1. A/E Mechanic certificate (Issued on Jan. 17, 1997)
  2. A/E Mechanic (to expire on Jan. 9, 2003)
  3. Physical examination certificate (Class C A/E Mechanic, expiring on Jan. 31, 2001)
- The mechanic served Far Eastern Air Transport Corp. from March

1991 to March 1997 in the capacity of maintenance mechanic in Maintenence Division. Admitted in EMERALD PACIFIC AIRLINES in Feb. 1998, the mechanic is responsible for maintenance and airworthiness release. The mechanic had a normal lifestyle and was not an alcoholic.

1.6 Aircraft Information

1.6.1 General Information

1.6.1.1 Airframe

Property of	: Chen Hui-Li
Operator	: EMERALD PACIFIC AIRLINES
Airworthiness certificate	: To expire on March 31, 2000
Radio license	: To expire on March 30, 2001
Nationality	: Republic of China
Registration No.	: B31007
Type of aircraft	: Class-3 performance, for agricultural operations, 3-seat, no survival equipment for overwater operations.
Model	: UH-12E
Serial No.	5056
Date of manufacture	: Oct. 13, 1978
Maximum takeoff weight	: 3,100Lbs
Total flight hours	: 3,333 hours 31 minutes
Total landings	: 1,010

1.6.1.2 Engine

Model	: VO-540-C2A
Manufacturer	: LYCOMING
Manufacture No.	: L2495-43
Maximum rpm	: 3,200rpm
Minimum rpm	: 1,750rpm
Maximum HP	: 305bhp/3,200rpm
Total service time	: 589 hours 36 minutes

1.6.1.3 Main Rotor

Maximum rpm : 395rpm
Minimum rpm : 314rpm

1.6.1.4 Airworthiness and Maintenance Records

Last major regular maintenance: 100-hour check on Nov. 11, 1999 showed no abnormality. The maintenance records for the past 6 months for the aircraft show no abnormalities.

1.6.2 Weight and Balance

- Deadweight (with sprayer)： 1,927Lbs
- 30 gallons of fuel (at 6.6Lbs/gallon)： 178Lbs
- 2 crewmembers (150Lbs each) weighing approximately 300Lbs.

The takeoff weight of the flight was 2,405Lbs, within the maximum takeoff weight limit of 3,100Lbs. (The flight was a return flight back to Chishan Base and carried no insecticide.)

1.7 Meteorological Information

At 0630, B31007 took off from the EMERALD PACIFIC AIRLINES base near Chiwei Bridge to carry out its airborne spraying mission, which is usually assigned to areas within the control zone of Pingtung South Airport. Before taking off, the aircraft did not contact either Pingtung Airport or Kaohsiung Airport for pertinent meteorological information.

At 0630, the weather at the Pingtung Airport was as follows:

> Wind calm, visibility 5kms with fog, clouds： scattered at
>
> 1,200 feet, overcast at 3,200 feet, temperature 18°C, dew point 16°C, QNH 1,019Hpa.

At 0910, the weather reported as follows [Note 2]:

Wind 230° at 2 knots, visibility 4,800 meters, drizzle and fog, clouds： scattered at 1,000 feet, overcast at 4,000 feet, temperature 20°C, dew point 17°C, QNH 1,019Hpa.

At 0940, the weather reported as follows:

Wind calm, visibility 3,200 feet, drizzle and fog, clouds： scattered at 800 feet, overcast at 4,000 feet, temperature 20°C, dew point 17°C,QNH 1,020Hpa

At 1000, weather at the Pingtung Airport reported as follows:

Wind calm, visibility 3,200 feet, drizzle and fog, clouds： scattered at 800 feet, overcast at 4,000 feet, temperature 20°C, dew point 17°C, QNH 1,019Hpa.

1.8 Navigational Aids

N/A.

1.9 Communications

The aircraft never contacted the flight following position of Kaohsiung Approach during the flight.

1.10 Aerodrome Information

N/A.

1.11 Flight Recorders

None.

Note 2 : After 0910, visibility dropped to below the VFR minimum within the controlled airspace.

1.12 Wreckage and Impact Information

1.12.1 Landmarks in the vicinity of the accident scene & the wreckage distribution

The B31007 crashed to the northeast of the Southern Water Resources Bureau by Kaoping Stream, at 320 meters from the pier on the west bank and 80 meters from the retaining dam on the south. The main airframe and the tail rotor were close to each other at E120°40'34. 8"/N22°40'12. 1".

After the mission, the aircraft took off from the quarry (E120°25'39. 14"/N22°38'6. 29") and headed north along Kaoping Stream. The mechanic indicates that after passing by the tower near Kaoping Stream Bridge, the aircraft then passed underneath the powerline located to the southwest of the glide path ofPingtung. The 6 towers are numbered from west to east 002 to 07. The quarry is 5.6 kms from the retaining dam and Tower 003 is 2.2 kms from the retaining dam. See Fig. 1.12.1-1 and Fig. 1.12.1-2 for the high-voltage towers and the crash site of B31007.

The mechanic also indicates that the aircraft might have passed between Tower 003 and Tower 004 or Tower 004 and Tower 005 and the Chiuchu /Fuhsing 69KV route chart provided by Taiwan PowerCompany, suggesting that B31007 did pass underneath powerline during its flight. All the towers in the sector carry high-voltage powerlines of 4-wire-span both on the left and on the right. Sandy hills and riverbanks dominate the terrain below. The following tables show the clearance or distance between the high-voltage wires and the water or ground:

Table 1.12.1-1 Clearance or distance between high-voltage wires and water or ground

Tower	Distance	Minimum clearance between wire & water or ground
002 to 003	268.5M	28 meters
003 to 004	400M	14.8 meters
004 to 005	392.45M	15.4 meters
005 to 006	314.9M	20.2 meters
006 to 007	256M	24 meters
Courtesy: Taiwan Power Company		

1.12.2 Recovery of the aircraft

Crash site processing

Date	Progress
Monday 11/29/99	Accident took place
Tuesday 11/30/99	Failure to recover by Search & Rescue Association
Wednesday 12/01/99	Request to the Navy for assistance
Thursday 12/02/99	Standby
Friday 12/03/99	Standby and contact Rescue Company for survey
Saturday 12/04/99	Successful recovery with support by Search & Rescue Association

Monday 11/29/99 Accidentoccurred

Time	Progress
1100	Receipt of notification on accident.
1130	Launch of Go-Team
1220	Flightto Kaohsiung
1300	Arrived Kaohsiung Airport staff.
1330	Travel to crash site at Kaohsu Primary School
1420	Arrival at crash site for investigation, recovery coordination and witness interviews.
1700	Visit of Managing Director and Investigator-in-Charge to Hongching Hospital to interview mechanic and briefing by Go-Team
1800	Progress Meeting

Tuesday 11/30/99 Failure to recover by Search & Rescue Association

Time	Progress
0900	Kaohsiung Search & Rescue Association began recovery operation upon request by EMERALD PACIFIC AIRLINES. Operators turned the helicopter up straight using bamboo raft before towing it ashore using power on land. The aircraft overturned when towed.
1900	Progress Meeting

Wednesday 12/01/99 Request the Navy for assistance

Time	Progress
0800	Go-Team returned to office and contacted the Navy rescue team. Go-Team standby in Taipei.
1300	Go-Team traveled to Kaohsiung waiting for the Navy rescue team.

Thursday 12/02/99 Standby

Full-day standby, no reply from the Navy rescue team.

Friday 12/03/99 Standby and contact Rescue Company for investigation

Accident scene survey accompanied by representatives of EMERALD PACIFIC AIRLINES and discussion with Search & Rescue Association over recovery plan.

Saturday 12/04/99 Successful recovery with support by Search & Rescue Association

Time	Progress
0800	Go-Team arrived at scene
0930	Effort failed to attach 4 truck tire tubes to the key points of the airframe and inflate to lift the aircraft.
1400	Aircraft was not floating despite four more tubes added and inflated.
1600	Successful attempt at towing the aircraft.
1640	The aircraft was towed to the retaining dam and lift effort begins.
1720	Aircraft was lifted ashore for initial photography and securing on trailer after wrapping.
1830	Towing toKaohsiung Airport.
1930	Arrival in hangar at Kaohsiung Airport.
2015	Depart hangar.
2040	Return to Taipei.

Lifted ashore after being submerged in water for 6 days, the instrumental panel of the aircraft was covered with mud. There was no way to be certain of instrumentation settings at the time of the crash.

1.12.3 System damage

1.12.3.1 Power system

As shown in Fig. 1.12.3.1-1, the engine of B31007 was found roughly intact, The lubricant tank, fuel tank and the lubricant radiator were contaminated by the water. The fuel tank wall shows marks of squeezing though there are no signs of cracking or leakage. There are a few deformed cooling fan blades.

The mechanic who survived the accident states "before the crash, the aircraft had normal power, the engine was running and there was no burst, stall or overheating in the cylinders. Fuel supply was smooth."

The other two eyewitnesses on the ground stated that before the crash, the engine of the aircraft showed no interruption or any abnormality.

1.12.3.2 Flight control system

It is found that the cyclic pitch stick remained freely operational and the trip was smooth. The rod of the cyclic pitch stick was slightly bent and a connector linking the pitch rod with the collective pitch stick was broken. The tail rotor pedals (directional) are loose because of the broken tail beam and the wire steel. The two joysticks (Fig. 1.12.3.2-1) and the instrumental panel (Fig. 1.12.3.2-2) remain intact. It is difficult to determine instrumentation settings following the aircraft’s recovery.

1.12.3.3 Directional panel & the main rotor blade

The directional panel, shear arm and the main bearing of the rotor blade head appear intact. The two broken main rotor blades show the steel spar. See Fig. 1.12.3.3-1, Fig. 1.12.3.3-2 and Fig. 1.12.3.3-3 for damage to the rotor blade head and blades.

1.12.3.4 Tail rotor

Besides the external wear, the tail rotor that has broken and fallen off the tail beam is slightly bent.

1.12.3.5 Flight instruments

Both the instrumental panel and the gauge panel suffered minor damage. The carburetor heat is on Cold, the mixture ratio stick on Full Rich and the fuel switch On, all suggesting that the operation was conducted as indicated in the flight manual. The switch of the power auxiliary fuel pump was OFF.

1.12.4 Aircraft structural damage

1.12.4.1 Airframe damage

1. The main airframe and the structure of the engine were found roughly intact, though the tail is separated from the main wreckage. The tail beam with yellow finish and red primer is shown in Fig. 1.12.4.1-1, while Fig. 1.12.4.1-2 shows the full dimensions of the aircraft.
2. Fig. 1.12.4.1-3 shows the broken cockpit windshield and the deformed frame structure.
3. Fig. 1.12.4.1-4 shows the missing cockpit seat cushion and the intact structure of the cockpit.
4. Fig. 1.12.4.1-5 shows the instrumental panel and the 2 joysticks.
5. Fig. 1.12.4.1-6 shows the slight scratches on the right skin of the cockpit and the 3-cm crack on the skin near the floor.
6. Fig. 1.12.4.1-7 shows the intact VHF antenna under the cockpit on the outside and the refilling pump as well as the hose.
7. Fig. 1.12.4.1-8 & Fig. 1.12.4.1-9 show the 40cm×40cm dent on the left skin of the cockpit and a transverse 30cm crack on the joint with the floor.
8. Fig. 1.12.4.1-10 shows the slight dent on the right front sleigh and the bent and cracked sleigh with the sprinkler rod.
9. Fig. 1.12.4.1-11 shows intact left sleigh and the bent and broken sleigh and the sprinkler rod.
10. Fig. 1.12.4.1-12 shows the S/N1088 main rotor blade of 496cm in length that has broken tip and the bent blade STA92 turned upward. The bent portion between blade STA92 to STA177 turns upward (blade tip turns upward at 5°). Yellow and red paint is found on the

front edge of the blade tip.

11. The 1119 main rotor blade is broken into 4 pieces. A 45° turn is shown at Blade STA 42, STA 100 and STA 130. The portion between the blade base and Blade STA 42 is intact. The portion between blade STA 42 and blade STA 100 turns back 60° and downward. Yellow and red paint remains on the upper and lower surface of the front edge of the blade; the portion between STA 100 and blade STA 130 is horizontal and yellow and red paint remains on the upper and lower surface of the front edge of the blade; the portion between blade STA 130 and the blade tip is intact and turns upward, yellow paint remains on the front edge, as shown in Fig. 1.12.4.1-13.
12. The tail forms a 〈 shape and twists down to the right and toward the longitudinal axis. The tail turns rightward at STA74. The tail rotor breaks at STA160. At STA57, there is a slight 26cm long crack on the bottom of the tail that turns upward at 45° as shown in fig. 1.12.4.1-14.
13. The portion that covers STA167 throughout the end, including the entire tail rotor and the stabilizer has separated from the tail beam. This portion was found on Jan. 8, 2000 where the main wreckage was. The tail rotor and the transmission shaft are in good connection and the transmission is fair, as the tail rotor is free to rotate. One of the rotors is intact and the other is slightly distorted. The stabilizer is apparently intact and the steel wire is free to control angles of the fail rotor. Fig. 1.12.4.1-15 shows the entire aspect.

1.12.4.2 Engine structural damage

1. Fig. 1.12.4.2-1 shows the 13cm×17cm dent on the exhaust.
2. Fig. 1.12.4.2-2 shows the broken shell of the wiring box located on the lower right.
3. Fig. 1.12.4.2-3 shows the broken and fallen metal mask of the right shock-absorbing rubber to the engine shock-absorber seat.
4. Fig. 1.12.4.2-4 shows the main rotor blade shaft in longitudinal bend.
5. Fig. 1.12.4.2-5 shows the bent tail-rotor-blade transmission shaft and the broken gear that has fallen off the gearing box.

6. Fig. 1.12.4.2-6 shows the 3 cylinders that appear intact.
7. Fig. 1.12.4.2-7 shows the 2cm dent on the wiring box located on the rear right resulting from the impact, at approximately 15cm from the nearest structure.
8. Fig. 1.12.4.2-8 shows the broken pitch rod head and the bent pitch rod beneath it.
9. Fig. 1.12.4.2-9 shows the broken metal mask of the left shock-absorbing rubber to the engine shock-absorber seat that has not fallen off.
10. Fig. 1.12.4.2-10 shows the broken shell of the lubricant cooling manifold. Also shown are the two shock absorbers; the left one on the engine is missing and the other is off the fixation rack, as shown in Fig. 1.12.4.2-11.
11. Fig. 1.12.4.2-12 shows the three cylinders that appear intact.
12. Fig. 1.12.4.2-13 shows the broken lubricant tank seat.
13. Fig. 1.12.4.2-14 shows the intact structure of the intake and the filter screen and the intake manifold with vertical cracks.
14. Fig. 1.12.4.2-15 shows the seven blades of the engine-cooling fan bend forward and the root with partial tears.
15. Fig. 1.12.4.2-16 shows the intact insecticide container.
16. Fig. 1.12.4.2-17 shows both sides of the insecticide nozzle bent slightly, with the left support turned 90° and the right one slightly bent.

1.13 Medical and Pathological

The pilot of B31007 held a Class B pilot physical examination certificate issued by the Civil Aeronautics Administration that was to expire on Nov. 30, 1999. Before this flight, the pilot had been living a normal life and had had sufficient rest. His physical condition was normal and showed no mental irregularities. The death certificate issued by the Kaohsiung District Attorney's Office indicates that the pilot died of asphyxiation from drowning. No blood alcohol tests were conducted.

The mechanic suffered a wound to the forehead when the windshield broke on impact, striking him. The mechanic was rescued and then rushed to Hongching Hospital in Kaohsiung, where he was treated and discharged the next day. Blood samples taken showed 56mg/dl (0.056% BAC). Interviews with other people suggest that the mechanic is not an alcoholic and had not consumed any alcoholic drinks before the accident.

The accident took place at 1000 and the blood sample was taken in Hongching Hospital in Kaohsiung at 1800. Another blood sample was taken in Shanchie Medical Test Center in Tainan at 1800 the following day. The samples were not added 1% of NaF and they were not kept refrigerated before the test.

1.14 Fire

No fire was detected.

1.15 Survival Aspects

After crashing into water, B31007 rolled to the right side, resting on the riverbed. The left side remained slightly above water. The mechanic in the left seat unbuckled his safety belt and left the aircraft from the left door to cling to the airframe. The pilot followed and called for help while standing on the aircraft with the mechanic. People ashore then called the police. The search and rescue squad rushed to the scene after receiving the call. The mechanic attempted to swim the short distance to the shore but had to turn back. Again he clung to the airframe. Then the pilot tried to swim but drowned halfway to shore. The pilot showed no vital signs when pulled from the water.

1.16 Tests and Research

The Aviation Research Laboratory of the Chung Shan Institute of Science and Technology conducted the following tests:

1. Lubricant quality test: The lubricant shows high iron and copper content but no water sample was taken as the lubricant suffered contamination and dilution. Carbon was found on the lubricant filter screen because of the contaminated water.
2. Structural and metallographic analysis: The broken cover of the engine shock absorber shows penetrating destruction on the outside and suggests overload, though there is no sign of destruction by fatigue.

1.17 Organizational and Management

Drug and alcohol tests:

In accordance with Art. 75 of the Fixed-wing Aircraft Flight Operation Management Procedure for the Commercial Airlines Industry, all aircraft operators shall establish appropriate drug and alcohol test plans and random tests shall be conducted on flight personnel (including pilots, flight attendants, dispatchers and line maintenance personnel). The test records shall be filed for reference.

The Civil Aeronautics Administration may, on a regular or irregular basis, conduct drug and alcohol tests on flight personnel (including pilots, flight attendants, dispatchers and line maintenance personnel). Those failing a test shall be banned from flight operations. The aforementioned tests shall be conducted in accordance with the following criteria:

1. Drug tests: Urine sample showing negative
2. Alcohol test: Alcohol in the blood shall not be over 0.04%BAC.

However, in the Helicopter Flights Management Procedure of Commercial Airlines compiled in the Civil Aviation Regulations shows no drug and alcohol test management plan as indicated above.

EMERALD PACIFIC AIRLINES does have its own alcohol test procedure for aircrew in the Flight Safety Operation Manual.

1.18 Additional Information

1.18.1 Visual flight altitude

Art. 54, Section 3, Chapter 3 Visual Flight Altitude of Flight Regulations indicates: Except when necessary for take off or landing, or except by permission from the appropriate authority, aircraft shall not be flown:

（1）Over the congested areas of cities, towns or settlements or over an open-air assembly of persons at a height of less than 1000 feet above the highest obstacle within a radius of 2000 feet from the aircraft, or

（2）Elsewhere at a height of less than 500 feet above the ground or water.

Chapter 2 Analysis

2.1 Aircraft wreckage structural analysis

Upon request of this office, the Aeronautical Research Laboratory of the Chung Shan Institute of Science and Technology conducted a metal materials analysis, with the following results: (See Attachment 1).

2.1.1 Damage to skin of lower airframe of cockpit and the damage pattern

Fig.1.12.4.1-6 shows a 3cm crack on the right edge near the lower airframe of the cockpit. The uneven trip indicates that the crack developed rapidly, a product of destruction from heavy impact.

There is another crack of 4cm to the left edge near the lower part of the airframe near the cockpit. There is a 35cm long crack but the metal inside is almost intact, as suggested in Fig. 1.12.4.1-8. There are a number of fine cracks in addition to the primary crack, all suggesting destruction from heavy impact. This crack indicates that the impact here is much heavier than the one on the right side, as there are many additional fine cracks here.

Fig. 1.12.4.1-7 shows a 40cm×4cm dent on the lower airframe skin near the cockpit. We assume that a side impact not only created the dent but also the bend on the skin. The side impact also left cracks on both sides of the skin near the floor. The left crack is much larger than the right one.

2.1.2 Damage to main rotor & shaft and destruction pattern

The S/N 1088 main rotor blade measures 496cm in length. In an area on the leading edge that extends some 90cm from the tip there is yellow and red paint. The entire blade bends slightly upward. The blade tip suffered the most damage. The metal skin of the wing was crushed and the metal honeycomb on the trailing edge was cut open, removing the skin, as shown in Fig. A1. This area may have come in contact with sharpobjects, possibly the tail rotor which rotated forward into the S/N1088 main rotor blade. At the moment of impact, the main rotor blade

bent upward and backward. Besides the severe destruction to the blade tip, front pressure created buckling at approximately 256cm(roughly in the middle of the blade).

The S/N 1119 main rotor blade broke into 4 pieces. The 3 curves measured from the root to the tip measure 130, 275 and 355cm respectively. The 3 curves are at 45°. The 130cm area of the blade was intact. The portion between 130cm and 275cm turns 60° backward and downward. There is yellow and dark red paint along the front edge and along an area between 275cm and 335cm. From 355cm to the tip, the face turns upward with yellow paint on the front edge surface. The dark red paint is primer and the yellow finish from the tail rotor. This suggests that the tail rotor contacted the S/N1119 main rotor blade, leaving both primer and finish on the main rotor blade and the tail rotor. The portion between 275 and 335cm and the preceding area are the ones suffering most contact with the tail rotor and there are a large number of turns. At the moment of impact, the main rotor blade was rotating and the face turned in 60° from the front edge to the rear. Most of the paint left on the tail rotor is found on the front edge of the S/N1119 main rotor blade.

The main rotor shaft bends longitudinally. The turn is found where the main rotor shaft contacts the concentric shaft end. This is where the main rotor blade suffered its most damage as its face was pressed in. There are circular wear marks created by contact with the main rotor blade. A remarkable wear mark is at 45° from the circular shaft. The included angle between the tail of the marks and the main rotor shaft is 60°, as shown in Fig. A2.

The damage to the main rotor blade and the main rotor shaft allow us to develop the following destruction mechanism and order:

First the main rotor shaft bent down and was dented from right pressure created by the S/N1119 main rotor blade. Foreign material, possibly mud from the river, forced the S/N1119 main rotor blade to bend 130cm downward.

When the main rotor shaft bent, the entire S/N1088 main rotor blade tilted 45° downward, forcing the tail end of the S/N1088 main rotor blade into contact with the tail rotor and severely damaging the 1088 main rotor end.

The wear marks with the 60° included angle came from the S/N1119 main rotor blade contacting the tail rotor, creating the numerous bends and fractures to the S/N1119 main rotor blade.

Nothing out of the ordinary was found on the broken surface of the main rotor blade and the main rotor shaft.

2.1.3 Damage to the tail structure, tail rotor & counterweight stabilizer & damage pattern

Fig. 1.12.4.1-14 shows the broken and twisted portion of the tail rotor at 187cm where it bends to the right when measured from the joint of the airframe with the tail rotor; the section beyond 407cm is completely gone. In addition to twists at 187cm, areas of the upper right section are pushed in, as shown in Fig. A3. It is determined that this face received pressure from the S/N1119 main rotor blade. There are a large number of 45° cracks on the tail rotor. The one on the bottom of the tail rotor at 146cm measures 26cm. This coarse and broken surface is product of the overwhelming torsion. Many of the cracks at 407cm are produced by the 45° cracks, suggesting destruction by torsion. The torsion was produced by the impact of the tail rotor with the S/N1088 main rotor blade.

The entire tail rotor, stabilizer and part of the tail rotor have separated from the aircraft. This is shown in Fig. 1.12.4.1-15. In general, the tail rotor and the transmission shaft are in fair connection and transmission and the tail rotor rotates freely. One of the tail rotor blades appears intact while the other shows slight torsion, resulting from the impact with the S/N1088 main rotor blade. The stabilizer appears intact and the control cable freely adjusts angles of the tail rotor blade.

The broken surface of the tail structure, tail rotor blade and the stabilizer shows no other signs than forced destruction.

2.1.4 Destruction of the metal shell of the rubber shock on the seat of the engine and its destruction pattern

Fig. A4 shows that the metal shell of the right rubber shock located on one side of the engine seat is broken in half. The other has a long crack, as shown in A5.

Fig. A6 and Fig. A7 show the diagram of the broken halves. The broken halves have coarse faces and when viewed under a powerful scanning microscope, the broken halves show the following:

Forced & fragile destruction as shown in Fig. A8.

Tapered and branch-like structures contained inside the material are

shown in Fig. A9 and Fig. A10 and both suggest cast material.

The result of the material analysis given in Attachment 1 suggests that the connecting rings are cast aluminum alloy A356.0.

2.1.5 General analysis

A close check of the destroyed parts shows that the aircraft experienced forceful destruction from impact with the water. The analysis sequence of the destruction of the main structure is given as follows:

1. The titled main rotor blades created the circular marks on the main rotor shaft when the two main rotor blades came in contact with the river,.
2. When the S/N1119 main rotor blade contacted the mud, the portion of the S/N1119 main rotor blade beyond 135cm turned downward and broke the main rotor.
3. With the main rotor blade still rotating 180°, the tail rotor came in contact with the S/N1088 main rotor blade, destroying the end of the S/N1088 main rotor and bending it pointing the middle as well as twisting a tail rotor blade. The tail structure shows destruction by torsion.
4. When the main rotor blade kept rotating 180°, the S/N1119 main rotor blade contacted the tail structure, damaging the S/N1119 main rotor blade and the tail structure.

2.2 Survival Aspects

2.2.1 Helicopter flight over water

1. Operating in the agricultural zone along Kaoping Stream, the aircraft could not complete its mission without passing over the stream.
2. Kaoping Stream is a key landmark and following the steam is a familiar route.
3. Interviews state that the spraying was conducted over a banana plantation. The aircraft’s altitude was under 10 meters and its speed less than 60 mph. The aircraft had to make seven trips across Kaoping Stream to the refilling and refueling vehicles. The aircraft flew at an altitude of 300 feet (some 90 meters) over the water.
4. Our investigation measured the riveras 900 meters wide. The aircraft could have landed safely if it had lost power while flying over

Kaoping Stream

5. The aircraft's flight path forced it to fly over waterand while it was a class-3 helicopter, it failed to carry offshore life gear as required by 1.18.3 Helicopters Flight Management Procedure.
6. The pilot escaped from the cockpit after the crash but drowned when he attempted to swim ashore without a floatation device.

2.2.2 Pilot cause of death

The report prepared by Kaohsiung District Court states that the pilot died of asphyxiation from drowning.

2.3 Communications

The pilot did not submit a flight plan to the Kaohsiung Communications Tracker before take-off. The aircraft's low altitude after take-off kept him from communicating with the tracker by radio. The Kaohsiung tracker was unaware of the aircraft's activities.

Clause 2 of Art. 8 of Visual Flights Regulations for Light Aircraft in the Taipei Flight Information Area concerning Responsibilities of Communication Tracking of the Flight Control Agency states:

To ensure adequate processing by the flight control agency and air safety, both the pilot of the aircraft and the flight control agency shall assist one another in providing flight information.

During the flight, radio communication at Pingnan Airport was normal and the tower did not receive any requests for assistance in relaying any critical information to the Kaohsiung Communication Tracker. For this reason the Kaohsiung Communication Tracker was unable to offer search and rescue service after the accident.

2.4 Flight control procedure

2.4.1 Visual flight regulations

EMERALD PACIFIC AIRLINES had applied for an operating altitude of 200 feet for B31007[Note3NOTE 3], but the operating altitude was only for within the operating area and never to include the air space

[Note3] See Attachment 2

between the airfield and the operating area. Concerning visual flights, it is states in Art. 54, Sec. 3 of Chapter 3 Visual Flights Regulations of the Flight Regulations:

Unless otherwise approved by competent authorities or required by takeoffs and landings, the minimum altitude of a visual flight shall be governed by the following:

1. When flying over highly populated cities or areas or assembly plazas, the minimum altitude shall be at least 1,000 feet above the tallest building located within the range of 2,000 feet in radius from the aircraft.
2. When flying over other areas, the minimum altitude shall be 500 feet off water or ground.

Therefore, the aircraft was supposed to maintain an altitude of no more than 500 feet between the airfield and the operating area.

However, the testimony of the witnesses and the A/E mechanic state that when returning to the temporary airfield at Chishan after the mission, the pilot passed under the high-voltage cable over the stream (the cable has an average clearance over the river of some 100 feet) and after passing the taxiway at Pingnan, the flight altitude was approximately 50 feet, which is against the regulations governing visual flight altitudes.

Art. 92 of Chapter 3 Regular Airlines of Helicopters Flight Management Procedure states: Before the flight, the captain shall be fully aware of the meteorological information he (she) could have access to with respect of the scheduled flight.

The aircraft B31007 conducted seven airborne missions within the air space of Pingnan Airport that day.

Rain interrupted operations and the aircraft stood by on the ground before resuming the work when the rain stopped. At 0910, when the weather conditions at Pingnan deteriorated to below the minimum level for visual flight, the aircraft did not obtain meteorological information from the Pingnan Airport, nor did it apply for aspecific visual flight. This was against the regulations for visual flights and visual flight control regulations for light aircraft.

2.4.2 Flight plan

Items 1, 4 and 5 of Art. 9 of the Visual Flight Control Regulations

for Light Aircraft in the Taipei Flight Information Area:

1. The flight plan shall be relayed to the flight control agency 30 minutes before takeoff.
4. If there is no control tower in the takeoff site, the pilot of the aircraft shall submit a flight plan and the scheduled takeoff time using ground communications to the control tower of the nearest airport for the relay to the competent authorities.
5. If there is no control tower in the landing site, the pilot of the aircraft shall , make a report before landing to the control tower at the nearest airport for relay of the flight information to the pertinent authorities. The pilot may also, after landing, report the flight information to the control tower at the nearest airport to relay the flight information to the pertinent authorities.

The assigned pilot failed to send the flight plan either directly or through others to the Kaohsiung Communications Tracker, which was unaware of the aircraft location between takeoff and the accident.

2.5 The flight

B31007 carried neither a Cockpit Voice Recorder (VCR) nor a Flight Data Recorder (FDR). The investigation team gathered the following from relevant information and testimony of witnesses.

2.5.1 Pilot's familiarity with the route

On the day of the accident, the aircraft was on an airborne insecticide-spraying mission, a cyclic operation that would last 12 days. Each operation phase would have 10 cycles. The day's mission was the 8^{th} cycle of the phase, suggesting that the pilot was familiar with the flight pattern and the obstructions on the ground of the operation area.

2.5.2 Flight & meteorological factors

As an airborne mission governed by the visual flight regulations approved by the Civil Aeronautics Bureau, flight altitudes of less than 3,000 feet in restricted areas shall be subject to a standard visibility of 5kms. Lacking instrumental flight equipment, the aircraft would not

conduct any flight in inclement weather. On the morning of the accident, the flight crew phoned the operation personnel in Chishan and was informed of the forecast of inclement weather and a chance of rain.

The aircraft took off after the spraying mission heading back north to Chishan along Kaoping Stream. The aircraft failed to ascend to the minimum altitude of 500 feet for visual flights but instead passed under high-voltage cables. After passing through the taxiway at Pingnan Airport, the aircraft flew just above the water at an altitude of no more than 50 feet. It was raining and there was poor visibility. Flying at low altitude in bad weather and above open water near the sand-retaining dam, the pilot would have be able to identify the landmarks in the neighborhood.

2.5.3 Pilot's maneuvers

If the collective pitch stick helicopter remains unchanged, the main rotor blade would remain fixed and the aircraft will not change its altitude. According to the testimony of the mechanic, the aircraft struck the water as the pilot finished switching the radio band with his right hand and was tilting forward.

The pilot would usually hold the cyclic pitch sticks with both of his knees instead of his hands to maintain the altitude and the position of the aircraft, t. When flying just above the water (actually, mean altitude of the flight could be under 50 feet), altitude could be maintained and the pilot could make slight adjustments using his right hand. When he pressed the buttons on the instrumental panel, the he removed the force on the cyclic pitch stick necessary to maintain altitude and fly right into the water.

2.5.4 Flight assignment

The aircraft was conducting an airborne spray in the fly zone of Pingnan Airport, from which the pilot was supposed to obtain meteorological information before taking off.

2.5.5 Personnel resource management

the pilot and the mechanic did not talk at all during the flight back from the operating zone. The pilot had his headset on but the mechanic did not in the noisy cockpit and the two would have to shout to hear each other. As a result, the two would rarely talk during flight. The A/E mechanic was responsible for simple maintenance in the operating area

and on-board. When flying with the pilot, the mechanic is supposed to monitor the aircraft's mechanical conditionand have his headset on for communication with the pilot. He is to help the pilot keep alert for potential risks and hazards.

2.6 Regulations & policies

Commercial Aviation Regulations

According to 1.18.3 Helicopters Flight Management Procedure, when a class-3 helicopter is to fly over water, it may choose to carry one of two types of life and survival equipment as determined by the Civil Aeronautics Bureau. The Civil Aeronautics Bureau requires strict adherence with this regulation. That is to say, when a class-3 helicopter flies over water beyond the auto rotation or offshore distance for safe emergency landings, the life & survival equipment assigned to Class 1 and 2 helicopters would become necessary. Again the Civil Aeronautics Bureau indicates that when necessary, the airline may discuss the issue and have similar safety equipment installed on board. The airline may also set its own offshore operation distance though it lacks legal grounds. The unclear standards set by the administration invite disputes.

Company policy

The pilot drowned after the aircraft crashed and had apparently violated the minimum altitude of 500 feet set by 2.4.1 Visual Flights Regulations. The accident could be attributed to pilot error. However, the airline is not blameless as the assigned flight did not meet the regulations for flights over water. The airline failed to avoid potential risks and take adequate safety measures.

2.6 Blood alcohol tests

The following is the information produced by Shanchie Medical Test Center in Tainan:

【Reference】:

Concentration of alcohol in blood mg/dl	Occasional drinker	Alcoholic
<10mg/dl	No alcoholic content at all (contact, inhalation).	
50~100	Reddish face yet does not	Probably no symptoms

	jeopardize thinking or behavior	
100~150[Note4NOTE 4]	Deteriorated sight or slow reactions	Slightly drunk
200~250	Loss of alertness and sleepiness	Deteriorated self control
300~350	Deep slumber or coma	Mixed-up, slow action
>500	Potential death	Coma

When rescued, the mechanic was rushed to Hongching Hospital in Kaohsiung for medical treatment. During observation, blood samples were taken and blood tests were conducted. The results of the blood test conducted at the hospital differed from that taken at the time of the accident resulting from the space of 32 hours between the accident and the test. Without adding 1% NaF, it would be improbable for the blood alcohol level to remain constant. All these factors affect the outcome of the test.

[Note4] :>100mg/dl is the drunk driving criteria.

Chapter 3 Conclusions

3.1 Findings

1. The applicable civil aviation laws and the company regulations duly certify the crew.
2. The aircraft had met all airworthiness requirements and airworthiness certificate was issued accordingly.
3. No irregularities were shown in the maintenance records of the aircraft, as its weight and balance were kept within the allowable range.
4. When B31007 was heading base after a successful aerial crop dusting mission, visibility in the control zone of Pingnan Airport was 3,200 meters, which was below the minimum of visual meteorological conditions - 5kms.
5. The northbound return flight the aircraft took along the Kaoping Stream just above the water does not meet Art. 54 of the Visual Flight Rules which prohibits flights under 500 feet.
6. Due to the lack of a flight dispatcher, who would otherwise authorize a flight back to the base from the operation site in an ordinary aerial dusting operation, the pilot in this case made the decision to fly based on the weather conditions provided by ground personnel at Fengshan. It was drizzling when the accident occurred and visibility on the return flight was below visual flight rules minimum. Without checking first, the pilot decided to fly without sufficient weather information.
7. Both the ceiling and visibility at the time of the accident met the standards for special visual flight rules as stipulated in Art. 56 of the Visual Flight Regulations. The regulations state that there is a ceiling of 500 feet and visibility must not be less than 1.5kms for visual flights. The pilot, without complete or accurate weather information, did not request for a special visual flight from the ATC unit, thereby disregarding Art. 92 of the. This article states that it is mandatory that the captain is fully aware and has all meteorological information before a flight.
8. The Civil Aeronautics Administration under the Ministry of Transportation & Communications had given written approval for

the flight that day (to be carried out between Oct. 15, 1999 and Jan. 15, 2000) but no flight plan was filed. This is a violation of Art. 91 of which states 7. Successful flight plan before the flight. (this sentence is missing something after the word “states”).

9. As a crewmember, the mechanic should have been on alert as well. The pilot failed to brief the mechanic who could have alerted the pilot that the aircraft was in close proximity to the ground.
10. The Excessive external forces which overloaded the airframe destroyed the aircraft. Additionally, the aircraft apparently had sufficient power when it crashed into the water.
11. Crew resources management was not effectively used due to incomplete pilot training, as the annual recurrent training stipulated in the Training Manual is not included in the Crew Resource Management course, the resources in the cockpit were not in effective use.
12. While results of blood and alcohol tests conducted on the mechanic after the accident showed a level which exceeded limits, stated in interviews that they did not believe that the mechanic was an alcoholic nor had consumed any alcohol before the flight. The different blood alcohol reading from the one taken just after the accident points to an inaccurate testing method. A blood alcohol level of 56mg/dl would not significantly effect normal thinking and behavior.
13. Clause 3, Art. 35 of the Helicopters Aviation Management Procedure is vague.

3. 2 Probable causes

The aircraft flew in poor visibility, and failed to maintain safe altitude; there was a lack of situational awareness of ground (water) obstruction. The aircraft struck the water because it was flying at an altitude too low for the pilot to take corrective actions.

3.3 Contributing factors

1. Noncompliance with regulations to file a flight plans.
2. Failure to follow.visual flight rules.
3. Lack of training and ignorance of potential danger when conducting visual flights..

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Chapter 4 Recommendation

To EMERALD PACIFIC AIRLINES

5. Aircraft shall carry proper safety equipment for onboard personnel when flying over water. (ASC-ASR-00-10-001)
6. Aviators shall attend visual flight safety courses from the training manual. (ASC-ASR-00-10-002)
7. Regular on-duty training courses shall include Crewmember Resources Management. (ASC-ASR-00-10-003)
8. Air crew shall undergo training and performance examinations. (ASC-ASR-00-10-004)

To Civil Aeronautics Bureau under Ministry of Transportation & Communications

4. To ask the airline industry to abide by Art. 91 of Helicopters Aviation Management Procedure and assessthe applicability of Art. 35.[Note5] (ASC-ASR-00-10-005)
5. To confirm that the industry is following visual flight weather and minimum altitude standards. (ASC-ASR-00-10-006)
6. To increase industry inspections to determine if Crewmember Resources Management plans are adequate and followed. The industry is hereby requested to have Crewmember Resources Management be included in the regular on-duty training courses and in the training manual. (ASC-ASR-00-10-007).

[Note5] 1. The Ministry of Transportation & Communication renamed the Helicopters Aviation Management Procedure as Flight Operations Management Procedure in October 2000.

2. Art. 225 of Aircraft Flight Operation Regulations have revised the regulations governing the life vest available on Class 3 helicopters.

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