



FOREWORD
FINAL REPORT

Investigation into the Accident of R-66 Helicopter, Nationality and Registration Mark S2-AGT of Square Air Ltd (SAL) on 01 October 2017 at Chatmohar, Pabna, Bangladesh.

This accident investigation has been performed in accordance with Civil Aviation Act 2017, pursuant to Part 13 of CAR 1984 and in conformity with Annex 13 to the Chicago Convention on International Civil Aviation. The delegation of investigating authority was accorded to the Head of Aircraft Accident Investigation Group of Bangladesh (AAIG-BD); vide Office Order CAAB/CS/32/AAIG-BD/01/MASTER, dated 22 June 2016.

The Head of AAIG-BD received a Mandatory Occurrence Report (MOR) sent by the Operator narrating about the Accident of one Robinson R-66 helicopter, Nationality and Registration Mark S2-AGT of Square Air Ltd on 01 October 2017 at Chatmohar, Pabna, Bangladesh. The helicopter took off from VGHS at 1005 UTC with PIC plus four passengers on board for Pabna. The helicopter couldn't proceed to the destination due to bad weather and diverted from 15-20 nautical miles short of the destination to land at a nearby area for the weather to clear-up. While landing hurriedly on a paved surface at Chatmohar, Pabna, the helicopter got into Dynamic Rollover and toppled. The helicopter was damaged beyond economic repair. Pilot and all passengers survived with no significant injury.

Immediately following the occurrence, the Head of the AAIG-BD constituted an Aircraft Accident Investigation Team (AAIT) comprising two (02) investigators appointing an IIC to conduct the necessary investigation.

The Preliminary Investigation Report, in accordance with the requirements of ICAO Annex 13 and the Compendium on Aircraft Accident Investigation Group, Bangladesh (AAIG-BD) was published on October 31, 2017.

The sole objective of this investigation is to prevent aircraft accidents and incidents by identifying safety deficiencies as evidenced in the aircraft occurrences. Make recommendations to eliminate or reduce observed safety deficiencies. It is not the purpose of this activity to apportion blame or liability.

The information contained in this final report has been derived from the factual information and evidences gathered during the investigation of the occurrence.

The specific safety issues identified during the course of the investigation will be advised to all parties through the AAIG-BD Safety Recommendations procedure.

This draft final report represents the complete investigation, which will be refurbished after receiving comments from States and subsequently made public in due course of time, in conformity with ICAO Annex 13.

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FINAL INVESTIGATION REPORT OF R-66 HELICOPTER ACCIDENT AT PABNA BANGLADESH OCCURRED ON 01-10-2017

PROGRESSION OF THE INVESTIGATION

SL	ACTION BY THE AAIG-BD	DATE
1.	Date of the Occurrence	01 October 2017
2.	Formation of Accident Investigation Team (AAIT) as per Standard 5.1 of ICAO Annex 13	01 October 2017
3.	Date of Circulation of Notification to relevant States and others as per Standard 4.1 of ICAO Annex 13	02 October 2017
4.	Date of Circulation of 'Preliminary Report' as per Standard 7.1 of ICAO Annex 13	31 October 2017
5.	Date of Circulation of 'Draft Final Report' for Comments as per Standard 6.3 of ICAO Annex 13	24 April 2019
6.	Date of Completion of 'Final Report' upon receipt of comments as per Standard 6.3 of ICAO Annex 13	31 December 2019
7.	Date of Circulation of 'Final Report' as per Standard 6.4 of ICAO Annex 13	12 January 2020
8.	Estimated Date of Circulation of 'Final Report' together with the 'Format' on the preventive action taken or under consideration, or the reasons why no action will be taken on the 'Safety Recommendations' to relevant States and others as per Standard 6.8 of ICAO Annex 13	15 January 2020
9.	Estimated Date of Publication of 'Final Report' in (http://caab.portal.gov.bd/) as per Standard 6.5 of ICAO Annex 13	20 January 2020
9.	AAIG-BD Action on Reopening of investigation as per Standard 13 of ICAO Annex 13 (If required).	Reserved

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1. TITLE

1.1 Name of Operator	Square Air Ltd. (SAL)
1.2 Name of Manufacturer	Robinson Helicopter Company
1.3 Aircraft Model	R-66
1.4 Aircraft Nationality	Bangladesh
1.5 Aircraft Registration Marks	S2-AGT
1.6 Place of Occurrence	Chatmohar, Pabna, Bangladesh
1.7 Date of Occurrence	01 October 2017



2. SYNOPSIS

Para	Heading	Description
2.1	Notification of accident to national and foreign authorities	<p>The Head of the Aircraft Accident Investigation Group of Bangladesh (AAIG-BD) has notified to all relevant Authorities and Organizations/Agencies as per Standard 4.1 of ICAO Annex 13, Civil Aviation Authority Bangladesh, Rule 235 and Part C Para-6 of the Compendium of Aircraft Accident Investigation Group of Bangladesh (AAIG-BD). The notification included the following addresses:</p> <ol style="list-style-type: none"> 1. The State of Registry: All concerned of Civil Aviation Authority of Bangladesh; 2. The State of Operator: All concerned of Civil Aviation Authority of Bangladesh; 3. The State of Occurrence: (Minister MOCAT, Secretary MOCAT, Chairman CAAB, Member OPS CAAB, Director Flight Safety & Regulations CAAB and the Aircraft Accident Investigation Team designated by AAIG-BD); 4. The State of Manufacturer : USA (National Transportation Safety Board & Boeing); 5. The State of Design: NTSB; USA (National Transportation Safety Board & Boeing); 6. Other Organizations: International Civil Aviation Organization (ICAO).
2.2	Accident investigation Authority	Aircraft Accident Investigation Group of Bangladesh (AAIG-BD) CAAB Headquarters, Kurmitola, Dhaka, Bangladesh;
2.3	Accredited Representation	None
2.4	Organization of the Investigation	Aircraft Accident Investigation Team (AAIT), designated by the Head of the AAIG-BD and appointing an IIC through a 'Memorandum'.
2.5	Authority releasing the report	Aircraft Accident Investigation Group of Bangladesh (AAIG-BD).
2.6	Date of Circulation of report	24 April 2019
2.7	Brief resume of circumstances leading to the accident	<p>2.7.1 Square Air Ltd.(SAL), R66 helicopter, S2-AGT on 01 October 2017 conducted a corporate flight from Dhaka for Pabna. The operator is from Bangladesh and its main base is located at Hazrat Shah Jalal International Airport (HSIA), Dhaka. All its engineering and operational establishments are also located at the same place.</p> <p>2.7.2 On the day of the accident, on 01 October 2017, SAL, R-66 helicopter S2-AGT, operating a nonscheduled corporate domestic passenger flight, took-off from VGHS at 1005 UTC with 04 corporate personnel for Pabna Astras Helipad (Square House at 24°00.92'N, 089°12.67'E). The helicopter couldn't proceed to the destination due to bad weather and diverted from 15-20 nautical miles short of the destination. The Captain looked for a suitable landing area close by to land and wait for weather to clear up. He found a paved surface of a local rice mill (called Chatal at 24°13.28'N, 089°16.80'E) and</p>

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		<p>decided to land there. At around 1100 UTC while hurriedly landing and switching off, the helicopter suddenly became uncontrollable and toppled to the right side (pilot side). The pilot, immediately switched off the helicopter and came out through the left door and evacuated all passengers with the help of local people.</p> <p>2.7.3 There were 04 (four) Corporate passengers and 01 (one) pilot onboard at the time of accident. There was no significant injury to the passengers and the pilot.</p> <p>2.7.4 The helicopter was damaged extensively. During initial investigation the following damages were found:</p> <ul style="list-style-type: none"> ❖ Tail boom completely damaged and sheared off from helicopter fuselage. ❖ Tail rotor gearbox broken and sheared off from tail boom. ❖ Both the main rotor blades completely damaged. ❖ Swash plate and link rods badly damaged. ❖ Control tube broken. ❖ Tail rotor guard broken. ❖ Tail rotor transmission broken. ❖ Helicopter fuselage damaged in all areas. ❖ Status of the engine could not be ascertained, but looks damaged. ❖ The helicopter was found to be beyond economic repair. <p>2.7.5 The Pilot and all four (4) passengers were taken to Pabna by Road after the accident. The local doctor checked the pilot and found normal.</p> <p>2.7.6 The AAIT was formed on the same day, 01 October 2017 to investigate the cause of the accident.</p>
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3. FACTUAL INFORMATION

3.1 History of Flight

Date of Flight	01 October 2017
Flight Number/Call sign	Call Sign S2 AGT
Aircraft Registration	S2 -AGT
Aircraft Type	Robinson R66

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FINAL INVESTIGATION REPORT OF R-66 HELICOPTER ACCIDENT AT PABNA, BANGLADESH, OCCURRED ON 01-10-2017

Type of Operation	Non Scheduled Domestic Corporate Passenger Flight
Last Point of Departure	Hazrat Shahajalal International Airport (HSIA), Dhaka, Bangladesh.
Time of Departure	1005 UTC (1605 LT)
Point of Intended Landing	Astras Helipad (Square House at 24°00.92'N, 089°12.67'E), Pabna, Bangladesh.
Scheduled Time of Arrival	1045 UTC (1645 LT)
Time of Incident/Accident	1100 UTC (1700 LT)
Whether Day or Night	Day
Location (latitude, longitude, elevation) of the accident spot	N24°13.28' E089 ° 16.80'; Elevation: 52 Feet
Description of the flight and events leading to the accident	The weather at destination and around was bad. Low cloud, heavy rain and thundering was observed 15-20 NM en-route destination. The pilot decided to land in the clear area to wait for the weather to clear up. He landed on paved surface and switched-off. The surface was uneven and the helicopter went into dynamic rollover and toppled.

3.2 Injuries to persons:

Injuries	Crew	Passenger	Others
3.2.1 Fatal	None	None	None
3.2.2 Serious	None	None	None
3.2.3 Minor/None	None	None	None

3.3 Damage to Aircraft and Property:

3.3.1 Destroyed	Yes
3.3.2 Substantially damaged	No
3.3.3 Slightly damaged	No
3.3.4 No damage	No
3.3.5 Other damage	None

3.4 Personnel Information:

Pilot in Command	<ul style="list-style-type: none"> ❖ Age: 38 years. ❖ Nationality: Bangladeshi. ❖ CPL # 615, Valid till 01-06-2020. ❖ Aircraft Type Ratings: Current on R66 and Bell 407. ❖ Flying Experience (Total): 3564:10 Hours. ❖ Flying Experience (On type): 293:05 Hours. ❖ Duty time: Normal Rest Hours, 8:50 hours gap between two flights on the same day. ❖ Instructor Rating: Rated, valid till 17-04-2018. ❖ Instrument Rating: Rated, valid till 07-01-2018 ❖ Medical Status: Class-1 (One) till 28-03-2018 ❖ CRM training: Done on: 12-08-2017 ❖ Management Post: Chief of Flight Safety & Pilot, Square Air Ltd. ❖
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First Officer	NA
Cabin Crew	Nil
Other Personnel	Four Passengers

3.5 Aircraft Information:

Model	R-66
Manufacturer	Robinson Helicopter Company
Registration	S2-AGT
MSN	Corporate passenger flight
Engine Make and Model & SI No.	Rolls Royce, M250-C300/A1, RRE-200417
Certificate of Airworthiness	Valid Until 26-01-2018
TSN	852.08
Type of Fuel Used	JET A-1
Performance Status: Take-off Weight and CG	1220 kg at HSIA, CG OK (Long Fwd 91.93", Aft 98.17")
Performance Status: Landing Weight and CG	1150 kg at Chatmohor, CG OK (Long Fwd 91.93", Aft 98.17")

3.6 Meteorological Information:

3.6.1 There is no meteorological observatory at Pabna area. The weather report of VGHS on October 1, 2017 at 0900 UTC specify the weather condition as 'TEMPO+TSRA' with visibility 2 Km and 05 Kts southerly surface wind, thunder shower and rain. The Captain checked the en-route and destination weather in the internet weather web site. He found a big rain bearing cell all around Dhaka and the movement was towards northeast. At about 0930 UTC rain over Dhaka City stopped. The weather en-route Pabna was better. But, there were CB clouds near Rajbari – Kushtia area (15-20 NM left of track. On ground observation at destination also reported no rain at 0930 UTC. The weather over Pabna (destination) became bad again at about 1035 UTC. There was heavy rain, gusty wind and low clouds all around the destination. The pilot deviated to avoid the weather. The weather was marginal for helicopter operation and the major cause of the accident was adverse weather.

3.6.2 Helicopters are adversely affected by changing weather conditions which jeopardizes its safety. Helicopters are mostly flown at low altitudes, as such are more susceptible to bad weather. Bad weather in Bangladesh at times are unpredictable, therefore all pilots should take special precautions and know the bad weather procedures. The susceptibility of helicopters in bad weather are described in Appendix A.

3.6.3 Natural light conditions at the time of accident was sunlight and cloudy.

3.7 Aids to Navigation:

Sufficient Navigation Aids were available for operation of the helicopter. The GPS/ COM/ NAV X'CVR, Model GNS430W with related equipment was available. There was no evidence that non-availability of Navigation Aids adversely affected the circumstances of the accident and the pilot's decision making.

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3.8 Communications:

Communication between S2-AGT and the air traffic control of Hazrat Shahajalal International Airport (VGHS), Dhaka, Bangladesh were normal. There was no communication with VGRJ before the accident. The pilot did not communicate to any ATC as height was very low and the weather was bad. No evidence was found to suggest that any aspect of the communications between the pilot and ATC adversely affected the circumstances of the accident and the pilots' decision making.

3.9 Aerodrome Information:

The landing area was selected from available areas on deviation from the intended route. The area was adequate for the helicopter to land. No heliport/ helipad facility was available.

3.10 Flight Recorders:

No flight recorder was installed with this helicopter. The helicopter was equipped with an Engine Monitoring Unit (EMU), that is a digital recording device mounted behind the right rear seat back panel. The EMU records and retains data consisting of total engine run time, an engine start counter (whenever N1 exceeds 30% and MGT is at least 343 C, and exceedances for N1, N1 run limit, N2 transient, N2 run limit, Torque Meter Oil Pressure (TMOP) transient, TMOP exceedance, TMOP run limit, MGT transient run mode, MGT run mode, MGT run limit run mode, and torque. The EMU also records and retains data consisting of flight history (date, engine start time and duration), and in 1 second increments N1 and N2 speeds in percent, TMOP psi, and MGT in Fahrenheit. The data downloaded from the EMU revealed no exceedance and no errors reported during the accident flight. The engine was found to operate normally and there was no evidence of pre impact failure or malfunction.

3.11 Wreckage and Impact Information:

The helicopter was damaged extensively including its engine, rotating blades, structure, landing gear etc. Tail boom completely damaged and sheared off from helicopter fuselage. Tail rotor gearbox broken and sheared off from tail boom. Both the main rotor blades completely damaged. Swashplate and link rods badly damaged. Control tube broken. Tail rotor guard broken. Tail rotor transmission broken. Helicopter fuselage damaged in all areas. The engine driveshaft broke due to heavy stress. The helicopter was found to be beyond economic repair as the total structure was damaged, broken and deformed due to high stress and different type of tensile, compressive and twisting force. The damaged helicopter photographs are shown in the Appendix B.

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3.12 Medical and Pathological Information:

The Pilot and all four (4) passengers suffered no injury. However, the investigating officer send the pilot to a local doctor at Pabna for medical checkup. The pilot was certified to be physically and mentally fit.

3.13 Fire:

There was no pre or post impact fire to the helicopter and its engine.

3.14 Survival Aspects:

All passengers and crew were immediately evacuated with the help of local people. The helicopter crashed in a populated area, therefore, immediate communication was possible. Helicopter company and ATS were immediately notified.

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3.15 Test and Research:

3.15.1 No technical test was carried out as the cause of the accident was touchdown and landing problem. The two major causes of R66 helicopter crashes, i.e. Mast Bumping and Dynamic Rollover were taken into consideration.

3.15.2 In case of Mast Bumping, the main rotor blade was supposed to stuck the fuselage, causing the helicopter to break up in flight. The helicopter had no problem till touchdown, therefore, Mast Bumping was not the cause.

3.11.3 The helicopter rolled to the right on touchdown due to uneven surface and toppled. A case of Dynamic Rollover as the impact observed and the main rotor hit the ground first. The pilot was in hurry to land and switch-off as the weather was very bad. He didn't notice the hump/slope at the touchdown point. The pilot failed to use proper landing technique of slope landing and apply the required corrective actions. In this case the right skid was low on the slope and became a pivot point, the helicopter reached critical rollover angle and rolled to the right and toppled.

3.16 Organizational and Management Information:

3.16.1 The Operator's R66, S2-AGT was cleared by CAAB for Square Hospital – Pabna (Night Stop) – Square Hospital – VGHS. The Alternate Aerodrome shown was: Any open Field. A planned diversion/alternate could help the pilot in bad weather recovery of the flight.

3.16.2 One of the Directors of Square Group was onboard, the pilot took-off in marginal weather and wanted to proceed to Pabna. The corporate passengers came all the way from Square Hospital Helipad to VGHS to avail the flight. The pilot was obliged to carry out the flight. Once he saw bad weather at the destination, he wanted to make a short stopover to take the passengers to the destination instead of returning back to VGHS.

4. ANALYSIS

Analyzed below as appropriate, only the information documented in 'Factual Information' and which are relevant to the 'Determination of Conclusions' and 'Causes and/or Contributing Factors'.

4.1 Man

4.1.1 The pilot was engaged in corporate passenger flight when the accident occurred. The flight was in VFR with marginal weather. There was heavy rain, gusty wind, poor visibility at and around the destination. The pilot had sufficient flying experience on type and on helicopters. The pilot was on regular flying practice and instructor on type. The pilot's decision to land at an unknown place without any recce was wrong. During landing also the pilot hurried up and didn't do the landing checks. The touchdown procedure was wrong and unacceptable with his experience.

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4.1.2 The four corporate passengers include one of the Directors of the operator. They were very much interested to avail the flight. The pilot considered the weather information and thought there was a gap to proceed to the destination after some delay. The pilot's decision to fly in marginal weather was also influenced by the presence of the corporate passengers at the VGHS SAL Hangar.

4.1.3 The pilot failed to consider the aspects of Dynamic Rollover while landing at an unprepared surface. The critical rollover angle was reduced under the existing conditions and the helicopter toppled.

4.2 Dynamic Rollover

4.2.1 A helicopter is susceptible to a lateral rolling tendency, called dynamic rollover. This might occur during liftoff or touchdown of the helicopter. For dynamic rollover, some factors has to first cause the helicopter to roll or pivot around the landing gear wheel / skid, until its critical rollover angle is reached. Then, beyond this point, main rotor thrust continues the roll and recovery is impossible. If the critical rollover angle is exceeded, the helicopter rolls on its side regardless of the cyclic control corrections made. The details on dynamic rollover is attached as Appendix-C.

4.2.2 Section 10 of Robinson Model R66 Pilots Flight Manual, Safety Tips # 13 describes the possibility of Dynamic Rollover in R66 helicopter as follows. "The helicopter is stable on its landing gear as long as ground contact is made vertically or with the aircraft moving forward. Should ground contact be made with the helicopter moving rearward or sideward, damage and possibly a rollover could occur."

4.2.3 Robinson Helicopter Company Safety Notices SN-9 emphasizes that many accidents involve dynamic rollover. It also prescribes how to avoid a dynamic rollover. The SN-9 is attached as Appendix-D.

4.3 Machine

4.3.1 The helicopter was maintained as per the existing regulations and there were no defects reported prior to the accident. The helicopter had only flown 852.08 hours TSN.

4.3.2 The helicopter had sufficient fuel to fly back to VGHS or proceed to nearest airport VGRJ or any secured area away from the bad weather. There was no requirement for immediate landing.

4.4 Environment

4.4.1 The helicopter had air-conditioning system, therefore, the flight was comfortable for both pilot and passengers. The weather was bumpy, for light helicopter it was sometimes uncomfortable.

4.4.2 The weather was marginal both at departure and destination. The weather over Pabna (destination) and around became bad prior to arrival. There was heavy rain, gusty wind and low clouds all around the destination. The pilot deviated to avoid the weather. The weather was marginal for helicopter operation and the main cause of the accident was adverse weather.

4.5 Organizational Aspects

4.5.1 The pilots should know the bad weather procedures at any stage of flying. The diversions should be planned

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and standardized. In case of landing at an unknown place proper recce must be done prior to touchdown.

4.5.2 No compromise with weather should be practiced and implemented by all operators and pilots. All corporate obligations must be avoided.

4.6 Action Taken by CAA, Bangladesh Following the Accident

4.6.1 CAAB initiated this investigation and appointed the Aircraft Accident Investigation Team (AAIT) delegated by the Aircraft Accident Investigation Group of Bangladesh (AAIG-BD). The AAIT inspected the accident site and the crashed helicopter next day due to bad weather and nightfall.

4.6.2 CAAB reminded all operators to be careful about the weather conditions and helicopter limitations in adverse weather. All operators were reminded to follow CAAB Circular 2/2016 on 'Helicopter Operations'

5. CONCLUSIONS

6. Findings

6.1.1 The helicopter was certified, equipped and maintained in accordance with existing regulations and approved procedures.

6.1.2 The helicopter had a valid Certificate of Airworthiness and had been maintained in compliance with the regulations.

6.1.3 The helicopter was Airworthy when dispatched for the flight.

6.1.4 The Maintenance Records and the recent analysis revealed no defect existed prior to the dispatch of the helicopter.

6.1.5 The load and balance was within the limits and had no relevance with the occurrence.

6.1.6 The pilot had valid commercial pilot licence with instrument and flight instructor's ratings. The pilot was type rated on R-66 with adequate flying experience.

6.1.7 The pilot was in possession of a valid medical certificate.

6.1.8 The helicopter crashed on a paved uneven surface in a rice mill while landing and switch-off.

6.1.9 The weather was marginal to bad almost the whole day. The pilot should have been more careful about the weather and bad weather diversions.

6.1.10 TAs there were four corporate passengers including a Director of the operator company who intended to avail the flight, the pilot was obliged to fly in marginal weather conditions.

6.1.11 The pilot failed to recce the landing site prior to touchdown. There was a hump and the right skid fall on that while touchdown. The helicopter pivoted on the right skid and toppled due to dynamic rollover.

6.1.12 Operators do not conduct regular briefings on procedures and emergencies drills.

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7. CAUSES

The main cause of the accident was Dynamic Rollover during a hurried landing.

8. CONTRIBUTING FACTORS

- 8.1 Bad weather
- 8.2 The uneven surface at the landing point.
- 8.3 Wrong landing procedure.
- 8.4 Corporate syndrome.

9. INTERMEDIARY SAFETY RECOMMENDATIONS

Nil

10. SAFETY RECOMMENDATIONS

10.1 Safety Recommendations to be implemented by CAAB

10.1.1 CAAB should advise all helicopter operators to submit Bad Weather Procedure for scrutiny and future inclusion in the OM and SOP.

10.1.2 CAAB may promulgate safety circulars comprising all aspects of helicopter flying for the operators to comply with.

10.2 Safety Recommendations to the Operator of S2-AGS

10.2.1 The operator should include Bad Weather Procedure in their OM and train the pilots on bad weather procedures and emergency handling of the helicopters.

10.2.2 Robinson Helicopter Company Safety Tips and Notices must be studied regularly by all Robinson Helicopter pilots to know about the mistakes made by other pilots and avoid making the same errors.

10.2.3 All Robinson helicopter pilots must attend the Robinson Safety Course on regular intervals to remain current on emergency practices.

10.3 Safety Recommendations to all Other Operators

10.3.1 All helicopter operators must include Bad Weather Procedure in their OM and train the pilots on bad weather procedures and emergency handling of the helicopters

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FINAL INVESTIGATION REPORT OF R-66 HELICOPTER ACCIDENT AT PABNA, BANGLADESH, OCCURRED ON 01-10-2017

10.3.2 All helicopter operators must ensure Robinson Helicopter pilots does the Robinson Safety Course on regular intervals to remain current on emergency practices.

10.3.3 Robinson Helicopter Company Safety Tips and Notices must be studied regularly by all Robinson Helicopter pilots to know about the mistakes made by other pilots and avoid making the same errors.

11. APPENDICES

All evidences, data recordings, documents, photographs etc. have been systematically stored in file.

END

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