AIRCRAFT ACCIDENT REPORT AND EXECUTIVE SUMMARY

				Reference:	CA18/2/3/8661		
Aircraft Registration	**ZS-RJW**	**Date of Accident**	03 June 2009		**Time of Accident**	0850Z	
Type of Aircraft	Alouette III SE 3160		**Type of Operation**		Ferry Flight		
Pilot-in-command Licence Type	Commercial		**Age**	31	**Licence Valid**	Yes	
Pilot-in-command Flying Experience	Total Flying Hours	500.0			Hours on Type	400.0	
Last point of departure	Stutterheim – Eastern Cape						
Next point of intended landing	Hogsback – Eastern Cape						
Location of the accident site with reference to easily defined geographical points (GPS readings if possible)							
Hogsback landing zone.							
Meteorological Information	Surface wind: light variable, Temperature: 11ºC, Visibility: <10000m, Cloud cover: 7/8, Cloud base: 7500 feet.						
Number of people on board	1 + 1	**No. of people injured**	0	**No. of people killed**	0		

Synopsis

On Wednesday, 03 June 2009 at 0630Z, an Alouette III ex-military helicopter took off from an open grass field at Stutterheim and flew in a westerly direction to Hogsback. The pilot accompanied by a passenger flew the helicopter on a ferry flight which was under Visual Flight Rules by day. The initial information about the flight indicated that the aircraft was returning from a fire fighting operation in the area of Hogsback. According to the pilot, after the helicopter reached Hogsback, an open grass field was identified to execute the landing. During the final approach to the selected landing zone, the pilot noted a problem with the helicopter when the nose suddenly yawed to the left side. The helicopter was approximately three feet (one metre) above the ground when the pilot experienced a loss of tail rotor control which resulted in hard landing.

The investigation established that the loss of tail rotor control was caused by a broken tail rotor control cable. The cable was recovered from the accident site for further investigation. The cable had foreign object damage (FOD) embedded on it, which appeared to be a solution of combination of dust and oil. It was determined that due to friction between the cable and pulley, the FOD caused the cable to chafe through causing the cable to fail.

Probable Cause

The helicopter experienced loss of tail rotor control while landing due to failure of the tail rotor control cable.

IARC Date		Release Date	

AIRCRAFT ACCIDENT REPORT

Name of Owner/Operator : African Live Works
Manufacturer : SUD Aviation France
Model : Alouette III SE 3160
Nationality : South African
Registration Marks : ZS-RJW
Place : Hogsback area.
Date : 03 June 2009
Time : 0830Z

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 given without prejudice to the rights of the CAA, which are reserved.

1. FACTUAL INFORMATION

1.1 History of Flight

1.1.1 On Wednesday, 03 June 2009 at 0630Z, an Alouette III ex-military helicopter took off from an open grass field at Stutterheim and flew in a westerly direction to Hogsback. The initial information indicated that the helicopter was tasked to do fire fighting operation in the area of Hogsback. At the time of the accident, the pilot accompanied by a passenger was flying the helicopter on a ferry flight under visual flight rules (VFR) by day.

1.1.2 According to the pilot, after the helicopter reached Hogsback, an open grass field was identified to do the landing. During the final approach to the selected landing zone, the pilot noted a problem with the helicopter when the nose suddenly yawed to the left side. The helicopter was approximately 3 feet (one metre) above the ground when the pilot experienced a loss of tail rotor control which resulted in a hard landing.

1.1.3 The pilot reacted quickly to correct the situation by slowly lowering the collective pitch control lever so that the helicopter could descend onto the ground. The pilot intention was to avoid a hard landing. The time that the helicopter touched down on the ground, the torque of the main rotor caused it yaw and roll over onto the right side. The helicopter sustained substantial damage during the impact sequence. The pilot and passenger evacuated the helicopter and did not sustain any injuries.

1.2 Injuries to Persons

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

1.3 Damage to Aircraft

1.3.1 The helicopter sustained substantial damage in the accident.

Figure 1: Showing damage caused to helicopter.

1.4 Other Damage

1.4.1 None.

1.5 Personnel Information

Pilot in command

Nationality	South African	Gender	Male	Age	31
Licence Number	xxxxxxxxxxxxx	Licence Type	Commercial		
Licence valid	Yes	Type Endorsed	Yes		
Ratings	Night, Flight Test, Undersling/Winch Ratings				
Medical Expiry Date	31 December 2009				
Restrictions	None				
Previous Accidents	None				

Flying Experience:

Total Hours	500
Total Past 90 Days	150
Total on Type Past 90 Days	150
Total on Type	400

1.6 Aircraft Information

Airframe:

Type	Aespatiale Alouette III SE 3160	
Serial Number	1928	
Manufacturer	Sud Aviation France	
Date of Manufacture	02 June 1970	
Total Airframe Hours (At time of Accident)	6049.9	
Last MPI (Date & Hours)	02 March 2009	6011.1
Hours since Last MPI	38.8	
C of A (Issue Date)	14 March 2008	
C of R (Issue Date) (Present owner)	03 November 2004 Campbell JA	
Operating Categories	Standard	

Engine:

Type	Turbomeca Artoutse 3B1		
Serial Number	72		
Hours since New	6049.9	Cycles since New	14252.0
Hours since Overhaul	unknown	Cycles since Overhaul	unknown

1.6.1 The helicopter was first owned and operated by the South African Air Force (SAAF). The SAAF discontinued the use of the helicopter and it was sold to a private aviation company. For the period that the helicopter was operated by the SAAF, it was maintained according to military technical standards and airworthiness requirements. After the helicopter was sold, the new owner decided to register and operate it in the civilian aviation industry. The helicopter was registered on the Civil Aircraft Register, after the owner submitted an application for issuance of Certificate of Registration (C of R) on 20 March 1998.

1.6.2 Before the helicopter could be operated in the civilian aviation environment, the owner was required to do maintenance to the airframe and engine prior to the helicopter being certificated for civilian use**.** After the maintenance was completed the helicopter was certified airworthy and a Certificate of Release to Service (CRS) was issued. The owner then submitted an application for issuance of Certificate of Airworthiness (CoA) on 24 August 1998.

1.6.3 The helicopter was sold again and a Change of Ownership application submitted on 03 November 2004 to register it in the name of the current owner. The current owner utilised the helicopter for commercial flight operations. The aircraft documentation was checked during the investigation and found that the helicopter was issued with a valid CoA and CRS.

1.6.4 According to the maintenance documentation, an entry was made in the logbook indicating that after flying for total of 5893.8 hours, the helicopter was involved in an incident on 13 February 2008. The incident involved a rotor blade strike. After the incident occurred, the helicopter was taken to an Aircraft Maintenance Organisation (AMO) for repairs. The repairs were completed by the AMO and the helicopter was certified airworthy.

1.6.5 According to the engine manufacturer, the engine that was fitted to the helicopter last maintenance inspection was in 2005. At the time the engine was subjected to modifications to have it certificated for civilian use**.** The modifications were in compliance with service instructions of Service Bulletin (SB) A218720094. The engine hours were 1061 hours since overhaul (TBO) at the time.

1.6.6 According to the engine manufacturer, the overhaul interval of the engine is 3000 hours in operation. The engine hours were calculated to be the same as that of the airframe, which is approximately 6049.9 hours. As result it was determined that the engine should have been overhauled again at 6000 hours. As indicated in the column above, the engine operated for 49.9 hours over the required TBO time.

Fuel Status

1.6.7 The pilot indicated that the helicopter had a total of 400 pounds (lbs) of Jet A1 fuel in the tank when it took off from Stutterheim. There was approximately 300 lbs of fuel remaining in the tank after the accident occurred. The fuel status of the helicopter was found to be sufficient for the intended flight.

Failed tail rotor cable - broken part

1.6.8 During the recovery of the wreckage from the accident site, it was established that one of the tail rotor control cables had failed. The broken tail rotor cable was removed from the wreckage for further investigation.

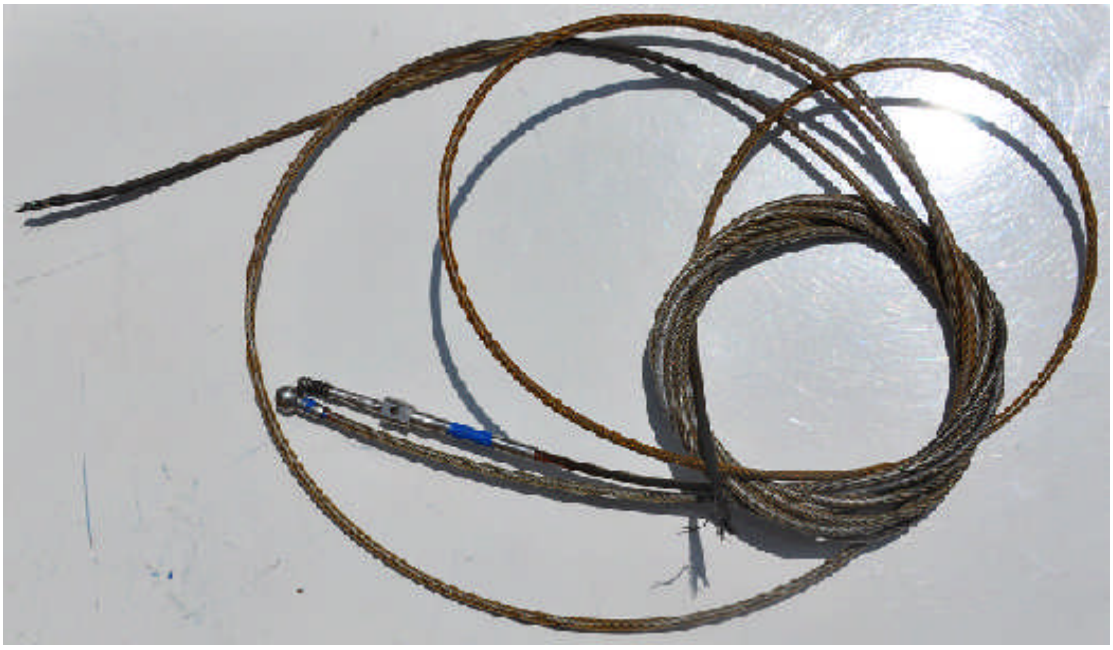

Figure 2: Showing tail rotor cable removed from wreckage.

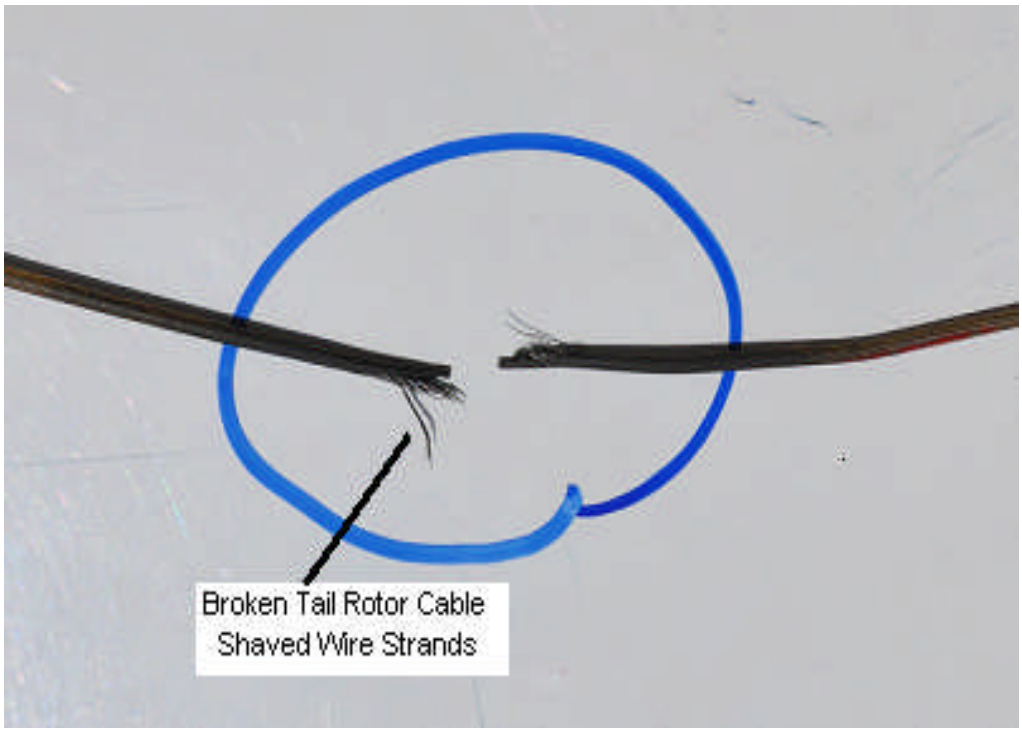

Figure 3: Indicating area where cable broke or shaved through the wire strands.

1.7 Meteorological Information

Wind direction	Light Variable	Wind speed	±3 kts	Visibility	< 10000m
Temperature	11 ºC	Cloud cover	7/8	Cloud base	7500 feet
Dew point	unknown				

1.7.1 The weather information in the column above was obtained from the Pilot Questionnaire. It was determined in the investigation that weather was not a contributory factor.

1.8 Aids to Navigation

1.8.1 The accident occurred in an open area which was not in the vicinity of an aerodrome and/or heliport. The pilot landed the helicopter at his own discretion, as there was no land based navigation aids available similar to that used at aerodromes.

1.8.2 The helicopter had standard navigation equipment installed which was approved for the type. The additional navigation equipment installed in the helicopter was found included on the approved equipment list. The pilot reported that all the navigation equipment was in a serviceable condition.

1.9 Communications.

1.9.1 The helicopter was operating outside of controlled airspace. The pilot was required to broadcast his intentions on VHF frequency 124.8 MHz in the area. The helicopter had VHF type of radio communication equipment installed. The pilot reported that the radio equipment was in a serviceable condition.

1.9.2 Immediately after the helicopter was involved in the accident, the Operator reported the accident to the Port Elizabeth Air Traffic Control (ATC) and SACAA Flight Operations Department. The ATC then also contacted the SACAA Accident and Incident Investigation Department with the information of the accident

1.10 Aerodrome Information

1.10.1 The helicopter was involved in the accident outside the boundaries of an aerodrome and/or heliport. The pilot landed in an open field which was covered with vegetation. The field elevation of the landing zone was approximately 5000 feet Above Mean Sea Level (AMSL).

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 required by regulations to be fitted to this type of helicopter.

1.12 Wreckage and Impact Information

1.12.1 The helicopter was approaching an open grass field for landing at Hogsback. When the landing gear touched down on the ground, the torque of the main rotor caused the helicopter to yaw and roll over onto its right side and the rotor struck the ground. The helicopter sustained substantial impact damage. The damage caused to the structure was mainly to the right side of the airframe. The main and tail rotors of the helicopter were still rotating when it rolled over onto its right side. The rotor blades struck ground and damaged. The engine was also damaged as a result of the accident. The damage caused to the engine was due to the helicopter rolling over onto the right side.

1.13 Medical and Pathological Information

1.13.1 None.

1.14 Fire

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

1.15 Survival Aspects

1.15.1 The accident was considered to be survivable. The cabin area of the helicopter was still intact after the accident. The pilot and passenger were properly restrained with the safety belts and harnesses. Both occupants evacuated out of the wreckage from the right side and did not sustain any injuries.

1.16 Tests and Research

1.16.1 The pilot reported that he experienced a loss of tail rotor control. It was established that the loss of tail rotor control was caused by a broken tail rotor control cable. Based on the findings identified, it was deemed necessary to investigate the relationship between the two causal factors which are (loss of tail rotor control and broken tail rotor control cable) in relation to their contribution into the functioning of the tail rotor control system. For the purpose, the Aircraft Maintenance Manual (AMM), which includes information about the tail rotor control system, was obtained from the SAAF. According to the AMM, the tail rotor control system operation is as follows:

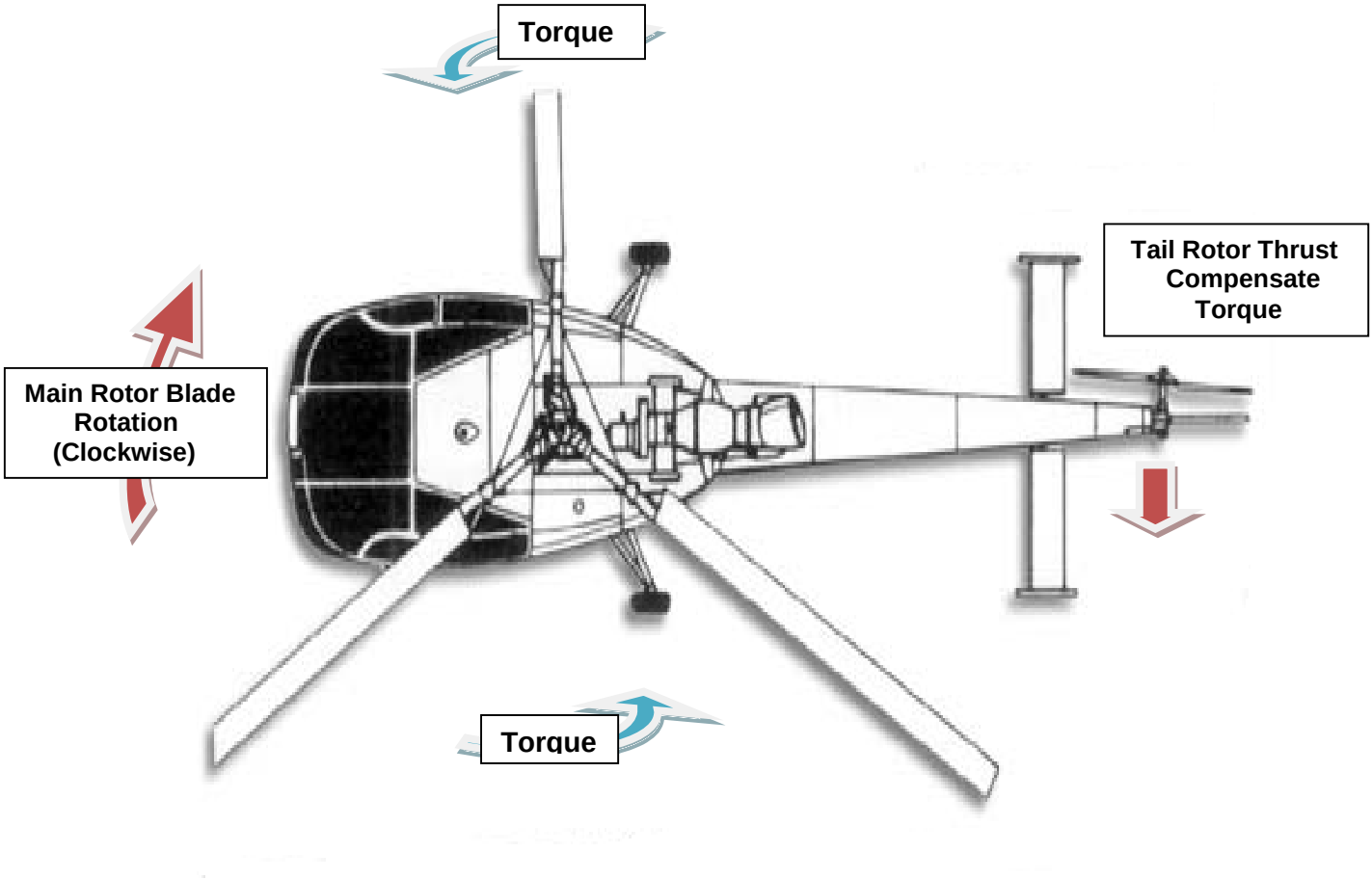

Figure 4, showing the different forces acting on the helicopter.

(i) The main rotor of the helicopter rotates in a clockwise direction when viewed from above. The torque produced by the main rotor causes the fuselage of the helicopter to rotate in opposite direction (nose left). The tail rotor (anti torque) system provides thrust which counters this torque movement and provides directional control.

(ii) The tail rotor turns faster than the main rotor. To keep the helicopter moving straight ahead without turning, the tail rotor blades pitch must be enough to counteract the force of the torque reaction. If the tail rotor generates more thrust to counter the main rotor torque, the helicopter will yaw or turn to the right. If the tail rotor generates less thrust to counter the main rotor torque, the helicopter will yaw or turn to the left.

(iii) The tail rotor provides control for steering to the left or right which is accomplished by the rudder pedals. Depressing on the right pedal decreases the pitch and the tail section of the helicopter will swing to the left. Depressing on the left pedal will result in the pitch increasing and tail section swing to the right. In a situation where a loss of tail rotor control is experienced, the helicopter will respond with an uncommanded rapid yaw to the left.

1.16.2 The pilot reported that during final approach for landing when he experienced a loss of tail rotor control, the nose of the helicopter suddenly yawed to the left side. As indicated by the information above, the conclusion can be made that the helicopter suddenly turned to the left due to the absence of effective tail rotor thrust to control the opposing torque element.

1.16.3 The ultimate effect of the broken tail rotor cable to the tail rotor system is as follows:

(i) The tail rotor is driven by the engine through a drive shaft which produces appropriate rotations per minute (R.P.M). The thrust/torque produced by the tail rotor requires that the rotor blade pitch angle to be deflected by means of applying a certain amount of rudder pedals input. The broken tail rotor control cable will affect the thrust of the rotor.

(ii) The tail rotor control system has three cables fitted. There are two cables that run from a bell crank on the left and right side. The third cable was rolled up on the drum and its two (left and right side) ends fastened at the turn buckles. The cables are identified by red and blue colour paint. The blue colour painted cable was found broken.

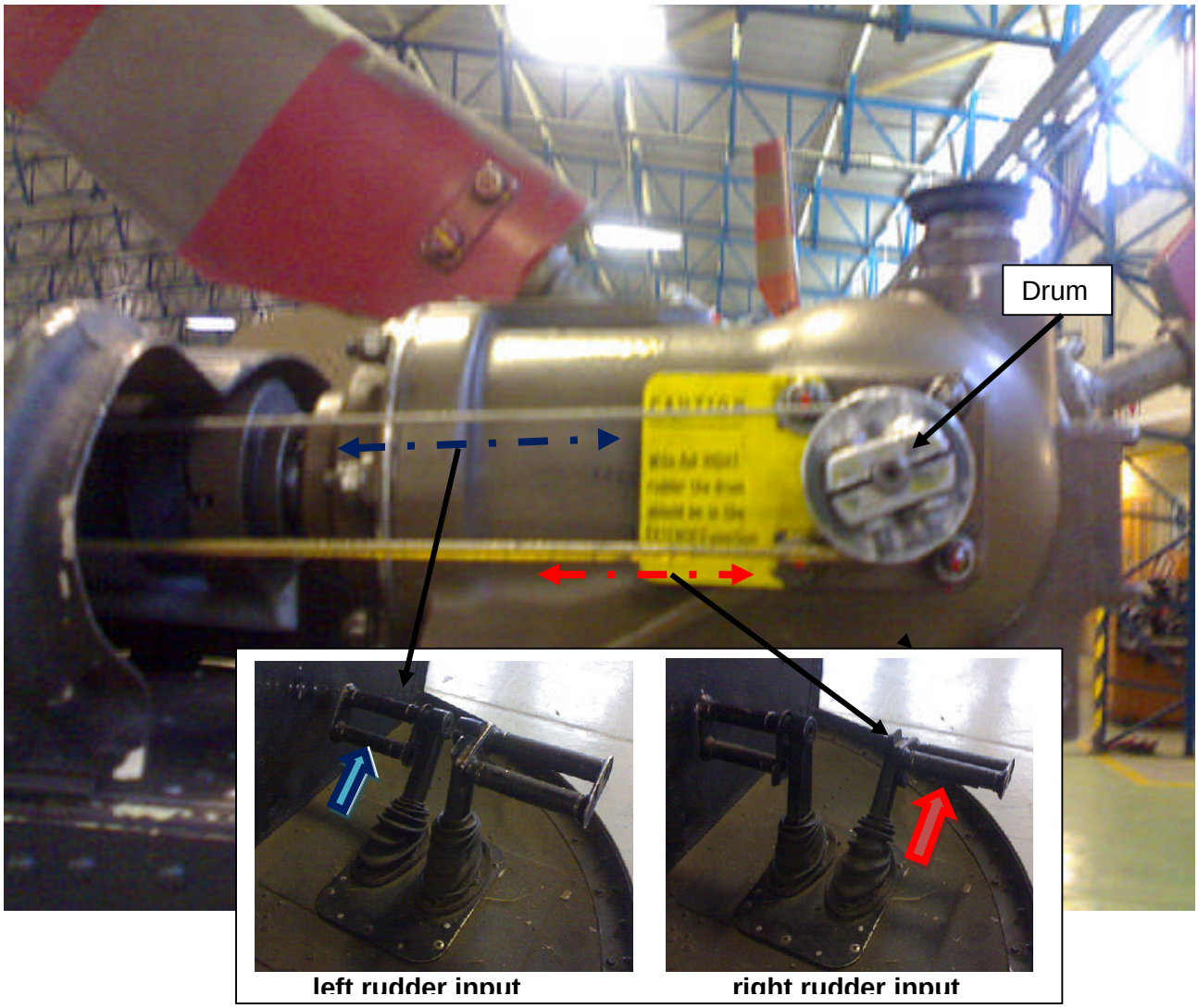

Figure 5: Showing functioning of tail rotor system after depressing rudder pedals.

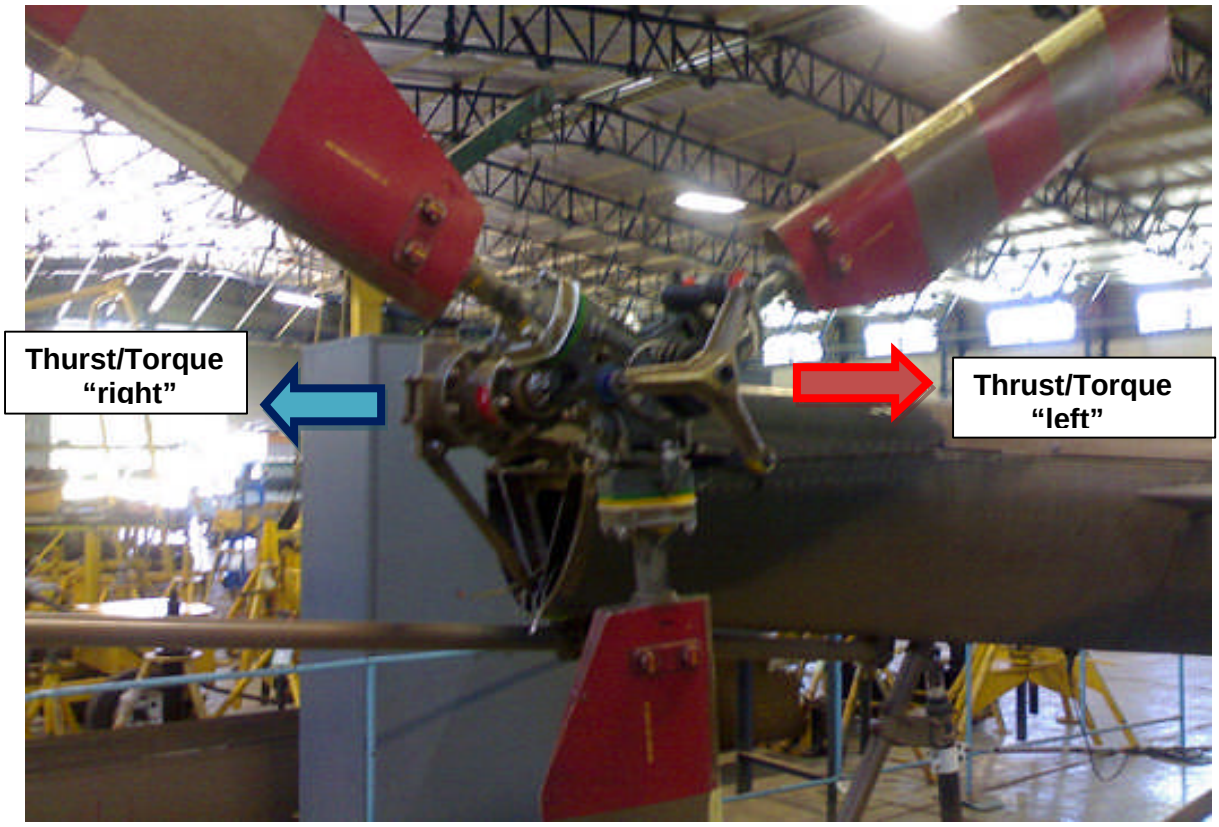

Figure 6: Showing tail rotor indicating thrust/torque direction depending on rudder pedal input.

1.16.4 The helicopter was examined in the investigation to determine which location on the airframe, the cable broke. It was found that the cable broke at the first set of pulleys underneath in the floor structure of the helicopter. Based on the fact that the pulleys were not easily accessible, it was not possible for the pilot to detect any problems with the tail rotor cable during the pre-flight inspection of the aircraft. The identified location in the floor of the helicopter will only be inspected during routine maintenance or at Mandatory Periodic Inspection (MPI).

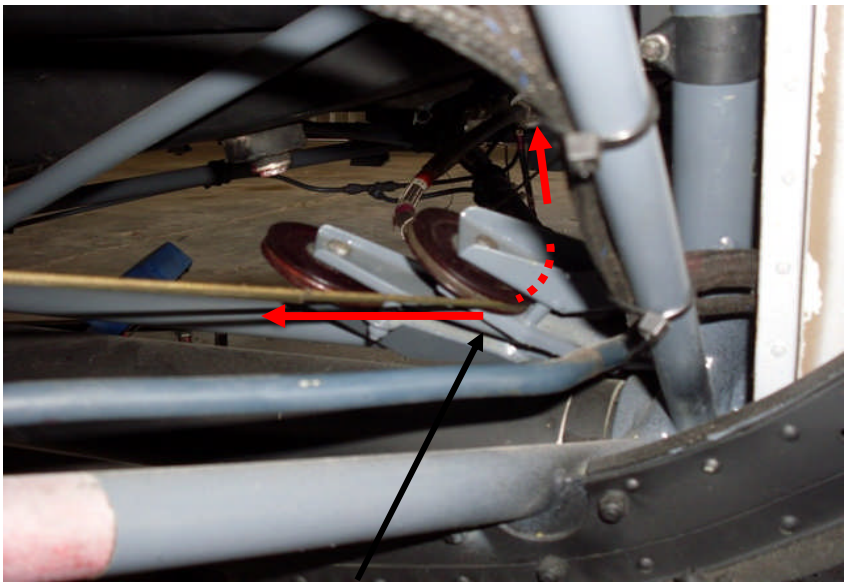

Figure 7: Showing location where the tail rotor control cable failed at the pulley.

1.16.5 After the tail rotor cable was closely examined, it was found that the control cable was covered by mixture of dust and oil. The substance was on the cable but limited to the area where contact is made with the pulley. Both the cable and pulley are supposed be uncontaminated and have smooth surface. It appears as though the mixture of dust and oil on the cable became a sticky compound which resulted in roughness between the two moving parts and contributed to the destruction of the protective material around the cable. Friction between the parts generated heat and eventually weakening the structure of the control cable. The control cable chafed through and broke.

1.16.6 According to maintenance manual, the cable should be tensioned correctly. All dust and oil should be cleaned from the cable and pulleys during maintenance. The pulleys should be rotated to change the area of contact between the cable and pulley. These actions will prevent development of a groove into the pulley by the cable.

1.17 Organizational and Management Information

1.17.1 The Owner used the helicopter for commercial operations which is in compliance with CAR, Part 127. The Organisation responsible for the operation had a valid Air Operating Certificate (AOC), which was issued on 31 March 2008 and expire on 23 March 2009. The accident helicopter registration was also included on the operator's AOC, authorised as one of the aircraft used by the Operator. The helicopter was being used to do fire fighting operation. There was no anomaly identified with the management and operation of the helicopter.

1.17.2 The helicopter was maintained by a South African Aircraft Maintenance Organisation (AMO), in accordance with CAR, Part 145. The Organisation had a valid AMO Approval Certificate which was renewed on 01 February 2009.

1.18 Additional Information

1.18.1 None.

1.19 Useful or Effective Investigation Techniques

1.19.1 None.

2. ANALYSIS

Man

2.1 The pilot had a valid licence and the helicopter type rating was endorsed on it. The pilot also had a valid Medical Certificate with no restrictions. He was in good physical health and had no medical complications which prevented him from flying the helicopter on the day.

Machine

2.2 The helicopter was first owned and operated by the SAAF. The use of the helicopter was discontinued and sold to a private owner. The helicopter was then put on the Civil Aircraft Register and issued with Certificate of Registration. The owner intention was that the helicopter be utilised in the civil aviation industry, but had to comply with manufacturers requirements which was to have it certificated for civilian use. The regulator conducted inspections on the helicopter and was satisfied with its condition and certified it for civil use. The helicopter was then issued with a CoA.

2.3 The helicopter was maintained by an approved AMO. The AMO conducted maintenance on the helicopter in accordance with manufactures requirements and in compliance with applicable regulations. There were no anomalies identified with the maintenance which the AMO carried out on the helicopter. It was the responsibility of the operator to return the aircraft to the AMO in case there was defects or items became due while operating away from base.

2.4 The helicopter was operated commercially doing fire fighting work. The Operator had a valid Air Service License and Air Operating Certificate.

2.5 The morning before the flight, the pilot conducted a before flight/pre-flight inspection on the helicopter. After the pre-flight inspection was carried out, the pilot was satisfied with the condition of the helicopter and continued with the flight. The flight to the intended destination was uneventful and the pilot experienced loss of tail rotor control during landing. The loss of tail rotor control was determined to be as a result of a broken tail rotor cable. The broken tail rotor cable was recovered from the accident site and examined in the investigation. There was proof found indicating that the cable was covered in something which appeared to be a combination of dust and oil. The indication was that due to friction between the cable and pulley, the dust and oil contaminant caused damage to the cable as a result it broke. The pilot then lost control over rudder pedal input which made the tail rotor ineffective.

2.6 Due to the loss of tail rotor control, there was no anti-torque or thrust coming from the tail rotor. In a case like this, the helicopter would then suddenly yaw to the left. The pilot felt the yaw movement, identified that it is probably a loss of tail rotor control and immediately acted to correct the situation. The helicopter was not far above the ground, hence, the pilot deciding to just lower the collective lever and land. The helicopter touched down, but due to torque of the main rotor it rolled over onto its right side and impacted the ground.

3. CONCLUSION

3.1 Findings

3.1.1 The pilot had a valid Commercial Pilot License (CPL) and helicopter type was endorsed on it. The pilot also had a valid Medical Certificate with no restrictions.

3.1.2 The helicopter had a valid Certificate of Airworthiness (CoA) and Certificate of Release to Service (CRS).

3.1.3 The Operator had a valid Air Service Licence issued by the Licensing Council and Air Operating Certificate (AOC) issued by SACAA.

3.1.4 The registration of the helicopter was included on the AOC as one of the aircraft which they are authorised to use for commercial operations.

3.1.5 The Aircraft Maintenance Organisation (AMO) responsible for maintenance of the helicopter had a valid AMO Approval Certificate issued by SACAA. In terms of the privileges included on the Approval Certificate, the AMO was duly authorised to conduct maintenance on the helicopter.

3.1.6 The helicopter was previously owned by the South African Air Force (SAAF). Whilst operated by the SAAF, it was maintained and certified airworthy according to military technical standards.

3.1.7 The SAAF sold the helicopter to private owners and an application submitted to the SACAA requesting to have it registered on the Civil Aircraft Register.

3.1.8 The pilot and crew member were engaged on a private flight from Stutterheim, under visual flight rules in day light condition to Hogsback in Port Elisabeth area. During landing at Hogsback, they experienced loss of tail rotor control resulting in the accident.

3.1.9 The helicopter rolled over onto its right side, sustaining major damage to the airframe structure and engine in the ground impact sequence.

3.1.10 The accident was considered to be survivable due to the fact that the cabin area found still intact and occupants surviving the accident without sustaining any injuries.

3.1.11 During the wreckage recovery, there was evidence found indicating that the tail rotor cable chafe through and failed.

3.1.12 The pilot in command experienced loss of tail rotor effectiveness/control. The helicopter spun and rolled over to the right side prior to it impacting the ground.

3.1.13.1 The tail rotor cable failed.

3.1.13.2 There was a contaminant that appeared like combination of dust and oil on the cable.

3.1.13.3 The cable broke as a result of friction between the cable and pulley. The cable chafed through and failed.

3.1.13.4 According to maintenance documentation, the tail rotor cable tensioning was found to be within limits at the time when the maintenance inspection was completed.

3.1.14 The helicopter was used for fire fighting operations in remote area. The possibility exists that the dust entered underneath the floor structure.

3.2 Probable Cause/s

The helicopter experienced loss of tail rotor control while landing due to failure of the tail rotor control cable.

Contributory Factors

3.2.1 There was combination of dust and oil found on the tail rotor cable and pulley, which resulted in friction between the two parts.

4. SAFETY RECOMMENDATIONS

4.1 None.

5. APPENDICES

5.1 None

Report reviewed and amended by the Advisory Safety Panel on 20 July 2010.

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