AIRCRAFT ACCIDENT REPORT AND EXECUTIVE SUMMARY

				Reference:	CA18/2/3/8010		
Aircraft Registration	**ZS-RRB**	**Date of Accident**	3 September 2005	**Time of Accident**	0935Z		
Type of Aircraft	Agusta Westland 109-K2			**Type of Operation**	Commercial		
Pilot-in-command Licence Type	Commercial	**Age**	34	**Licence Valid**	Yes		
Pilot-in-command Flying Experience	Total Flying Hours	2 640.0		Hours on Type	320.0		
Last point of departure	National Port Authority helipad, Richards Bay						
Next point of intended landing	National Port Authority helipad, Richards Bay						
Location of the accident site with reference to easily defined geographical points (GPS readings if possible)							
Crashed into the sea, Richards Bay Harbour (GPS position: South 28° 48.751' East 032° 06.012')							
Meteorological Information	Surface wind; 030°/12 to 24 knots; Temperature; 27.5°C, Visibility; +10 km						
Number of people on board	2 + 1	**No. of people injured**	1 + 1	**No. of people killed**	1		

Synopsis

The Agusta helicopter with registration number ZS-RRB, serial number 10035, was withdrawn from service and subjected to a 4,800-hour maintenance inspection in Pretoria. After the inspection and two test flights, the helicopter flew from Pretoria to Richards Bay, a total of 5 hours since the inspection, and commenced with marine pilot services for the National Ports Authority in Richards Bay.

On Saturday, 3 September 2005 at 0930Z, the helicopter pilot and the hoist operator were tasked to pick up a marine pilot from a Greek-registered cargo ship, the Alpha Afovos, which was exiting the harbour of Richards Bay. The cargo ship had a designated helicopter landing area on the deck and the ship's fire and rescue team was positioned, awaiting the landing of the helicopter.

After a two-way radio conversation between the helicopter pilot and the marine pilot, the helicopter approached the cargo ship from the stern on the right-hand side and formatted parallel with the cargo ship at a height of approximately 7 to 8 metres above the port bridge wing area, from where the marine pilot was hoisted. While the marine pilot was still hanging from the hoist, the helicopter started to roll uncontrollably to the right, impacted with the Inmarsat B antenna and the main mast of the cargo ship and crashed into the sea on the starboard side of the ship. Both the helicopter pilot and the marine pilot were rescued and taken to hospital with serious injuries. The hoist operator was fatally injured. Nobody on board the cargo ship was injured.

Probable Cause

The helicopter, in strong cross-wind conditions, probably ran out of lateral left control input when the additional mass of the marine pilot was lifted by the hoist. It then rolled over to the right, collided with the cargo ship, crashed into the sea and sunk.

IARC Date		Release Date	

AIRCRAFT ACCIDENT REPORT

Name of Owner	: Viamax Fleet Management (Pty) Ltd
Name of Operator	: Acher Aviation (Pty) Ltd
Manufacturer	: Agusta Westland Company
Model	: Agusta 109-K2
Nationality	: South African
Registration Marks	: ZS-RRB
Place	: Richards Bay Harbour (In the sea)
Date	: 3 September 2005
Time	: 0935Z

All times given in this report are Co-ordinated Universal Time (UTC) and will be denoted by (Z). South African Standard Time is UTC plus 2 hours.

Purpose of the Investigation:

*In terms of Regulation 12.03.1 of the Civil Aviation Regulations (1997) this report was compiled in the interest of the promotion of aviation safety and the reduction of the risk of aviation accidents or incidents and **not to establish legal liability**.*

Disclaimer:

This report is produce without prejudice to the rights of the CAA, which are reserved.

1. FACTUAL INFORMATION

1.1 History of Flight:

1.1.1 The National Ports Authority (NPA) of South Africa utilised an Agusta 109-K2 helicopter, based in Richards Bay, for the transportation and transferring of marine pilots within the harbour. Marine pilots would either be transferred from shore to a cargo ship waiting to enter the harbour, picked up from a cargo ship leaving the harbour or for inter-cargo-ship transfers. This operation requires a 24-hour service and the helicopter crews therefore worked in shifts. The Agusta 109-K2 is a twin-engine turbine helicopter with a single rotor. It was approved to operate in VFR or IFR non-icing conditions.

1.1.2 The helicopter with registration ZS-RRB, serial number 10035, was released to service on 2 September 2005 by an approved Agusta Aircraft Maintenance Organisation (AMO) in Pretoria after completion of a 4800-hour maintenance inspection. The helicopter was subjected to two test flights by an appropriately rated test pilot and flew from Pretoria to Richards Bay on the afternoon of 2 September 2005. According to the aircraft's flight folio, the helicopter had flown a total of 5 hours since the inspection.

1.1.3 In Richards Bay harbour at approximately 0930Z, the helicopter got airborne for a routine flight, which required a marine pilot to be off-loaded from the cargo ship which was sailing out of the harbour channel towards the open sea. The cargo ship was the Alpha Afovos, a Greek-registered cargo ship with a gross weight of 39 941 tons. It was 224.9 m long and 32.26 m wide with seven (7) cargo carrying compartments, each compartment being covered with a hatch cover. Hatch number four was demarcated as a helicopter landing area. The helicopter was tasked to land on this hatch in order to pick up the marine pilot. Instead, the helicopter hoisted the marine pilot from the wing of the right bridge and never landed or attempted to land on the demarcated area on the deck.

1.1.4 This arrangement had been made after a discussion between the marine pilot and the helicopter pilot via two-way radio. According to the pilot, he and the hoist operator were both comfortable with this arrangement as it was not out of the norm to perform bridge wing hoist operations. On many other cargo ships, marine pilots are hoisted from the bridges.

1.1.5 During the hoisting operation, the helicopter pilot flew parallel to the cargo ship and noticed that approximately 2 to 3 seconds after taking the weight of the marine pilot, the helicopter started a slow, uncontrolled right roll. He realized that the helicopter was not responding to his cyclic control inputs and noticed a full deflection to the left in order to counter the right roll. The hoist operator warned the helicopter pilot several times not to move to the right, but the helicopter was not responding to any control inputs.

1.1.6 The helicopter continued to roll right and first impacted with the Inmarsat B antenna (dome shaped) of the cargo ship and the main rotor blades of the helicopter struck the main mast of the cargo ship. At this stage the marine pilot was hanging below the helicopter and both crashed into the sea on the right-hand side of the cargo ship in a nose-down attitude.

1.1.7 The rescue crew from the cargo ship immediately threw several life rings into the water and the Master of the cargo ship informed the Port Control that the helicopter had crashed into the sea at the South Breakwater area.

1.1.8 Two persons in a kayak close by, saw the accident and assisted the helicopter pilot and marine pilot by keeping them afloat until a ski boat with professional divers on board, arrived on the scene. Both the helicopter pilot and marine pilot were seriously injured, and taken to a local private hospital.

1.1.9 The marine pilot was admitted to the intensive care unit (ICU) of the hospital where he was sedated for most of the time and remained in ICU for nearly two weeks. He had sustained several injuries, which included severe and multiple fractures to his ribs, broken collarbones, as well as head, shoulder and internal injuries, including punctured lungs. His recollection of the accident was very hazy.

1.1.10 The helicopter pilot sustained a serious back injury and was hospitalised for 12 days.

1.1.11 The hoist operator was fatally injured in the accident. Police divers recovered his body the following morning from the wreckage at a depth of approximately 22 metres.

1.1.12 The accident occurred during daylight conditions at a geographical position determined as South 28° 48.751' East 032° 06.012'.

1.2 Injuries to Persons:

Injuries	Pilot	Crew	Pass.	Other
Fatal	-	1	-	-
Serious	1	-	1	-
Minor	-	-	-	-
None	-	-	-	-

1.2.1 Both the helicopter pilot and the marine pilot survived the accident, but sustained serious injuries. Both were subjected to surgery, and hospitalised for several weeks.

1.2.2 The hoist operator's body was recovered from the wreckage the following morning by Police divers. He was wearing floatation equipment which was not inflated and found still secured by his safety harness in the aft cabin area of the helicopter.

1.3 Damage to Aircraft:

1.3.1 The helicopter was extensively damaged and found at the bottom of the sea.

A view of the wreckage being lifted out of the sea by a crane.

1.4 Other Damage:

1.4.1 The cargo ship suffered some structural damage caused by several main rotor blade strikes to the structure. The Inmarsat B antenna was destroyed in the process.

The Inmarsat antenna visible on the left and the main mast impact markings visible on the right of the picture.

1.5 Personnel Information:

1.5.1 Pilot-in-command:

Nationality	South African	Gender	Male	Age	34
Licence Number	***************	Licence Type	Commercial		
Licence valid	Yes	Type Endorsed	Yes		
Ratings	Instructor Rating Grade 2, Instrument Rating (H), Under sling/winch Rating				
Medical Expiry Date	31 January 2006				
Restrictions	None				
Previous Accident	Pilot was flying a sea rescue helicopter (Bell 206B, ZS-HEK, 29 December 2000) during the Trans-Agulhas yacht race when he experienced a loss of tail rotor effect (LTE) while flying over the sea. The helicopter crashed into the sea near Reebok in the Western Cape. All the occupants on board the helicopter survived the accident. The helicopter was later recovered from the sea.				

The pilot had flown several helicopter types prior to his conversion onto the Agusta 109 series helicopter. According to available records, the pilot had completed his conversion onto the Agusta 109-K2 on 5 February 2004. During his conversion training he flew a total of 3 hours and 30 minutes of dual instruction with an instructor. The required documentation was submitted to the SACAA on 25 February 2004 for endorsement of the Agusta 109 type helicopter onto his licence.

He was regarded by his colleagues as a very good pilot and had conducted over a thousand hoist operations.

Flying Experience:

Total Hours	2 640.0
Total Past 90 Days	50.0
Total on Type Past 90 Days	50.0
Total on Type	320.0

Breakdown of Flying Experience:

Total Flying Hours Aeroplane	970.0
Total Flying Hours Helicopter	1 670.0
Total Hours	**2 640.0**

1.5.2 Hoist operator:

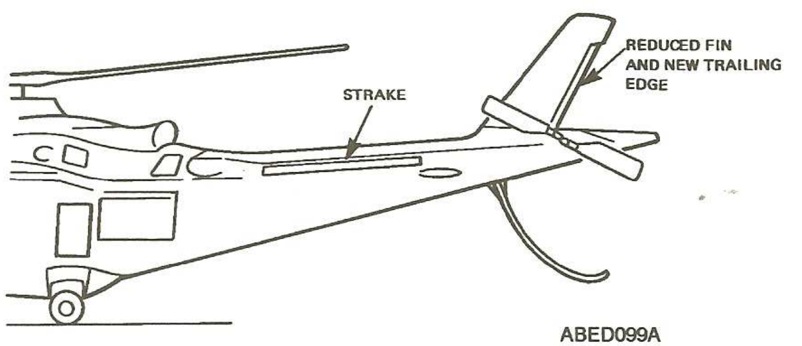
The hoist operator was employed by the operator. His designation was: "Hoist Operator daylight operations only, engineer under training". He had received his initial aviation training in the South African Air Force (SAAF) where he qualified as a maintenance engineer in January 2001. In November 2003 he qualified as a flight engineer. He resigned from the SAAF and joined the helicopter operator in December 2004. He was signed out as a hoist operator on 24 February 2005 for daylight service(s) only. He was in the process of obtaining his civilian Aircraft Maintenance Engineer (AME) qualification by attending the required training courses during designated periods, as stipulated in his employment contract.

1.6 Aircraft Information:

The Agusta 109-K2 is a twin-engine helicopter. It is equipped with two Turbomeca Arriel 1K1 turbo-shaft engines. The helicopter has eight seats and was certified under FAR 27 with the exemption of paragraph 27.1(a) for a maximum gross weight increase to 2 850 kg (6283 lb). The helicopter was approved for land operation under day and night VFR and IFR, non-icing conditions. No aerobatic manoeuvres were permitted.

A photo of the helicopter that was taken some time prior to the accident.

The helicopter was equipped with the 'High Altitude Configuration" P/N 109-0822-36 kit, which provides an improvement in yaw controllability in hovering and it was especially designed for rescue operations at high altitudes with an external hoist. The configuration consists of a horizontally mounted tail boom strake on the left side, and a reduced vertical fin surface with a new trailing edge.



Also included was a "Tail Rotor Configuration" P/N 109-08220-42 to extend the tail rotor pitch angle setting to 23°.

1.6.1 Airframe:

Type	Agusta 109-K2
Serial Number	10035
Manufacturer	Agusta Westland Company
Year of Manufacture	1998

Total Airframe Hours (At time of Accident)	4 801.1	
Last Inspection (Hours & Date)	4 796.1	2 September 2005
Hours since Last Inspection	5.0	
C of A (Issue Date)	9 December 1998	
C of A (Currency Fee, Expiry date)	8 December 2005	
C of R (Issue Date) (Present owner)	18 December 2001	
Operating Categories	Standard	
AD's and SB's status	Complied with	
Type acceptance in RSA	Yes	

1.6.2 Engine No. 1:

Type	Turbomeca Arriel 1K1
Serial Number	16077
Hours since New	4 321.6
Hours since Overhaul	Modular engine

1.6.3 Engine No. 2:

Type	Turbomeca Arriel 1K1
Serial Number	16079
Hours since New	5 811.6
Hours since Overhaul	Modular engine

1.6.4 Mass and Balance:

According to the helicopter's Airframe Logbook the Mass and Balance was last determined on 20 November 2003. The aircraft data used in the Mass and Balance calculation below was obtained from the mass sheet. The investigation calculated the mass of the helicopter and the centre of gravity (CG) as shown in Table 1.

Table 1: Mass and Balance sheet

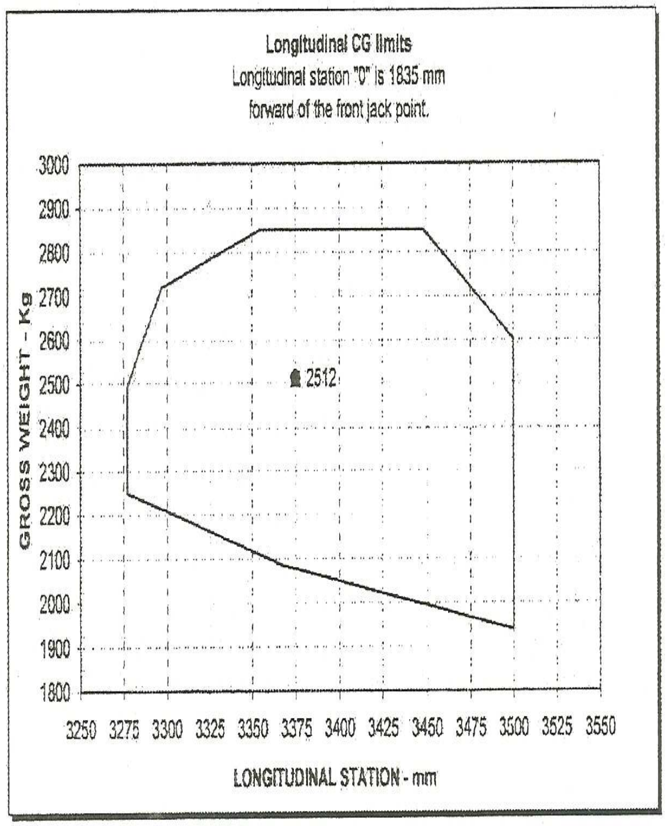
Item	Mass (kg)	Arm (mm)	Moment
A/C Empty Mass	1 973.4	3515	6936501
Engine Oil (15.0 kg)	15.0	3311	49665
Floats (56.0 kg)	0.0	3543	0
Hoist (46.7 kg) + Pass (85kg)	131.7	2720	358224
Cargo Hook (12.3 kg)	0.0	3415	0
Survival Equipment (12.0 kg)	12.0	2455	29460
Zero Fuel Mass	**2 132.1**	**3458**	**7373850**
Pilot	85.0	1585	134725
Co-pilot	0.0	1585	0
Passenger 1	0.0	2455	0
Passenger 2	0.0	2455	0
Passenger 3	75.0	2455	184125
Passenger 4	0.0	3200	0
Passenger 5	0.0	3200	0
Passenger 6	0.0	3200	0
Baggage	0.0	5650	0
Fuel: Main (max 462)	220.0	3570	785400
Fuel: Aux (max 120)	0.0	0	0
Total Weight	**2 512.1 Kg**	**3375**	**8478100**

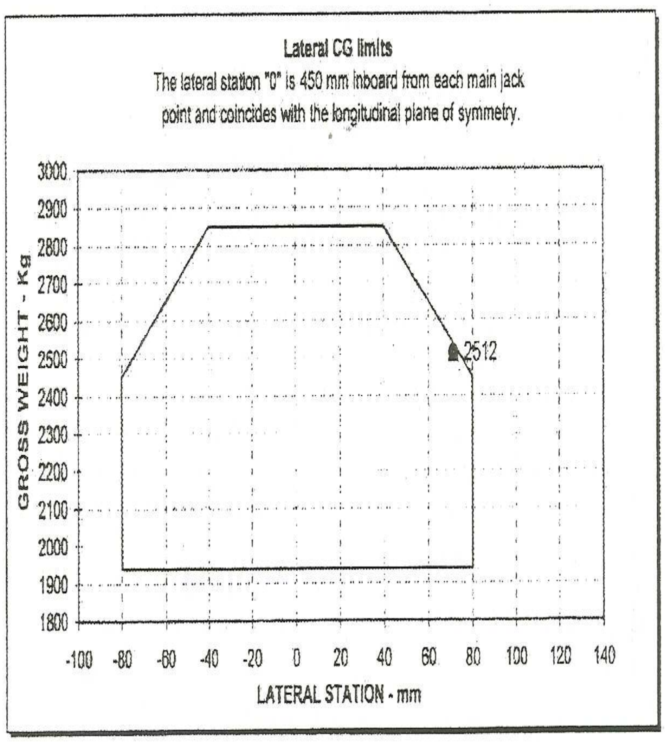
The maximum certified take-off mass of the helicopter according to the Pilot's Operating Handbook (POH), Section 1, Pg. 1-5 was not allowed to exceed 2 850 kg (6283 lb) which was well within the approved operating envelope of the helicopter.

*NOTE: For the purpose of determining the Mass and Balance calculation, the mass of the hoist operator was obtained from the post-mortem report. The mass of the marine pilot was taken as 85kg and that was added to the mass of the hoist and the combined mass acted at a point 930 mm to the right-hand side of the centre line of the helicopter. During the hoisting operation, the pilot as well as the hoist operator were situated on the right-hand side of the helicopter.

The remaining fuel load was taken as 220 kg. The pilot took off with a fuel load of approximately 260 kg and 40 kg of fuel was subtracted for the flight, including start-up. No actual weight and balance calculation was performed by the pilot prior to the accident flight.

From the CG table below, it is evident that the calculated mass was well inside the longitudinal envelope and well within limits, with the lateral table being on the edge of the allowable limit for non-hoisting operations.



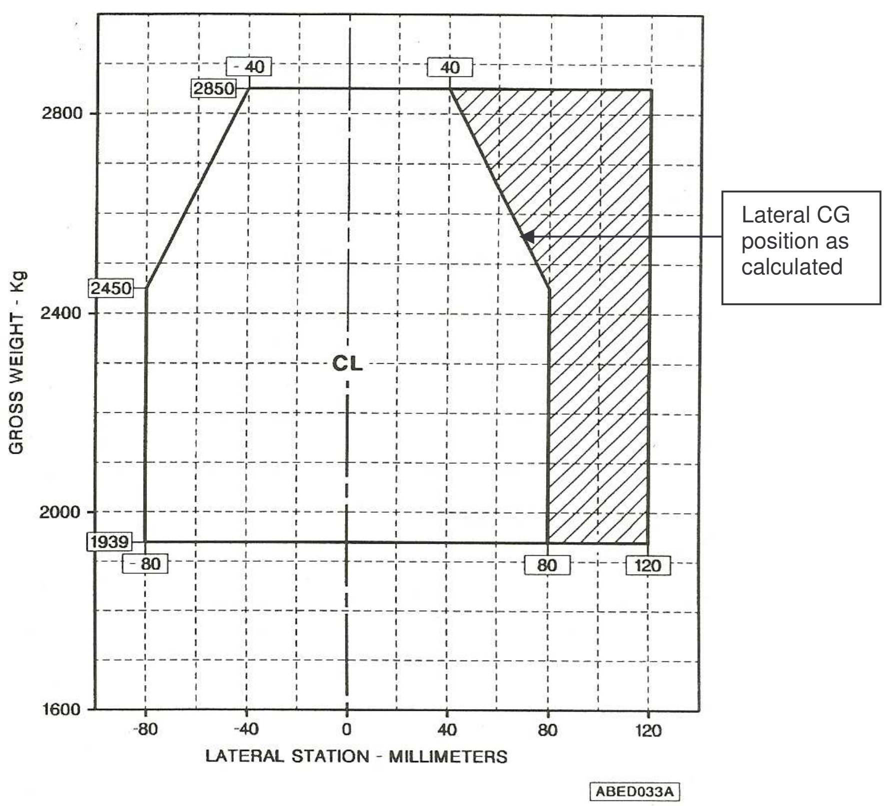


Below is a copy of the POH page, which allows the lateral Centre of Gravity (CG) to be increased into the shaded area when hoisting operations are being conducted. It should be noted that the longitudinal CG limits do not change when operating in the external hoist configuration. See figure 1-3 (on page 17) for Lateral CG limits.

RFM A109K2
IFR

APPENDIX 28

AGUSTA



NOTE

The lateral station "0" is 450 mm inboard from each main jack point and coincides with the helicopter longitudinal plane of symmetry.

NOTE

The diagram shaded area is applicable only during hoist operation.

Figure 1-3 (sheet 1 of 2). Lateral CG limits (metric).

Page 6 of 15 R.A.I. Approved

The POH continues on the subject of External Hoisting by stipulating in the pre-flight checks the requirement that the hoist operation should be verified. Refer below.

CAUTION

"Avoid, whenever possible, operating the hoist with crosswind or rear wind.

.

NOTE:

Lift hoist load slightly above contact surface, by application of collective pitch, to obtain a feeling of the controls.

EMERGENCY AND MALFUNCTION PROCEDURES

The external hoist installation is provided with an electrical cable cut system operated by the pilot. If an emergency condition should require the release of cargo, lift the guard to break the safety wire and operate CABLE CUT switch to shear the hoist cable. If the electrically operated cable cut system fails to operate, cut the cable with the manual cable cutter accessible to the operator. Cut the cable as close to the hoist as possible."

1.7 Meteorological Information:

1.7.1 An official weather report was obtained from the SA Weather Services following this accident.

(i) Weather conditions at the time of the accident:
A cold front south-west of the country with a high-pressure system east of the country, causing an offshore flow in the Richards Bay area.

(ii) Satellite Imagery:
The satellite imagery showed fine weather in the Richards Bay area with no clouds.

(iii) Weather conditions in the vicinity of the accident:
No official observation was available at the time and place of the accident. However, the satellite image shows fine weather in the area. The most likely weather conditions at the place and time of the accident were:

Temperature	-	27.5°C
Dew point	-	19.0°C
Wind direction	-	030°
Wind speed	-	12 knots
Cloud	-	Nil

1.7.2 The reported wind at the time of the accident according to the Master of the Alpha Afovos was 5 to 6 on the Beaufort scale, which was between 19 to 24 knots from the north-east.

1.7.3 The weather conditions at the time of the accident were well within the operating limitations of the helicopter and the pilot. According to the helicopter pilot, at no stage during the operation was the prevailing cross-wind a concern, as he was able to maintain a steady hover up until the right roll commenced.

1.8 Aids to Navigation:

1.8.1 The helicopter was certified for Instrument Flight Rule conditions and was properly equipped.

1.9 Communications:

1.9.1 The helicopter was equipped with a dual VHF radio as well as an FM Tactical Communication radio.

1.9.2 A recording of communication between the cargo ship, the marine pilot and Port Control was obtained from Port Control. During one of these recordings, the discussion of the marine pilot with the helicopter pilot regarding the position for the pick-up was clear but the response from the helicopter pilot was, however, not audible.

The following is a transcript of the communication by the marine pilot with the helicopter at 0934Z:

From marine pilot to helicopter pilot:

John, good afternoon, you know you can land on No. 4 hatch, over. It is marked 'Winch Only' but it is a landing area, by the way take me off anywhere you like from the bridge wing.
Unreadable communication from helicopter pilot.
Yes, are you talking about the bridge wing?
Unreadable communication from helicopter pilot.
South side?
Unreadable communication from helicopter pilot.
Port (unreadable word) I am on standby now.

1.9.3 Extract from the Operations Manual, Annexure H, SOP – Marine Pilot Services:

"Appendix K: Communications with Port Control and Shipping

The standard working channel for the helicopter is Channel 14 for Richards Bay and Channel 13 for Durban. This channel is used for communications with both Port Control and the ship. Port Control is required to monitor this channel for the duration of the flight. This is important because of the possibility of the helicopter ditching.

Appendix T: Communication with cargo ships

Various responsibilities that cannot be delegated are associated with ship service operations in general. This is especially true in the case of cargo ships transporting hazardous cargoes.

Communication between the helicopter and the cargo ship master or designate is a prerequisite.

Language limitations do sometimes require sound professional judgement from the helicopter crew in their efforts to provide the service.

Port Control/Signals are to establish contact with cargo ships, advise of the helicopter service and deal with the bulk of the information required in terms of the international guide to ship service operations by helicopter.

The helicopter should, however, still communicate directly with the cargo ship with the following brief requirements:

- Establish contact with the cargo ship
- Establish the position of authority of the respondent
- Advise of the helicopter ETA overhead
- Establish if there is a designated landing/hoisting area
- Request permission to land pilot/provide service.

It is recommended that communication be established with the cargo ship at least 30 minutes prior to service. This allows the cargo ship masters to organize and mobilize their fire crews if they feel that this is necessary.

It is the responsibility of the duty helicopter commander to ensure that he has all the information required to conduct a safe service. This most importantly includes the cargo ship master’s authority. Authority given to the marine pilot on board the helicopter is sufficient; provided that the helicopter commander confirms that he has heard the authority and any limitations associated with this authority."

1.10 Aerodrome Information:

1.10.1 Not applicable.

1.11 Flight Recorders:

1.11.1 The helicopter was not fitted with a Cockpit Voice Recorder (CVR) or a Flight Data Recorder (FDR) and neither was it required by regulation to be fitted to this type of helicopter.

1.12 Wreckage and Impact Information:

1.12.1 The right rear section of the fuselage of the helicopter from behind the main landing gear impacted with the Inmarsat B satellite communications antenna of the cargo ship. The main rotor blade contacted with the main mast five to seven metres above the antenna and impacted with various objects on the cargo ship before the helicopter ditched on the starboard side of the cargo ship. The helicopter yawed towards the right through 40° to 90° from the initial blade contact to water impact.

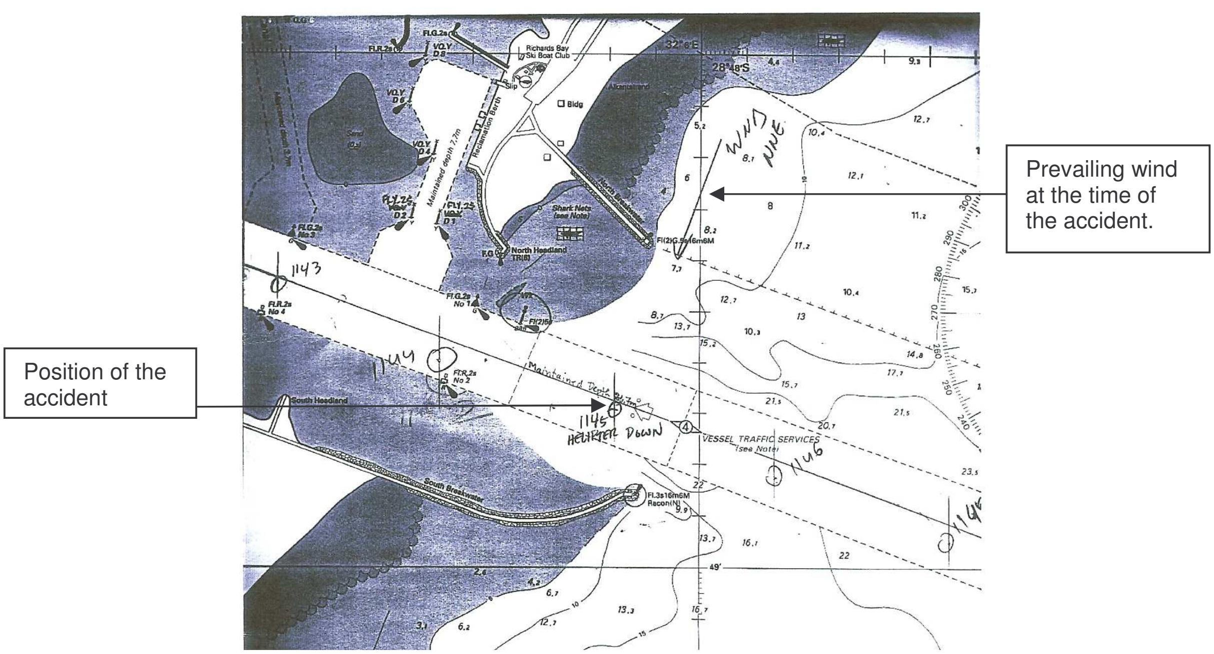


Illustration of accident position relative to the harbour channel.

1.12.2 The right side of the helicopter suffered substantial impact damage consistent with the damage to the cargo ship, residual paint marks and helicopter blade debris found on the cargo ship. The helicopter was predominantly intact except for the tail cone, including the tail rotor gearbox and blades. Impact marks on the right-hand vertical tail fin suggest that impact with the cargo ship had caused the separation of these components. Further blade rotational impact marks on the left stabiliser confirmed that the tail rotor was turning at the time of impact.

1.12.3 Water impact indentation on the nose section of the helicopter suggests that it impacted with the water in a nose-down attitude. Consistent with this, was the cabin roof bowing upwards due to the weight of the main gearbox, main rotor head and the nose cone.

1.12.4 The rescue hoist had separated from the attachment points at some stage during the accident and was found on top of the helicopter when recovered. This was due to impact with the cargo ship or severely distorted main rotor blade impact. Two point six five metres of the cable was still unreeled. The hoist cable and hook mechanism was found undamaged.

1.12.5 The top left side of the helicopter above the co-pilot's seat was separated from the wreckage due to main rotor blade impact.

1.12.6 Various other impact marks on the helicopter were found, consistent with impact with the cargo ship and the distorted main rotor blades.

1.12.7 The cockpit of the helicopter was damaged at the rear bottom of the cabin area and on top of the cabin just in front of the door posts between the cabin and the cockpit. This damage could, however, also have occurred during the recovery, towing and lifting of the wreckage out of the water by crane.

1.12.8 No underwater photos were taken while the helicopter was submerged prior to recovery, due to the poor visibility under the water.

1.13 Medical and Pathological Information:

1.13.1 The hoist operator was fatally injured. He was located in the rear cabin and found secured to the helicopter structure by means of an extended safety harness.

According to the post-mortem report the deceased did not drown, but was killed due to multiple blunt force injuries involving the head, the chest and lungs and the abdominal organs. There was no evidence to indicate that water was inhaled into the lungs. The injuries indicated a high level of impact forces due to the break-up of the helicopter or as a result of impact with the water.

A specimen of blood of the deceased was made available to the Forensic Chemistry Laboratory of the Department of Health in Pretoria and the following results were obtained:

(i) The concentration of alcohol in the blood was 0.00 grams per 100 millilitres.

(ii) The sample contained 2.5% sodium fluoride, which was sufficient to prevent the formation of alcohol therein.

(iii) The carbon monoxide saturation of the haemoglobin was less than 5%.

1.14 Fire:

1.14.1 There was no evidence of a pre- or post-accident impact fire.

1.15 Survival Aspects:

1.15.1 Helicopter Pilot:

The helicopter pilot was secured by the helicopter-installed four-point safety harness, and survived the accident but sustained serious injuries. After impact with the water, the helicopter started to sink and he followed the HUET (Helicopter-Under-Water-Escape-Training) procedure and exited the helicopter through the pilot's door and reached the surface. The pilot was wearing floatation equipment which was found inflated. He remained in hospital for a period of 12 days due to a fractured vertebra (L5) in his lower back.

1.15.2 Marine Pilot:

The marine pilot sustained serious injuries. He was also wearing emergency floatation equipment which was fully inflated around his waist instead of around his neck. He was taken to the same hospital as the helicopter pilot and was admitted to the Intensive Care Unit for 27 days. He sustained severe injuries, including severe and multiple fractures to his ribs, broken collar bones, injuries to his head and shoulder and internal injuries, which included punctured lungs. During most of this period he was heavily sedated.

1.15.3 Hoist Operator:

The hoist operator was seated in the rear cabin area behind the helicopter pilot on the right-hand side aft-facing seat. He was wearing emergency floatation equipment which was found to be not inflated. He was attached to the helicopter by means of a "monkey chain" which was attached to the roof structure of the helicopter. The quick release mechanism of the "monkey chain" was unsuitable for the application as the quick release was located behind his back and required effort to release in case of an emergency. Police divers recovered the hoist operator's body from the wreckage still secured to the "monkey chain".

1.15.4 Helicopter Floatation Gear:

The helicopter was not equipped with floatation gear. After impact, the helicopter wreckage sank within minutes to the bottom of the sea. According to the helicopter operator, the floatation gear was unserviceable at the time of the accident and was in the process of reparation.

Part 127 of the Operations Manual of the Operator, stipulates the following in Part 2, page 202:

"Over Water Flights;

(a) The operator ensures that, in the case of flight over water –

 (iii) The helicopter is equipped for flights over water in terms of the CARs.

The requirements in terms of the Civil Aviation Regulations of 1997;

Part 91.04.27 No owner or operator of –

(c) a helicopter, shall operate over water beyond authoritative distance from land, other than only for take-off and initial climb, or final approach and landing, unless –

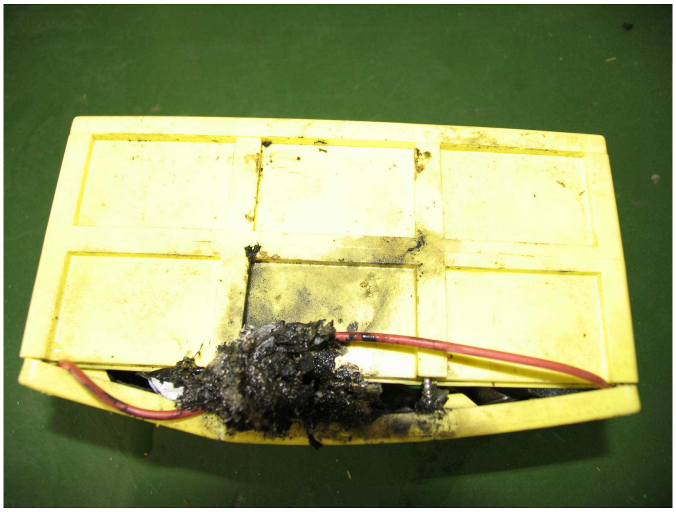
 (ii) such helicopter is equipped with –

  (bb) floatation equipment to ensure a safe ditching: Provided that in the case of aerial spraying operations over water, the owner or operator may apply to the Commissioner for an exemption in terms of Part 11."

1.15.5 Emergency Locator Transmitter (ELT)

The helicopter was equipped with a Kannad 406 MHz ELT with serial number 26115680005. The purpose of the unit is to broadcast a distress signal during activation (during the accident impact sequence) in order to locate the wreckage as quickly as possible, and to save human lives.

The ELT on this helicopter was located within the tail boom, as called for in Service Bulletin BT109K-41. The unit, however, was unable to survive the impact forces and was found to have burst open, as can be seen in the photo below. The activation selection button on the unit was also found to be in the off position, which rendered the unit of no value.



A view of the ELT as it was found after recovery of the wreckage.

1.16 Tests and Research:

1.16.1 Servo Actuators:

The three main servo actuators, as well as the tail rotor servo actuator, were removed from the wreckage and forwarded to Agusta in Italy for further investigation by the vendor Microtecnica. The following conclusions were made:

"All the servo actuators were subjected to functional tests. The results were in line with the manufacturer's requirements, except for minor deviations, which could not effect the normal operation of the items. Some of these deviations derived from the impact while others were function deviations. In most cases typical wear signs due to normal operation were visible. Some minor deformations, mainly on rods, were observed and were easily related to the impact damage. In some cases corrosion was observed at the input areas of the spools of the servo valves. In one case, corrosion was quite extended and probably existent before the accident".

The final assumption is that there was no evidence of malfunctioning prior to the accident.

The full investigation/technical report of the servo actuators can be found attached to this report as Annexure "B".

1.16.2 Engine Investigation:

Both engines were subjected to pre-removal inspections by a Turbomeca's engine accident investigator before removal from the wreckage. Both engines were subjected to a teardown inspection at the facilities of Turbomeca, under the auspices of the investigator-in-charge.

The engines were both found to be in a serviceable condition and were producing sufficient power at the time of the accident.

The non-rotation of the gas generator, the free turbine and gearbox assemblies were due to corrosion progression as a result of engine water submersion. The full investigation/technical report can be found in Annexure "C".

1.16.3 Metallurgical Examination Report:

A number of fractured metal components were removed for metallurgical examination in order to determine the possible failure modes. The tail rotor gearbox and tail rotor blades were never recovered from the sea. The following components were subjected for examination:

(i) Mixing Unit
(ii) Fractured main rotor blade horn
(iii) Main rotor gearbox supports

(iv) Flight control rods
(v) Main rotor pitch change link
(vi) Main drive shaft couplings
(vii) Tail rotor drive shaft coupling
(viii) Tail rotor gearbox attachment.

Conclusion:
All the components examined were found to have failed under the influence of overload stresses, either brittle failure caused by impact, or ductile failure caused by conditions associated with overload. No evidence of any pre-existing defects was observed. The available evidence therefore suggests that failure of all the components examined was caused by the accident.

NOTE:

Two of the components examined were components/structures related to the tail rotor. The tail rotor assembly was never recovered from the sea and therefore no physical evidence was available. It was therefore important to establish if the tail rotor assembly contributed or may have caused the accident. The recollection of the pilot and eyewitnesses did not indicate that it could have been a failure/event related to the tail rotor. The pilot did not mention any sudden loss of tail rotor control authority problems or any sudden yaw associated with a tail rotor failure. In order to eliminate any condition related to the tail rotor, available evidence had to be examined with the conclusion that the failure modes observed were caused by the accident itself.

The full report on the examination of the components listed above can be found attached to this report under reference Annexure “D”.

1.17 Organisational and Management Information:

1.17.1 The helicopter operator was the holder of a valid Class II and a Class III Air Service Licence, which was issued on 21 April 2004 by the Air Service Licensing Council in terms of the Air Services Licensing Act of 1990 (Act No. 115 of 1990). According to the certificate they were authorized to provide type G3, G11 and G15 air services, by making use of category H1 and H2 type aircraft.

1.17.2 The helicopter operator was in possession of a valid Air Operating Certificate (AOC) issued by the SACAA. The helicopter ZS-RRB was duly authorised to operate under the AOC.

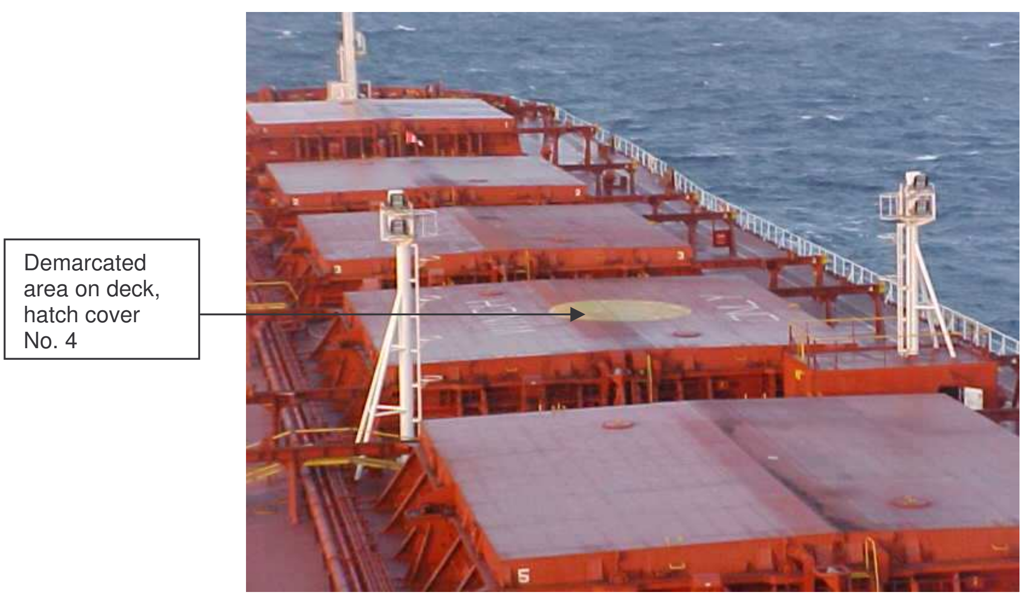
1.17.3 The Aircraft Maintenance Organisation (AMO) which had carried out the 4800-hour maintenance inspection on the helicopter was in possession of a valid AMO Approval. It should be noted that another team of maintenance personnel from a different AMO had assisted the maintenance personnel of AMO.

1.17.4 The day-to-day maintenance of the helicopter and the rectification of defects were the responsibility of AMO No. 852.

1.18 Additional Information:

1.18.1 Inspection on board the cargo ship Alpha Afovos.

After the accident, the cargo ship was allowed to leave port and was requested by Port Control to anchor in the open sea, clear of the harbour channel. Another helicopter from the same operator was dispatched from Durban and landed at the NPA helicopter base in Richards Bay. Four occupants were uplifted; a ship surveyor from the South African Maritime Safety Authority (SAMSA), the harbour captain and two senior members of the helicopter operator. The helicopter landed on the cargo ship to interview the Master of the cargo ship and the Chief Officer. During the subsequent inspection of the ship, several photos were taken on board, which were made available to the investigating team:



A view of the deck of the Alpha Afovos, indicating the helicopter area on deck.

A view of a helicopter that landed on the hatch cover of another similar type of cargo ship.

The investigating team did not get the opportunity to inspect the cargo ship and had to rely on the evidence that was made available. An attempt was made to inspect the cargo ship once it had docked in Brindisi, Italy, but the cargo ship owners refused to give them permission.

1.18.2 External Hoist:

The external hoist enables cargo and emergency rescue operations in areas where a landing cannot be accomplished. It consists of an electric hoist motor and winch assembly, mounting frame, and electronic control system that allow the pilot or the crew member to operate the hoist from the right-hand side of the helicopter and was installed on the right-hand side of the helicopter 904 mm from the centre-line of the helicopter.

The hoist unit contains 75 useable metres (245 feet) of hoist cable. Cargo hoisting and lowering can be controlled by the hoist operator through the remote control thumbwheel providing variable cable speeds, or by the pilot through the hoist control switch on the collective stick at a fixed cable speed.

Hoist operation was permitted with the helicopter in stationary hover only.

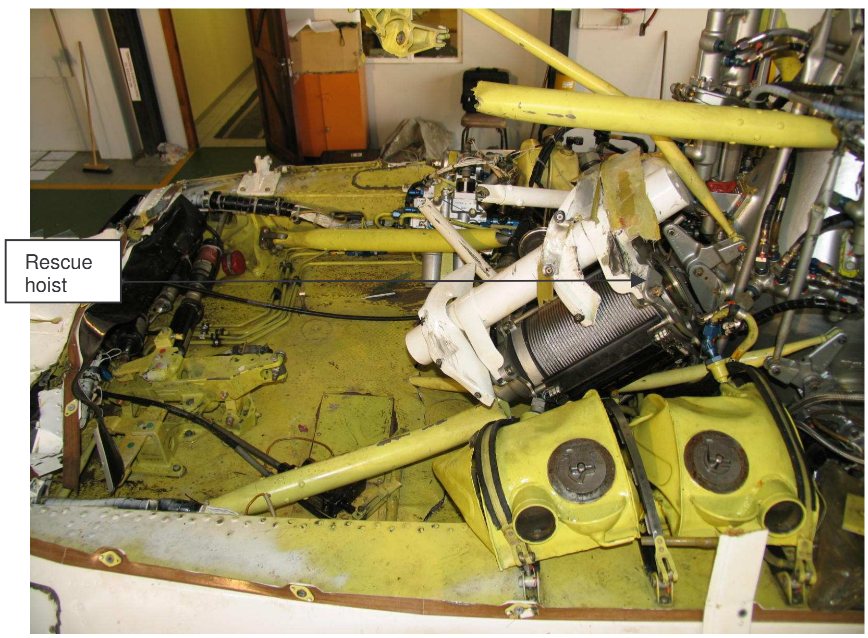
During this specific hoisting operation, the helicopter was not in stationary hover but at an airspeed of at least 6 knots, which was the speed of the ship.

Aircraft horizontal translation with external hoisted load outside the aircraft cabin is approved in any azimuth direction, limited to 20 knots relative airspeed up to 9 000 ft density altitude, provided that the following installations are installed:

P/N 109-0822-36	"High altitude configuration"
P/N 109-0822-42	"Tail rotor configuration"
or	
P/N 109-0822-36	"High altitude configuration"
P/N 109-0881-01	"Tail modification"
P/N 109-0822-42	"Tail rotor configuration."

The hoist unit was equipped with a squab mechanism that could be utilized by the pilot to jettison the load and the cable in the case of an emergency, which would usually be done in collaboration with the hoist operator.

However, the crew was not allowed to jettison a hoist cable during 'live cargo' operation at any time, as it would be against company policy and procedures. This was found to be in conflict with the SACAA approved Operations Manual of the Operator Part 127, Annexure H, Appendix S, Paragraph 3.2.



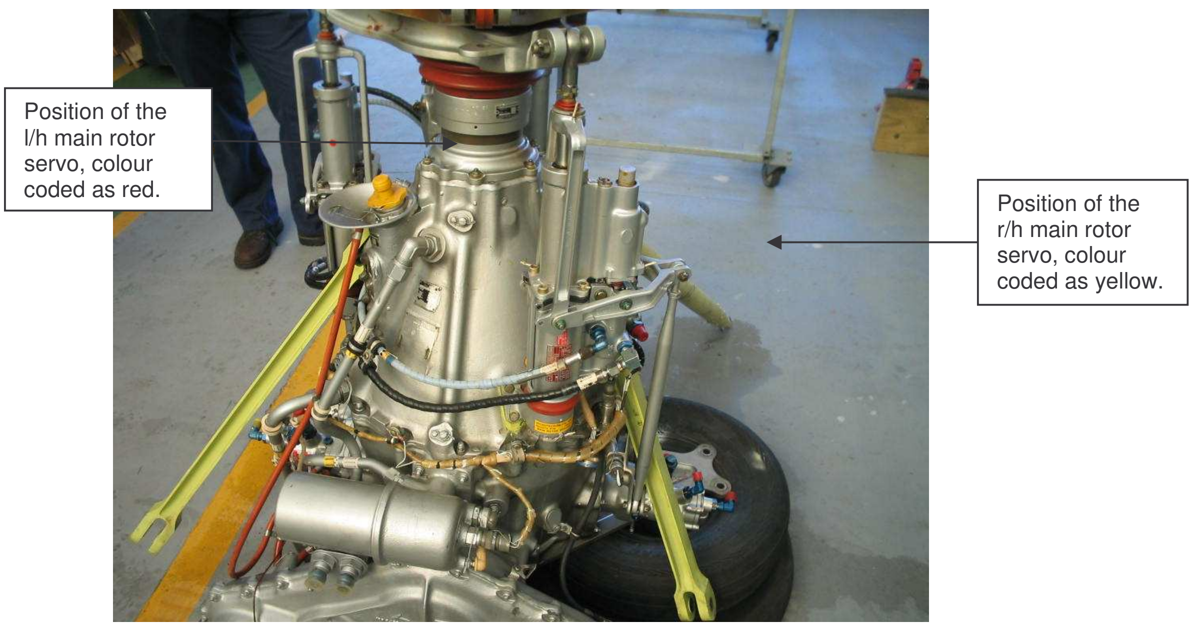
View of rescue hoist lying on top of the roof structure of the helicopter as recovered.

1.18.3 Main Rotor Servo Actuators:

The main rotor servo actuators installed on the helicopter were as follows:

	Main Rotor Servo (Red)	Main Rotor Servo (Yellow)	Main Rotor Servo (Blue)
Microtecnica Part Number	204-28007-00	5-28007RevB	206-28007-00
Agusta Part Number	109-0110-42-124	109-0110-42-5	109-0110-42-126(?)
Serial Number	02159	2016	81

*NOTE: The Agusta Part Numbers as reflected above were extracted from the Microtecnica report that was made available. The question mark next to the Agusta Part Number in the last column has been included to indicate that the part number that was installed on the helicopter under the "blue label" actually ended with #124 and not 126 as indicated by the report.



View of main rotor servo assembly taken from the aft position for illustration purposes.

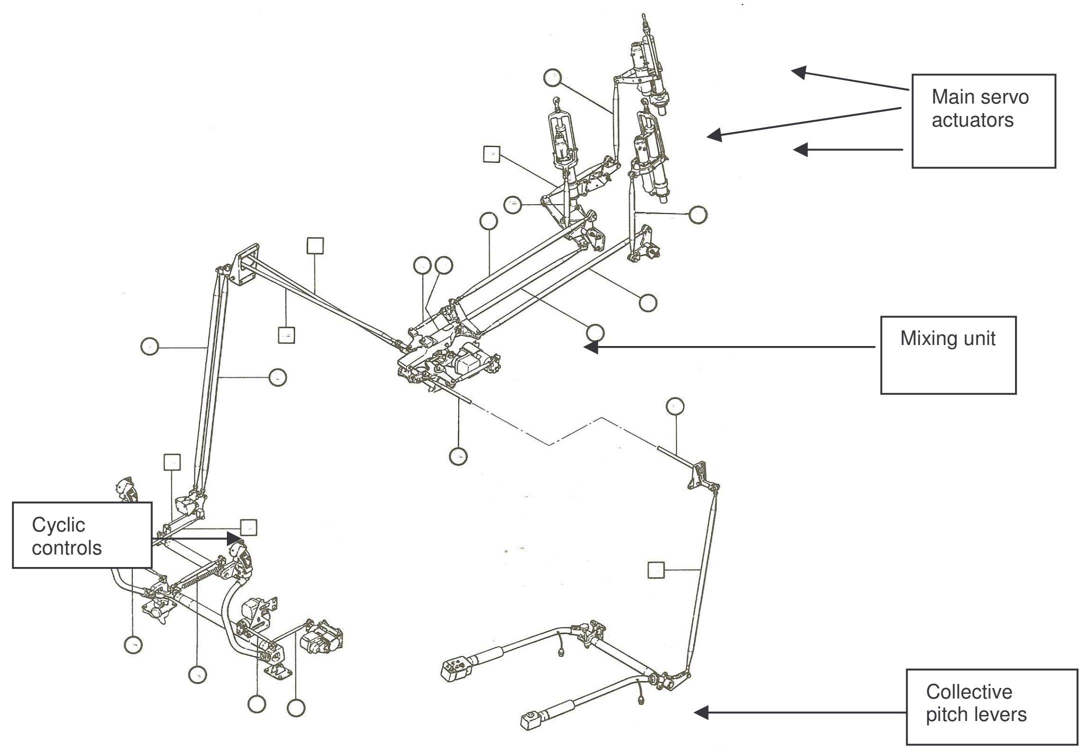
It should be noted that the red and blue main rotor servo actuators identified by the dashes 124/-126, were introduced by Agusta in an optional Bollettino Tecnico No. 109K-14, dated 4 September 1996, as revised on 19 May 1997.
Bollettino Tecnico No. 109K-14, from which the above information was extracted, can be found attached to this report, as Annexure A.

The main rotor servo actuators were removed from the wreckage and forwarded to the manufacturer Microtecnica for examination.

The Microtecnica Investigation/Technical Report TR-A109-205 pertaining to the servo actuators was made available, with the following conclusion; “The final assumption is that for all the items there was no evidence of any malfunctioning prior to the accident”. (Reference: Paragraph 1.16.1 of this report, as well as Annexure B).

1.18.4 Flight Controls:

After the recovery of the wreckage from the water and the subsequent post-crash inspection of the continuity of the flight controls, it was noted that a substantial number of control rods had failed during the impact. Most of these control rods were located on the transmission platform (forward roof structure) of the helicopter where it met up with the mixing unit and from there to different attachments on the main rotor head. The fact that the rescue hoist came to rest on the roof structure was probably due to a totally aerodynamically unstable main rotor blade, or portion of it that flexed down and impacted with the hoist motor, smashing its housing and dislodging it completely in the direction of blade rotation onto the top of the transmission platform. This resulted in the failure of nearly all the control rods on the transmission platform. It was not possible to check the rigging and status of the flight controls due to the destruction of the wreckage. All flight control rods were accounted for and several were subjected to metallurgical examination in order to determine the failure mode, which was found to be consistent with overload conditions.



Basic layout of the cyclic and collective pitch controls.

The tail rotor controls were also inspected and displayed continuity up to the station where the tail rotor assembly had separated from the tail boom. All four main rotor pitch change linkages were accounted for, and were found to be wire-locked as required.

1.18.5 Hydraulic System:

An inspection of the hydraulic system was undertaken. Due to the submersion in the sea, all evidence associated with a possible leak in the system was destroyed. All system-associated components were accounted for, apart from accident damage. According to the pilot, he had not experienced a hydraulic system failure nor any warning light associated with such a failure.

1.18.6 Tail Rotor Failure:

The tail rotor assembly separated from the wreckage during the impact, most probably during the events that followed the main rotor blade strike on the superstructure of the cargo ship. According to the pilot, he had full tail rotor authority while he was established in hover flight awaiting the pick-up of the marine pilot.

The initial roll of the helicopter to the right was not accompanied by any yaw but by a roll. The tail rotor associated linkages were subjected to metallurgical examination in order to determine the failure mode. All failures that were examined were consistent with overload failure mode.

1.18.7 Cyclic Control Stick Position:

The cyclic stick can be attached to the cyclic control stub to provide slightly different cyclic positions in the neutral position. The cyclic stick position was found to allow full control movement.

1.18.8 Post Maintenance Adjustments:

After the 1 200 hour maintenance inspection, no defects or any rectifications were recorded in any helicopter Flight Folio and logbooks. It came to the attention of the investigating team that during the night shift, some minor adjustments were made to the pitch change links of the main rotor system. According to the pilot who flew the helicopter at the time of the accident, no defects were reported during the two flights prior to the accident. The pitch change links were inspected and apart from having sustained accident-related damage, all four were found to be wire-locked as required.

1.18.9 Dynamic Roll-Over:

The possibility of a dynamic roll-over of the helicopter was investigated.

- No evidence could be found that the hoist cable got hooked or entangled during any phase of the hoisting operation. According to the helicopter pilot they were positioned approximately 7 to 8 metres above the bridge wing for the hoist pick-up. On recovery of the wreckage it was noted that 2.65 metres of the hoist cable was still extended, which indicated that the hoist was functional and the marine pilot had been in the process of being hoisted.

- There was no visible damage to the hoist cable or the hook mechanism that could have been associated with a hook-up or entanglement on the bridge wing.

- At no stage during the operation did the hoist operator indicate verbally to the helicopter pilot that the hoist cable was hooked up or entangled.

- Any hoist loading will introduce a lateral right roll-over of the helicopter due to the offset installation of the hoist.

- A left cross-wind component acting on a hovering helicopter would introduce a roll-over which would have to be counteracted by a left cyclic control stick input in order to maintain a steady hover. This means that the stronger the cross-wind, the more cyclic control input would be required to maintain a steady hover over a fixed point.

- Forward speed of the helicopter would aggravate the roll-over tendency of the helicopter, due to the increased pitch angle requirement of the retreating rotor blade.

- The hoist load is acting on a point forward of the longitudinal centre of gravity of the helicopter. Any hoist load would tend to lower the nose of the helicopter which through gyroscopic precession would act through 90 ° in the direction of rotation of the rotor. This means that the moment when the hoist takes load, a further tendency towards a right roll would be introduced with regard to the helicopter.

1.18.10 Cargo Ship Inspection Durban Harbour:

A while after the marine pilot’s discharge from hospital, he accompanied the investigation team to a similar cargo ship, the MSC Selin, which was harboured at Durban. Although the cargo ship was different in design, the bridge wing layout was very similar to the Alpha Afovos. He pointed out where he was standing on the bridge wing at the time when hoisting commenced and identified the possible hazards associated with such an operation.

The photo is included to serve as illustration, with a bridge wing hoist being conducted.

1.18.11 Agusta Westland Customer Support Engineer:

The helicopter manufacturer made available a Customer Support Engineer to assist in the post-accident inspection of the wreckage. The engineer assisted the investigating team and provided information in respect of technical questions during the wreckage inspection. Contrary to other aircraft manufacturers, no technical report was received after their participation. Two engine inspection reports were made available by the engine manufacturer, and are attached.

1.18.12 Guide to Helicopter/Ship Operations (International Chamber of Shipping)

“Chapter 8 (Marine Pilot Transfer)

This chapter contains additional information on the transfer of marine pilots by helicopter. As the potential benefits to both ship operators and pilotage services come to be recognised, so more ports are encouraging the use of helicopters for embarking and disembarking of pilots. Most of the services offered involve experienced and professional personnel whose operations would meet in full the recommendations in this guide. However, the following points should be borne in mind.

(a) The transfer of a marine pilot between helicopter and ship should take place only when the conditions set out in the appropriate sections of the guide are met and the ship operator and master are satisfied that the transfer can be conducted safely.

(b) The transfer of marine pilots by helicopter is now a routine operation and familiarity must not be allowed to compromise safety standards for the helicopter, the pilot, the ship or its personnel.

(c) The helicopter operator must confirm that he carries sufficient third party insurance to cover all his possible liabilities in helicopter/ship pilot transfer.

(d) In order to agree on a safe and effective rendezvous, it is important that sufficient advance notice of the intended helicopter/ship pilot transfer is given to all parties concerned.

(e) Adherence to the recommended procedures for continuous communication, regarding the rendezvous and for ship identification, is essential for helicopter/ship operations: it must be remembered that a helicopter may have to service a number of widely separated cargo ships in the course of a single flight.

(f) Although ultimate responsibility for the safety of the ship and its navigation in pilotage waters rest with the Master, the marine pilot has a direct interest in the choice of time and place for his transfer to the ship. He should be party to the agreement reached between the Master and the helicopter operator and pilot before the transfer operation commences. There may be special circumstances affecting the suitability of time or location of a proposed rendezvous on which the marine pilot may be able to advise. Sufficient prior notice will allow necessary arrangements to be agreed upon (see Chapter 5).

(g) Marine pilots should be required to do an approved course involving training in helicopter flight procedures, embarkation and disembarkation (including winching) and safety and emergency drills before undertaking helicopter transfers (see Section 6.6). The operational and organisational procedures and arrangements regarding safety as set out in Chapter 6 must be fully understood.

(h) When embarking or disembarking either by winch or from the landing area, the marine pilot should wear protective clothing similar to that recommended for the deck party (see Section 6.4.1), and while in flight a life jacket, and if necessary a survival suit (see Section 6.6.1(e) and (f). On long flights in certain aircraft, the noise level may temporarily impair hearing and in such circumstances marine pilots should wear suitable ear protection.

(i) A member of the deck party should be detailed to assist and guide the marine pilot between the landing area and the bridge.

(j) Operations involving helicopter touch-down on ships equipped with helicopter landing areas marked as in Section 4.2 are preferred by helicopter operators for marine pilot transfers.

The advantages of helicopter transfers of marine pilots can only be fully realised when the service is reliable and capable of being maintained with almost all ships under all but the most adverse weather conditions. While commercial pressure to see helicopter/pilot services operating universally will be a consideration in the provision of helicopter landing areas on new ships of most types, the critical examination of space on board existing ships for safety of landing or for facilities for helicopter winching operations should be undertaken in the light of industry guidance".

1.18.13 Helicopter Balance (Centre of Gravity):

Reference: Principles of Helicopter Flight, W.J. Wagtendonk, Pg. 251, 252, 253.

"Even though the weight of a helicopter may fall within the prescribed limits, if the distribution of this weight is not correct the helicopter's centre of gravity (CG) may be outside authorized limits, in which case the aircraft's balance is unsatisfactory and the aircraft is unsafe for flight.

The CG of a body can simply be defined as the point through which weight acts. It is the point of balance of the aircraft. If a helicopter is placed on a fulcrum (support) in such a way that the aircraft's CG is exactly above the fulcrum, the aircraft tips neither forward or back, left or right. Similarly, when the main rotor is suspending the aircraft in the calm hover, the helicopter hangs level beneath the rotor, provided the rotor mast and the CG position are in line vertically.

As pilot(s), crew, payload and fuel are either added to or subtracted from the aircraft, the point of balance (CG) moves and the helicopter no longer hangs horizontally beneath the rotor. Instead it hangs nose up or nose down, depending on the weight distribution. This pitching movement causes the disc to be displaced and the aircraft moves forward, back or to one side. To compensate for a re-positioned CG, cyclic inputs are required. An aft CG needs forward cyclic, while a forward CG needs aft cyclic, the amounts depending on the CG distance from datum.

The same principles also apply to lateral CG positions in that CG movement either to the left or right requires lateral compensating cyclic inputs. This factor is worthy of note particularly for aircraft equipped with hoist operations where lateral CG positions become very important and because of that, maximum permissible hoist loads are invariably stipulated in the aircraft's Flight Manual.

There comes a CG position where no more cyclic input is available and the helicopter becomes uncontrollable. To avoid this situation, the manufacturer of the aircraft predetermines the allowable amount of CG movement that can be safely accepted. This information is published in the aircraft's Flight Manual in terms of distance from the datum line, fore and aft, and left and right CG limits.

Some helicopters have the longitudinal datum coincidental with the rotor mast, in which case the CG limits are expressed in units of distance forward or aft of datum. Since this arrangement involves positive and negative turning moments and since it is easy to make mistakes adding these different values, few helicopters use this arrangement. A more common datum is one located at the front of the skids, in which case the CG limits are expressed in units of distance aft of datum only. Some helicopters have datum located three feet or more in front of the skids. This arrangement makes all moments positive because all weights acting aft of the datum produce a clockwise turning moment (which is positive).

Lateral datum is usually the butt line running through the CG of the aircraft from the nose to the tail. To calculate lateral CG position, it is impossible to avoid positive and negative moments because various weight items are on either side of the butt line.

Excessive Lateral CG

Limits for lateral CG are often quite small and, especially in the case of light helicopters, great care must be exercised to remain within lateral limits. Depending on fuel tank location, the pilot may have to occupy a seat on the opposite side when flying solo to ensure that lateral limits are not exceeded. (The pilot's operating handbook for the specific helicopter model being flown should always be obeyed.) The consequences of excessive lateral CG are similar to those for longitudinal CG.

The longitudinal and lateral CG positions are both important for the safe operation of a helicopter. Thorough calculations must be made prior to flight to ensure that limits are not exceeded".

1.18.14 The quick release mechanism on the specific harness was located behind the hoist operator's back. It furthermore necessitates that both levers be depressed simultaneously (as can be seen in the photo below); once that was achieved it still needed to be unhooked from the harness that was secured around the person's waist before the person could be detached from the airframe.

Safety harness: quick release mechanism that was worn by the hoist operator.

The body harness (waist harness) buckle was of the insertion type and also requires time and effort before it can be released.

The airframe attachment was again located behind the hoist operator's back. The release of this mechanism requires it to be unsecured before the latch mechanism can be depressed and the harness can be unhooked from its latch.

It is therefore recommended that the operator (and all other helicopter operators making use of the extended safety harness) comply to the same standard by making use of an approved safety harness that is equipped with a quick release mechanism that is safe and easily accessible and in the case of an emergency can be released without undue effort. The USCG (U.S. Coast Guard) would be a good benchmark to work from in this regard.

1.19 Useful or Effective Investigation Techniques:

1.19.1 None.

2. ANALYSIS

2.1 No member of the investigating team had the opportunity to inspect the cargo ship. The investigating team had to depend on information made available by the Master of the cargo ship, the First Officer, the shipping agent, a SAMSA official and two senior members of the helicopter operator. Although alternative attempts were made to inspect the cargo ship, the owners refused the SACAA's investigating team permission to board the cargo ship once it had left South African waters.

2.2 The helicopter crew was well qualified to perform the task. Conducting a bridge wing hoist was considered to be a standard operation for the operator and the crew. Both crew members were well rested and both were wearing life jackets.

2.3 Since reporting for duty, the crew had conducted a few flights prior to the accident. The marine pilot had had two land-on, drop-off and pick-ups. The only difference was that this was the first hoisting operation since this helicopter had returned to service the previous day. After the recovery of the wreckage, only 2.65 m of cable was still unreeled. This indicated that the hoist was in the process of reeling the marine pilot upwards.

2.4 The hoist jettison mechanism was not armed due to the fact that company policy did not allow live cargo to be jettisoned, irrespective of what situation or emergency might be encountered. This decision meant that the helicopter operator was indirectly willing to sacrifice an entire helicopter, the lives of the crew members and potential damage to third parties and property. All rescue hoists are designed and equipped with a jettison mechanism for emergency purposes and could have saved a life in this case.

2.5 The helicopter pilot's communication was not audible on the recording, but it would appear that the final decision for the pick-up from the bridge was made by the helicopter pilot. This arrangement was in contradiction with the arrangements made by the Master of the cargo ship, who had his fire and rescue team in position on the deck, awaiting the arrival of the helicopter to land on the deck.

2.5 The weather conditions were reported to be fine; the wind was from the north north-east at between 19 and 24 knots. This would have constituted a cross-wind component of between 19 and 24 knots on the cargo ship and since the helicopter was flying parallel to the cargo ship, this cross-wind component was also applicable to the helicopter. In order for the pilot to compensate for this cross-wind condition, the cyclic control input would have had to be utilised.

2.6 The helicopter was fitted with a 'High Altitude Configuration Kit', which improves the yaw controllability in the hover and especially during rescue hoist operations at high altitude. The helicopter pilot did not indicate that he had any problem in maintaining directional control in the yaw plane prior to the pick-up.

2.7 Why did the helicopter start to roll to the right as the marine pilot was lifted?

The following factors were considered:

(i) The lateral CG limit was exceeded, thereby exceeding the left cyclic input available. The pilot attempted to counteract the right roll movement by applying left cyclic input to such an extent that he had the cyclic control stick all the way deflected against his inner left leg. The lateral CG was calculated to be on the edge of the allowable CG limit for normal flight operations. The POH, however, allowed for an amended CG envelope, which was applicable for hoisting operations only. Utilizing the amended graph, the calculated lateral CG limit was found to be within the approved shaded area for a hoisting operation into wind.

(ii) The weight of the helicopter changed when the marine pilot was picked up on the hoist. The post-accident weight and balance calculation indicated that the helicopter was well within its maximum gross weight limitation as stipulated in the POH.

(iii) The prevailing cross-wind measured at the time was ± 24 knots from the left-hand side. This already imposed a lateral force on the helicopter from the left, which required some control input to maintain a steady hover over the moving ship. The reason why the pilot did not turn the helicopter into wind could be attributed to the obstructions on the bridge and the danger of the tail rotor operating even closer to the ship. The POH does indicate to the user that during hoisting operations cross-wind operations should be avoided.

(iv) The hoisting technique that was used by the operator differs from the procedure recommended in the POH. The POH procedure recommends that the helicopter pilot lift the weight from the deck. "Lift hoist load slightly above contact surface, by application of the collective pitch, to obtain a feeling of the controls".

(v) The pilot might have aggravated the situation by applying collective pitch (increased power demand), but at that moment it might have been the most logical action to take in order to prevent any form of main rotor blade or fuselage contact with the cargo ship.

(vi) The pilot stated that he had not experienced any right roll control tendency prior to commencing the hoist pick-up. The right roll only manifested itself when the marine pilot was lifted with the hoist. This was confirmed by the chief officer of the cargo ship, who was standing on the deck at hatch number 4 looking at the helicopter from the front. "It would appear that the marine pilot was too heavy for the helicopter".

(vii) The possibility that the hoist cable or the marine pilot was hooked up or entangled during the hoist lift can be ruled out.

3. CONCLUSION

3.1 Findings

3.1.1 Helicopter Pilot:

(i) The pilot was the holder of a valid commercial pilot's licence and had the helicopter type endorsed in his logbook.

(ii) The pilot was in possession of a valid aviation medical certificate that had been issued by an approved SACAA medical examiner.

(iii) The pilot was well rested prior to commencing his duties on the morning of 3 September 2005.

(iv) The pilot was current on the HUET (helicopter under water escape training) procedures.

(v) Although the pilot was properly restrained to his seat at the time of the accident via his four-point aircraft equipped safety harness, he sustained serious injuries.

(vi) The pilot was wearing a May-West (life jacket) during the flight.

(vii) The pilot had not conducted a weight and balance calculation for the flight in question.

3.1.2 Helicopter:

(i) The helicopter was subjected to a 1 200-hour maintenance inspection during the period 22 July 2005 to 2 September 2005 and had returned to service the day prior to the accident.

(ii) After the inspection of the helicopter, two acceptance test flights were performed on 2 September 2005, whereafter it was released to service and flown from Pretoria to Richards Bay.

(iii) On arrival at Richards Bay, the aircraft was returned to service and five subsequent flights were conducted before the accident flight, with no serious defects being reported.

(iv) The ELT unit that was installed on the helicopter was not able to sustain the impact forces associated with the accident.

(v) The helicopter was not equipped with floatation gear.

(vi) Aircraft examinations revealed that one of the main rotor servo actuators, part number (P/N); 109-0110-42-5 was not of the same compliance status as the other two actuators P/Ns 109-0110-42-124/-126.

(vii) Agusta Bollettino Tecnico No. 109K-14 Rev A, compliance instructions note states the following; "the servo actuators P/Ns 109-0110-42-124/-125/-126 are not mixable with the servo actuators P/N 109-0110-42-4/-5/-6 or 114/-115/-116".

(viii) The discrepancy regarding the servo actuators was never noticed by the maintenance personnel.

(ix) No evidence of any pre-impact engine failures or mechanical malfunctions was found.

(x) All indications were that the tail rotor assembly failed due to impact with the structure of the cargo ship.

(xi) The helicopter's weight and balance as well as the centre of gravity (both longitudinal and lateral) were found to be within the approved POH limitations as amended for hoisting operations.

(xii) The un-commanded right roll commenced when the helicopter took the weight of the marine pilot.

3.1.3 Hoist Operator:

(i) The hoist operator was wearing a May-West (life jacket) during the flight. He was not wearing a helmet.

(ii) He was secured in the aft cabin area by means of an extended safety harness (monkey chain) and was not secured in a seat.

(iii) The extended safety harness was found to be ineffective due to the release mechanism situated behind the hoist operator's back.

(iv) The hoist operator was familiar with his task.

(v) Available records indicate that the hoist operator had not received any HUET procedure training.

(vi) There was no evidence that physiological factors or incapacitation had affected the performance of the hoist operator.

3.1.4 Marine Pilot:

(i) The marine pilot was wearing a life jacket at the time of the accident.

(ii) He was still in the process of being hoisted at the time of the accident.

(iii) He was carrying a 'shoulder' bag which was never recovered.

(iv) The marine pilot was well familiar with helicopter hoisting operations.

(v) The marine pilot had completed two 'land-on' tasks earlier in the shift without incident.

(vi) The decision to conduct the hoist pick-up from the bridge wing was a collaborated decision between the marine pilot and the helicopter pilot.

(vii) He was familiar with, and current on the HUET procedure.

(viii) The marine pilot was seriously injured in the accident.

3.1.5 Cargo ship (Alpha Afovos)

(i) The cargo ship sustained some impact damage, mostly from the main rotor blade impact.

(ii) After the accident the cargo ship was requested by Port Control to go on anchor in the open, where it was inspected by a SAMSA official and was declared seaworthy to continue the journey.

(iii) The cargo ship was never inspected by a SACAA investigator. All evidence used to compile this report was obtained from external sources.

(iv) The cargo ship had a demarcated helicopter landing area on hatch cover No. 4, which was duly marked.

(v) The fire and rescue crew of the ship was positioned on deck in close vicinity to hatch No. 4, awaiting the arrival and landing of the helicopter to uplift the marine pilot.

(vi) The Master of the cargo ship instructed the marine pilot to make use of the demarcated helicopter landing area on hatch No. 4.

(vii) The Master of the cargo ship never communicated with the helicopter pilot at any stage during the operation.

(viii) There was no crew on standby to assist the marine pilot on the bridge wing.

3.1.6 Helicopter Operator:

(i) Failure by the Operator not to allow 'live cargo' being jettisoned or cut away during hoisting operations, jeopardized the entire hoisting operation. This is regarded as a significant operational shortcoming.

(ii) The helicopter service sometimes allowed several pick-ups and drop-offs during one mission, which rendered it impossible for flying crew to perform a detailed mass calculation for each and every task. Therefore most of the centre of gravity calculations involving marine pilot operations were of a generic nature.

3.1.7 Weather Conditions:

(i) The wind at the time was directly from the left-hand side at ± 24 knots cross-wind to the cargo ship and the helicopter.

3.2 Probable Cause/s:

The helicopter was operated with an already marginal lateral centre of gravity position and contrary to the manufacturer's warning, they carried out a hoisting operation in strong cross-wind conditions.

The combined effect of the cross-wind and forward speed of the helicopter flying parallel to the cargo ship probably aggravated the roll-over effect of the helicopter.

The helicopter probably ran out of lateral left input control when the additional mass was lifted by the hoist, rolled over to the right, collided with the cargo ship, crashed into the sea and sunk.

3.2 Contributory Factor/s:

The helicopter pilot deviated from the instruction to land the helicopter on the cargo ship and instead carried out the hoisting operation when uplifting the marine pilot from the cargo ship. This decision was made by the marine pilot and the helicopter pilot.

4. SAFETY RECOMMENDATIONS

4.1 The extended safety harness (monkey chain) of the hoist operator was considered to be an unsuitable/unsafe harness for helicopter operations.

4.2 It is recommended that an MOU (Memorandum of Understanding) be drafted and implemented between the SACAA and SAMSA to ensure that a recurrence of this accident is avoided in the future.

The MOU should clearly stipulate the work ethic and requirements to be met by the two Authorities.

In this case the Alpha Afovos was released to sail by a SAMSA official without consultation with a SACAA investigator at any time prior to making the decision.

The fact that no member of the SACAA investigating team had the opportunity to inspect the cargo ship in person should be regarded as a significant shortcoming to this investigation.

4.3 The post-mortem report of the hoist operator, which indicates that he suffered a serious head injury during the impact sequence; and several other fatal aircraft accidents that have occurred during the past few years, indicate that a substantial number of fatalities could have been prevented if the pilot/s or crew-member/s had worn helmets at the time of such accident/s. In many cases the person/s had died as the result of an isolated head injury sustained during the impact sequence.

It is recommended that all flying crew be encouraged to fly with helmets at all times in the interests of aviation safety and the redemption of human lives.

4.4 The aircraft Flight Folio in use by the helicopter Operator was found not to comply with Part 91.03.5, Document SA-CATS-OPS 91. The design/layout of the Flight Folio (called Captain's Log) by the Operator was of such a nature that it was designed to cater more for the type of operation (marine pilot service/s) and therefore it was lacking maintenance-related information and any outstanding deferred defects.

It is recommended that the "Flight Folio" that was in use by the Operator be brought in line with the requirements as stipulated in Part 91.03.5 of the Civil Aviation Regulations of 1997 and Document SA-CATS-OPS 91 listed below.

The main reason for the recommendation is the lack of defect and maintenance-related entries, and the action/s that followed to rectify such defects/maintenance, if any.

Flight Folio requirements as stated in Document SA-CATS-OPS 91:

"Part 91.03.5 Flight Folio (Information to be contained in a flight folio)

(1) An owner or operator must retain the following information for each flight in the form of a flight folio:

(a) Aircraft registration;
(b) date;
(c) name(s) of flight crew member(s);
(d) Duty assignment of flight crew member(s);
(e) Place of departure;
(f) Place of arrival;
(g) Time of departure (off-block time);
(h) Time of arrival (on-block time);
(i) Hours of flight;
(j) Nature of flight;
(k) Incidents, observations (if any);
(l) Signature of pilot-in-command;
(m) The current maintenance statement giving the aeroplane maintenance

status of what maintenance, scheduled or out of phase, is next due;

(n) All outstanding deferred defects which affect the operation of the aeroplane;

(o) Fuel used; and

(p) Fuel uplift.

(2) The owner or operator need not keep a flight folio or parts thereof, if the relevant information is available in other documentation.

(3) The owner or operator must ensure that all entries are made concurrently and that they are permanent in nature."

4.5 It is recommended that Helicopter Underwater Escape Training (HUET) as well as refresher training be made compulsory to all helicopter off-shore operational crew members.

4.6 It is recommended that the SACAA conduct a study into the international best practice for hoist operations with regard to cable jettison procedures involving an in-flight emergency.

5. APPENDICES

5.1 Annexure A (Agusta Bollettino Tecnico No. 109K-14 Rev A)

5.2 Annexure B (Microtechnica, Servo Actuators test report)

5.3 Annexure C (Turbomeca Engine teardown inspection report)

5.4 Annexure D (Facet Consulting Metallurgical report)

5.5 Annexure E (Agusta Helicopters, Technical Note N. PBE/A109/03/2005)

5.6 Annexure F (Operations Manual, page 68)

5.7 Annexure G (Statement from Master and Chief Officer of the Alpha Afovos).

Report reviewed and amended by Office of the EM:AIID
12 Aug 2009.

-END-