FINAL REPORT ON SERIOUS INCIDENT TO PAWAN HANS HELICOPTER LIMITED'S DAUPHIN AS365N3 HELICOPTER VT-PHP ON 27TH SEPT 2007 AT LAKSHADWEEP (KAVARATTI)

1. Aircraft Type

	Model	: Dauphin AS365N3
	Nationality	: INDIAN
	Registration	: VT-PHP

2. Name of the Owner/ Operator : M/s. Pawan Hans Helicopters Limited

3. Pilot – in – Command

	License No.	: CHPL No.286
	Extent of injuries	: Nil

4. Co – pilot

	License No.	: CHPL No.308
	Extent of injuries	: Nil
AME	License No.	: AME No.3399
	Extent of Injuries	: Nil

5. Passengers:-

No. of Persons on board	: Nil
Extent of injuries	: Nil

6. Place of incident	: Kavaratti, Lakshadweep
7. Date & Time of Incident	: 27/09/2007 Approx. 0630UTC
8. Last point of departure	: (VAJJ) Cochin Intl. Airport
9. Point of intended landing	: Kavaratti, Lakshadweep
10. Phase of Operation	: Landing phase.
11. Type of incident	: Serious Incident

(All timings in the report are in UTC unless or otherwise specified)

Synopsis:-

Pawan Hans Helicopter Limited's Dauphin 365 N3 Helicopter Regn. VT-PHP on 27th September 2007, departed Cochin International Airport at 0440 UTC for Lakshadweep (Kavaratti) island for inter island services with two Operating crew and one AME as pax. on board. The total flight time was approx. 1Hrs.50min. Total fuel on board was 860Kgs. The flight was uneventful till it got in to landing phase of Kavaratti island. During the landing phase, the crew had experienced sudden yawing motion of the machine towards their left and the crew responded immediately for recovery actions. However, with no recovery in the yawing motion, the helicopter started rotating viciously and within a couple of seconds, crashed onto the left hand side bushes adjacent to the helipad at around 0630UTC. The Helicopter got substantial damage and all the occupants escaped without any injury. There was no fire.

1. FACTUAL INFORMATION

1.1 History of the flight:

Pawan Hans Helicopter's Limited Dauphin 365N3 Helicopter Regn. VT-PHP on 27th September 2007, released by the AME for regular flight after carrying out preflight inspection schedule at 0355 UTC. This was the first flight of the day having total 860Kgs. of fuel onboard. The helicopter departed from Cochin international Airport at 0440 UTC for Kavaratti with 2 Operating Crew and one AME as pax. after obtaining destination and en-route weather from IMD, Cochin. The Helicopter was cleared by Cochin ATC for 4500ft. The flight was uneventful till it got in to Kavaratti. During landing phase, i.e aprox. 15-20ft short off Kavaratti Helipad, the helicopter started yawing towards its left. The crew applied right rudder to arrest the yawing motion. However, helicopter started yawing viciously towards its left and within a couple of seconds crashed to the left hand side of the helipad into the bushes at around 0630UTC. The Helicopter in its final position was found at approx. 14 meters from the starting point of the air strip's right hand side on heading 060 degrees. The Helicopter got substantial

damage however, there was no fire. All the occupants i.e. Crew and AME had escaped from the helicopter without any injury. The incident occurred in day time and weather during the time of approach was reported by the Crew as wind:- 280/15Kts and visibility was clear.

1.2 Injuries to persons:

Injuries	Crew	Passengers	Others
Fatal	Nil	Nil	Nil
Serious	Nil	Nil	Nil
Minor/none	Nil/03	Nil	Nil

1.3 Damage to aircraft:

The Helicopter got substantial damages to its structure and the details of which are as follows;

A. All the 4 main rotor blades and rotor head components fully damaged.
B. Forward tail rotor driven shaft found broken.
C. Pilot side rudder pedal area floor board damaged.
D. No.2 engine intake and exhaust damaged.
E. Nose oleo found detached from the mounting.
F. Bottom side VHF and HF antenna found broken.
G. RH landing light came out of the panel.
H. Both pitot heads found broken.
I. Co-pilot canopy plexy partially found broken.
J. Both side fins found broken.

1.4 Other damages:

Nil.

1.5 **Personnel information:**

1.5.1 Pilot in command:-

License No :- CHPL No.286

Age :- 56 Years

Date of issue :- 05 Jan. 1989

Validity of License :- 09 Mar. 2008

Endorsement :- DAUPHIN N3

Other type rating :- HT-2, HARVARD T6G, VAMPIRE T55&T52, HJT-16, Alouette III, Chetak, Dauphin SA365N

IR :- 1403 Valid 12 Jun 08

FRTO License No :- 4136

Date of Medical Exam:- 31 Aug.2007

Validity of Medical :- 29 Feb.2008

Date of IR checks :- 13 Jun 2007

Date of Route Checks :- 11Jan 2007

Date of Refresher & Validity :- PC 19 May 2007 valid upto 20 Nov 2007

Flying Experience:

a. Total :- 13640 Hrs.

b. On Type :- 600 Hrs.

c. Experience as PIC:- :9114 Hrs.

Total flying experiences:-

a. During last 90 Days : 132.35Hrs.

b. During last 30 Days : 72:07 Hrs.

c. During last 07 Days : 27:35 Hrs.

d. During last 24 Hours : 02:05 Hrs.

M/s. Pawan Hans Helicopter Limited released the Pilot-in-Command on Temporary Duty to Lakshadweep for 14 days from 15th Sept.2007.

1.5.2 Co-Pilot:-

License No	:- CHPL No.308
Age	:- 53 Years
Date of issue	:- 09 Mar. 1990
Validity of License	:- 22 Dec 2011.
Endorsement	:- DAUPHIN N3
	:- HT-2, HARVARD T66, KIRAN HJT-16, VAMPIRE T55, HUGHES 300, CHETAK – III, MATEH ROLE, DAUPHIN SA365N
IR	:- 2012 Valid 06 Jun 2008
FRTO License No	:- 4720
Date of Medical Exam:-	20 Feb. 2007
Validity of Medical	:- 19 Aug. 2007
Date of IR checks	:- 07 Jun 2007
Date of Route Checks	:- 10 Sept. 2007
Date of Refresher & Validity	:- PC 06/06/2007 Valid 05 Dec. 2007

Flying Experience:

a. Total :- 10462:35Hrs.
b. On Type :- 191: 00Hrs.
c. Experience as PIC:- 6999:00 Hrs.

Total flying experiences:-

a. During last 90 Days : 190:40 Hrs.
b. During last 30 Days : 52:00 Hrs.
c. During last 07 Days : 23:15 Hrs.
d. During last 24 Hours : 02:05 Hrs.

M/s. Pawan Hans Helicopter Limited released the Co-pilot on Temporary Duty to Lakshadweep for 21days from 13th Sept.2007.

As per records, both the pilots before flight were adequately rested and there was no FDTL violation.

1.6 Aircraft information:

a). Brief statement on airworthiness and maintenance of the Helicopter

Helicopter Manufacturer	: M/s. Eurocopter, France
Type	: Dauphin AS365N3
Constructors S. NO.	: 6736
Year of Manufacture	: 2T 2006
Certificate of Airworthiness	: No. 2681 (Initially issued on 24.04.2006)
Last CofA issued on	: 01 Jun. 2007 (No. 2799)
Valid up to	: 31/05/2012
Category	: Normal
Sub Division	: Passenger
Certificate of Registration	: No. 3390 (initially issued on 29 Jun. 2006)
Owner	: M/s. Pawan Hans Helicopter Ltd.,
Maximum All Up Weight	: 4300 Kg
Total A/F Time	: 747:54 Hrs.
Total landings	: 6079
Last Major Inspection	: 600Hrs. inspection Schedule carried out at 432.18 A/F Hrs. on 31/05/2007

ENGINES:-

		LH	RH
Manufacturer	:	Turbomeca	Turbomeca
Type	:	Arriel 2C	Arriel 2C
Serial No.	:	24300	24294
Date of Construction	:	09/12/2005	08/11/005
Initial log	:	40:18Hrs.(11/07/06)	40:18Hrs.(11/07/06)
Engine Hrs. (Total)	:	747:54Hrs.(26.9.2007)	747:54Hrs(26.9.2007)
Total Cycles	:	GasGenerator(NG)1324.69	FreeTurbine (FT) 1300.00
Last Major Inspection:		600Hrs./12months at 432.18 A/F Hrs. on 31/05/2007.	600Hrs./12months at 432.18 A/F Hrs. on 31/05/2007

Radio FRC Valid upto 05/10/2007

Helicopter's Certificate for release to Service (CRS) was issued by the AME on 24/09/2007 at Kavaratti after completing 25Hrs. inspections, T4.5 Check and Power Margin check at 739:18 Air Frame Hours.

The Dauphin AS 365N3 Helicopter Serial Number 6736 was manufactured by M/s. Eurocpoter, France in 2006. From the manufacturer the helicopter was delivered to PHHL with 40:18Hrs of A/F hours and 198 landings. At the time of incident, this helicopter had flown 749:59Hrs. (including incident flight of 02:05min.) and carried out 6079 total landings. The Helicopter has got approval for IFR and VFR flying. Helicopter approved for seating capacity of 11 passengers and 2 operating crew (Pilot and Co-pilot).

M/s. PHHL released this Helicopter for the Lakshadweep assignment and the Helicopter landed at Lakshadweep on 07/09/2007 and the helicopter was flying till the time of incident at Lakshadweep.

Flight log book shows that on 27th Sept. 2007 the helicopter was released from Cochin to Kavaratti sector after carrying out Pre-flight inspection by the qualified AME and the aircraft was accepted with "NIL" snag by the designated crew.

Flight log report showed that on 18th Sept. 2007 and 23rd Sept. 2007, 50 ml engine oil (for both the engines) upliftments were made. However, no records was available indicating the TGB oil upliftments status.

During the Lakshadweep assignment no snag was reported or detected. Only T4.5 and power margin checks were checked on 11th , 15th, 18th and 24th Sept. 2007 and found satisfactory in auto mode.

Airframe log book and Engine log books denotes that all the approved maintenance schedules like 25Hrs, 50Hrs/ 30days, 100Hrs/ 6months, were found complied with.

Scrutinizing the Flight log, it has been observed that the fuel uplifted qty. was not filled up properly.

Tail Gear Box SOAP test Data

As per the Manufacturer, Spectral Oil Analysis Program (SOAP) is optional and to be carried out every 100Hrs. and TGB – Oil to be drain every 400Hrs/ 2Years. As 'Mg' element content was more in (SOAP), PHHL decided to carry out TGB oil samples draining and checking at regular intervals of 100Hrs. TGB Oil SOAP test for the incident helicopter were carried out at 137.3Hrs., 234.48Hrs., 333.06Hrs., 432.18Hrs., 522.12Hrs., 620.24Hrs., 716.36Hrs. The test carried out at 234.48Hrs., 333.06Hrs., 522.12Hrs. and 620.24Hrs. show that there were increase trend of Fe element of 15.054 (against datum of 52.2), Cu element of 9.241 (against the alert value of 19.55) and Mg element of 7.484 and at 716.36 it was 9.08 (against the alert value of 12.85) in the oil samples.

However, during the 432.18Hrs test, all the Fe, Cu and Mg content were zero and at 716.36 A/F Hrs., all the element composition were found reduced from the 620.24A/F Hrs. and test carried out after the incident i.e. at 747.54 Hrs, the Fe element and Mg content was 2 times high than the alert value.

As per the record (Air Frame log book), TGB oil drained and replenished at 716.36Hrs. on 18/09/2007

As per Maintenance Manual, the maximum concentration values for setting under close monitoring for TGB under Plasma process has been fixed as: Fe :- 52.2; Cu:-19.55 and Mg:- 12.85. Further it has stated that if a metal concentration value is exceeded, monitoring of magnetic plugs and filters becomes every 10 Hours check for 50 Hours inspection schedule and if metal concentration is in limits then 50 hrs inspection is kept.

Tail Rotor Drive System:-

The rotating output motion from the Main Gear Box is transmitted to the Tail Rotor by means of Tail Rotor Transmission System comprises, Tail Rotor Drive Shaft and Tail Gear Box.

The Tail drive shaft interconnects the main and tail rotor gearboxes. It comprises three sections Viz., Forward, Centre and Aft section. The drive shaft is mounted on the transmission deck and the tail boom. The rear shaft section enters the tail unit and mates with the splined coupling flange of the tail rotor gearbox.

Tail Rotor Gear Box is mounted at the aft end of the tail boom in the fenestron tunnel.

It Provides:

a). 90 Deg. Drive angle change

b). RPM reduction

c). Tail Rotor Drive.

d). Blade pitch variation.

Tail Servo Control:-

It ensures that the control of the tail rotor blade collective Pitch. Tail Servo control consists of two cylinders bolted together in series. Each cylinder is separate in order to prevent crack propagation from one cylinder to the other. Each cylinder is supplied via a different hydraulic system:

The main system (R.H. System) supplies the R.H. cylinder and the Auxiliary system (L.H. system) supplies the L.H. cylinder which is secured to the TGB by four studs. Each cylinder is supplied via a dual distributor provided with a seizer detector for the main distributor. This detector is tested automatically. If one system fails, the remaining cylinder still supplied and is capable of ensuring the control within the whole flight envelope.

TAIL GEARBOX (TGB)

The TGB is a splash-lubricated reduction bevel gear whose output gear shaft drives the tail rotor. Input speed is 4009 rpm and Output speed is 3665 rpm

TAIL ROTOR:-

The tail rotor develops a thrust which balances the reaction torque of the main rotor ; it provides control of the helicopter on the yaw axis by providing a positive or negative thrust as required by the pilot.

The tail rotor is driven by the tail gearbox and it rotates clockwise when viewed from the left side of the helicopter. The tail rotor is of the “FENESTRON” type with ten variable pitch blades and is housed in the fin tunnel. The “Silent” Fenestron differs from the other Dauphin Fenestron rotors in that each blade is set at a different angle, it includes a guide vane and new-design blades in the profiles, materials and manufacturing technologies.

The pitch change control rod, actuated by the tail servo control, drives the control shaft which slides in and rotates with the rotor shaft. The pitch change spider is integral with the control shaft and it actuates the blade root crankpins.

Tail Rotor Controls:

The yaw control pedals operate the tail blade incidence angle through control channel operated by a servo-control.

Forward movement of the right hand pedal increases the blade pitch and forward movement of the left hand pedal reduces the blade pitch.

TAIL ROTOR HUB (T.R.H.)

Rotor integral with the fin.
Tunnel Diameter ..... 1100 mm
Rotation speed ..... 3579 rpm
Rotor radius .....546 mm
Number of blades 10
Pitch angle .....(Left Side) -17° to (Right Side) +35°

b) Helicopter performance

The Helicopter is certified for Class – I operations performance. Authorized Maximum All up weight of the Helicopter was 4300 Kgs. As per the Crew, the estimated Takeoff weight was 3936Kgs. (i.e. Empty Weight:-2811Kgs., Crew Weight:-170Kgs. (85*2), Passenger Weight:-75Kgs., Fuel Weight:- 860Kgs. and Personal Baggage's Weight:-20Kgs.) Weight and center of gravity were found within the prescribed limits during the phase of operation. The performance of the Helicopter was found satisfactory and the aircraft was not released under MEL or with any operational limitations.

However, no records were available to show that the Load and Trim sheet was prepared by the Crew for the incident flight. Further, no system available to carryout Load and Trim sheet calculation at outstations.

As per Flight Manual, under Daily check under Sec. 8.4 ' Check before the first flight of the day includes under Sec. 1.8. RH side of Tail Boom, TGB – Oil level check should be carried out either by the Pilot or Mechanic and the same was carried out by the AME.

c) Type of fuel used.

Recommended type of fuel used.

1.7 Meteorological information:

a) Metrological conditions prevailed at Cochin Aerodrome , enroute weather and Kavaratti were fine and above the operating minima.

Flight and Aerodrome forecasts issued by IMD Cochin at 0500 UTC on 27.09.2007.

TAFS issued on 27the Sept.2007 by IMA, valid 0312.

VOCI:- 25010KT 5000Hz FEW015 SCT 020 BKN 090 TEMPO0312 2000TSRA/RA SCT 006 SCT012 FEW 025CB OVC090=

VOKV:- 25010KT 5000Hz FEW015 SCT 020 BKN 090 TEMPO0312 2000TSRA/RA SCT 008 SCT012 FEW 025CB BKN090=

As per the Met report issued by IMD, Cochin the validity of the TAFS was not mentioned correctly.

Flight Forecast issued by VOCI, IMD at 0500 GMT. The Surface Visibility was :- 3000M in HZ BEC 04/05 6KM TEMPO 00/12 2000M in TSRA/RA. And Significant Weather was TSRA/RA MOD TURB/ ICING in CB TEMPO 00/12 2000M in TSRA/RA.

Weather forecast issued by IMD Chennai issued at 0900HRS (IST) for the next 24Hrs. enroute Lakshadweep from Kerala coast reflect as: Wind Direction:- Westerly and Wind speed 10-15Kts gusting to 20 Kts. Occasionally. Weather fairly widespread showers and moderate visibility and becomes poor in showers.

Meteorological information like Flight and Aerodrome forecasts , TAFS enroute forecast were available to the crew prior to the takeoff and the operation was in day time.

1.8 Aids of navigation:

Helicopter Departed from Cochin International Airport Limited. Destination was Lakshadweep (Kavaratti) island. There was no landing aid like PAR, ILS, NDB, night landing facility available at Kavaratti. One windsock is available as visual Ground aid and it was found in serviceable condition.

1.9 Communication:

ATC:- for all (Scheduled) operations to and from Union Territory of Lakshadweep (UTL), Agatti airfield remains open for ATC facilities and diversion for flight to mainland. Agatti island (airfield) is situated at around 55kmtrs in the western direction from the Kavaratti island.

There is Lakshadweep Port HF at frequency 8275KHz (main) and 4393.4 KHz(std. by) being maintain by all island ports for jetty operations. Through that Helicopter arrival / departure information is being passed. Kavaratti Radio remains on during Helicopter flight on 1584KHz.

Marine NDBs:- for navigational aid, NDB's on 320KHz located at Calicut, Cochin and Minicoy are being used.

At Agatti, ATC Services, Meteorological Dept., Services etc., functions only during the Schedule operations timing and rest of the time it will be remains closed. At the time of incident the ATC, met facility at Aggati was not available.

At Kavaratti, No ATC, communication & Navigational aids were available.

1.10 Aerodrome information:

Kavaratti Helipad is located in the northern side of the island and its co-ordinates are103240N, 723693E. Elevation of the Kavaratti is 30 feet above mean sea level. Kavaratti helipad has got 60x 40meter Apron area and Rwy width of 12meters in 315-135 direction having extended to 40meter towards Rwy 135 and 32meter in the Rwy 315 side beyond apron.

Towards North and North East direction of the Apron, PHHL hanger and Pax. facilitation & waiting hall, Fuel storage room are available. In the south, South East, south west and North west direction surrounded by Arabian Sea.

Other than wind shock in the northern direction of the helipad, no other Navigational and Communicational aids are available. Arrival Departure information are being passed through R.T. to jetty Radio Officer of Kavaratti island.

The helicopter took off from Cochin International Airport Limited and the QNH was not neither passed by ATC nor asked by the crew before departure for setting the altimeter. Even the destination QNH was not asked by the crew.

1.11 Flight recorders:

This Dauphin 365 N3 helicopter has got a Solid State Cockpit Voice Flight Data Recorder (SSCVFDR) which is a combination of Cockpit Voice Recorder and Flight Data Recorder. The unit of 'Honeywell' make bearing Part No. 980-6021-066 was found installed in the Helicopter. The unit found intact and the recorded information were downloaded at the M/s. Pawan Hans Helicopter's Limited facility at Mumbai.

COCKPIT VOICE RECORDER:-

Tape transcript was prepared for the Cockpit Voice Recorder. From the tape, the followings observations made:-

1. The Helicopter used Rwy 27 of Cochin airport to Kavaratti.
2. The Helicopter was initially cleared to Kavaratti via 260 Radial under calm wind condition with level restriction of 1000 ft and later at 15 DME cleared on 280 Radial at 4500ft.
3. The Helicopter route was approved by Cochin ATC after establishing 280 and 25miles out of Cochin.
4. There were very few conversation of Jeppesen data other than that sterile cockpit was maintained by the crew.
5. All the checklist like, checks before takeoff, Takeoff Briefing, Hover checks, Checks after Takeoff, Checks before landing etc., were not carried out by the crew.
6. Just 2 minutes prior to the incident Helicopter called the Kavaratti Jetty control to convey that another five minutes they would be landing.
7. However, immediately after passing one minute from that call, Pilot realized that they got rudder failure and asked the Co-pilot to help him by applying right rudder.
8. Co-pilot asked him whether he could control that (After application of the right rudder), and the Pilot replied he could not.
9. Captain shouted 'Don't do… that…….Don't do… that …..' immediately after that call, the helicopter crashed in to the bushes.
10. There was no aural warnings recorded in the CVR throughout the flight.
11. There was no crew conversation with ATC found recorded in the CVR tape about QNH parameters of Departure and destination airport.

DIGITAL FLIGHT DATA RECORDER:-

From DFDR data, the followings were noted.

1. The data was monitored for the whole flight and after 01:53:13Hrs., of the last sector, the recorded data found erratic.
2. Approx. 25 minutes prior to the incident, i.e. at 01:29:38Hrs. tail rotor pedal position changed from 57.48% to 68.9% without any change on the speed and the heading of the aircraft by the Crew.
3. There was no warning encountered by the Crew through out the flight till time of crash.
4. The Helicopter spun to the left 4 times before impacting the ground.
5. During the time of incident, i.e. between 01:52:49 Hrs. to 01:53:05Hrs. the pressure altitude recorded was 144 Feet and between 01:53:06 to 01:53:12Hrs. Pressure altitude had increased to 160 feet and then changed to 128 ft for 1sec.
6. At time 01:52:53Hrs, the heading was 256.70Deg., the tail rotor pedal was 76.07% and IAS was 13Kts, collective pitch was 62.81, lateral cyclic was 38.27 and longitudinal cyclic was 52.70.
7. At 01:52:54Hrs., IAS monetarily dropped to zero and reached to 18.00 kts and the Heading changed to 242.99Deg.
8. At time 01:52:57 Hrs., IAS was Zero, Collective pitch was 62.15, Lateral cyclic was 44.74, Longitudinal was 45.3, Tail rotor pedal was 76.07 and Heading was 187.34Deg. (Mostly this was the time Pilot informed Rudder failure).
9. At time 01:52:58, IAS was Zero, Collective was 62.56, Lateral cyclic was 48.89, Longitudinal was 46.81, Tail rotor pedal was 75.87 and Heading was 157.19Deg.
10. At time 01:52:59, IAS was Zero, Collective was 63.08, Lateral cyclic was 55.21, Longitudinal was 52.72, Tail rotor pedal was 76.31 and Heading was 117.98Deg.
11. At time 01:53:00, IAS was Zero, Collective was 67.42, Lateral cyclic was 60.20, Longitudinal was 47.79, Tail rotor pedal was 78.51 and Heading was 61.10Deg.
12. At time 01:53:01, IAS was Zero, Collective was 73.63, Lateral cyclic was 46.18, Longitudinal was 69.16, Tail rotor pedal was 78.31 and Heading was 336.26Deg.
13. Between 01:53:02 to 01:53:03, collective varied from 70.06 to64.57 and between 01:53:04 (Heading 355.60Deg.,) to 01:53:05(Heading 195:43Deg.), it started rising from 65.76 to 77.26.

14. At 01:53:05Hrs. Tail rotor pedal reached 79.76 (Maximum Position) and the Lateral cyclic was 61.39, Longitudinal was 85.23 and Heading was 195.43.

When the uncontrollable yaw starts, the crew was carrying out the directional control with the help of rudder pedal which reached its maximum limit at 79.76 at time 01:53:05. However, before that the directional control was being carried out the lateral cyclic was used at time 01:52:59 hrs. Then, at time 01:53:00 hrs the crew used the collective control to encounter the left yaw.

In spite of all actions by the crew, the heading was continued to change quickly and the helicopter took about 4 turns in air before contacting with the ground. However the exact height at which the uncontrollable yaw started could not be pin pointed due to pilot did not set the QNH on Altimeter before departure. The uncontrollable yaw started about 26 seconds before final impact with the ground.

As per the Helicopter flight manual (RFM), in case of tail rotor failure at low air speeds the crew should reduce the collective pitch and land immediately. However, from the DFDR readout, it has been observed that (though it was not the main cause for the incident) the crew did not use the recommended procedure as referred in the RFM.

1.12 Wreckage and impact information:

During on site investigation, the wreckages were found within the confined area. The helicopter wreckage was found at approx. 14 meters from the starting point of the air strip's right hand side on heading 060 Deg in the bushy area. The co-ordinates of the site are Lat- 103240N, Long- 723693E. Elevation of the Kavaratti is 30 feet above mean sea level.

AME who was onboard the helicopter has stated that he was sitting at the middle seat of the middle row. When the helicopter was about to land, approx. 10-15 ft above the ground, the helicopter turned to left. At that time he thought the helicopter was repositioning for the refueling point or into the wind position. But the helicopter did not land on the 'H' marking rather it was turning to left and the rotation speed was

increasing. After approx. 2 full rotation, the helicopter started roll towards left and he felt, he was moving towards left and up from his seat position. He tried to hold the front row seats with his hands. However, within fraction of seconds, he realized that the helicopter was crashed into the bushes.

As the incident site was located behind fuel storage building and the other sides were surrounded by sea, there was no real Eyewitness available to comment over the incident.

1.13 Medical and pathological information:

Both the Crew had undergone Blood and urine sample test once they came out of the crashed helicopter. The test results reflected that the both were not under the influence of Alcohol.

1.14 Fire:

There was no fire noticed during or after the incident.

1.15 Survival aspects:

The helicopter crashed on to the bushes in the near by side of the helipad. Evacuation and rescue operation was carried out by the ground personnel.

The incident took place during landing phase and the helicopter broken pieces were found confined to certain area and no injuries to the persons on-board or ground personnel. The situation did not warrant for any search and rescue operations.

1.16 Tests and research:

Following inspection/ checks were carried out in situ on the Helicopter, when the helicopter was brought to PHHL hanger at Juhu Aerodrome, Rudder movement was checked by applying rudder pedal.

The broken tail rotor shafts were forwarded to R&D directorate of DGCA, HQ for carrying out the Fracture/ Failure analysis. The R&D Dte. report, has stated that the fibrous fracture of mount, studs, tail rotor flapping stop etc., indicates that the mount assembly and associated parts have failed under overloading condition. There was no progressive damage/ corrosion noticed on the tail rotor drive shaft.

Cracking of paint around the bolts suggests that this portion was over stressed circumferentially. The tail rotor shaft has failed in torsional overload condition.

R&D report has finally concluded that the tail rotor along with TGB has failed under overload condition.

EUROCOPTER'S PRELIMINARY ANALYSIS ON THE TAIL ROTOR SYSTEM:

The Manufacturer, M/s. Eurocopter experts were invited to participate in the investigation carried out at M/s. PHHL Hanger, Mumbai between 4th Feb. 2008 to 6th Feb.2008. M/s. Eurocopter had carried out certain checks and associated in the investigation. The followings are their preliminary findings:

1. The continuity of yaw control was found satisfactory.
2. It was decided to energize the tail servo control with a hydraulic power supply in order to control the tail rotor blade motion from stop to stop of the servo control (internal stops). During that check on tail servo control with a hydraulic power supply, the servo control was working normally from stop to stop but several times the retracting motion of the piston (corresponding to an increasing pitch of the blades when right pedal is pushed forward) when arriving near high pitch stop it was heard a loud noise followed by a pitch blade angle change. It was noticed that when this phenomenon occurred the tail servo control piston did not move and that the pitch change spider was moving.

3. Check of the magnetic plug showed contaminated oil (grey colour) with soft deposit on the magnetic area. First analysis shows yellow bright metallic particles (more probably brass from the bearing cages).
4. The tail control rod was removed from the tail gearbox and First examination showed of the bearing showed an axial play in excess and a foreign object (like a "plastic shim" (0,25 mm thick, 2 mm width, around 70 mm diameter) inside the gear in the area of the split bush.
5. During investigation, it was clear that the tail control rod bearing was damaged, the contamination of the oil was a consequence of the bearing degradation and a foreign object was found.
6. The analysis of the "plastic chip" shows that it is made of the same material as the split friction ring and for further analysis the TGB, Servo control valve were taken by Euro copter for the detailed laboratory examination.

EUROCOPTER'S TAIL GEAR BOX INVESTIGATION REPORT:-

1. The Control rod/ shaft assembly shows two serious deteriorations. One on the large PA66 guide ring (change the angle of the tail rotor blades) and the other on the control bearing.

    a. PA 66 guide ring:- only the large ring shows the traces of heating and creep for the inner diameter towers the OD (Burr formation)
    b. Control Bearing: The bearing has several traces of deterioration. The inner half ring, rotor side shows the flaking wear on the bearing raceway as well as light golden brown colouring caused by heating. The rotor side balls shows heavy wear of around 1mm on the diameter. The two cages shows a blackish colouring caused by heating of bearing. The rotor side cage shows wear over the entire circumference of the inner diameter. The rotor side bearing raceway of the outer ring shows races of heating and abnormal operation. The nut and lock washer shows signs of heavy wear as cracks in each slot/ nut blending radius.

2. Control Rod :- It shows the light golden brown colouring as well as slight wear at the seal.

The lab report has concluded that it is impossible to determine the precise cause of PA 66 ring and control bearing deterioration. The burr caused by temperature creep of the PA ring and present between the control shaft and the bevel wheel is in all likelihood, consequence of the deterioration of the control bearing.

DFDR preliminary data analysis

1. These data confirm that the aircraft spin to the left 4 times before impacting the ground.
2. It was clear that the yaw control pedals do not move more than 8% from the approach position to the landing position (maximum last position around 78%). Micro switch link data confirms that the pilot was applying forces on the pedals.
3. Analysis of the last flight FDR data shows that during cruise the pilot took the control (vs AFCS control) by applying 16% right pedal more to be able to keep the heading (same speed and same collective pitch position).

Flight time	1H 20.02	1H 23.53	1H 24.59	1H 27.11	1H 29.39	1HH 30.37	1H 43.33
Heading (deg)	278.86	277.54	276.40	280.26	280.35	280.44	280.53
IAS (Kt)	148	147	147	147	146	146	148
Collective pitch (%)	84.27	84.27	84.27	84.25	84.27	84.30	81.15
Tail rotor pedal (%)	52.55	52.55	51.94	56.73	68.82	68.72	68.47
Tail rotor Actuator	OFF	OFF	ON	0N	OFF	OFF	OFF

Note: Tail rotor actuator "OFF" = no pilot's action on the pedals (Aircraft fully under-controlled by AFCS) and Tail rotor actuator "ON" = Pilot moves the pedals (AFCS still active on pitch and roll, pilot controls the yaw).

4. Something happened between Flight time 1H 24.59 and 1H 29.39 because the tail rotor pedal position changed from 52.5% to 68.8% without any

change on the speed and the heading of the aircraft. As the tail rotor thrust shall remain constant (no change for heading and IAS) the tail rotor pedal motion corresponds to an axial play of the bearing.

DFDR Final analysis report:

1. The duration of the flight was 01Hour 53minutes 10Seconds.
2. At the time 01H 26Min., in cruise flight, it noticed +16% right pedal position offset (in the direction of a tail rotor thrust rising) to maintain constant heading and the speed of the aircraft. The reason of this supplementary right pedal input doesnot appear to have been identified by the pilot.
3. During the landing phase, the right yaw pedal input is increased upto 77% which is considered as a normal pedals position for this flight phase. Nevertheless this input corresponding in reality to 77%-16% =61% on the contro1 rod position does not keep the helicopter yaw control.
4. When the helicopter began to spin left, no supplementary right yaw pedal input to counteract the starting left rotation was applied and the helicopter turned 4/5 times before hitting the ground.

Ground exercise on maximum Tail Rotor Pedal travel on serviceable Helicopters

Ground exercise on serviceable Helicopters was conducted to check the maximum Tail Rotor Pedal travel and found that in one helicopter it varies from 74.33% to 23.08% i.e. max. travel of 51.25 and in another Helicopter it lies between 74.65% to 19.63% i.e. max. travel of 55.02.

VT- PHP data reveals that the maximum tail rotor pedal deflection was 79.76% as recorded in the DFDR. This implies that crew has applied the full tail rotor pitch during yaw recovery.

1.17 Organisational & Management Information:-

Pawan Hans Helicopters Limited is a Public sector a Govt. of India undertaking organization operating under Non-Scheduled Air Transport Services permit vide permit No.. 2/1998 The validity of permit issued on 16th Mar. 2007 to 15th Mar. 2008.

Since 1987, PHHL has been operating one Dauphin Helicopter detachment ex-Kavaratti for the Union Territory of Lakshadweep to maintain inter- island communication. Helicopter is planned to fly daily to maintain inter –island link for carriage of passengers, carry out emergency evacuation of patients to mainland and other essential items of administrative requirement. All civil flights operating to Agatti from Cochin are linked by Helicopter for passengers to and from Kavaratti. Kavaratti is being used as the base for PHHL operations. At Kavaratti the PHHL has a hangar and other facilities like refueling and maintenance facility to carry out the DI, 10 hrs inspections etc.

1.18. Additional information:

There is a Service- Letter Bo. 1673-67-04 dated 04.02.05 to all Pilots for all types of Helicopters fitted with a tail rotor (Main Rotor rotating Clockwise when seen from above). With the subject ' Reminder concerning the Yaw axis control for all helicopters in some flight conditions' concludes the followings:-

1. In hover flight or at very low forward speed, stopping a quick rotation to the left must be performed by immediately applying the RH yaw pedal with significant and maintained amplitude, regardless of the tail rotor type.
2. In hover flight or at very low speed, intentional initiation of a turn to the left shall always be made by moderate action the yaw pedals.
3. Wind coming from the left or tail wind increases the aircraft rotation speed.

From the previous history, it could be seen that in Feb. 2006, M/s. Eurocopter had released Alert Service Bulletin 05:00:52 in order to introduce a periodic check for absence of play in the double bearing of the tail rotor Hub control rod due to loss of the

yaw control on an AS 565 MB helicopter resulted from the progressive deterioration of the double bearing on the control rod. Further analysis revealed that Metal chip resulting from this deterioration remained trapped in the area around the bearing and were not detected by the magnetic plug of the TGB and non detection of the chips resulting from this deterioration was due to insufficient oil flow, when the oil level in the TGB is continuously maintained at the "min" level. Subsequent to the above incident, TGB oil level asked to held at maximum level to ensure that any chips resulting from possible deterioration of the control rod bearing are detected by the magnetic plug and a check for absence of play in the bearing was introduced.

Based on the investigation on the subject incident (VT-PHP on 27th Sept. 2007), M/s. Euro copter has issued a Telex information on 25th March 2008 'Double Bearing of the Tail Rotor pitch control Rod' and followed by an Alert Service Bulletin No. 05:00.54 on 11.08.2008 for 'Maintaining the oil level in the tail gearbox (TGB) at its maximum level and detailed procedure for checking the tail rotor Hub pitch change control rod bearing for absence of play.'

1.19 Useful or effective investigation techniques:-

Nil.

2. Analysis:-

Operational factor:

The PIC accepted the helicopter at 1000 Hrs. (IST) and with NIL snag for Cochin-Kavaratti sector. Before start up the Met briefing was obtained by the pilot from Cochin Airport IMD, office. This was the first flight of the day. The take-off from R/W 27 was normal and so was cruise at 4500 feet.

As per the Pilot, during the final approach at Kavaratti, close to the helipad approx. 15 feet, the helicopter started yaw to the left. The winds prevailing were 280/15 kts. Right rudder was used to prevent yaw. However, he could not move the rudder. PIC

shouted to Co-Pilot to help him in the recovery. However, the helicopter started spinning viciously to the left and the helicopter crashed a couple of seconds later. After crash, pilot could manage to switch off the Fuel Flow Control Lever and the boosters and other switches to off position.

During investigation, pilot stated that he was on control and approx. 50 ft from the beginning of concrete surface while approaching on heading 315 Deg., the aircraft started yawing to the left and there was no additional control input given other than the rudder pedal and the cyclic with collective inputs were given. Initially the rate of rotation was slow turn and when he asked the Co-pilot for help, the rate of turn had increased substantially and thereafter it increased tremendously. He further stated that no attempt was made for go around as the same was no longer possible below the airspeed of 40 Kts. When the speed is dropping, power application is increased and there is a requirement of additional right Rudder. If, the application of right ruder is insufficient then the aircraft would yaw to the left. Moreover during rotation the wind parameter changed from headwind to tail winds which contributed to the rapid yaw movement of helicopter towards left.

Co-Pilot stated that when the aircraft entered into left yaw and pilot could not recover, he sought help and when he applied the right rudder pedal it had already reached his maximum position. By the time, helicopter started spinning viciously to the left and the helicopter crashed a couple of seconds later. After the crash, copilot un-strapped himself and crawled out to the back in the cabin so that Captain could un-strap and come to his seat which was below him. Thereafter Captain evacuated the aircraft from the right hand pilot door and he followed him through the same door with the help of ground crew. Further, he has stated that when PIC asked for assistance, the helicopter had already turned about 100Deg from the original position ie. 315Deg. and was out of helipad area in the South West direction. Later on, Copilot had stated that when the pilot asked for the help by applying right rudder he applied full right rudder. But there was no effect at all. When the yaw got really vicious in the second or third spin to the right, he applied right cyclic to prevent a roll to the left in addition to the yaw.

Pilot also stated that when the application of right rudder did not have any effect, he noticed that the Co-pilot hand moved towards the cyclic stick hence he scrammed Donot do that … Donot do that……. The same is corroborated through the DFDR data of the flight wherein lateral cyclic was used to control the yaw.

AME stated that he was sitting in the middle seat of the middle row. When the helicopter was about to land, approx. 10-15 ft above the ground, the helicopter turned to left. At that time he thought the helicopter was repositioning for the refueling point or into the wind position. But the helicopter did not land on the 'H' marking rather it was turning to left and the rotation speed was increasing. After approx. 2 full rotation, the helicopter started roll towards left and he felt, he was moving towards left and up from his seat position. He tried to hold the front row seats with his hands. However, within seconds, he realized that the helicopter was crashed into the bushes and some machinery running sound he felt. As he realized the situation, he opened the rear sliding door lock from inside and moved the sliding door rearward. He un-strapped seat belt and he climbed upto the neck outside and searched for main rotor to escape without caught into the main rotor blade rotation. As he noticed all the ground staff were running towards the helicopter, he jumped out of the helicopter and rushed out about 20 feet from the site. Some smoke was coming from the engine side of the helicopter, he rushed back towards the helicopter and he was standing just near the canopy to help crew.

The CVFDR CB's in the cockpit was pulled out by the ground crew after the incident.

After the incident crew went to the Chief Medical Officer, Indira Gandhi Hospital, Kavaratti for medical checkup and the doctor examined them and they were not found under the influence of alcohol.

Port Assistant stated that after the crash, he started to inform Medical room, Fire services and others. With the available staff, rescue operation and preventive measures

were taken to prevent fire with available portable fire extinguishers. He took action for arranging police force to guard the chopper.

As the incident site was located behind fuel storage building and the other sides were surrounded by sea, there was no real Eyewitness available to comment over the incident.

As per the Flight Manual, for Tail Rotor Failure, Tail rotor failure is indicated by Yawing motion. The rate of turn depends on the aircraft power and airspeed at the time of failure. There are two cases are described under the Tail Rotor failure. One is Failure in Hover or at low speed in Ground effect and another one is Failure during climb or Hover.

For Failure in Hover or at low air speed in Ground effect quickly reduce the collective pitch and LAND IMMEDIATELY. In this incident, as ground speed was nil and they were in the hovering phase. Under this condition, the crew did not try for go around as the speed dropped below 40Kts and thereby affecting the Tail Fin efficiency. However, due to shortage of Rudder force they could not able to control the yaw and subsequent manipulation of control made by the crew has made the helicopter to yaw viciously to the left and went out of control of the crew.

From the CVR tape it is evident that the Captain asked the Co-pilot to apply right rudder as he could not able to control the yaw. Co-Pilot also applied right rudder. However, immediately after couple of seconds, he shouted Don't …. Don't …… Don't do that….., Don't do that……. and immediately the helicopter crashed in to the bushes. Further, it has been observed that there was no checklist carried out in flight by the crew.

While taking off from Cochin the crew did not set the QNH on altimeter and neither they obtained the QNH for Kavaratti the destination helipad. No system available to carryout Load and Trim sheet calculation at out stations. No records were available to show that the Load and Trim sheet was prepared by the Crew for the incident flight.

There is no ATC facility, MET Services, Communication and Navigational Aids, Ambulance Services, Crash Fire Tender available at Kavaratti helipad.

The validity of the TAFS issued by IMD, Cochin International Airport Limited on 27th Sept. 2007 was not mentioned correctly by IMD, Cochin.

From DFDR data, it is seen that about 25 minutes prior to the incident, 68% (Max. 79.76%) of the tail rotor was used by the crew for maintaining steady and level flight and prior to the Yaw, crew almost used 76% of the tail rotor pedal and they left with only 2-3% rudder force for total recovery action. The helicopter before impacting the ground has made 4 turns in the air. Further, from DFDR data, first the crew has used the tail rotor rudder pedal fully with cyclic control and later on collective control during the recovery action. This indicates that crew has not used the recommended procedure for recovery from uncontrollable yaw, which asks the collective to dump and land immediately.

As mentioned in the M/s Eurocopter DFDR analysis report "When the helicopter began to spin left, no supplementary right yaw pedal input to counteract the starting left rotation was applied" is not justifiable as in case of such type of emergencies the pilot would apply maximum rudder pedal force to counter act the yawing motion and further crew applied the full rudder is supported by the CVR tape and the pilot statement.

Maintenance factor:

On 27th September 2007, the helicopter was released from Cochin to Kavaratti sector after carrying out Pre-flight inspection by the qualified AME and the aircraft was accepted with Nil snag by the designated crew and this was the first flight of the day having total 860 Kgs. of fuel onboard. The helicopter had a valid C of A at the time of incident. Helicopter's Certificate for release to Service (CRS) was issued by the AME after completing 25Hrs. inspections, T4.5 Check and Power Margin check at 739:18 Air Frame Hours on 24/09/2007 at Kavaratti and was valid on the day of incident. During the Lakshadweep assignment no snag was reported or detected from the date of release till the day of incident on 27th Sept. 2007. Only T4.5 and power margin checks were carried out on 11th , 15th, 18th and 24th Sept. 2007 and found satisfactory in auto mode. Airframe

log book and Engine log books denotes that all the approved maintenance schedules like 25Hrs, 50Hrs/ 30days, 100Hrs/ 6months, were found complied with.

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Even though, TGB Oil SOAP tests is an Optional, these procedures were still carried out by PHHL. At 400 hrs the TGB oil was drained before the incident. As Magnesium (Mg) value was above permitted limit, draining and replenishing of fresh oil for every 100Hrs. inspection was issued with effective from 04.09.2007 by QC Dept. of PHHL. That is why there is discontinuity in the TGB Oil SOAP test results. However, no mandatory check was spelled out by the Manufacturer on TGB oil SOAP test.

On site investigation reveals that the TGB oil level was maintained in the Maximum level and there was some metal particles surrounded the magnetic plug noticed. On removal of TGB, after incident, SOAP test carried out and the results are:- Fe:- 1649.47; Cu:- 105.42; Mg:- 35.20.

Scrutinizing the Flight log, it was observed that the fuel uplifted qty. was not filled up properly. Flight log report showed that on 18th Sept. 2007 and 23rd Sept. 2007, 50 ml engine oil (for both the engines) upliftments were made. However, no records available recording the TGB oil up liftment status as there was no guideline issued by M/s. Euro copter for the upkeepment of TGB oil records.

Euro copter examination:

As per M/s. Eurocopter, continuity check of yaw control was found normal. However, during investigation, in order to control the tail rotor blade motion from stop to stop of the servo control (internal stops) with a hydraulic power supply, it was observed that on several times a loud noise followed by a pitch blade angle change during the retracting motion of the piston (corresponding to an increasing pitch of the blades when right pedal is pushed forward) when arriving near high pitch stop it was heard and when this phenomenon occurred the tail servo control piston did not move and that the pitch change spider was moving. Check of the magnetic plug also showed contaminated oil (grey

colour) with soft deposit on the magnetic area. First analysis shows yellow bright metallic particles (more probably brass from the bearing cages).

On removal of Tail control rod from the tail gearbox for examination, a foreign object - like a “plastic shim” of 0.25 mm thick, 2 mm width, around 70 mm diameter inside the gear in the area of the split bush was noticed. Also axial play in excess was noticed. Further, M/s. Eurocopter has stated that the tail control rod bearing was damaged, the contamination of the oil was a consequence of the bearing degradation and a foreign object was found. The analysis of the "plastic chip" shows that it is made of the same material as the split friction ring.

M/s. Eurocopter had carried out TGB failure investigation & DFDR analysis and concluded that;

a. Lab report of M/s. Eurocopter had following observations ;

The Control rod/ Shaft assembly shows serious deteriorations :

- PA 6.6 large guide ring :- This ring shows traces of heating and creep from the inner diameter towards the outer diameter (burr forming). The foreign object ’Plastic Shim’ described during the insite investigtaion is in fact a burr created by the temperature elevation of the PA 6.6 guide ring as a consequence of deterioration of the control rod bearing. The guide ring is compliant with the design specifications.
- Control rod bearing :-
  1. The inner half ring tail rotor side shows flaking wear on the bearing raceway aswell as a light golden brown colouring caused by heating.
  2. The rotor side balls shows heavy wear of around 1mm on the diameter.
  3. the two cages shows a blackish colouring caused by the heating of the bearing. The rotor side cage shows wear over the entire circumference of the inner diameter.

4. The rotor side bearing raceway of the outer ring shows traces of heating and abnormal operation.
5. Prescence of significant amount of particles M50 (steel rolling up the order) agglomerated with oil within the control rod.
6. The nut and the lock washer shows signs of heavy wear as cracks in each slot/ nut blending radius.

- Control rod :- Evidence of a light golden brown colouring.

The burr, created by the temperature creep of the P.A. 6.6 guide ring and present between the control rod/ shaft and the level wheel is, in all likelihood, conseqnence of the deterioriation of the control bearing. From the laboratory findings, it is impossible to determine the root cause of P.A. 6.6 guide ring and control bearing deteriorations.

b. Eurocopter's DFDR report :

1. The duration of the flight was 01Hour 53minutes 10Seconds.
2. At the time 01H 26Min., in cruise flight, it noticed +16% right pedal position offset in the direction of a tail rotor thrust rising) to maintain constant heading and the speed of the aircraft. The reason of this supplementary right pedal input doesnot appear to have been identified by the pilot.
3. During the landing phase, the right yaw pedal input is increased upto 77% which is considered as a normal pedals position for this flight phase. Nevertheless this input corresponding in reality to 77%-16% =61% on the contro1 rod position does not keep the helicopter yaw control.
4. When the helicopter began to spin left, no supplementary right yaw pedal input to counteract the starting left rotation was applied and the helicopter turned 4/5 times before hitting the ground.

There was an earlier case of similar type of failure on the Eurocopter Helicopter and Alert Service Bulletin 05:00:52 was issued.

On the basis of the subject incident, M/s. Eurocopter has issued a Telex information on 25th March 2008 'Double Bearing of the Tail Rotor pitch control Rod' and followed by an Alert Service Bulletin No. 05:00.54 on 11.08.2008 for 'Maintaining the oil level in the Tail Gear Box (TGB) at its maximum level and checking the tail rotor Hub pitch change control rod bearing for absence of play.'

Sequence of events:

From the above discussion it is inferred that at approx. 25minutes prior to the incident i.e. Between flight time 1H25mins. and 1H30mins, the tail rotor position was changed from 52.6% to 68.8% by the pilot to maintain the heading. This indicates that during that time the TGB control rod bearing had failed and the excessive rudder force applied by the crew to maintain the heading was not noted by the crew as there was no indication/warning appeared to the crew. When the helicopter was coming for landing, the helicopter was controlled by the pilot, with the continuous application of right rudder pedal and during the recovery the crew applied their full right pedal force. However, as the rudder force was not sufficient to recover from the yaw motion, the helicopter had crashed after making 4/5 turns.

Investigation revealed that there was degradation of control rod bearing not clearly identified with the procedures of the routine maintenance checks in place at the time of incident. Subsequently manufacturer issued the alert SB to improve the maintenance procedures. Also there was similar case of incident reported to the manufacturer in which the bearing failure was the cause of loss of yaw control. It is not agreeable to the manufacturer's DFDR analysis that there was no supplementary input to the right pedal to counteract the helicopter spin due to the fact that the full right rudder pedal was applied as indicated in the CVR tape and the pilot statement.

3. Conclusion:-

3.1 Findings:-

1. The helicopter was having valid C of A and was in serviceable condition.
2. Crew were having valid licenses and their medical was current.
3. Met information regarding Departure, destination, enroute forecast briefing was obtained from Cochin International Airports Limited prior to departure.
4. No facilities like ATC, Met , Communication etc., were available at Kavaratti Helipad.
5. The takeoff from Rwy 27 at Cochin and flight during cruise was normal.
6. During the final Approach at Kavaratti Helipad, the helicopter started yaw to the left. Crew used the right rudder to prevent yaw.
7. The winds prevailing were 280/15Kts.
8. The helicopter continued to spin in air thus winds parameters changed from Head wind to Tail wind.
9. As per DFDR the Helicopter made 4 rotations in air prior to impact with the ground.
10. The exact altitude at which the uncommanded yaw has started could not be pinpointed due to non-setting of QNH on the altimeter by the Crew.
11. As per DFDR , first the crew has used the tail rotor rudder pedal fully with cyclic control and later on collective control was used during the recovery action.
12. As per DFDR, right rudder was used fully to prevent the yaw. However, the helicopter started spinning viciously to the left and the helicopter crashed a couple of seconds later.
13. From DFDR data, it is evident that 25 minutes prior to the incident, 68% (Max. 79.76%) of the tail rotor was used by the crew for maintaining steady and level flight and prior to the Yaw, crew almost used 76% of the tail rotor pedal and they left with only 2-3% rudder force for total recovery action.
14. As the Collective was increased during the yaw recovery, helicopter gained altitude and no sufficient rudder force was available to the crew.

15. As per DFDR, crew did not use the recommended procedure for recovery from uncontrollable yaw which requires the collective to dump and land immediately.
16. Sterile cockpit was maintained during the flight.
17. From CVR tape, No normal checklists carried out by the Crew during flight.
18. Load &Trim calculation was not prepared prior to the commencement of flight.
19. SOAP test data shows that the Alert value of 'Fe' and 'Mg' drastically changed with out any caution and no mandatory system by the manufacturer available for condition monitoring of the TGB.
20. There is no TGB oil consumption recording procedure available for monitoring.
21. Fuel uplifted quantity was not filled up properly by the Engineering personnel.
22. All the approved maintenance schedules like 25Hrs, 50Hrs/ 30days, 100Hrs/ 6 months, were found complied with.
23. There was similar kind of control rod bearing failure reported in year 2006 to the manufacturer and the necessary maintenance service bulletin was issued
24. During detailed examination of TGB with M/s. Eurocopter, France, 'Plastic Chip' was found on the Tail rotor Control rod.
25. Plastic chip was from the PA ring which caused the restriction of the control rod and affecting the pitch change mechanism.
26. The burr created by the temperature creep of the P.A 6.6 guide ring and present between the control rod/ shaft and the bevel wheel is, in all likelihood, a consequence of the deterioration of the control rod bearing.
27. There was degradation of control rod bearing whcih was not identified with the existing maintenance checks.
28. Subsequent to the incident alert service bulletin was issued by manufacturer on the improved maintenance procedures.
29. M/s Eurocopter DFDR analysis report over the crew action as "When the helicopter began to spin left, no supplementary right yaw pedal input to counteract the starting left rotation was applied" is not justifiable as in case of such type of emergencies the pilot would apply maximum rudder pedal force to counter act the yawing motion and further crew applied the full rudder is supported by the CVR tape and the pilot statement.

3.2 **Probable cause:-**

The incident occurred due to the degradation of the control rod bearing in the tail gear box. However the exact reason for the bearing degrading could not be established.

4. Safety Recommendations:-

1. Matter may be taken up with DGAC, France to instruct M/s. Eurocopter, France to improve the design features of control rod bearing in TGB due failure of same and till the time the design/ modification of the component is completed, manufacturer should release any special/ revised maintenance instructions to prevent recurrence of same in future.
2. Union Territory of Lakshadweep , Administration may be tie up with Met Department & Airports Authority of India to provide all the essential services like Communication and Nav. Aids, weather related information for smooth operations of the Helicopter.
3. AAI, Agatti may be asked to provide all the ATC related services whenever required by the Helicopter operations.
4. Action as deemed appropriate be taken against both pilots for not following the recommended procedure for recovery from uncommanded yaw and for not carrying out the normal check lists and non-preparation of Load and Trim sheet.
5. M/s. PHHL engineering should be asked to maintain proper records for TGB oil consumption and fuel upliftment records.

(R. Rajendran)
Senior Air Safety Officer – Engg.,
Inquiry Officer of VT-PHP

28/08/2009