This report is prepared by Accident Investigation Commission constituted by Ministry of Culture, Tourism and
Civil Aviation, Government of Nepal, in accordance with Civil Aviation (Accident Investigation) Rules, 2024 B.S.

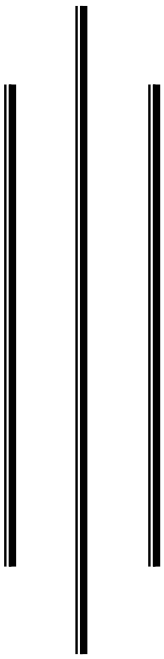
Aircraft Accident Investigation Report

Karnali Air Pvt. Ltd.

9N-AGS MI-17 IV Helicopter

Kathmandu

on 08 August 2006



November, 2006

Government of Nepal

COMPOSITION OF THE INVESTIGATION COMMISSION

Vide decision of Government of Nepal dated 4 September 2006, the Accident Investigation Commission was setup comprising of the following.

Mr. Medini Prasad Sharma – Chairman
Joint Secretary
Ministry of Culture, Tourism and Civil Aviation

Pilot Col. Pramod Kumar Lama – Member
Rotory Wing
No. 11 Brigade

Engr. Kumar Prasad Upadhyaya – Member
Airworthiness

Mr.Indra Kumar Chongtenli – Member
Under Secretary (Legal)
Ministry of Culture, Tourism and Civil Aviation

Engr. Mukul Mishra – Member
Civil Aviation Authority of Nepal (CAAN)

Mr. Surya Bahadur Raut – Member-Secretary
Under Secretary (Technical)
Ministry of Culture, Tourism and Civil Aviation

The Commision also sought and used the expertise of:

Engr. Lt. Col. Santosh Kumar Karki
Quality Assurance
No. 11 Brigade

Contents

SYNOPSIS

On 8th August 2006, at 08:45 UTC a MI-8 MTV (MI-17 IV) helicopter belonging to Karnali Air with registration 9N-AGS was involved in an accident at East Helipad of Tribhuvan International Airport during engine ground run. The helicopter was on ground run to check the parameters of main gearbox (MGB). The helicopter had a complement of three crew members (two pilots and one flight engineer). The intention of the ground run was to check the parameters of MGB (BR-14) for life prolongation.

The helicopter began to resonate as power was applied along with increasing collective. The pilots, none of whom were P1 rated, were unable to control the ground resonance and subsequent hovering (turn over) resulting from the progressive application of the collective. Improper control inputs by the pilots resulted in the helicopter toppling on its side incurring significant damages. All the six occupants escaped with minor injuries.

The Commission concludes that the probable cause of accident of the helicopter was the improper handling of controls by crew due to lack of crew coordination.

Other contributing factors were:

a. Lack of sufficient type experience

b. Absence of briefing before commencing the ground run

d. Lack of clear provisions in SOP for conducting ground runs.

e. Improper rostering of crew by Karnali Air management.

f. Ambiguous CAAN regulation regarding engagement of rotors in helicopters (5.2.2 c).

1. FACTUAL INFORMATION

1.1. History of the Ground Run.

On 8th August 2006, at 08:45 UTC a MI-8 MTV (MI-17 IV) helicopter belonging to Karnali Air with registration 9N-AGS was involved in an accident at East Helipad of Tribhuvan International Airport during engine ground run. The helicopter was on ground run to check the parameters of main gearbox (MGB). The helicopter had a complement of three crew members (two pilots and one flight engineer). The intention of the ground run was to check the parameters of MGB (BR-14) for life prolongation. There were two Nepalese Engineers and one specialist from Klimov Factory (Designer/Manufacturer) inside the passenger cabin. The specialist from Klimov-Russia was present inside the cabin for checking the parameters of MGB.

The crew started the Auxiliary Power Unit (APU) and the engines at 08:32 UTC and soon after the main rotor revolution per minute (RPM) reached 93%. The necessary main gear box parameters were noted. The ground run continued for about 8-9 minutes. The Russian specialist requested to select pitch angle of 3^0 and then asked for applying nominal power in order to note parameters at this power. Since the crew had started feeling some ground resonance they decided to increase power gradually. The collective pitch was gradually increased to 7.5^0. At this stage the crew appeared to have pulled the cycle stick further aft causing the rotor disc to tilt backwards. As a result the tail guard impacted the ground. This caused the helicopter to bounce forward. At this moment, both the pilots tried to take control of the helicopter individually resulting in uncontrolled movement of the helicopter. This action caused the tail guard to impact ground damaging the tail rotor blades. In the absence of the tail rotor to counteract the main rotor reactive moment, the helicopter became uncontrollable and it swung left about 270^0. The main rotors struck the ground and the helicopter toppled on its right side. The helicopter came to rest facing west.

The crew and the Engineers inside the cabin were injured. They were evacuated and rescued by the ground handling staff of the same company.

Thick black smoke was observed from Kathmandu control tower at the accident site. Rescue and fire fighting services were directed to the site immediately. Visual observation of the wreckage of the helicopter indicated that smoke had emanated due to spillage of oil on the engine hot surfaces. There was no indication of any fire.

The accident site was at 27^0 41:50' N latitude 085^0 21.28' E longitude at an elevation of 4300 feet.

The Safety Department's (CAAN) personnel visited the crash site immediately after the accident and collected some evidence and seized the necessary records of the ill fated helicopter and reported to Ministry of Culture, Tourism and Civil Aviation for conducting a detailed investigation.

An investigation commission was formed by the order of Ministry on 19.05.063 B.S. for carrying out detailed investigation of the accident as per ICAO Annex 13 provisions.

1.2 Injuries to Persons.

Injuries	Crew	Passengers	Others
Fatal	0	0	0
Serious	0	0	0
Minor/None	3	0	3

1.3 Damage to Aircraft

The members of the commission visited the crash site on 6th September 2006 and observed the following damage:

a. Central fuselage section was damaged
b. The main rotor blades were broken into pieces and scattered around the accident site.
c. Main rotor head was damaged.
d. Tail boom was detached at the attachment point from the fuselage section.
e. Vibration damper detached.
f. Swash plates, hydraulic boosters were damaged.
g. Tail rotor drive shaft was decoupled & bearing supports were damaged.
h. Horizontal stabilizers were damaged.
i. Tail bumper was detached.
j. Pylon was twisted and damaged
k. Tail gear box was damaged.
l. Tail rotor head was damaged and tail rotor blades broken into pieces and was found scattered.
m. Intermediate gearbox was damaged.
n. Electrical instrument panels have some minor damage.
o. Kerosene heater (KO-50) was damaged.
p. Some electrical units were detached from their mounting.
q. Main gearbox was damaged.
r. Rear Cargo door was damaged.
s. Windshield and blisters were damaged.
t. Fuel tanks damaged and there was fuel and oil spillage.
v. No sign of Foreign Object Damage (FOD) inside the engine intakes was found. First stage compressor blades of both engines appeared intact.
x. Turbine blades appeared intact.

Some photographs are attached in (Appendix-C)

1.4 Other Damage

Slight damage to the apron surface was observed due to rotor blade impact.

1.5 Personnel Information:

The pilots (including the one seated at the P1 seat) were not rated as P1 on MI -17 IV but possessed type ratings as P2. They had received trainings required by current CAAN regulations and had been deputed to carryout the ground run by Operation Department at the request of Engineering Department of the airline (Appendix-D)

The Flight Engineer (F/E), too, had received trainings required by current regulations and held a valid F/E license on MI-17 IV.

The F/E stated that he had carried out preflight inspection in accordance with approved inspection schedule and signed the preflight sheets before starting the engines. However, he was neither a staff of Karnali Air nor authorized by CAAN to carry out ground run on Karnali Air's helicopter 9N-AGS.

The crew was not involved in any past accidents and stated that had they had carried out several ground runs on MI-17-IVs earlier. The crew details are given in (Appendix-A)

1.6. Aircraft Information:

The helicopter MI-17 IV was manufactured in February 1993 by Kazan Helicopter Plant and initially registered in Russia and operated by Russian Army Aviation from 27 February 1993. Later it was acquired by Skytech International of Luxembourg on 27 March 1999 It was imported to Nepal in June 2001 and was operated by Air Ananya, Space Air, Manang Air, in that order, and finally purchased by Karnali Air Pvt. Ltd. on 11 October 2002. The C of A of the helicopter had expired on 31 July 2006 (Appendix-E). The detail of the helicopter history is given in Appendix-B

The airframe of MI-17-IV was initially certified for 1500 Hours of operation or 9 years whichever comes first. Latest inspection work for the extension of 450 Hrs. (3050 Hours to 3500 Hours) and calendar period up to 21 March, 2007 was carried out by MIL Moscow Helicopter Plan and was approved by Civil Aviation Authority of Nepal (CAAN) on 24 March 2006 (Appendix-F)

Records indicate that an incident involving this helicopter had occurred in March 2005 in Surkhet area of Western Nepal when a sudden power loss of both the engines compelled the crew for emergency landing. The engines were sent for overhaul to Ural factory of Civil Aviation, Russia in September 2005 and reinstalled on that helicopter on 03 December 2006.

The fuel used was Jet-A1, as specified in the flight manual.

1.7. Meteorological Information:

The weather reported by Kathmandu tower at the time of accident was fair and wind calm. Daylight conditions existed at the time of accident.

1.8. Aids to Navigation:

Not Applicable

1.9. Communication:

Kathmandu airport is equipped with HF and VHF Communication systems with recording facilities.

The ground run was carried out at control area (East Helipad) and the crew had received clearance over the radio from Kathmandu Surface Movement Control (SMC). The Commission did not find any evidence of this from the tape obtained from TIA. However, Cockpit Voice Recorder transcript indicates that they had established communication at about 08:42 UTC with Control Tower, in Nepali language.

(TIA report is included in Appendix-G)

1.10. Aerodrome Information:

Engine ground run was carried out at control area (East Helipad) near the old fire station. East helipad is usually allocated for carrying ground runs and checks. The maintenance works are also carried out at this site due to lack of hangar facilities for operators. The area is visible from the control tower and fire station watch tower.

(A photograph attached in (Appendix-H)

1.11. Flight Recorders:

The helicopter was fitted with Cockpit Voice Recorder (CVR) model P-503 B and a photographic film type Flight Data Recorder (FDR) model SARPP-12D1M . The FDR cassette and the CVR spools were sent for readout at Interstate Aviation Committee (IAC) facility in Moscow, Russia. Both FDR and CVR were serviceable and appropriate information was registered. The last calibration was done in 1992 as per log-card. The IAC report has commented on the possible degradation of accuracy on this account.

(Readouts of CVR&VDR in Appendix-I)

1.12. Wreckage and Impact Information:

The Commission members visited the site in order to collect the available evidences and the information regarding the accident on 06 September, 2006 from available witnesses. Observation showed that the first impact was on paved area and the helicopter swung about 270^0 before toppling on its right side facing west. The wreckage and pieces that were scattered over the area had been removed to prevent foreign object damage (FOD) to other aircraft. There were signs of fuel spillage from the helicopter at the site. Assessment of the helicopter and the site indicated that the damage incurred by the helicopter was post impact.

(Some photographs are attached in (Appendix-J)

1.13. Medical and Pathological Information:

The crew and engineers on board were sent to the nearest hospital for treatment. The blood samples of pilots were taken and tested and found to be free from alcohol and other sedatives.

(Details attached in (Appendix–K)

1.14. Fire:

Thick black smoke was observed rising from the helicopter at the time of accident. The rescue and firefighting services at TIA were directed to the accident site. They discharged aqueous film forming foam (AFFF) extinguishing agent on the helicopter. The preliminary investigation team, which visited the crash site immediately after the accident did not find any indication of fire. The black smoke seemed to have come due to oil spillage on the hot engine surfaces.

1.15. Survival Aspects:

The helicopter first swung on the ground about 270^{o} before toppling on its right side. Thus, the occupants were not subjected to excessive forces. Since the crew (P1, P2 and FE) was harnessed on to their seats they escaped any injuries while an engineer who was standing besides the FE inside the cabin received minor injuries due to impact with cabin wall. The crew and other occupants were evacuated through the inspection hatch by the ground staff of the same airline immediately after the accident through the inspection hatch.

1.16. Tests and Research:

Not necessary

1.17. Organizational and Management Information:

1.17.1 Karnali Air Pvt. Ltd.

Karnali Air Pvt. Ltd was formed under the Company Act of the Government of Nepal and received the air operator certificate (AOC) in 1997 which was valid up to 16 July 2007 (Appendix-L).

Karnali Air is engaged in providing chartered air services (Cargo) by MI–17 IV and BK–117 helicopters. The key positions of the airline are Chairman, Managing Director, Deputy Managing Director, Managers for Operations and Engineering. The commander, flight engineer and ground engineers of MI-17 IV helicopter are Russian who were on vacation at the time of accident. The F/E and Co-Pilots of MI-17 IV helicopter are Nepalese.

From the study of available documents and interview of different personnel of Karnali Air, it was observed that there are some deficiencies in,

(i) Ground run briefing,
(ii) Crew rostering
(iii) Training management
(iv) Monitoring system of crew's performance
(v) Specific SOP for ground runs.

1.17.2 Civil Aviation Authority of Nepal (CAAN)

Civil Aviation Authority of Nepal (CAAN), which is responsible for safety oversight of aircraft registered in Nepal, has three distinct Divisions for the implementation of the International Civil Aviation Organization (ICAO) Annex 1 (Licensing), Annex 6 (Operation of Aircraft), and Annex 8 (Airworthiness of Aircraft) under the Aviation Safety Department. National

regulations for compliance of Annex 6 is called the Flight Operations Requirement (3rd Edition, 2005 in force) while Annex 8 is called Nepalese Civil Airworthiness Requirements (July 2002 Edition in force). Some provisions regarding the operation of helicopters is provided in the FOR.

1.18. Additional Information:

Airworthiness Inspection Division of Aviation Safety Department had granted 450 hours service life extension (from 3050-3500 hrs) and calendar period of up to 21 March 2007 for 9N-AGS helicopter. It had granted the permission to Karnali Air to carry out inspection of MGB by the specialist from Klimov factory, Russia for the life extension (Appendix-M).

Aircraft maintenance history and safety oversight audit report were studied and detailed enquiries were made with Flight Engineer, Engineering Manager and Quality Assurance (QA) Manager of Karnali Air by the members of the Commission in order to find out if there was any persistent maintenance problems or technical problem observed on that helicopter during ground run (Appendix-N).

The Commission didn't find any problems with the helicopter but there were many open deficiencies regarding the airline functioning and the standard operating procedure (SOP) noted in the audit reports.

The Flight Operations Requirements (FOR) Section 5.2.2 c, has clearly defined the procedure for engaging the rotors only by certified pilots. But it does not differentiate between a ground run of a light or heavy helicopter. Nor does it provide a detailed training program requirement (ground and flight training curriculum) for P2 and P1 type endorsement.

The helicopter was subjected to ground run on the request of the specialist from Klimov factory, Russia, to note the necessary parameters of MGB in different power modes and to check whether the MGB chip warning light is indicated or not during ground run and to check for presence of metal particles present in the MGB oil after the ground run.

The certificate of airworthiness had expired on 31 July 2006 but it did not prohibit carrying out maintenance works on the helicopter. The ground run is a part of maintenance works to be done to increase the MGB life.

The Commission was formed about one month after the accident and as a result was unable to visit the site immediately to collect fresh evidence and record witness statement. The Klimov factory specialist, too, had left for Russia in the meantime and was not available to the Commission for consultations.

2. ANALYSIS

2.1.

The crew was directed to conduct engine ground run checks of 9N-AGS helicopter by the Karnali Air Operations Department. Both the pilots possessed current P2 ratings for MI-17IV, while the flight engineer (F/E) was qualified by CAAN regulations. The F/E had carried out the preflight inspection in accordance with approved schedule and also signed pre-flight schedule sheet.

AT 08:35 UTC the F/E started the Auxiliary Power Unit (APU) and after about 4½ minutes started both the engines. The crew noted down all the relevant parameters including main gearbox oil temperature and pressure as requested by the Klimov specialist. As per Flight Data Readouts (FDR) rotor RPM reached 93% after 8 minutes. Over the duration of ground run, altitude (height) and air speed were remained zero. Cockpit Voice Recorder (CVR) read out data indicate the crew had made contact with Kathmandu Surface Movement Control and received permission for ground run. The conversation was made in Nepali language by the crew. Details of communication was not found from the read out of tapes provided by TIA, but was confirmed by the tower personnel. From FDR it was found that after 11 minutes from the starting of engines Collective was moved from 1^0 to 2^0 but other parameters did not change. After 2 minutes the Russian specialist, requested to check parameters in nominal mode (99% Ng). Since the crew had started feeling some ground resonance, the pilots decided to raise the Collective pitch lever slowly. Cyclic pitch and roll remained constant at $+4^0$ (pitch, nose up) and -2^0 (left roll). The indicated value shows that the helicopter was in a normal attitude on the ground. The value of Collective pitch of main rotor was slowly increased and it reached 7.5^0 within 14 sec resulting in the helicopter becoming light on wheels and the shock absorber strut extended. Extension of the shock absorber strut caused the opening of the micro-switch which cutout the electromagnetic valve automatically. This disengaged the hydraulic stop of the longitudinal movement of cyclic control which is set at 2^0 ±12' thus freeing it. The pilot did not realize this phenomenon and inadvertently moved the cyclic stick back causing the rotor disc to tilt backwards. As a result the helicopter came to a tail down attitude and the tail rotor guard impacted the ground. This caused the helicopter to bounce back forward.

The pilot on the command seat did not have much type experience on Mi-17 IV (approximately 50 hrs.) and was handling the controls of the helicopter. On the other hand, the pilot sitting at the First Officer (F/O) seat, who had more experience on Mi-17IV (Approx. 2000 hrs.) may have noticed the unusual behavior of the helicopter and tried to control the forward bounce by bringing the Cyclic stick back causing "over controlling" of the helicopter without coordinating with the other pilot. As a result the tail rotor guard hit the ground and the tail rotor guard was damaged. It caused the rotating tail rotor blades to hit the ground disintegrating it. Without the tail rotor to compensate the torque of main the rotor the helicopter swung towards left and main rotor blades hit the ground. The main rotor blades were smashed into pieces and the main rotor head (hub) and swash plate were also damaged in the process. As a result main rotor blade disc load and collective pitch control load decreased and pitch control indication increased up to 7.5^0. Pitch and roll were changed from $+4^0$…$+13^0$…-5^0 (cyclic pitch) and -2^0…$+9^0$…-17^0 (roll). The helicopter swung anticlockwise by almost 270^0 and toppled on its right side.

The improper and uncoordinated use of the controls and lack of CRM led to the helicopter becoming uncontrollable and resulting in the accident.

The CVR (P-503) and FDR (SARPP) system stopped registration of parameters after 14 minutes of APU start.

2.2. Ground run requirements:

According to Flight Operation Requirement (FOR), Chapter 5, "Operation at an Aerodrome and Aircraft" as stated in 5.2.2 (c) "no other persons other than certified pilots are allowed to engage the rotors in helicopter". FOR does not indicate the proficiency level or rating required for conducting ground runs. The pilots were only rated as P2. The pilot seated in the command seat had expressed his desire to control the aircraft to gain more experience. It indicates that he had not gained enough confidence in controlling the helicopter and in such a situation it was improper for him to participate in the ground run. (Appendix - P)

2.3 Flight Engineer (F/E):

The F/E had completed the approved type course from the manufacturer approved training center (Kazan Helicopter Plant) and received the license for MI-17 IV operations from CAAN. The F/E was authorized to perform all inspections including pre-flight and daily inspection in accordance with approved schedule. The F/E is a key member in MI-17 IV operations. (Appendix-Q)

2.4 Company Manual:

The engineering manual, operations manual, training manual, standard operating procedure were reviewed by the Commission and was found approved by CAAN. Many deficiencies had been pointed out by safety oversight audit report.

2.5. Power Plant and Technical Failure:

The FDR and CVR report supports the fact that there was no power plant or other technical deficiencies or failure before the impact.

2.6 Training Components

As per written statement, personnel records and log book there was a gap of about 15-16 months between the completion of crew type conversion ground training and the beginning of flight training, which was carried out over a period of two months with frequent interruptions. Training was carried out subject to availability of helicopter. The flight instructor was a Russian national whose English was not fluent and there was a communication gap between instructor and student. It indicates that the whole training program was not effective. For this category of complex aircraft, the duration of the initial ground course was found to be insufficient. There is no requirement for simulator training on Mi-17 helicopters in the FOR despite the fact that some emergency drills cannot be practiced in flight.

The Commission concluded that successful completion of an approved type course at an appropriate training facility followed by simulator training and flying training by qualified instructors is essential for the pilots applying for issue/renewal of type ratings on large helicopters. Simulator training for the initial issue/renewal of a type rating at least once a year for both P1 and P2 ratings may enhance competency of the crew. Although the training program curriculum and instructor was approved by CAAN, lack of clear guidance from CAAN, in the form of adequate guidance material also appears to be a major hindrance for the operator to have an effective training program. Thus, the training requirements by CAAN must provide mandatory inclusion of necessary ground training curriculum and simulator training for type endorsement as well as renewal.

2.7. Crew Briefing:

Crew briefing was not carried out by the Operation Department/Engineering Department on the specific flight parameters to be maintained by the flight crew during ground run resulting in confusion among crew members. The roster of a suitable mix of crew with at least one pilot with P1 rating was not observed.. The absence of proper rostering of crew also creates confusion between the crew members as to who among them is to command the helicopter from P1 position. However, it appears that they had decided it on the basis of seniority and to gain more experience from P1 position.

2.8. Ground Resonance*

2.8.1 Definition

Ground resonance can be defined as a forced or self induced large amplitude vibration of a helicopter in contact with the ground. It is recognized from a rocking motion or oscillation of the fuselage. If early corrective action is not taken, the amplitude can quickly increase to a point where it will be uncontrollable and the helicopter will roll over.

2.8.2 Entry Into Ground Resonance

An object has a natural frequency of vibration; if it is vibrated at its natural frequency it will continue, or damp out, depending on the source of vibration. If another vibration of the same frequency is present it will amplify the original vibration, and they can resonate to destruction. (Example; a wineglass shattered by a soprano singer). Therefore two vibrations are required for resonance to occur. The initial vibration may already be present in the rotor before the helicopter comes in contact with the ground. Ideally a rotor disc should have its centre of gravity at the centre of rotation. However, if for some reason the rotor blades become displaced unequally about their drag hinges the rotor centre of gravity will be forced away from the centre of rotation. This will give an effect similar to an unbalanced fly-wheel rotating at speed. For most in-flight conditions this imbalance will rapidly right itself as the individual blades space themselves out around the disc. Each blade leads and lags in such a way as to spiral the combined centre of gravity in towards the centre of rotation, its correct position. The problem exists when the helicopter comes into contact with the ground. The resulting whirling motion due to the offset centrifugal force may be at the right frequency to match the frequency of bounce of the wheels, tire, oleo struts and

fuselage. If this occurs the centre of gravity of the rotor disc, instead of spiraling gently inwards, spirals violently outward, producing a rotating force at the rotor hub that no helicopter can withstand.

** Training manual, Bristow Helicopters U.K.*

2.8.3 Causes Of Ground Resonance

The following mechanical and handling faults can induce ground resonance:

Rotor head vibration can be caused by:

i) Blades of unequal weight or balance. Blades should be correctly weighted and balanced during manufacture. Flight in icing conditions, however, can cause imbalance due to the uneven accumulation of ice on the blades. Absorption or ingress of moisture and blade damage can also cause imbalance.

ii) Faulty drag dampers. With a three-bladed rotor system the blades should be equally spaced at 120^0 apart. If a maladjusted or sticking drag damper allows uneven spacing of the blades, the centre of gravity of the blades will be displaced away from the axis of rotation. Take off or landing on sloping ground are situation where a slightly maladjusted damper, although having little effect in normal flight, can induce ground resonance. The rotor disc is kept level with the horizon and becomes tilted relative to the fuselage as the fuselage tilts over at some angle. This will introduce coriolis effect, which in turn tends to displace the rotor's centre of gravity.

iii) Faulty Tracking. A rotor, which is badly out of track, that is, one blade on a tip path plane well removed from that of the remaining blades, may set up an unbalanced condition. This type of imbalance transmitted to the fuselage, usually results in nothing more than a "ROUGH" helicopter and a "BEAT" in the cyclic stick. If the imbalance is sufficiently large it may be possible for it to combine with other factors to induce ground resonance. The centre of gravity of the "FLYING HIGH" out of track blade will be nearer the axis of rotation than that of the other blades. This will offset the rotor centre of gravity.

iv) Faulty automatic flight control system (AFCS)/automatic stabilization equipment (ASE). Certain faults in the AFCS/ASE can generate control inputs, which may be in sympathy with the natural undercarriage frequencies. This would result in the onset of ground resonance. It is, therefore, normal to disengage the AFCS/ASE when on the ground.

2.8.4 Recovery Action

Recovery from ground resonance is achieved by eliminating the forces inducing the resonant frequency. Therefore, as soon as the resonance is recognized, either ground contact must be broken, or the rotor RPM changed. The more appropriate of the following actions must be taken as quickly but smoothly as possible.

a) If the rotor RPM is within the normal flying band, take off must be made immediately. It is essential that rotor RPM is always maintained in the operating range until the landing is completed and the lever is in the fully down position.

b) If take-off rotor RPM are not available or insufficient power is available to lift off, or the serviceability of the helicopter is in doubt, the following actions should be taken.

   i) Lower the lever fully.

   ii) Shut the engine down.

   iii) Apply the rotor brake.

   iv) Apply the wheel brakes.

   (Appendix - H)

2.9. Company Resource Management (CRM):

It is evident that a briefing was not carried out by the Operation Department of Karnali Air as to the specific flight parameters to be maintained, engine power to be selected or for how long it was to be maintained resulting in confusion among crew members during the ground run.

2.10. Crew Rostering:

From the interview with the Management of Karnali Air, its crew members and study of logbooks and relevant documents, it was clear that P2 was on controls during ground run. The pilots were not confident, whether they could properly carry out the ground run. CVR readout indicates that they have not coordinated well during ground run. (Details of interviews in Appendix-O)

2.11. Operation of Mechanism of Switching on Hydraulic Stop

At the instant of landing and taxing the shock struts are fully compressed. The upper section of the torque link by pressing onto pusher 6 (see Fig.), turns the rocker 5 and releases the micro switch rod. The rod, taking the initial position, actuates the switch. A signal is supplied through respective contacts, for switching on the hydraulic stop system in the helicopter longitudinal control.

The turn of the rocker by an angle ensuring a clearance of 1 ± 0.5 mm between its upper arm and micro switch rod in its initial position is adjusted with pusher 6.

When the strut is not compressed and the upper section of the torque link is separated from the pusher, the rocker upper arm, under the action of the spring, presses

on the micro switch rod, the micro switch operates and through respective contacts cuts out the hydraulic stop system.

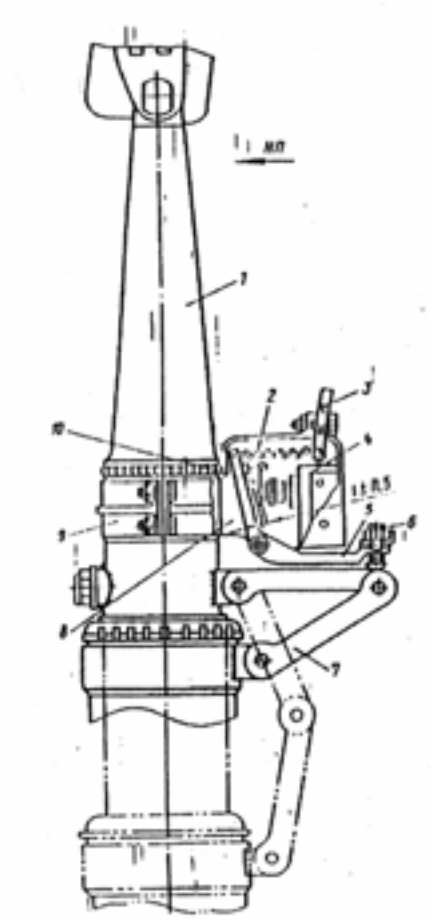


Fig. . Mechanism for switching-on hydraulic stop

1. Shuck strut of main landing gear
2. Spring
3. Wire cable
4. Microswitch AM-800K
5. Rocker
6. Pusher
7. Splined joint
8. Detachable bolt
9. Clip
10. Port for measuring the gap of microswitch

Note. Fig. illustrates the rocker in position of fully compressed piston of low-pressure chamber of the shock strut (at helicopter parked)

НП. Direction of flight

2.12. Improper rostering.

The written statement of Chief's of Flight Safety and Operation Department indicate that they had not paid attention on the competency of pilots to carry out ground run. They had not prepared a roster with specific P1 position and P2 position responsibilities. The pilots decided this among themselves. The pilot who was on P1 position clearly indicated that he made a choice to sit on P1 position to gain more experience. This indicates that he was not confident to carryout a ground run of MI-17 IV. (Appendix-P)

2.13. FDR performance.

The SARPP-12DIM installed on 9N-AGS records the following parameters:

a) Pressure equivalent altitude within the range of 50 to 6000 m.
b) Indicated airspeed (IAS) within the range of 60 to 400 km/hr.
c) Collective-pitch control in the range of -30^0 to $+30^0$.
d) Main rotor RPM within the range of 70 to 110 %
e) Angle of bank within the range of -60^0 to $+60^0$ and
f) Angle of cyclic pitch within the range of -45^0 to $+45^0$
(Appendix-R)

3. CONCLUSION

3.1 Findings:

a. The certificate of airworthiness of the helicopter had expired on 17 July 2006 but this did not prohibit carrying out ground run for maintenance purposes.

b. The ground run was made on the request of the specialist from Klimov Factory, Russia to check the operational condition of MGB in order to increase its service life.

c. Flight Operation department of Karnali Air had permitted the crew to carry out ground run without properly rostering the pilots for P1 and P2 positions.

d. Both the pilots were certified for P2 of MI-17 in accordance with existing Flight Operation Requirement (FOR). However, the FOR is not clear about crew proficiency level requirement on large helicopters.

e. The FE was rated for MI-17 IV type helicopter from CAAN but was neither a regular staff of Karnali Air nor authorized by CAAN to act as F/E on 9N- AGS.

f. The weather was fair with calm wind at the time of accident.

g. All the damages to the helicopter were post impact and there was no evidence in CVR/FDR to support technical failure before accident.

h. The crew and the Engineers on board had sustained minor injury and was rescued by ground handling staff of the same company.

i. The blood sample examination indicated that the flight crew was free from alcohol and sedatives.

j. Fuel and oil had leaked from the toppled helicopter.

k. Maintenance works and scheduled inspections on the helicopter had been performed in a timely manner and all log books had been maintained properly.

l. The logbooks and log cards were maintained properly.

m. Type training and other training courses were not properly scheduled and were inadequate as well as ineffective.

n. The pilots, although authorized to carry out ground run, were not confident to make the ground run.

o. The FDR and CVR of the helicopter were serviceable and appropriate information was recorded.

p. Improper handling of controls by crew led to the accident.

q. Crew coordination onboard was very poor.

r. The pilots were using Nepali language to communicate with Kathmandu Tower and among them.

s. Required ground run briefing was not conducted.

t. Ground run procedure was not provided in the company SOP.

u. The Inter State Aviation Committee's assistance was sought for decoding and analysis of CVR/FDR at their laboratory in Russia.

v. Many of the deficiencies observed during safety oversight audit by CAAN had remained open for consecutive years.

Cause

The Commission concludes that the probable cause of accident of the helicopter was the improper handling of controls by crew due to lack of crew coordination.

Other contributing factors were:

a. Lack of sufficient type experience

b. Absence briefing before commencing the ground run

d. Lack of clear provisions in SOP for conducting ground runs.

e. Improper rostering of crew by Karnali Air management.

f. Ambiguous CAAN regulation regarding engagement of rotors in helicopters (5.2.2 c).

4. RECOMMENDATION

CAAN

i. Review the air operators training program for P2 and P1 type rating on large helicopters like MI-17.

ii. Include requirement for simulator training for the issue/renewal of type rating of large helicopters like MI-17. (Appendix-R)

iii. Introduce company resource management training course to the personnel engaged in safety and operational departments of the airlines within a reasonable time frame. Safety audit reports should be properly evaluated, especially for deficient trainings, before renewal of AOC.

iv. Review FOR to include the requirements on the qualification, competency and proficiency of crew on large helicopters.

v. Review the crew and controller training and include high emphasis on the ability to communicate in English before to issue/endorse license.

Karnali Air and Other Mi-17 IV Air Operators

i. Review Training manual to meet the FOR requirements of CAAN.

ii. Incorporate clear provisions for ground runs in SOP.

iii. Ensure proper briefing of crew before ground run checks and flight.

iv. Operation Department should ensure the competency of crew before job assignment or rostering.

v. Company's Safety Department should monitor the performance of crew at regular intervals or as directed by CAAN.

vi. Conduct company resource management trainings for all crew and key personnel of the company.

Appendices

Appendix A – History of the helicopter

Appendix B – Crew Details

Appendix C – Photographs of Damaged helicopter

Appendix D – Permission Letter from Karnali Air

Appendix E – Certificate of Airworthiness (C of A)

Appendix F – Permission Letter of CAAN

Appendix G – TIA Accident Report

Appendix H – Photograph of East Helipad (TIA)

Appendix I – Readouts of FDR/CVR

Appendix J – Wreckage Photographs

Appendix K – Pathological Information

Appendix L – Permission to carry out the inspection of MGB (BR-14)

Appendix M – Statement of Different Personnel

Appendix N – Pre Flight Inspection

Appendix O – Flight Data Recorder SARPP-12 DM Parameters

Appendix P – Flight Simulator of MI-17 IV Helicopter

APPENDIX-A

History of the Helicopter

Aircraft History:

Manufacturer: Kazan Helicopter Plant Jsc, Russia.
Aircraft Registration No.: 9N AGS
Model: MI-8MTB1 (MI-17 IV)
No. of Engines: Two
Aircraft Serial No. 96079
Date of Manufacture: 02 February 1993
Date of Issue of C of A in Nepal.: 11 October, 2002
Validity of C of A: 31 July, 2006 (expired at the time of Accident)
Latest Inspection Completion: 16 June 2006 (100 Hours Inspection)
Total time since new: 3125:35 Hrs.
Total landings: 5704

Engine History:

Left Engine
Manufacturer: Motorsich, Ukraine
Model: TV3-117VM
Engine Serial No.: 7087882300007
Engine TTSN: 1235:13 Hrs.
TSO : 300:13
Installed Date: 08 December 2005
Latest Inspection Completed: 15 June 2006 (100 Hours Inspection)

Right Engine
Manufacturer: Motorsich, Ukraine
Model: TV3-117VM
Engine Serial No.: 7087883300118
Engine TTSN: 2046:13 Hrs.
TSO: 300:13
Installed Date: 08 December 2005
Latest Inspection Completed: 15 June 2006 (100 Hours Inspection)

Main Gear Box History:

Manufacturer: Perm Motors Russia
Model: VR-14 (BP-14)
Serial No.: 1040141203083
Hours TTSN: 3350
Hours: TSO: 966:00
Manufacturer Date: 04 September, 1992
Latest Inspection Completed: 07 July 2006

Auxiliary Power Unit (APU) History:

Manufacturer: Motor Switch
Model: AI-9 B
Serial No.: 3870921800037
Hours TTSN: 145:48 Hours
Hours: TSO: 0:10 Hours
Manufacturer Date: 04 August, 1978
Last Overhaul: 15 Dec., 2005
Installation Date: 07 July, 2006

APPENDIX-B

Crew Details

Pilot-in-Command Seat:

Captain:	Male
Date of Birth:	20 Apr, 1975
Nationality	Nepalese
Validity of License:	30 June, 2007
Ratings:	BK117 & AS350 – as P1, MI-17 – as P2
Last Proficiency Check:	05 March 2006
Total Hours:	3740
Hours on type:	50
Hours flown in last 90 days	65
Hours flown in last 30 days	1:50
Hours flown in last 07 days	0

Pilot in First Officer Seat:

Captain:	Male
Date of Birth:	02 November, 1973
Nationality:	Nepalese
Validity of License:	31 March, 2007
Ratings:	MI-17
Last Proficiency Check:	11 March 2006
Total Hours:	2200
Hours on type:	1900
Hours flown in last 90 days	21:09
Hours flown in last 30 days	0
Hours flown in last 07 days	0

Flight Engineer:

Flight Engineer:	Male
Date of Birth:	17 June, 1971
Nationality:	Nepalese
Validity of License:	28 February, 2007
Ratings:	MI-17, FE, A & C
Last Proficiency Check:	09 March, 2006

Ground Engineer:

Ground Engineer:	Male*
Date of Birth:	08 Oct. 1965
Nationality:	Russian
License No.:	#K-078-016
Validity of License:	21 January 2008

** An authorized representative Klimov Plant, Russia (Designer of Engine and Main Gearbox)*

APPENDIX-C

APPENDIX-J